SUPPLY CHAIN MANAGEMENT PROBLEMS EXPERIENCED BY SOUTH AFRICAN AUTOMOTIVE COMPONENT MANUFACTURERS

by

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DECLARATION

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I declare that **SUPPLY CHAIN MANAGEMENT PROBLEMS EXPERIENCED BY SOUTH AFRICAN AUTOMOTIVE COMPONENT MANUFACTURERS** is my own work and all the sources I have used or quoted have been indicated and acknowledged by means of complete references.

SIGNATURE (Mrs M J A Naude)	DATE

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SUMMARY

The South African automotive industry has experienced significant changes in the last 20 years. Globalisation, the implementation of lean production and the development of modularisation have had a profound influence on the relationships between original equipment manufacturers (OEMs) and their suppliers, the automotive component manufacturers (ACMs), and their suppliers. South Africa has a number of OEMs and a vibrant automotive component manufacturing industry (ACM), which supplies the South African aftermarket and a spread of export markets. These ACMs are the focus of this study.

The main objective of this research study was to identify the supply chain management problems ACMs in South Africa encounter, to what extent they face these problems and how these can be overcome. The problems were identified through a literature review and interviews with two OEMs in South Africa. Using this data a questionnaire was compiled and sent to all NAACAM members for completion. This study is by nature descriptive and exploratory and contains quantitative and qualitative elements. Seven hypotheses were formulated to guide the research.

The findings of this research indicate that the geographic location, age and size of the business, have no bearing on the supply chain problems ACMs face, whist the relationship between ACMs and their suppliers and ACMs and their customers is a significant problem.

The findings also indicate that the following are some of the main supply chain problems facing ACMs: pressure by OEMs to reduce prices; the price of materials; cancellation of orders; 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unreliability of rail transport and rail capacity problems; the high cost of South African ports; the cost of replacing outdated technology; and BBBEE **–** achieving and verifying BEE scorecards. The findings further indicate a lack of skills and labour problems, both of which are time consuming to resolve.

This study was completed over a four-year period. At the commencement of this study the automotive industry was booming, but in mid-2008, a global economic crisis started. This crisis impacted adversely on the automotive industry globally and in South Africa.

Despite these challenges, leaders in the South African automotive component industry remain positive about the future.

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LIST OF COMMONLY USED ABBREVIATED ACRONYMS

ACs:	Automotive components
ACMs:	Automotive component manufacturers
CBUs:	Completely built-up units
C-commerce:	Collaborative commerce
CI:	Continuous improvement
CPFR:	Collaborative planning, forecasting and replenishment
CRM:	Customer relationship management
CRP:	Continuous replenishment programme
DWAF:	Department of Water and Forestry Affairs
E-commerce:	Electronic commerce
EDI:	Electronic data interchange
ERP:	Enterprise resource planning
EU:	European Union
GDP:	Gross domestic product
Gemba:	Japanese term for a visit to the production area for a first-hand look
Genchi Genbutsu:	A central Toyota way principle that means the actual place, the actual part. The principle involves visiting the actual place and understanding the real situation through direct observation
HCV:	Heavy commercial vehicle
HBR:	Harvard Business Review
IDC:	Industrial Development Corporation
IPPC:	International Plant Protection Convention
ISPMs:	International Standards for Phytosanitary Measures
JIT:	Just-in-time
Kaizen:	Continuous improvement
KPI:	Key performance indicator
LCV:	Light commercial vehicle
MERCOSUR:	A trading bloc was formed in 1991 as a common market consisting of Argentina, Brazil, Paraguay and Uruguay; Chile and Bolivia joined in 1995
MIDP:	Motor Industry Development Programme

MMOG:	Material Management Operating Guidelines
MPL:	Material planning and logistics
MRP:	Materials requirement planning
Muda:	Japanese term for waste
MNE:	Multinational enterprises
NAACAM:	National Association of Automotive Component and Allied Manufacturers
NAAMSA:	National Association of Automobile Manufacturers South Africa
NAFTA:	North American Free Trade Agreement
NPA:	National Ports Authority
OEMs:	Original equipment manufacturers
OESs:	Original equipment suppliers
ROI:	Return on investment
SAPO:	South African Port Operations
SC:	Supply chain
SCIS:	Supply chain information systems
SCM:	Supply chain management
SIAM:	Society of Indian Automobile Manufacturers
SIMS:	Supplier information management system
SMED:	Single minute exchange of dies
SPSS:	Statistical Package for the Social Sciences
S&OP:	Sales and operations planning
TPS:	Toyota production system
TQM:	Total quality management
VSM:	Value stream mapping

KEY WORDS

Original equipment manufacturers (OEMs)

Automotive component manufacturers (ACMs)

Supply chain management

Value chain

Supplier relationships

Supply chain flows

Logistics

Lean operations and JIT

Supply chain problems

Customer service

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Globalisation has increased the scope of opportunities for well-established industries such as the textile, communications, automotive, computers and semiconductors industries. Formerly, national economies were comparatively isolated from one another, whereas today there is shift towards a world in which national economies are uniting into a commonly dependent global economic system (Hill 2001:4). Thompson, Gamble and Strickland III (2006:64) observe that competition begins to shift from a national to an international focus when businesses expand into foreign markets in order to increase market share or when businesses move their production facilities to countries where costs are the lowest.

Because of globalisation, international competition has increased performance standards in many areas such as cost, quality, service, dependability, flexibility, productivity and time compression. Consequently, companies are finding that they must develop global management expertise in order to compete successfully in global markets. In the 21st century, competitiveness will be achieved only by those capable of not only meeting but also exceeding global standards. Furthermore, it should be noted that global standards are not fixed but require continuous improvement from a company and its employees (Hitt, Ireland & Hoskisson 2001:16). This also applies to the automotive industry which has experienced considerable turmoil in recent times – not only globally but also in South Africa. Indeed, during the past decade, the industry has experienced some of the greatest changes in history.

During the 20th century, the automotive industry was dominated by three original equipment manufacturers (OEMs), namely Ford Motor Company, General Motors and Chrysler. In 1998, Chrysler merged with Daimler Benz to become Daimler-Chrysler. In the automotive industry, these three large OEMs became known as “the Big 3”. Traditionally, in the automotive industry the chain of command has been one whereby the OEMs at the top purchased components and supplies from large first-tier suppliers such as Johnson Controls and Delphi. These suppliers in turn, procured components and supplies from smaller second-tier suppliers, which, in turn, procured from yet smaller third-tier suppliers. This hierarchical structure resulted in ineffectual processes, inefficiencies and a strong culture of distrust among industry participants (Applegate & Collins 2005:1).

During the 1970s, US OEMs gradually began losing market share to foreign competitors, particularly to Japanese OEMs, which, because of lean, flexible manufacturing and Keiretsu-style supply chains were able to build and deliver cars faster and at a lower cost than their US counterparts (Applegate et al 2005:1). According to Pearce and Robinson (2007:124), because of these extensive changes in the competitive business environment it makes economic sense for businesses to enter into the global arena by way of counterattack. This enables businesses entering the global arena to compete globally, at the same time, protecting their domestic market share.

Morris, Donnelly and Donnelly (2004:129) acknowledge that the automotive industry has experienced great structural and other changes in the last 20 years. The influences of globalisation, the implementation of lean production and the development of modularisation have had a huge influence on the relationships between original equipment manufacturers (OEMs) and their suppliers (particularly those in the first tier), known as automotive component manufacturers (ACMs), the main focus of this study.

Barnes (1999:2) concurs about the changing role and importance of ACMs by stating that even though the changes are more evident in the assembly sector, even more significant changes were taking place in the component industry because of changes in the nature of value chain relationships between OEMs and ACMs (Barnes 1999:2).

South Africa, for example, has a number of OEMs, namely BMW, Nissan, Ford, Volkswagen, Daimler-Chrysler/Mercedes, General Motors and Toyota. These all have production facilities in various locations around the country. Vehicles are produced for both the local and international market (Tera 2003:1). This motor industry has been well supported via a vibrant automotive component manufacturing (ACMs) industry which supplies the OEMs, the South African aftermarket and a spread of 249 export markets, mostly in the European Union (EU) (TISA 2003:27).

However, the extent of the current global economic crisis has impacted negatively on the automotive industry globally, including South Africa. For example, auto sales have decreased considerably and this has had a knock-on effect on component suppliers. As indicated in the KPMG survey 2009 to 2013, the near future is going to be tough for the automotive industry. However, businesses in the automotive industry continue to retain a long-term focus on innovation and technology – particularly fuel technologies (Momentum: KPMG's Global Auto Executive Survey 2009:4).

1.2 CATEGORIES OF BUSINESSES

At this stage it is already clear that the automotive industry consists of different parties or role players. The main role players are identified below and indicated in figure 1.1 (adapted from Barnes 1992:2; Naude 2005:12):

(1) *The automotive component manufacturers (ACMs)***.** The ACMs supply components to OEMs, OESs and the independent aftermarket. The ACMs can be seen as the first-tier supplier in the automotive supply chain. (This study will focus on these role players [ACMs] in the South African industry, for example, Aunde and GUD).

(2) *The original equipment manufacturers (OEMs) or automotive assemblers*. This category comprises both passenger and commercial vehicle assemblers, for example, Toyota and Ford.

(3) *The original equipment suppliers (OESs).* This category comprises automotive parts and accessory sales through the OEMs.

(4) *The automotive retail and aftermarket*. This category consists of automotive parts and accessory sales, through independent retailers and repair shops.

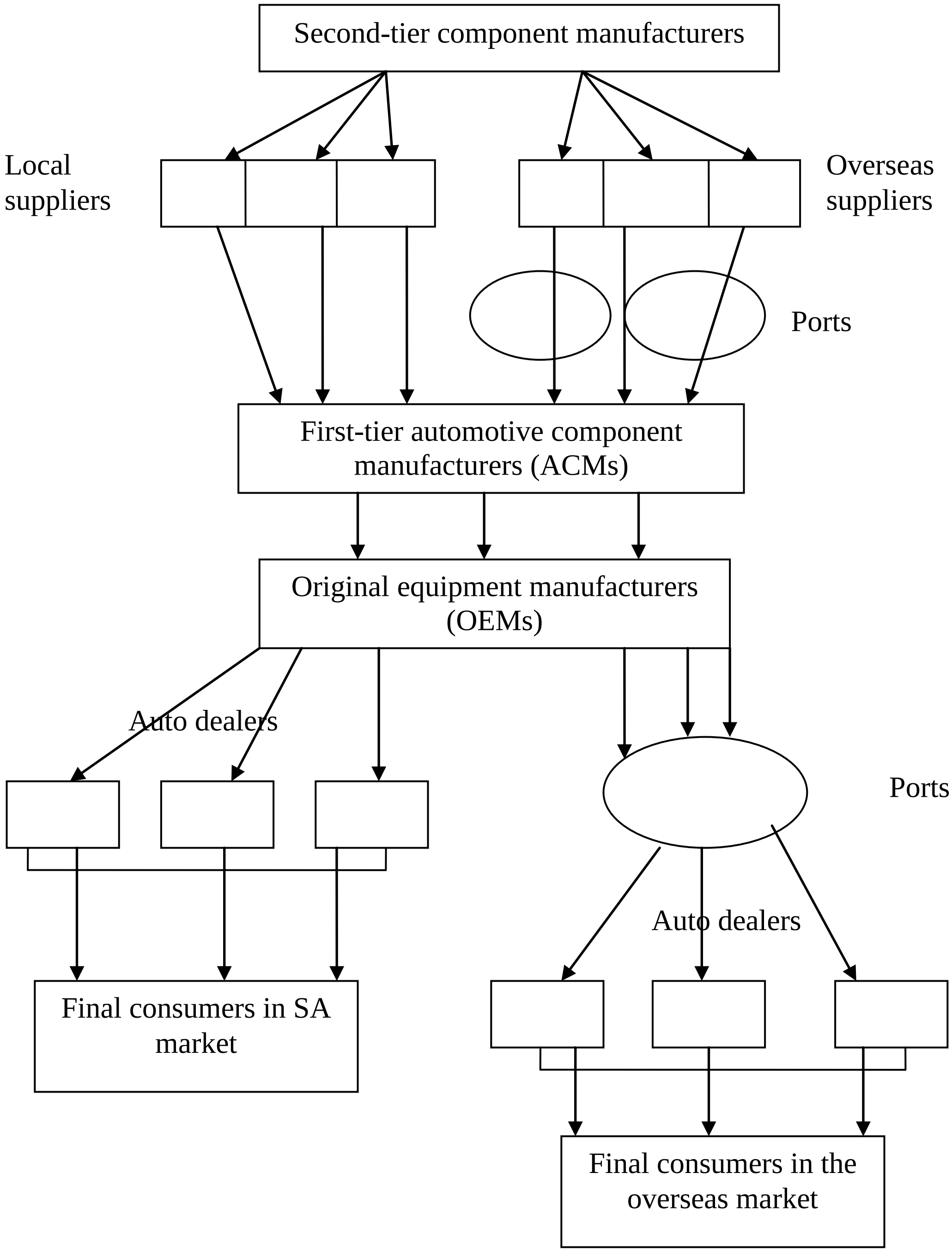
Figure 1.1 clearly indicates the materials flow in a typical supply chain in the South African motor industry. The second-tier supplier supplies parts, components and/or supplies to first-tier suppliers, the ACMs. These parts can be either purchased locally or internationally by the ACMs. The average local content of components produced in South Africa ranged between 70 and 80% in 2005. However, the value of local components used in vehicles is significantly lower, averaging 28% in 2005 (Pitot 2007:1). ACMs, in turn, supply OEMs. Final consumers, both domestically and internationally, are able to purchase motor cars from auto dealers. ACMs also supply OESs and the retail and independent aftermarket.

From figure 1.1 it is clear that the supply chain in the motor industry involves many parties, nodes, links and logistical processes in order to deliver the final product to the final customer. It is general knowledge that the motor industry is highly competitive, and world-class management practices such as just-in-time (JIT), total quality management (TQM) and continuous improvement (CI) are already in use in these supply chains, and have been for many decades.

Despite the use of these management practices, South African motor industry supply chains face realities and challenges such as poor railway services, high fuel costs, congested road networks, and the poor condition of roads and inefficient ports. These challenges impact on delivery in terms of components being delivered at the right place and time, and higher inventory holding at every stage of the supply chain if logistical services are unreliable and irregular. Hence the focus of this study is to investigate supply chain management problems in automotive assembly supply chains in South Africa. Owing to the scope and complexity of the motor industry supply chains and the key role of ACMs in the competitiveness of automotive supply chains (as indicated in sec 1.1), it was decided to limit the study to ACMs in South Africa only.

The movement of materials through the supply chain is the core of any supply chain since it is essentially aimed at creating a competitive advantage by providing outstanding customer service (by means of delivery). This enables a company to differentiate itself from its competitors in the market and enhances current and future profitability by balancing costs and service levels (Hugo, Badenhorst-Weiss & Van Biljon 2004:199).

Figure 1.1: Materials flow in a typical supply chain in the South African motor industry



Source: Compiled by researcher

In December 2008, as indicated in table 1.1, in terms of the importance of the motor industry and specifically ACMs, there were 36 000 persons employed by OEMs and 81 500 persons employed by ACMs.

However, since the global economic crisis and credit crunch, the number of employees in the domestic automotive industry has declined considerably. The industry reported that more than 16 000 jobs (± 20% of the total) have been lost in the component manufacturing sector in the past six months. Therefore as at March 2009, employment was estimated to have fallen to 65 500 employees (NAACAM Newsletter, March 2009:1).

Table 1.1: Number of employees in the domestic automotive industry: June 1998 to June 2008

SECTOR	1998 ('000)	1999 ('000)	2000 ('000)	2001 ('000)	2002 ('000)	2003 ('000)	2004 ('000)	2005 ('000)	2006 ('000)	2007 ('000)	2008 ('000)
Automotive assemblers (OEMs)	33.7	32.0	32.3	32.7	32.4	31.6	31.8	34.3	37.9	38.4	36.0
Component manufacturers (ACMs)	70.0	67.2	69.5	72.1	74.1	75.0	75.0	78.0	78.0	81.0	81.5
Tyre industry	9.1	6.7	6.6	6.3	6.0	6.0	7.2	6.8	6.5	6.9	7.0
Motor trade, distribution & servicing	170.0	175.0	180.0	182.0	185.0	191.0	194.0	198.0	198.0	200.0	200.0

Source: Adapted from TISA (2003:47), Barnes (2000:9) and NAAMSA, in South African Automotive Yearbook (2009, Secs 9:1 & 9.2)

As indicated in the South African Automotive Yearbook (2009:5) the number of employees in the automotive component industry fell to an estimated 76 000 towards the end of 2008 as a direct result of the economic decline in the second half of 2008, which resulted in ACMs retrenching employees.

In addition to creating employment the South African ACMs (clearly shown in table 1.1) had annual sales that totalled USD10 billion in 2008, capital spending of USD1.4 billion and used 70 to 80% of local content in their own manufacturing processes (SA Automotive Week, 22 July 2009).

The purpose of the next section is to provide a clear understanding of the concept, dimensions and elements of and practices in supply chain management and how these elements and practices support the overall objectives of supply chain management.

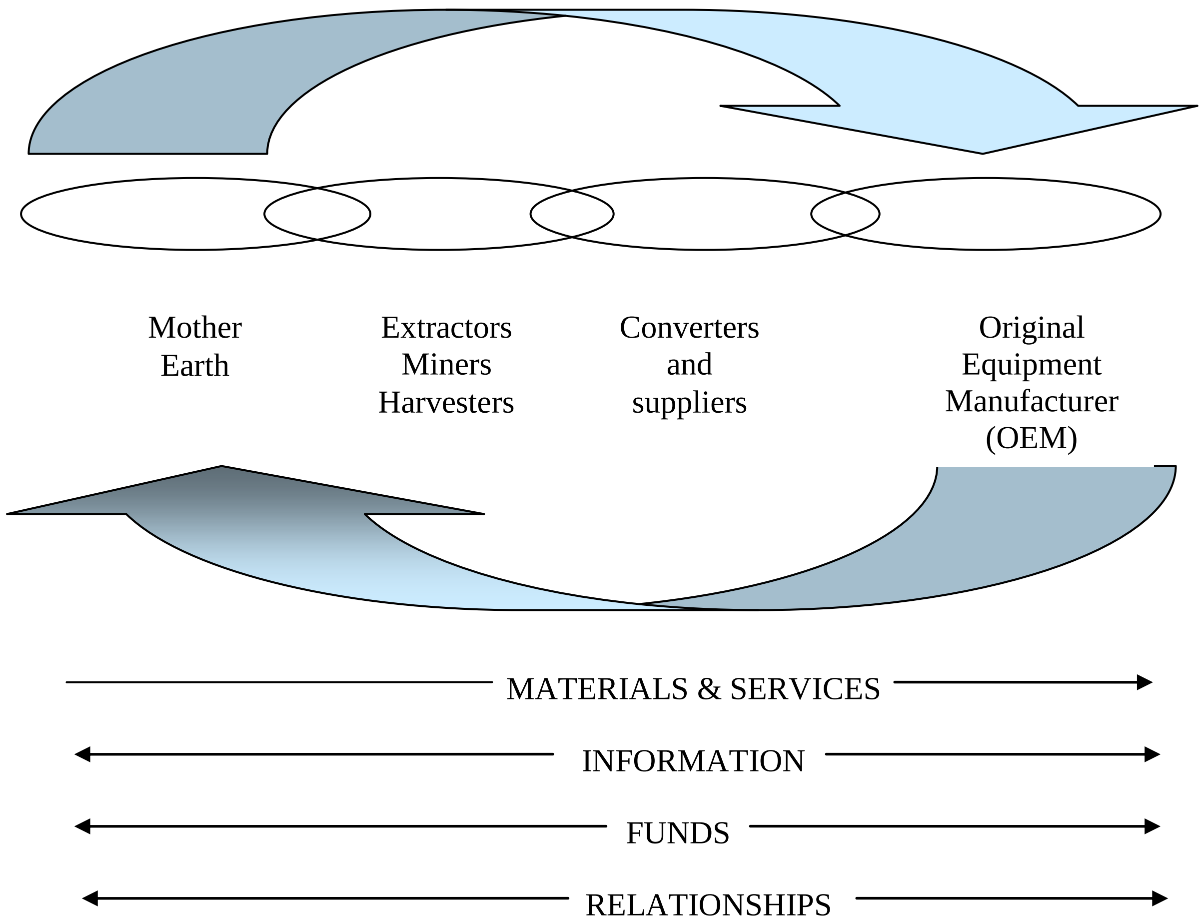
1.3 SUPPLY CHAIN MANAGEMENT

1.3.1 The concept of supply chain and supply chain management

Supply chain management is the management of activities involved in purchasing materials, transforming them into intermediate goods and final products and delivering a product or service. The sequence begins with the basic suppliers of raw materials and extends all the way to the final customers. The facilities involved in an assembly-type supply chain such as automotive component manufacturers include warehouses, factories, processing centres, distribution centres, retail outlets and offices. Activities include forecasting, planning, purchasing, inventory management, information management, quality assurance, scheduling production, distribution, delivery, disposal and customer service (Heizer & Render 2008:434; Stevenson 2005:692). It is clear that supply chain management includes all those activities involved in the flow of materials through the supply chain.

According to Burt, Petcavage and Pinkerton (2010:15), the supply chain extends from the ultimate customer back to mother earth (see fig 1.2). The chain is viewed as one unit as opposed to fragmented units, each performing its own task.

Figure 1.2: The supply chain



Source: Burt et al (2010:15)

As indicated in figure 1.2, there are five kinds of movement flow in the supply system: the physical movement of materials, usually in the direction of the end of the chain (which is the focus point of the supply chain); the exchange of information; the fund (money) flow; the relationship flow; and the flow back to mother earth, which would include the recycling, remanufacturing and disposal of products (Stevenson 2005:492; Burt, Dobler & Starling 2003:7).

Wisner, Keong and Tan (2005:485) observe that the supply chain includes all the series of businesses that ultimately make products and services available to consumers, including all the functions that promote the production, delivery and recycling of materials, components, end products and services. Wisner et al (2005:7) further quote supply chain management as defined by Dr Hau Lee and Mr Corey Billington: "the integration activities taking place among a network of facilities that procure raw materials, transform them into intermediate goods and then final products, and deliver products to customers through a distribution centre".

According to Leenders, Johnson, Flynn and Fearon (2006:6), supply chain management is the systems approach to managing the whole flow of information and the flow of materials and services, from raw materials suppliers through factories and warehouses to the end user.

From the above definitions, a more comprehensive definition of supply chain management in the automotive industry can now be formulated. Supply chain management in the manufacturing of automobiles includes the integration of activities taking place among a network of facilities that procure the inputs needed at each level or tier of the supply chain, to be ultimately transformed into finished automotive components and deliver these to customers through a distribution centre. Inputs include information from customers, raw materials, inventory, equipment, machinery, labour and finances. The transformation or conversion process transforms inputs such as raw material and labour into outputs in the form of finished goods and services delivered to the customer at the next lower level of the supply chain. This process is continued at all levels of the supply chain until the final product (a motor car) reaches the final customer.

In conclusion, supply chain management as a philosophy and concept has developed as business organisations realised that they need their suppliers to decrease costs and improve efficiency. Also, their customers need their cooperation as suppliers to further decrease costs and improve efficiency. It was therefore realised that by cooperating and managing it as one process, the supply chain members could be more efficient together than separately (Hugo et al 2004:10). The word "coordination" implies a certain relationship between people or groups of people.

1.3.2 Dimensions of the supply chain management philosophy

Fierce competition in today's global markets, the introduction of products with short life cycles and the increased expectations of customers have forced businesses to invest in and focus their attention on their supply chains (Simchi-Levi, Kaminsky & Simchi-Levi, 2003:1). Hence, the supply chain profession is experiencing a period of rapid change and increasing influence (O'Marah 2007:16).

According to Cagliano, Caniato and Spina (2006:282) managing the supply chain has become the main focus for many businesses. A number of economic and business trends determined the need to broaden the managerial focus from a traditional functional viewpoint to a more strategic one.

The impact of supply chain management on businesses is immense – particularly when products are *time-critical* and *time-sensitive* (Velia & Valodia 2003:9). From a business perspective, every excess rand of capital tied up in inventory, warehousing, processing and distribution can negatively affect a business's competitiveness. Every additional minute in the supply chain between shipper and consumer translates directly into cost and lost value.

Historically, most businesses tended to concentrate on their own operations and on their immediate suppliers. Today, however, a number of factors make it advantageous for businesses to actively manage their supply chains at all levels or tiers. According to Stevenson (2005:695-696), some of the major factors that have necessitated this are as follows:

- *Competitive pressures*. These have resulted in an increased number of new products, short product development cycles, an increased demand for customised products, the adoption of quick response strategies and efforts to reduce lead times.
- *Increasing globalisation.* This has resulted in longer supply chains.
- *The need to improve operations*. In the previous decade, many businesses adopted practices such as lean production and TQM. This resulted in their being able to achieve improved quality while eliminating excess costs from their systems. Opportunities to sustain a competitive advantage lie largely with the management of the supply chain.
- *Increasing transportation costs.* Since these costs are increasing, they need to be carefully managed. This also lies within the domain of supply chain management.
- *The need to manage inventories*. Inventories play a major part in the success or failure of a business. Shortages can disrupt the timely flow of work and have far-reaching effects, while

excess inventories add unnecessary costs. Supply chain management includes the management of inventories throughout the entire supply chain.

- *Increasing levels of outsourcing*. Many businesses buy goods or services instead of producing or providing them in-house. Increasing levels of outsourcing result in businesses spending more time on supply-related activities such as packaging, sorting, moving, loading and unloading.
- *Increasing importance of e-commerce.* This has added a new dimension to businesses' purchasing and selling. The efficient management of the supply chain determines the success of the use of e-commerce.
- *The complexity of supply chains*. Supply chains are complex and dynamic and have many basic uncertainties that can impact negatively on the supply chain, for example, inaccurate forecasts, late deliveries, substandard quality, equipment breakdowns and cancelled or changed orders.

1.3.3 The impact of Japanese best practices in supply chain management

Numerous books and articles have been published about Japanese business practices and many research studies were conducted during the last part of the previous century. One book in particular, *The machine that changed the world* (published in 1990) is regarded as the first authoritative work that successfully highlighted the huge gap in performance between the best performers in Japan and others elsewhere in the world. For example, gaps in performance between the best Japanese and the other component manufacturers in the automotive industry are significant as the gap affecting automotive assembly companies. Supply chain management practices have played a part in the superiority of these companies (Stevenson 2009:694; Saunders 1997:310; Van Biljon, 1998:130).

Saunders (1997:16) acknowledges that an international team of researchers looked at the comparative performance of the major car assemblers in the global automotive industry. The outcome was the adoption of the structural and infrastructural changes associated with TQM and JIT, as a new type of production model. Nowadays, this model is known as the *lean* production model – it is the successor to the *mass* production model – typified by the high-volume car assembly line developed by Henry Ford I. The practices of TQM and JIT are essentially those operated by the best of the Japanese companies.

It should be pointed out that even though the sources quoted in the previous two paragraphs were written in the late 1990s, the text is relevant to highlight the impact of Japanese best practices over the years. Goodman, Fandt, Michlitsch and Lewis (2007:44) indicate that much of what we call the Japanese management philosophy originated in the Japanese automobile industry. These manufacturers admit that most of their technical innovations and ideas were borrowed from the methods used by the US automobile manufacturers during the era of Henry Ford.

In light of the above, Wisner et al (2005:17) observe that the practice of supply chain management is a recent trend because many businesses are only beginning to realise the benefits and problems that accompany an integrated supply chain. The implication is that businesses that practise supply chain management concepts continually improve their ability to reduce waste, decrease time, be flexible and cut costs, which ensures future profitability. However, as competitive situations, products, technology and customers change, the priorities for the supply chain should also change, requiring supply chains to always be more flexible in responding quickly to these changes.

1.3.3.1 Total quality management (TQM)

Jacobs and Chase (2008:138) define TQM as “managing the entire organisation so that it excels on all dimensions of products and services that are important to the customer”. TQM has two fundamental operational goals, namely careful design of the product or service and ensuring that the business’ systems can consistently produce the design.

According to Waller (2003:84), in TQM attention to quality permeates the whole operation and not only one particular division. The driving force of the word “TQM” lies in the word “top management”, because top management should be the originator of TQM. Management has to provide leadership, motivation and support.

Jacobs and Chase (2008:138) note that TQM gained momentum in the USA in the 1980s primarily in response to Japanese quality superiority in manufacturing motor cars. Also gaining major attention at this time was the requirement that suppliers show that they are measuring and documenting their quality practices according to the specified criteria referred to as the ISO standards, if they wished to compete internationally.

In South Africa, TISA (2003:15) indicates that increased consumer demand and governmental regulations have placed greater pressure on vehicle manufacturers and their suppliers to match up to environmental standards and continuously improve on the environmental impact of the product. Hence ISO 14001 is increasingly being regarded as a prerequisite for OEMs and component manufacturers wishing to export.

1.3.3.2 Continuous improvement (CI)

According to Burt et al (2003:124-129), Masaaki Imai introduced the world to continuous improvement through its book "*Kaizen: the key to Japan's competitive success".* In a working environment, kaizen means continuous process improvement involving everybody. However, it was Taichi Ohno, the pioneer of the Kanban system at Toyota, who developed continuous improvement into a viable, tangible management approach. CI is independent of JIT because it can be implemented without JIT, but CI has received its most publicised adopters in businesses that run JIT system.

1.3.3.3 Just-in-time (JIT)

Heizer and Render (2008:642) state that JIT means producing goods and services precisely when they are needed – neither before they are needed so that they wait as inventory nor after they are needed so that the customer has to wait. Heizer and Render (2008:642) define JIT as follows: "Continuous and forced problem solving via a focus on throughput and reduced inventory".

As indicated by Stevenson (2009:694), the aim of JIT is to meet the demand for products just as they are needed, with perfect quality and no waste.

Various authors (Van Biljon 1998:131: Krajweski, Ritzman & Malhotra 2007:348; Stevenson, 2009:407) indicate that the Toyota production system (TPS) has become known as the world premier production system, and the manufacturing process as "lean manufacturing". Toyota pioneered the ideas associated with *lean* production by means of TPS (Jacobs, Chase & Aquilano 2009:418). TPS is Toyota's version of JIT and consists of two pillars, namely the JIT pull scheduling (the production and conveyance of what is needed, when it is needed in the amounts it is needed); and Jidoka (stopping the operations process in the event of problems, either by the staff who are process owners or by the machines themselves) (Pycraft, Singh & Phihlela 2001:549; Van Biljon 1998:131; Krajweski et al 2007:348).

Van Biljon (1998:131) further notes that there are many similarities between supply chain management and JIT philosophies. For example, both support the demand pull methodology, value adding and the elimination of waste.

1.3.3.4 Lean production

Lean production is one of the names given to the manufacturing strategy developed by Taijichi Ohno and Eiji Toyoda of the Toyota Motor Company. Lean production has its roots in the Toyota Automobile Company of Japan where waste was to be avoided at all cost (Waller 2003:458). Saunders (1997:16) and Jacobs et al (2008:404) acknowledge that "lean" is an integrated set of activities designed to obtain the same output from half the resources used by older production methods – in other words, half the resources in terms of, half the number of workers who are multiskilled and work in teams, half the number of design engineers and half the level of inventory. At the same time, this involves the use of half the resources achieving higher levels of quality, more frequent new model launches and more varied product variations.

Simchi-Levi et al (2003:5) agree that in the 1980s, businesses discovered new manufacturing technologies which enabled them to reduce costs and therefore compete better in different markets. These strategies, which included, inter alia, total quality management, continuous improvement, just-in-time, and lean production, became popular. During the last few years, it has become clear that many businesses have reduced manufacturing costs as much as is practicably possible and are now discovering that effective supply chain management is the next step they need to take in order to increase profit and market share.

1.3.4 Systems integration

As a major part of supply chain management, procurement (one of the processes in supply chains), for example, is traditionally supported by information technology. With the implementation of enterprise resource planning (ERP) or manufacturing resource planning (MRP) systems in the 1980s, electronic data interchange (EDI) connections with suppliers were established (Puschmann & Alt, 2005:122). There are further developments of EDI which make systems integration/connectivity in supply chains possible. These are e-commerce, e-procurement and e-sourcing. Each will be briefly discussed below.

a. E-commerce

Goodman et al (2007:84) observe that the most significant technological advances of the recent past have related to information technology. Not only have new software applications such as ERP systems revolutionised many business processes, but the arrival of the internet has changed the way businesses operate and consumers purchase goods and services. The authors defined electronic commerce (e-commerce) as the process of buying and selling goods and services electronically with computerised business transactions (2007:435).

Simchi-Levi et al (2008:198) agree that the influence of the internet and e-commerce on business practice has been great. Business to Business (B2B) e-commerce has made possible more efficient supply chain management strategies for virtually all businesses and business to consumer (B2C). E-commerce has radically changed the retail industry, from books to music to clothing (Goodman et al 2007:84).

b. e-Procurement

Hugo et al (2004:269) state that e-procurement is the execution of purchases against a pre-negotiated contract and includes technology such as electronic catalogues. Table 1.2 shows e-procurement benefits by category.

Table 1.2: E-procurement benefits by category

Indirect	**Direct**	**Sourcing**
Price reduction Improved contract compliance Shortened cycle times Reduced administrative costs Enhanced inventory management	Visibility of customer demand Visibility of supply chain capacity Accuracy of production capacity Reduced inventory costs Shortened process cycle times	Unit cost reduction Enhanced decision making Improved market intelligence

Source: Benton (2007:132)

c. E-*sourcing*

E-sourcing, unlike e-procurement, includes all the activities that lead up to creating the contract for the goods and services a business plans to purchase. Two major elements of e-sourcing are spending analysis and workflow or negotiation tools (Hugo et al 2004:269).

1.4 SCOPE OF THE STUDY

The focus of this study will be on the supply chain philosophy, practices and problems, in the motor industry in South Africa**.** According to the Executive director of NAACAM, it is estimated that there are 300 automotive parts manufacturers or ACMs who are primarily producing automotive parts. These ACMs supply OEMs, OESs and the aftermarket and are spread throughout the country. Then there are another 150 companies producing parts for the automotive industry, as well as for other sectors such as light engineering, mining, construction and defence (*South African Automotive Yearbook* 2006:3). Just under half of these suppliers are located in

Gauteng, a third in the Eastern Cape, a quarter in KwaZulu-Natal and the remainder in the Western Cape.

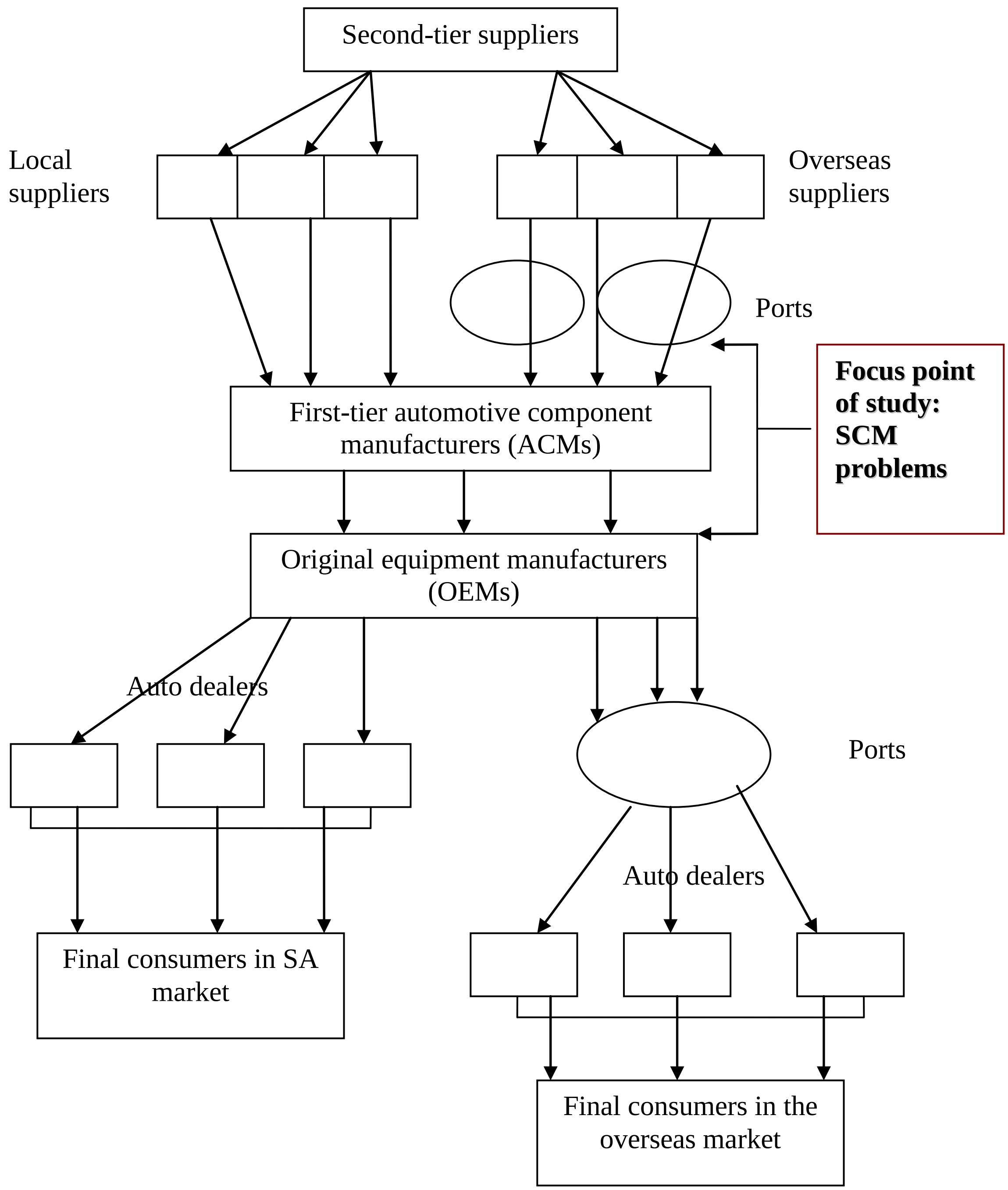
As indicated by the Executive Director, of the 300 ACMs referred to above, approximately 60% are members of NACAAM. The Association currently has 181 members, many with different plants in various geographical regions. A company that may be a first-tier supplier for one OEM, may also be a second-tier supplier. For example, an ACM may manufacture and supply a steering wheel to an OEM plant directly, but may also supply a steering wheel to a first-tier supplier, which, in turn, supplies the whole interior cockpit to another OEM. The Association has 11 associated members who are classified as service providers (SPs). These associate members will not be included in this study. An example is Absa Debtor Finance (Pty) Ltd.

ACMs supply automotive spares to original equipment manufacturers (vehicle manufacturers), original equipment suppliers and the automotive retail and aftermarket.

As mentioned earlier and indicated in figure 1.3, it is clear that the supply chain in the motor industry involves many parties, nodes, links and logistical processes to deliver the final product to the final customer. It is obvious that if problems are experienced by one party, node or link, this will influence the performance and competitiveness of the whole supply chain. As mentioned in section 1.1, it is well known that the motor industry is highly competitive, and as a result, world-class management practices such as JIT, TQM and CI are already in use in these supply chains. In spite of these management practices it is a known fact that the South African motor industry still faces certain difficulties in its supply chains (Naude 2005:145).

Owing to the scope and complexity of the motor industry supply chains and the importance of ACMs in the competitiveness of the motor industry sector, it was decided to focus the study on ACMs in South Africa. This focus means that the study will be done from the ACMs perspective. Because of the nature of supply chain management, many problems in the supply chain will originate in and between supply chain partners. A study focusing on the supply chain of ACMs will therefore also have to include some investigation into other parties in the supply chain. The aim of the study is to identify supply chain management problems experienced by automotive component manufacturers in South Africa and to suggest strategies to overcome these problems.

Figure: 1.3: Materials flow in a typical supply chain in the South African motor industry



Source: Compiled by researcher

1.5 RATIONALE FOR THE STUDY

For any business to compete successfully in a business environment nowadays requires it to become involved in the way its suppliers and customers do business. Owing to intensified global competition, businesses need to be more aware of where their suppliers' material comes from, how their suppliers' design and assemble their products and services, and finally how they store and distribute their finished products (Wisner et al 2005:4).

A successful automotive industry is often seen as a symbol of a country's economic success. The automotive industry plays a vital part in the economic well-being of South Africa (TISA 2003:6). South Africa's automotive industry has become an increasingly important contributor to the country's gross domestic product (GDP). It is imperative that the South African automotive industry stays internationally competitive to prevent other international competitors from easily penetrating the South African market.

In 2003, South Africa was ranked 19th in the world in terms of vehicle production. However, in 2006, it was ranked only 23rd in the world (PwC 2006). South Africa is responsible for approximately 80% of Africa's vehicle output, and produces 0.7% of the world's vehicles (South Africa.info Reporter 2003:1). In addition, according to PwC (2006), South Africa ranks 29th in terms of automotive parts exports and its imports grew from 0.4% of global trade in 2000 to 1.3% in 2006.

Maxton and Wormald (2004:145) indicate that nowadays, OEMs control 25% of the value of the products coming out of their assembly plants. The remaining 75% is in the hands of suppliers, who supply OEMs with raw materials, individual components and subsystems. This clearly implies that this study is vital for the following reasons:

- A successful automotive industry is often seen as a symbol of the economic success of a country and the industry plays a key part in the economic well-being of South Africa. This study will focus on identifying possible problem areas in which improvements could stimulate competitiveness among South African ACMs.

- The field of SCM is extremely dynamic. The study of literature, trends and new developments will contribute to the body of knowledge and provide new insight into this field.

1.6 PROBLEM STATEMENT AND OBJECTIVES OF THE STUDY

The South African motor industry makes a significant contribution to the South African economy in general. ACMs are vital role players in the South African motor industry. The survival and growth of these businesses in an ever-increasing competitive global market are of the utmost importance. These businesses will only survive and grow if they are able to compete internationally.

To compete internationally, the focus is no longer on the management, survival, growth and competitiveness of individual organisations, but on supply chains. Suppliers can be a crucial source of competitive advantage for an organisation in their own value package they offer to the customers in the market. The emphasis thus shifts from individual firm efficiencies to the management and challenge of the whole supply chain.

With the above as background, the problem statement of the study can be formulated as follows:

What are the supply chain management problems that ACMs in South Africa face and how can these be overcome?

The objectives of the study become clear from the problem statement.

- ***Primary objectives***

The primary objectives of the study are as follows:

(1) to identify the supply chain problems South African ACMs face
(2) to identify and suggest remedies to overcome these problems

- ***Secondary objectives***

The secondary objectives of the study are as follows:

(1) to obtain a perspective of the automotive industry, both in South Africa and internationally as the industry and environment within which ACMs operate

(2) to give an overview of the scope, concept and philosophy of supply chain management

(3) to identify important best practices in SCM (which will serve as guidelines to investigate the ACMs' supply chain)

(4) to give an overview of the automotive supply chains from the ACMs' perspective in South Africa

(5) to describe the enabling environment of automotive component manufacturers in South Africa

(6) to identify supply chain problems

(7) to determine the extent of the supply chain problems experienced (through a qualitative investigation including in-depth semi-structured interviews and a quantitative investigation by means of a survey)

(8) to compare the supply chain problems faced in the provinces and determine possible geographic-related problems

(9) to compare these problems with regard to age and size of an ACM in order to determine whether age or size impacts on an ACM's problems

(10) to determine relationships (correlations) and their significance in the supply chain

(11) to refine, pinpoint and explain the reasons for these problems (through a qualitative section included in the questionnaire)

(12) to identify and suggest remedies to ACMs and the motor industry as a whole to overcome the problems identified.

1.7 RESEARCH SYNOPSIS

The research methodology of this study is dealt with extensively in chapter 5.

In line with the objectives of this research study as indicated in section 1.6, the aim is to identify supply chain problems South African ACMs face and the extent thereof. This study is both descriptive and exploratory and contains quantitative and qualitative elements. In order to achieve the first five secondary objectives, an extensive literature review was undertaken, which is addressed in chapters 2, 3 and 4.

In order to achieve objectives 6, 7, 8, 9, 10 and 11, empirical research was conducted. This empirical research consisted of two phases.

The first phase of the research consisted of semi-structured interviews with both management at executive and senior level at Ford and Toyota in order to clarify information and identify possible supply chain problems facing ACMs in South Africa. Once these possible problems had been identified from the qualitative research, a questionnaire was designed which included all the problems identified in the literature review and the semi-structured interviews. The aim of the questionnaire was to test identified problems facing ACMs in order to refine, pinpoint and explain the reasons for and consequences of these problems. The results of this study are dealt with in chapter 6.

The second phase of the research consisted of administering the questionnaire. The population of this study was automotive component manufacturers in South Africa. Only NACAAM members were included since it is accepted that the largest and most important ACMs in South Africa are members of this association. A total of 173 questionnaires were sent to respondents and a response rate of 30.6% was achieved. The completed questionnaires were coded and the responses captured in Excel and then exported into SPDSS 17 by the statistician. The results of this study are dealt with in chapter 7.

Chapter 8 deals with the last primary and secondary objective of this study, namely recommendations and conclusions.

1.8 EXPECTED CONTRIBUTION TO THE BODY OF KNOWLEDGE

Owing to local conditions, the automotive component industry faces certain supply chain problems. The study aims to identify these supply chain problems and their extent which South African ACMs have to deal with. Possible causes will be identified and remedies suggested to manufacturers in the industry to overcome identified supply chain problems.

Since the field of SCM is extremely dynamic, the study of literature, trends, new developments and the research will contribute to the body of knowledge and provide new insight into this field.

1.9 LIMITATIONS OF THE RESEARCH STUDY

There are imitations to this study which are outlined below:

(1) Only component manufacturers who are members of NACAAM are included in the study. According to NACAAM, currently only 60% of ACMs are members of NACAAM. Although the members make up 60% of the population of the ACMs, they are not a random sample of all ACMs. The findings cannot therefore be generalised to all ACMs in South Africa.

(2) Supply chain problems have been identified through the literature review and in-depth semi-structured interviews with respondents at senior management level at *two* automotive assembly plants in South Africa only. The implication is that not all supply chain problems may have been identified.

1.10 AN OVERVIEW OF THESES ON RELATED RESEARCH

Past research theses that could be traced on the Nexus Database in South Africa in the field of supply chain management and the automotive industry, relevant to this research topic, are summarised in table 1.3. Only three theses, out of the 15 theses listed in table 1.3 were doctoral studies – those by James (2007), Barnes (2002) and Van Biljon (1998). Although all three of these focus on the South African automotive industry, Barnes's thesis focuses on World-class manufacturing and the South African automotive component industry.

The main hypothesis underpinning Barnes's (2002:4) thesis is as follows:

- "The adoption of lean production is possible in the South African context, more specifically in the South African automotive component industry and this will lead to increased competition.
- The adoption of lean production will enable firms to achieve world class operating standards; and
- Once lean production processes have been adopted, improvements will be achieved throughout the firm with operating progress resulting in improved economic performance".

The research by Naude (2005) was a previous study by this researcher. It is a master's study focusing on supply chain-related challenges facing the South African automotive component industry in the export market. The objectives of this study were as follows (Naude 2005:8):

- "To provide an understanding of Supply Chain Management practices in the automotive component industry in South Africa.
- To identify the issues involved and challenges faced with regard to supply chain management related matters.
- To analyse the automotive component export market in South Africa with special reference to selected sub-sectors: from a supply chain perspective.
- To review literature on globalisation in order to identify guidelines on challenges facing the Automotive Industry in South Africa.
- To identify appropriate steps policy makers can take to reduce the impact of globalisation on the export industry".

The main limitation of the study was that *only four sub-sectors* (catalytic converters, stitched leather components, tyres and road wheels and parts) in the automotive component manufacturers' sector in South Africa were included, and the quota sample subsequently consisted of 27 component manufacturers. In addition, supply chain challenges were identified in the literature review only and the main focus was on the export market and globalisation.

Table 1.3: An overview of past research relating to supply chain management and the automotive industry (a summary of theses completed in South Africa).

YEAR	NAME	TITLE AND DEGREE TYPE	UNIVERSITY
2007	James, JP	Field and laboratory analyses of manual tasks in the South African automotive industry (PhD)	Rhodes University
2006	Braun, GP	Analysing the effect of technological pressure on the automotive industry's value chain (confidential) (MBA)	Millpark Business School
2006	Franse, R	The response of an original equipment manufacturer to the Motor Industry Development Programme: a case study (MBA)	Rhodes University
2005	Zehner, CO	Supply chain management in the automotive industry: a European perspective (MCom)	University of Pretoria
2005	Njokweni, TL	The enhancement of logistic processes in the South African automotive industry to become competitive (MBA)	Nelson Mandela Metropolitan University
2005	Naude, MJA	Challenges facing component manufacturers in the export market in South Africa with special reference to selected subsectors: a supply chain perspective (MCom)	University of Kwa Zulu-Natal

2004	Kosser, H	An evaluation tool to select suppliers in the South African automotive components industry (MSc Eng)	University of the Witswatersrand
2003	Van der Horst, FA	South African automotive industry: globalisation, restructuring and world-class manufacture (MCom)	University of the Western Cape
2002	Tinderholm, PJ	An analysis of supply chain improvement strategies for first-tier automotive component suppliers in the Nelson Mandela Metropole (MBA)	Port Elizabeth Technikon
2002	Whitehead, GA	An investigation into the use of e-commerce, as a primary tool for streamlining the supply chain of a Port Elizabeth automotive component manufacturer (MBA)	Port Elizabeth Technikon
2002	Barnes, JR	World-class manufacturing as a necessary but insufficient condition for industry success: a case study of the South African automotive components industry (DPhil)	University of Natal
2001	Makuwaza, GC	Clustering as a tool for manufacturing performance for the automotive industry in the Eastern Cape Province (MCom)	Rhodes University
2000	Qobo, M	The effects of globalisation on the South African automotive industry (MA)	Stellenbosch University
1998	Van Biljon, EHB	Supplier network re-engineering by automotive assemblers in the province of Eastern Cape (DCom)	University of Port Elizabeth
1993	Hammond, I	Buyer-seller relationships in the automotive component industry (MBA)	University of the Witswatersrand

Although Naude (2005) focuses on the challenges facing component manufacturers in the export market in South Africa with special reference to *selected subsectors*, none of the studies in table 1.3 focuses primarily on supply chain difficulties or problems experienced by South African Automotive component manufacturers. With this as background, an outline of this study follows.

1.11 OUTLINE OF THE STUDY

CHAPTER 1	INTRODUCTION • Background • The rationale for the study • Outline of the study
CHAPTER 2	THE GLOBAL AND SOUTH AFRICAN AUTOMOTIVE INDUSTRY • Global overview of the automotive industry • Main parties in the automotive industry • The South African automotive industry
CHAPTER 3	SUPPLY CHAINS, SUPPLY CHAIN MANAGEMENT AND RELATED CONCEPTS • Reasons for development of supply chain management concepts • The supply chain concept • The supply chain philosophy • Components of supply chain management • The motor industry supply chain • The application of supply chain management by the motor industry
CHAPTER 4	SUPPLY CHAIN MANAGEMENT PRACTICES AND TOOLS • Supply chain practices and tools • Information technology • Supply chain foundations • Functions included in supply chain management • Value stream mapping • Total cost of ownership • Early supplier involvement
CHAPTER 5	RESEARCH DESIGN AND METHODOLOGY • What is the meaning of research design? • Problem statement and objectives of the study • Validity and reliability considerations • Methodological approaches in social sciences

	• The methodological approach adopted for this research project • Quantitative versus qualitative research • Collection of primary data using an interview guide and questionnaires • Research aims • Research strategies • Conclusion
CHAPTER 6	PROBLEMS EXPERIENCED BY ACMS FROM THEIR CUSTOMERS' PERSPECTIVE • In-depth semi-structured interviews with respondents at both Ford SA and Toyota • Analysis of findings • Identify supply chain problems or difficulties that ACMs face in South Africa
CHAPTER 7	SUPPLY CHAIN PROBLEMS FACING ACMS IN SOUTH AFRICA: EMPIRICAL RESEARCH • Introduction • Analysis of findings • Discuss the extent and significance of the supply chain problems experienced by ACMs • Hypothesis testing – Compare the problems experienced in the provinces nationally to determine possible geographic-related problems – Compare these problems with regard to the age and size of the business in order to determine whether the age or size impacts on an ACM's problems – Determine relationships (correlations) and their significance in the supply chain • Refine, pinpoint and explain the reasons for these problems
CHAPTER 8	SUMMARY, RECOMMENDATIONS, CAVEATS AND SUGGESTIONS FOR FUTURE RESEARCH
BIBLIOGRAPHY APPENDICES	

CHAPTER 1

Introduction

CHAPTER 2

The global and South African automotive industry

CHAPTER 3

Supply chains, supply chain management and related concepts

CHAPTER 4

Supply chain management practices and tools

CHAPTER 5

Research design and methodology

CHAPTER 6

Problems experienced by ACMs from their customer's perspective

CHAPTER 7

Supply chain problems facing ACMs in South Africa: empirical research

CHAPTER 8

Summary, recommendations, caveats and suggestions for further research

OUTCOME

To identify problems or difficulties in the supply chain and suggest remedies to ACMs and the motor industry as a whole

CHAPTER 2

THE GLOBAL AND SOUTH AFRICAN AUTOMOTIVE INDUSTRY

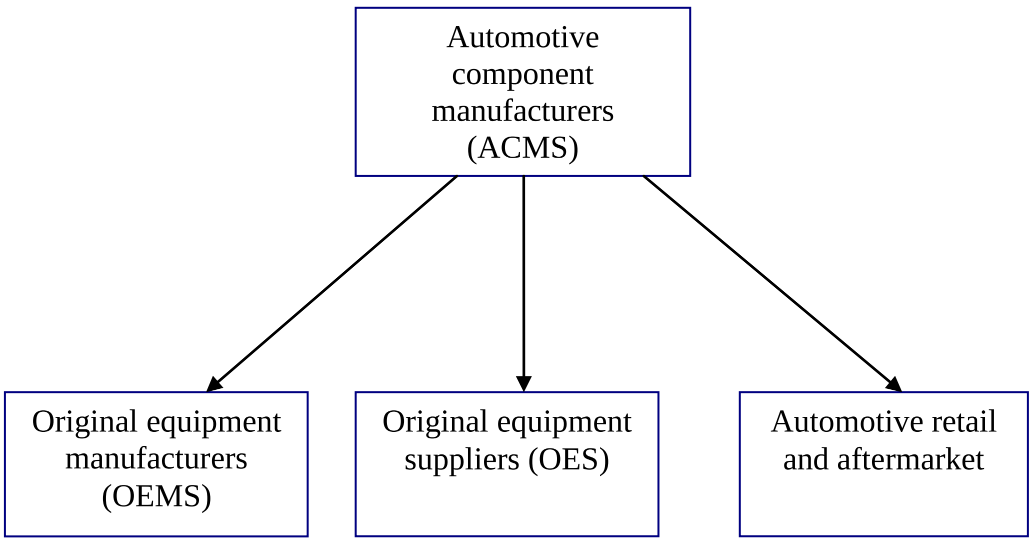
2.1 INTRODUCTION

The previous chapter dealt with the background on and introduction to the study. In this chapter the role and trends in the automotive industry, world-wide and in South Africa, are described. This will provide the background on this study in the automotive industry and also serve as further justification for the study. The next section provides an overview of the global automotive industry.

2.2 MAIN PARTIES IN THE AUTOMOTIVE INDUSTRY

As indicated in section 1.2, the automotive industry consists mainly of original equipment manufacturers, original equipment suppliers, automotive component manufacturers and the automotive retail and aftermarket. Figure 2.1 indicates the main parties or types of businesses in the automotive industry or automotive supply chains.

Figure 2.1: Categories of businesses



Source: Compiled by the researcher

As indicated in figure 2.1, automotive component manufacturers supply automotive spares to original equipment manufacturers (vehicle manufacturers), original equipment suppliers and the automotive retail and aftermarket.

Candler (1998:6) notes that OEMs do not wish to deal with a large number of suppliers because this results in increased expenditure in administration, increased design costs and quality problems. Hence, instead of dealing with a large number of suppliers, suppliers are organised into tiers, where first-tier suppliers are left to design many of the assemblies themselves and second-tier suppliers to assist in designing and producing the components.

According to Humphrey and Memedovic (2003:21), the global automotive industry is composed of a number of different parts, as outlined in table 2.1. The requirements for these different sections are quite clear.

Table 2.1: Capability requirements in the global automotive industry

Category	**Description**
Assemblers	Motor vehicle assemblers require an increasing scale to spread costs of vehicle design and branding. Innovation and design capabilities remain critical (eg Toyota maintains an emphasis on manufacturing excellence and competence).
Global mega-suppliers	These firms supply major systems to the assemblers. They are sometimes referred to as "tier-0.5" suppliers because they are closer to the assemblers than the first-tier suppliers. Global mega-suppliers need design and innovation capabilities in order to provide "black-box" solutions for the requirements of their customers. (Black-box solutions are solutions created by the suppliers using their own technology to meet the performance and interface requirements set by assemblers). There are currently no global mega-suppliers in South Africa.
First-tier suppliers (ACMs)	These are firms that supply to the assemblers or global mega-suppliers. First-tier suppliers require design and innovation capabilities.

	ACMs are the focus of this study, but as noted in chapter 1, an ACM may be both a first-tier and a second tier supplier. The example cited was that of an ACM that may be manufacturing and supplying a steering wheel to an OEM plant directly, but may also supply a steering wheel to a first-tier supplier, which, in turn, supplies the whole interior cockpit to another OEM.
Second-tier suppliers (ACMs)	These firms often work to designs provided by assemblers or global mega-suppliers. These suppliers require process engineering skills in order to meet cost and flexibility requirements. Also, the ability to meet quality requirements and obtain quality certification (eg ISO14001 & TS16949) is essential for remaining in the market.
Third-tier suppliers	These firms supply basic products. In most cases only elementary engineering skills are required. At this point in the chain, firms compete mainly on price.
Aftermarket	A further significant segment of the automotive value chain is the market for replacement parts. Firms in this section compete mainly on price. Access to cheaper raw materials and process engineering skills is important.

Source: Adapted from Humphrey & Memedovic (2003:22)

2.3 OVERVIEW OF THE GLOBAL AUTOMOTIVE INDUSTRY

2.3.1 Introduction

Since the Industrial Revolution, the automotive industry has consistently been one of the most global of all industries. This industry has manufactured goods for global distribution and use and is led by a small number of businesses with global recognition (Humphrey & Memodovic 2003:2; Sutherland, Gunther, Allen, Bauer, Bras, Gutowski, Murphy, Piwonka, Sheng, Thurston & Wolff 2004:107). Morris et al (2004:129) acknowledge that in the last two decades, the automotive industry has experienced major changes, which have come about through the pressure of globalisation, the introduction of lean production practices and the development of modularisation. These changes have thus affected the relationships between original equipment manufacturers (OEMs) and their suppliers, most particularly those in the first tier, known as automotive component manufacturers (ACMs) – the main focus of this study

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. The globalisation of the automotive industry has gathered momentum since 1995 owing to the building of facilities in foreign countries and the formation of mergers between multinational automotive assemblers (Bera 2004:1). The level of concentration in the industry between 2006 and 2007 is shown in table 2.2.

Table 2.2: Motor vehicle production by manufacturer and world ranking (2006 & 2007)

WORLD RANKING		MANUFACTURER: PASSENGER CARS ONLY	UNIT PRODUCTION CARS	
2007	**2006**		**2006**	**2007**
1	1	General Motors	5,708,038	6,259,520
2	2	Toyota	6,800,228	7,211,474
3	4	Volkswagen	5,429,896	5,964,004
4	5	Honda	3,549,787	3,868,546
5	3	Ford	3,800,633	3,565,626
6	6	PSA Peugeot Citroën	2.961,437	3,024,863
7	7	Nissan	2,512,519	2,650,813
8	10	Hyundai	2,231,313	2,292,075
9	12	Suzuki	2,004,310	2,284,139
10	9	Renault	2,085,837	2,276,044
11	11	Fiat	1,753,673	1,990,715
12	16	BMW	1,366,838	1,541,503
13	13	Daimler (see Chrysler from 2006)	1,275,152	1,335,226
14	15	Kia	1,181,877	1,286,299
15	14	Mazda	1,169,640	1,165,660
16	17	Mitsubishi	1,008,970	1,100,528
17	8	Chrysler	710,291	754,855

18	19	Avtovaz	765,627	735,897
19	18	Daihatsu	905,932	711,595
20	24	FAW	393 754	690,712
21	22	Chana	446,492	543,787
		Other Manufacturers	7,246,181	5,047,240
		Total manufacturers shown (cars)	**51,953,234**	**56,301,121**

Source: Adapted from South African automotive yearbook (2009, Sec 3); OICA Correspondents Survey (2007).

In order to clarify the world ranking in table 2.2, it should be noted that the listed unit production excludes the manufacture of light commercial vehicles (LCVs), heavy commercial vehicles (HCVs) and heavy buses. For example, in 2006, total production (including cars, LCVs, HCVs and heavy buses) for General Motors was 8 926 160 and 8 036 019 for Toyota. In 2007, total production for General Motors was 9 349 818 and 8 534 690 for Toyota. Therefore the number one world ranking manufacturer for total vehicles in 2006 and 2007 was General Motors even though Toyota produced more passenger cars.

According to Barnes and Morris (2008:32), the automotive industry is one of the largest and most advanced scale industries in terms of output levels and direct and indirect employment. Dannenberg and Kleinhans (2004:1) comment that 8.8 million people are employed in the global automotive industry. The industry contributes 15% of the word's gross domestic product and is made up of both automotive assemblers and automotive component manufacturers. Maxton and Wormald (2004:3) agree with Barnes and Morris that the industry is one of the most vital economic sectors and the world's largest single manufacturing activity. Dannenberg and Kleinhans (2004:1) comment further that globally, the value creation characterised by automotive progress and production (excluding sales, replacement components and service) is expected to grow in the region of 2.6% annually for the next 12 years, that is, from EUR645 billion in 2004 to EUR903 billion in 2015.

A global growth rate of 2.6% annually over the next 12 years is considered low and is a concern for South African automotive component manufacturers which export into international markets. For example, the EU represents 47.7% of South African automotive component exports (DTI 2005:5). It is therefore essential that South African assemblers and automotive component manufacturers remain globally competitive in a slowly growing global economy.

However, it should be pointed out that because of the global financial crisis, during 2008, global vehicle production fell by 16% and South African new vehicle sales fell by 28.3% year on year in November. Germany's new vehicle sales fell by 17.6% year on year – Germany is Europe's largest car manufacturer. This has resulted in job losses worldwide and any significant improvement is expected to happen towards the middle of 2010 (Milazi 2009:5). This development has impacted on automotive component manufacturers in that volumes have dropped in line with vehicle production, which has resulted in the downsizing of both business and the workforce.

2.3.2 Changes in the global automotive industry

Humphrey and Memedovic (2003:2) comment that the increase of vehicle production in the emerging economies escalated greatly during the boom years of the 1990s when these economies expanded significantly. Sutherland et al (2004:87) confirm that there were 700 million motor cars registered in the world. In the 1990s, the number of motor cars globally grew three times faster than the human population. Humphrey and Memedovic (2003:2) comment further that the impact of globalisation on the automotive industry of the emerging countries not only occurred because of the changes in trade and investment policies and the international strategies of leading businesses, but also as a result of the changes in automotive industry value chains. These authors acknowledge that the following factors have impacted on the automotive industry:

- amendments in trade and investment policies
- the globalisation strategies of leading businesses
- amendments in the automotive industry value chains

Humphrey and Memedovic (2003:2) indicate that in the beginning of the 1990s, there were numerous independent automotive industries in Latin America, the ASEAN region

(Malaysia, Thailand, Philippines & Indonesia), India and China. In these countries, the imports of vehicles and components were limited. Exports were also limited, with the exception of Brazil and Mexico. This arrangement began to change in the 1990s because of trade liberalisation, when import restrictions were phased out and import tariffs reduced. However, investment control measures such as the meeting of local content requirements and foreign exchange balancing came under increasing threat. Also, during this period, the production and sales strategies of the main multinational OEMs changed, and the emerging countries gained importance in order to help the multinationals achieve their plans. For the global manufacturers, fast growing markets in emerging countries were a means to (1) establish cheap production sites for the manufacture of selected vehicles or models; and (2) spread new vehicle development costs (Humphrey & Memedovic, 2003:2). The degree to which leading manufacturers grew their manufacturing capacity into emerging countries is shown in table 2.3 (the early 1990s) and table 2.4 (the late 1990s).

The view of Humphrey and Memedovic (2003:2) is affirmed in both Veloso and Kumar (2002:2) and Maxton and Wormald (2004:6), who state that in the last decade, in the three regions of North America, Japan and Western Europe, OEMs have faced a mature market, with stagnant demand, an oversupply of motor vehicles and tough price competition. In order to better reach local consumers and establish lower costs for the production of vehicles, the majority of OEMs invested a great deal of money in assembly plants outside their home base.

As per table 2.4, the haste to invest in the developing markets can be seen in the examples of Brazil and India. After 1994 to 1995, existing vehicle manufacturers invested a great deal in Brazil (Humphrey & Memedovic 2003:7). Equivalent investments were seen in India, in that by 1997, 10 OEMs revealed plans to start the assembly of motor cars in India. It was noted that the capacity of these plants was in the region of 660 000 motor cars per annum. However, growth of total vehicle sales over the periods, from 1996/1997 to 2001/2002 was 4.7%. This resulted in global production overcapacity (Humphrey & Memedovic 2003:9).

Veloso and Kumar (2002:2-3) contend that the evolution in India will be slower because the country's levels of economic development lag well behind those of Brazil. Nonetheless, India is viewed as a key market, because of its size of the population. Another booming area is Eastern Europe (Poland, Hungary, the Czech Republic, Slovenia and Slovakia). Eastern Europe had no car imports during the time of the Soviet Bloc. This part of Europe is currently using its improvement in economic growth and living standards to purchase greater volumes of motor vehicles. In 1999, sales in Eastern Europe reached one million. In 1994, this figure was half that of 1999.

Table 2.3: Main light-vehicle assembly plant investment in emerging markets by Triad region (North America, European Union & Japan) OEMs (early 1990s)

Country	**GM**	**Ford**	**VW Group**	**Daimler/ Chrysler**	**Fiat**	**Renault**	**PSA Group**	**Toyota**	**Nissan**	**Honda**
Mexico	X	X	X	X					X	
Argentina		X	X			X	X			
Brazil	X	X	XX		X					
Malaysia								X	X	
Thailand								X	X	X
Indonesia								X		X
Czech/Slovak			X							
Poland	X				X					
Hungary										
India										
China			X	X		X	X			

Source: Humphrey & Memedovic (2003:7)

Note: X = number of plants operational by early 1990s. XX = two light-vehicle assembly plants owned by the company in the same country.

Table 2.4: Main light-vehicle assembly plant investment in emerging markets by Triad region (North America, European Union & Japan) OEMs (late 1990s)

Country	GM	Ford	VW Group	Daimler/ Chrysler	Fiat	Renault	PSA Group	Toyota	Nissan	Honda
Mexico	X	X	X	XX					X	X
Argentina	X	X	X	X	XX	X	X	X		
Brazil	XX	XX	XXX	X	X	X	X	X		X
Malaysia							X	X	X	
Thailand	X	X						X	X	X
Indonesia								X	X	X
Czech/Slovak			X			X				
Poland	XX	X			XX					
Hungary	X		X							
India	X	X	X		X			X		X
China	X	X	X	X			X		X	X

Source: Humphrey & Memedovic (2003:7)

Notes: X = number of plants operational by late 1990s. XX = two light-vehicle assembly plants owned by the company in the same country.

One of the main reasons for the rapid changes in the automotive industry is global production overcapacity. In order to understand the magnitude of this overcapacity, it is necessary to note that a number of OEMs have invested in new assembly operations, with Eastern Europe, the Mercosur region (Argentina & Brazil) and India. Even though the changes are more obvious in the assembly sector, even more significant changes have occurred in the component industry because of the changes in the nature of value chain relationships between the OEMs and ACMs (Barnes 1999:2).

Table 2.5 provides an overview of the size of North American, European, Japanese, South Korean, Asian, Chinese, Indian and Australian automotive industry vehicle production in 2007.

Table 2.5: Automotive industry vehicle production per country (2007)

PRODUCTION 2007	MOTOR CARS	COMMERCIAL VEHICLES	TOTAL	% CHANGE 2006
Japan	9,944,637	1,651,690	11,596,327	1.0%
United States	3,924,268	6,856,461	10,780,729	-4.5%
China	6,381,116	2,501,340	8,882,456	22.0%
Germany	5,709,139	504,321	6,213,460	6.8%
South Korea	3,723,482	362,826	4,086,308	6.4%
France	2,550,869	464,985	3,015,854	-4.8%
Spain	2,195,780	693,923	2,889,703	4.0%
Brazil	2,388,402	582,416	2,970,818	13.8%
Canada	1,342,133	1,236,105	2,578,238	0.3%
India	1,707,839	598,929	2,306,768	14.4%
Mexico	1,209,097	886,148	2,095,245	2.4%
United Kingdom	1,534,567	215,686	1,750,253	6.1%
Russia	1,288,652	371,468	1,660,120	10.4%
Italy	910,860	373,452	1,284,312	6.0%
Thailand	315,444	971,902	1,287,346	7.8%
Turkey	634,883	464,531	1,099,414	11.3%
Iran	882,000	115,240	997,240	10.3%
Czech Rep	925,778	12,749	938,527	9.8%
Belgium	789,674	44,729	834,403	-9.1%
Poland	695,000	89,700	784,700	9.8%
Slovakia	571,071	0	571,071	93.3%
Argentina	350,735	193,912	544,647	26.0%
South Africa	276,018	258,472	534,490	-9.1%
Malaysia	347,971	93,690	441,661	-12.2%
Indonesia	309,208	103,580	412,788	39%
Ukraine	380,061	22,530	402,591	39.7%
Sweden	316,850	49,170	366,020	9.9%
Australia	283,348	51,269	334,617	0.9%
Hungary	287,982	4,045	292,027	53.5%
Taiwan	212,685	70,354	283,039	-6.7%
Romania	234,103	7,609	241,712	13.2%
Austria	199,969	28,097	228,066	-17.0%
Slovenia	174,209	24,193	198,402	29.6%
Uzbekistan	170,000	14,900	184,900	68.1%
Portugal	134,047	42,195	176,242	-22.5%
Netherlands	61,912	76,656	138,568	-13.1%
Egypt	67,149	36,403	103,552	13.1%
Finland	24,000	303	24,303	-25.8%
Serbia	8,236	1,667	9,903	-11.4%
Other countries	429,430	168,466	597,896	12.5%
Total	53,049,391	20,103,305	73,152,696	5.7%

Source: http://oica.net/net/category/production-statistics

Table 2.5 further highlights the following brief discussion of the international automotive market:

2.3.2.1 North American automotive market

According to Bera (2004:1), the automotive industry is one of the major players in the USA. This industry is vital to the USA economy because it contributes significantly to employment and productivity. It is noted that of the US motor car production, the so-called “Big 3” (General Motors, Ford and Chrysler) make up ± 76% of the total, while the Japanese OEMs (Nissan, Toyota, Subaru, Honda, Mitsubishi, and Isuzu) comprise 18% and the European OEMs (BMW and Mercedes) nearly 2%. As indicated in table 2.5, of the total units produced, the North American automotive industry ranks third in the world, with the European automotive market, the leader. According to Barnes and Morris (2008:32), most of the global vehicle production is locked into North America, Western Europe and Japan.

Sutherland et al (2004:107) observe that in the USA, the emphasis is on compliance with government regulations and promoting the safety of workers

2.3.2.2 European automotive market

According to Bera (2004:1), the European automotive industry makes up ± 9% of the total European Union (EU) manufacturing sector. The EU comprises 25 member states and is the world's largest automotive market and the largest manufacturing region. The European automotive industry is thus regarded as a leader in the international market with total integrated operations comprising research and development, design, production and sales. The industry has a broad highly sophisticated global network which includes joint ventures and cooperatives, plus various worldwide production and assembly sites. The industry’s manufacturers combined have a production capacity exceeding that of Japan and the USA. It should be noted however, that not one EU country manufactures more than its Japanese or US competitors (see table 2.5). (http://europa.eu.int/comm/trade/issues/ sectoral/ industry/ auto/index_en.htm).

The significance of the automotive industry for the economies of each EU country varies by country. The countries with the largest automotive markets in the EU region are Germany at 30% of EU's total production, France at 19%, Spain at 17%, and the UK at 10%**.** According to recent reports, automobile production represents approximately 10% of total manufacturing in the countries of Germany, France, Spain and Sweden, while the average for the balance of the EU is approximately 8% (http://http:usitc.gov/pub/reports/studies/PUB3545.PDF)

At this point, it is necessary to mention the fact that the Japanese are still struggling in Europe, and academics, experts and politicians have observed that this is because of "the informal quotas" – "voluntary agreements that kept Japanese car sales in Western Europe capped at 10% to 15% of the market", and that without these barriers, which were implemented between 1991 and 1999, the Japanese car manufacturers would have effectively eliminated the European car manufacturers, just as they did with the Big 3 in the 1980s (Seidenfuss & Kathawala 2002:2). In 1991, after nearly two years of negotiations, the EU and Japan reached an agreement on a transitional period, starting in 1993 and ending 1999, whereby the European car manufacturers were given time to restructure and adjust to new competitive conditions. According to the EU Commission, the agreement was reached to "prevent disruption and help EU producers prepare to meet the full force of international competition" when the agreement eventually expired (European Commission 1991).

Sutherland et al (2004:107) observe that in Europe, attention is focused on reducing waste and achieving ISO14000 accreditation.

2.3.2.3 Asian automotive industry

Barnes and Morris (2008:32) acknowledge that in terms of employment, income and technology spillovers, the Asian automotive industry constitutes a fraction of the percentage of total global production. The Asian automotive industry comprises three markets, namely South Korea, Japan and China, with the Korean and Chinese automotive industry growing the most rapidly. Analysts have predicated that over the next decade, Korean and Chinese light-vehicle sales will more than double, equalling the volumes of Japan (Veloso & Kumar 2002:23). Barnes and Morris (2008:39) confirm this in their statement that Asia – excluding Japan – is expected to significantly increase its contribution to global vehicle production by 2012.

2.3.2.4 Japan's automotive industry

The Japanese automotive industry comprises a significant percentage of Japan's economy, making up 13% of its manufacturing output and employing 10% of the economically active people. After the EU, Japan ranks second as the leading manufacturer of motor vehicles. The USA is the largest single export market for Japanese vehicles. The Japanese automotive industry depends greatly on exports as opposed to imports which make up a much smaller percentage of auto trade (Bera 2004:2)

Sutherland et al (2004:107) observe that, in Japan, the focus is on reducing waste and energy usage/CO_2 emissions.

2.3.2.5 South Korea's automotive industry

South Korea has the world's sixth largest automotive industry (table 2.5), and is the world's third largest motor car exporter. The country exports 41% of its total motor vehicle production with over one-third of its exports being destined for the USA. Interestingly, imports make up less than 1% of motor vehicle trade in the domestic market (Bera 2004:3).

2.3.2.6 China's automotive industry

The Chinese automotive industry continues to grow rapidly and Veloso and Kumar (2002:28) have forecast that by 2010, China will have one of the world's largest automotive industries. As indicated in table 2.5, in 2007, China was already producing in excess of 8.8 million units and effectively ranked fifth in the global market. The Chinese automotive industry comprises 120 complete OEMs, employing nearly 1.85 million workers (Veloso & Kumar 2002:28).

2.3.2.7 India's automotive industry

India is identified as one of the most attractive future markets for the automotive industry because it has a population of over one billion people. However, owing to the low incomes of the population, the number of motor cars sold in the country stands at only 600 000 per annum. It is unlikely that new vehicle sales in India will exceed two million units per annum by 2010. The rapid growth in investment means that there are currently 24 OEMs in India and the result is a problem of overcapacity. This will inevitably lead to a shake-out in the industry, with mergers and acquisitions between OEMs, and the probable closure of some assembly plants (Veloso & Kumar 2002:27).

Over 300 small and medium component manufacturers and suppliers supply the 24 OEMs in the country. Historically, this components sector was extremely fragmented and experienced significant quality problems (Veloso & Kumar 2002:27). However, this sector is rapidly changing into a more competitive one. This is being achieved through the implementation of world-class technologies, larger production volumes and adherence to the stricter delivery schedules as designated by global manufacturers. Many Indian companies have entered into technological partnerships with global leaders in automotive components. Furthermore, subsidiaries of global vehicle assemblers such as Delphi have set up components manufacturing facilities in India, which will enable the Indian automotive components market to measure up to strict quality standards and implement the latest technology (Sharma 2004:1).

In 1998, the Society of Indian Automobile Manufacturers (SIAM) was formed in order to promote the sustainable development of the automotive industry, focusing on technology, the environment and safety. SIAM plays a key role as coordinator and communicator with the Indian government, and national and international organisations (Sobti 2003:4).

Recently, Indian vehicles have started to be accepted by the global market because of the improvement in vehicle quality and performance (Sobti 2003:14). The Indian automotive component sector plays a role in promoting trade and is a high investment sector of the economy with state-of-the art technology, serving most vehicle models (Sobti 2003:16-17).

2.3.2.8 The Australian automotive industry

The Australian passenger motor vehicle industry consists of four car assemblers (Ford, Mitsubishi, Holden and Toyota) with more than 200 component, tooling, design and engineering firms. Most of the businesses in the motor industry are based in Victoria and Southern Australia (Automotive Industry 2007:1).

In 2006, the four car assemblers, Ford, Mitsubishi, Holden and Toyota, produced 326 960 vehicles in Australia. In this year, the value of the automotive exports from Australia was $4.65 billion with another $1.78 billion of automotive components also being exported (Australian dollars). The main export destination is the Middle East (37% of exports) followed by Nafta (22% of exports) (Automotive Industry 2007:1).

2.3.3 Conclusion

From the above discussion it is clear that the global automotive industry is supported by a vibrant automotive component industry. As indicated in Barnes and Morris (2008:34), the bulk of manufacturing value lies in the components industry, as opposed to the assembly of motor cars. The split is estimated to be 70:30. However, the above authors do point out that it is the OEMs that determine the scale and scope of automotive component activity.

Since the focus of the research for this study is on the South African automotive component industry (suppliers to OEMs), the next section deals with this industry.

2.4 THE SOUTH AFRICAN AUTOMOTIVE INDUSTRY

This section provides a historical overview of the role of the automotive industry in South Africa's economy.

2.4.1 History of the motor industry in South Africa

Hough, Neuland and Bothma (2003:41) affirm that South Africa has always been dependent on international trade. For example, right up until 1925, the country's economic growth of the relied almost entirely on the export of gold, diamonds and agricultural products. Hough and Neuland (2007:32) acknowledge that in order to grow South Africa's manufacturing industry, right up to the period before 1960, there was a strong move to develop the local industry as a substitute for imports. This resulted in the rapid growth of the manufacturing industry.

This is confirmed in an article in TISA (2003:8) which states that the South African automotive industry began receiving support from the government in the 1920s. The industry was built up from 1961 onwards through protectionist policies. During this time, the heavy import duties on imported motor cars (100% + 15% surcharge) promoted the development of an industry of small assembly plants producing a relatively wide range of models in small volumes at high cost (Humphrey et al 2003:38).

According to Parkin, Powell and Matthews (2005:757), a tariff is a tax imposed by the importing country, when goods are brought into a country. Basically, tariffs have been used as a source of government revenue for centuries, and many countries, including the UK and the USA hid behind enormous tariff barriers that restricted international trade. These barriers to international trade were slowly dismantled after World War II. For example, according to Barnes (2000:2), in South Africa in the 1920s, some components such as batteries, glass and tyres were produced locally as a direct result of tariff protection being afforded to automotive assemblers. At this time, as noted in Humphrey et al (2003:38), a 50% import duty was levied on all imported components for assembled motor cars. The situation did not change significantly over the next 20 years, but the low levels of value added led the government to target this industry for development measures after World War II.

As Hough et al (2003:42) indicate, during the import substitution process, widespread use of trade barriers, such as high import duties, quotas and subsidisation to protect local industries against foreign competition, is created. According to these authors, one of the advantages of import substitution is that the balance of payment situation improves as fewer products are imported. However, after World War II, South Africa began to show an ongoing deficit in the current balance in payments (Hough et al 2007:32). At this time, the country relied on the inflow of foreign investment in order to maintain equilibrium in the overall balance of payments. Towards the end of the 1960s, the deficit in the balance of payments increased to such a level, that import controls and a devaluation of the rand became necessary to correct the state of affairs. Also, it became evident that the main sources of foreign currency (gold and agricultural products) could no longer be depended on to the degree that they had previously been because South Africa's ore reserves were diminishing and agricultural products were often affected by poor weather and unpredictable international supply and demand patterns (Hough et al 2003:42).

During the 1980s, the need for a shift in South Africa's protectionist policy became apparent, and protectionism was thus limited. Findings of studies conducted by the World Bank and the International Monetary Fund (IMF) showed that countries that largely pursued an import substitution path had achieved far lower economic growth rates than countries following an export development policy (Hough et al 2003:42; Hough & Neuland (2007:33). This is affirmed by Van Biljon (1998:6), who indicates that the protective policies of the past – in terms of high import duties placed on imported vehicles and components and local content requirements – led to the rise of low-volume assemblers supplied by low-volume, high variety component manufacturers. Because of low volume and lack of economies of scale, the cost of locally produced components was not competitive, which resulted in the South African assembly industry being uncompetitive.

As stated in (TISA 2003:6), "a successful automotive industry is often seen as a symbol of economic success and as a sign of mastery of modern technologies". In South Africa, the outcome of well-designed and well-managed government policies – primarily the Motor Industry Development Programme (MIDP) – is the firm growth of this industry. For example, South Africa is a major supplier of platinum catalytic converters for motor vehicle exhausts. The main customers for these converters are foreign automotive assemblers (http://www.sa-exporter.com/fast_facts_about_ south_ africa.asp**).**

According to Humphrey and Memedovic (2003:36), in some instances, South Africa has moved in the same direction as Australia, although a greater measure of protection has been retained. Barnes (2000:2) acknowledges that government involvement led to a series of five local content (the use local raw materials or locally produced inputs that go into the manufacture of components) phases. These ended in 1995, and were similar to protective procedures in developing countries such as India and Brazil. The five phases included a combination of tariffs and import permits. The intention of each new phase was to increase the amount of local content and further promote OEM/ACM relationships in South Africa.

TISA (2003:8) and Barnes and Morris (2008:39) confirm this, by stating that during 1961 and 1995, six local content programmes of government support for the industry were identified. These phases included ongoing market protection and a range of incentives and requirements for increased local content. Local content requirements were supported by punitive tariffs on imported components (Flatters 2002:2). Phase VI was introduced in 1989, and put forward a key policy change through the encouragement of automotive exports. Key modifications included terms allowing exports to be counted towards local content requirements and the local content requirements were substantially reduced. Because of this protected environment, the number of different vehicle models being manufactured increased (Flatters 2002:3).

Humphrey et al (2003:36) report that in 1995, a new policy, the Motor Industry Development Plan (MIDP), shifted the industry towards increasing integration into the global value chains of the transnational OEMs. Barnes (2000:3) indicates that the Motor Industry Development Plan (MIDP) was launched in September 1995, and at that time the industry was reintegrated into the global automotive industry. The MIDP was established to readjust the structure of the automotive industry so that global competitiveness could be achieved. The MIDP is aimed at developing an internationally competitive and growing automotive industry with five main objectives: (1) improve the global competitiveness of South African OEMs and ACMs; (2) provide superior quality; and produce affordable vehicles and components to the domestic and international markets; (3) enhance growth of the assembly and automotive components firms; (4) stabilise employment levels and improve the economic growth of the country by increasing production; and (5) thus improve the industry's trade balance (TISA 2003:8)**.**

As confirmed in South Africa's Automotive Industry (2007:3), the MIDP commenced in 1995 and is due to terminate in 2012. The aim of the plan was to increase local exports. This was achieved by making it possible for local OEMs and ACMs to include total export values as part of their local content total, and on this basis, allow these OEMs and ACMSs to import the same value of goods duty free. This enabled OEMs and ACMs to focus on manufacturing certain vehicles or components for export, while importing other models (South Africa's Automotive Industry 2007:3).

The main objective of the MIDP programme was to slowly reintegrate South Africa into the global motor industry. Import tariffs were gradually reduced to give the local industry a chance to adapt (Naude, 2005:44). Initially, this practice had resulted in the loss of employment over the past five years. Presently, the South African motor industry is starting to show attributes of international competitiveness (Vermeulen 2004:1).

As stated in the National Association of Automobile Manufacturers of South Africa (NAAMSA) Annual Report (2007:36), the Ministry of Trade and Industry conducted a review of the MIDP. In the interim, until the outcome of the review is announced, government has assured the industry of ongoing support and confirmed that it will maintain support for the industry through to 2020, in the context of government's official vision for the industry, namely to double South Africa's vehicle production to *1.2 million* units a year by 2020. Venter (2008:1) confirms that a new support programme for the motor industry "aimed at improving the domestic value chain" will be introduced to run until 2020.

In *Mind Motor Industry News Digest* (October–December 2006), Dr van Zyl indicates that he believes that production of 1 million units would put South Africa on the international map as a supply source. This would result in support for the component suppliers, job creation, more affordable vehicles (through economies of scale) and export growth that would be compliant with WTO regulations. Compliance with WTO regulations will result if MIDP complies with the requirements of the WTO.

2.4.2 Employment levels

Rationalisation and restructuring occurred during the early years as the automotive industry became exposed to lower levels of protection. For example, the import duty on a fully imported motor car between 1995 and 2002 was programmed to drop from 65% to 40% and that on components from 49 to 30% (Flatters 2002:3). This resulted in job losses, particularly in the assembly side of the automotive industry (OEMs). Job losses on the manufacturing (ACMs) side of the industry evened out from 1998/1999 onwards (Vermeulen 2004:1; Naude 2005:44).

As indicated in table 2.6, the number of employees in the total automotive industry in South Africa in June 2008 was 323 600. This figure increased (June 1997) from 304 600 (a total of 19 000). The majority of employees in this industry are employed in the Motor Trade, Distribution and Servicing sector. In 2008, the employment levels in OEMs were 36 000 and in ACMs 81 500.

Table 2.6: Number of employees in the domestic automotive industry June 1998 to June 2008

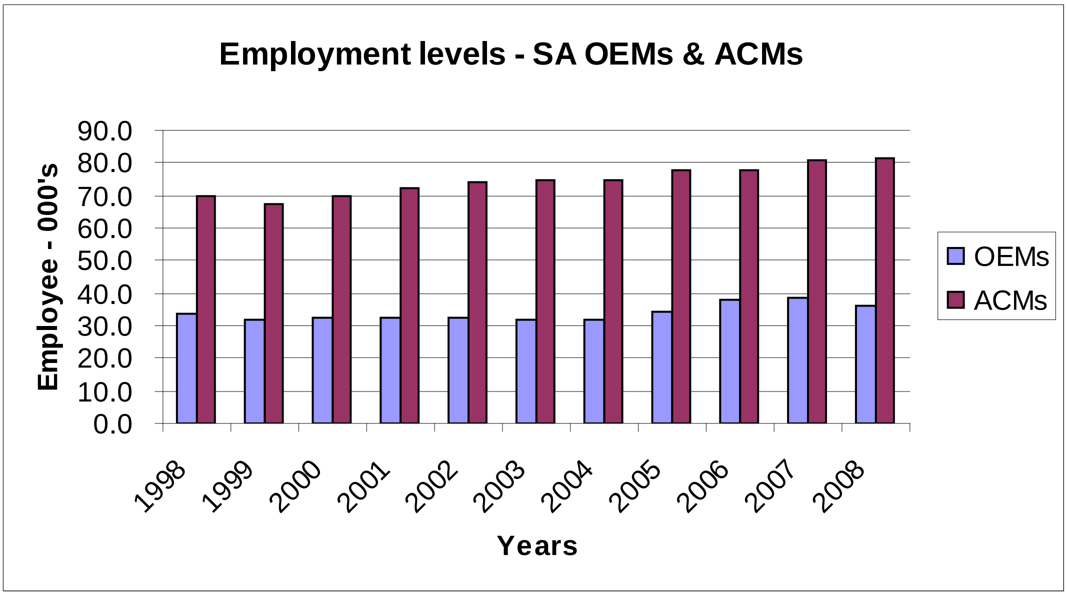
SECTOR	1998 ('000)	1999 ('000)	2000 ('000)	2001 ('000)	2002 ('000)	2003 ('000)	2004 ('000)	2005 ('000)	2006 ('000)	2007 ('000)	2008 ('000)
Automotive assemblers (OEMs)	33.7	32.0	32.3	32.7	32.4	31.6	31.8	34.3	37.9	38.4	36.0
Component manufacturers (ACMs)	70.0	67.2	69.5	72.1	74.1	75.0	75.0	78.0	78.0	81.0	81.5
Tyre industry	9.1	6.7	6.6	6.3	6.0	6.0	7.2	6.8	6.5	6.9	7.0
Motor trade, distribution & servicing	170.0	175.0	180.0	182.0	185.0	191.0	194.0	198.0	198.0	200.0	200.0

Source: Adapted from TISA (2003:47); Barnes (2000:9); NAAMSA in South Africa Automotive Yearbook (2009: Secs 9:1 & 9.2).

Figure 2.2 tracks the employment trends in both the automotive assemblers and component manufacturers from June 1998 to June 2008.

As indicated in section 1.2, since the global economic crisis and credit crunch the number of employees in the domestic automotive industry has declined considerably. The industry has reported that more than 16 000 jobs (± 20% of the total) have been lost in the component manufacturing sector in the past six months, and as at March 2009, employment was estimated to have declined to 65 500 employees (NAACAM Newsletter, March 2009:1).

Figure 2.2: Employment levels of South African OEMs and ACMs



Source: Adapted from TISA (2003:47); Barnes (2000:9) and NAAMSA, in South African Automotive Yearbook (2009: Secs 9:1 & 9.2)

2.4.3 The size and role of the South African motor industry

As indicated earlier on in this chapter, South Africa's automotive industry has become an increasingly important contributor to the country's GDP and employment opportunities. In terms of its international contribution, globally, the industry ranked 19th in 2003 and 20th in 2006 in terms of vehicle production. South Africa was responsible for approximately 80% of Africa's vehicle output and produced 0.7% of the world's vehicles in 2003. In 2006, South Africa was responsible for approximately 85% of Africa's total vehicle output and 0.85% of the world's total vehicle production (South Africa.info Reporter 2003:1; NAAMSA Annual Report 2007:10).

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).

Table 2.7: South Africa's automotive industry's performance in a global context

	2000	**2004**	**2005**	**2006**	**% change 2006**
Global vehicle production	58,40 million	64,49 million	66,55 million	69,21 million	+ 4,0%
SA vehicle production	0,357 million	0,455 million	0,525 million	0,588 million	+11,9%
SA share of global production	0,61%	0,70%	0,79%	0,85%	+ 7,6%

Source: Vermeulen (2007:2); Oica (2008); Mbiko (2007:7)

As mentioned in chapter 1, the size and production ability of the South African automotive market is relatively small. However, South Africa is in a position to provide competitive advantages to international concerns. An article in *South Africa's Automotive Industry* (2007) states that, according to projections, South African vehicle exports will increase sharply from 2006 to 2008. Domestic new vehicle sales rose by a record 22% in 2004, followed by a new record in 2005 of 27%, making the country one of the best performing automotive markets globally. A few examples (South Africa's Automotive Industry 2007:1) are provided below:

- In April 2005, General Motors awarded its South African arm a contract worth US$3 billion to manufacture a new global version of its Hummer sports vehicle (the H3) for export to markets in Europe, Asia Pacific, the Middle East and Africa.
- General Motors pledged to make a US$100 million investment in product development and production at the General Motors plant in Port Elizabeth. This assembly plant currently manufactures Opel and Isuzu vehicles. This pledge is in addition to (1) the $50 million that General Motors invested in plant and equipment upgrades; and (2) the $80 million it invested in the new Isuzu KB in 2004.
- In May 2005, Toyota South Africa announced that it would continue its Corolla export programme to Australia and also export a new light commercial vehicle and sports utility vehicle to Europe and Africa as part of its global IMV (innovative international multipurpose vehicle) project. (South Africa's Automotive Industry 2007:1)

However, at the time of compiling this thesis, numerous reports have circulated that new vehicle sales had plunged by 20.3% in August 2008 compared August 2007. According to NAAMSA, new passenger cars sales continue to remain under pressure because of increased interest rates, rising inflation and high personal debt levels (New car sales plunge 2008:7). This challenge is not unique to South Africa because car sales have plunged globally.

Most of the global major motor vehicle manufacturers are represented in South Africa and are located in three of the country's nine provinces. These vehicle manufacturers include BMW, Nissan, Fiat and Ford (incorporating Mazda), which operate in Gauteng, Volkswagen, DaimlerChrysler and General Motors operate in the Eastern Cape and Toyota operates in KwaZulu-Natal. According to Mbiko (2006:3), seven of the eight OEMs are wholly foreign-owned multinationals. Until August 2008, Toyota was 75% foreign owned and 25% locally owned by Wesco Investments Ltd. In late August 2008, Toyota South Africa became a wholly owned subsidiary of Toyota Motors (Staff Reporter, 6 August 2008:1).

As indicated earlier, this study focuses mainly on the automotive component manufacturers (ACMs) which are first-tier suppliers to OEMs (automotive assemblers). As indicated in section 1.4, it is estimated that there are 300 automotive parts manufacturers or ACMs (which supply OEMs, OESs and the aftermarket), and another 150, spread throughout the country, producing parts for the automotive industry, as well as for other sectors such as light engineering, mining, construction and defence (South African Automotive Yearbook 2008:3). Just under half of these suppliers are located in Gauteng, a third in the Eastern Cape, a quarter in KwaZulu-Natal and a few companies in the Western Cape (Mbiko 2006:3).

As indicated in table 2.8, ACMs export a wide array of components. Key component exports include catalytic converters, silencers, exhaust pipes, tyres, road wheels and parts and stitched leather seats. The growth rates for exports of these were around 40% between 1994 and 2004, and are expected to remain high (South Africa's Automotive Industry 2007:2).

Table 2.8: Export data for components (2005 – 2007)

Code	Component	2005	2006	2007	%Diff 2007/6
1	Air conditioners	14	11	21	90.9
2	Alarm systems	55	81	97	19.8
3	Automotive tooling	332	272	520	91.2
4	Axles (driving/non-driving)	201	375	273	-27.2
4A	Batteries	75	83	115	19.8
5	Body parts/panels	78	115	127	10.4
6	Brake parts	120	120	138	15
7	Car radios	268	377	589	56.2
8	Catalytic converters	9935	15810	21683	37.1
9	Clutches/shaft couplings	73	81	152	87.7
10	Engines/engine parts	1781	2200	2172	-1.3
11A	Filters	174	218	275	26.1
12	Gaskets	36	45	70	55.6
13	Gauges/instruments/parts	161	184	248	34.8
14	Gear boxes	82	113	86	-23.9
15	Glass (automotive)	359	321	295	-8.1
16	Ignition/starting equipment	185	174	204	17.2
17	Jacks	10	18	60	233.3
18	Lighting/signalling/wiping	58	63	164	160.3
19	Radiators	220	365	368	0.8
20	Road wheels/parts	737	681	772	13.4
21	Seats	4	7	8	14.3
22	Seat parts/leather covers	2693	2549	2760	8.3
23	Seatbelts	61	60	62	3.3
24	Shock absorbers	5	1	12	1100
25	Silencers/exhaust pipes	492	407	1705	318.9
26	Springs	28	38	44	15.8
27	Steering wheels/columns/box	33	69	150	117.4
28	Transmission shafts/cranks	553	351	556	58.4
29	Tyres	1183	1220	1196	-2
30	Wiring harnesses	258	208	198	-4.8
31	Other components	3016	3435	3986	30.1
	Total (R million)	**23280**	**30052**	**39106**	**16.3**

Source: Compiled by the South African Automotive Yearbook (2009: sec 2).

Germany is the largest destination for South African component exports with other major markets including Spain, the UK, France, the USA, Belgium and Poland (South African Automotive Yearbook 2009: sec 2).

However, as indicated by Jennings (2009:5), globally the economic crisis has increased overcapacity in vehicle production and forced several vehicle and component manufacturers' to close, operate on short time and reduce the labour force. It is anticipated that this will have a negative impact on exports.

2.4.4 Broad-based black economic empowerment

The Broad-Based Black Economic Empowerment (BBBEE) Act 53 of 2003 was promulgated in 2003. Previous to this, the steps taken by government to support disadvantaged purchasing programmes mainly affected "organs of state". The BBBEE strategy is the result of an extensive consultation process with government and the private sector (Hugo et al 2006:331). Hence government has mandated certain industries to produce a BEE charter. A BEE charter for the various industries has already been produced as follows:

- the Maritime Transport and Service Industry BEE Charter;
- the Forwarding and Clearing (F & C) Industry Charter;
- the Information, Communication and Technology (ICT) Charter;
- the Mining Charter;
- the Tourism Industry Empowerment and Transformation Charter;
- the Petroleum and Liquid Fuels Industry Charter;
- the Construction Sector Charter No. 29616;
- the Financial Sector Charter No. 29610;
- the Property Sector Charter No. 30333; and
- the AGRIBEE Sector Charter No. 30886.

(the dti/the dti BEE Charters (2008).

It is anticipated that several charters will be introduced in other sectors in the economy. For example, NAAMSA members are currently formulating BEE enterprise charters for the automotive industry. These member companies have taken on BBBEE as a vital aspect of the business environment and are both individually and collectively working towards the rapid implementation of BBBEE initiatives and projects (NAAMSA Annual Report 2007:43)

In order to determine progress made in achieving BEE compliance by businesses and business sectors, government uses a balanced scorecard. This scorecard measures three core elements of BEE as indicated below (Hugo et al 2006:334):

1. "Direct empowerment through ownership and control of enterprises and assets
2. Human resource development and employment equity
3. Indirect empowerment through preferential procurement and enterprise development".

It is estimated that as much as 30% of an OEM's sales is made up of direct sales to national government, corporate and fleet buyers. In the main, these entities require their suppliers to meet certain BBBEE compliance criteria and in the existing business environment, OEMs cannot afford to lose a fraction of these sales. Hence OEMs located in South Africa have made a commitment to drive BBBEE compliance (*NAACAM Newsletter* March 2008:8).

As stated in the NAACAM Newsletter, dated May 2008, OEMs in South Africa carried out a joint project to assess the level of BBBEE compliance in their supply base. A consolidated list of 100 suppliers (in terms of value spend) across the OEMs was compiled. It was found that 38% of the suppliers contacted are BBBEE compliant. The remaining suppliers, which are noncompliant or do not have a scorecard in place indicated that they had started a process to measure their BBBEE compliance and would increase it over time (*NAACAM Newsletter* May 2008:8).

To complicate matters, draft documentation released by the Department of Trade and Industry (DTI) indicates that companies must verify their scorecard measurement via a rating agency (Government Gazette 2008). A rating agency simply audits the scorecard and supporting documentation.

The OEMs have engaged rating agencies to verify their scorecards and can therefore only count a supplier's BBBEE compliance if the supplier's scorecard has been verified by a rating agency. Currently the Retail Motor Industry (RMI), NAACAM and NAAMSA are in discussions to introduce a single scorecard toolkit and database. The OEMs therefore require verified scorecards. NAACAM encourages its members to prepare for its verification process by using the NAACAM toolkit or the automotive industry toolkit once it is launched (NAACAM Newsletter, May 2008:8).

2.5 CONCLUSION

From the overview of the global and local automotive industry, it is clear that a successful automotive industry is often regarded as a symbol of a country's economic success. The automotive industry and specifically ACMs play a vital part in the economic well-being of South Africa (TISA 2003:6), and the industry has become an increasingly important contributor to the country's GDP. It is therefore imperative that the South African automotive industry, and ACMs in particular, remain internationally competitive to prevent other international competitors from easily penetrating the South African market.

Chapter 3 explains the concepts of supply chain, supply chain management and related concepts. The following topics will be dealt with:

- the reasons for development of supply chain management concepts
- the supply chain concept
- the supply chain philosophy
- components of supply chain management
- the motor industry supply chain
- the application of supply chain management by the motor industry

CHAPTER 1

Introduction

CHAPTER 2

The global and South African automotive industry

CHAPTER 3

Supply chains, supply chain management and related concepts

CHAPTER 4

Supply chain management practices and tools

CHAPTER 5

Research design and methodology

CHAPTER 6

Problems experienced by ACMs from their customer's perspective

CHAPTER 7

Supply chain problems facing ACMs in South Africa: empirical research

CHAPTER 8

Summary, recommendations, caveats and suggestions for further research

OUTCOME

To identify problems or difficulties in the supply chain and suggest remedies to ACMs and the motor industry as a whole

CHAPTER 3

SUPPLY CHAINS, SUPPLY CHAIN MANAGEMENT AND RELATED CONCEPTS

3.1 INTRODUCTION

The significance of a successful automotive industry in the South African economy was highlighted in Chapter 2. The aim of this chapter is to provide a solid foundation in supply chain management and discuss the essential concepts and practices, including examples of how to put these to use. This chapter will deal with key principles and business operations that drive any supply chain; the objectives and dimensions of supply chain management; building relationships; supply chain integration; supply chain design; supply chain flows; supply chain issues in the South African automotive industry; and future trends in supply chain management.

Hugos (2006:2) highlights the fact that supply chains include the organisations and business activities necessary to "*design*, *make, deliver* and *use*" a product or service. Organisations rely on their supply chain networks to give them what they require to prosper and survive. Every single organisation fits into one or more supply chains and has a role to play in each.

Environmental change and uncertainty about how markets will progress and fierce competition have made it progressively more crucial for organisations to be mindful of the supply chains they take part in and be aware of the roles they play. It has been noted that the outcome of organisations capable of developing and participating in strong supply chains is a significant competitive advantage in their respective markets (Hugos 2006:2; Simchi-Levi et al 2008:1)

3.2 SUPPLY CHAIN MANAGEMENT

3.2.1 An overview of supply chain management

"Kicking boxes and licking labels" was a phrase coined to describe supply chain during a leadership summit hosted by IBM and Disney. This phrase emerged from the fact that a number of individuals are of the opinion that supply chain management consists of merely shipping and logistics (O'Marah 2007:17).

As indicated by Hugo et al (2006:57) the term "supply chain management" is not yet generally accepted as describing, the exciting new method aimed at enhancing customer service and providing the organisation with a competitive advantage through efficient management of the flow of materials and services.

The Council of Supply Chain Management professionals (2005:7) define supply chain management as:

> "managing supply and demand, sourcing raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channels, and delivery to the customer".

Supply chain management is the management of actions involved in purchasing materials, converting them into intermediate goods and end products and distributing a product or service. The chain starts with basic suppliers of raw materials and extends all the way to the final customers. The facilities or parties involved in an assembly type of supply chain, such as automotive component manufacturers, include warehouses, factories, processing centres, distribution centres, retail outlets and offices. The activities involved include demand planning, sourcing, managing inventory, information and quality, scheduling production, distribution, disposal and customer service (Heizer & Render 2008:434; Stevenson 2005:692).

Hugos (2006:4) defines supply chain management as follows: "Supply chain management is the coordination of production, inventory, location and transportation among the participants in a supply chain to achieve the best mix of responsiveness and efficiency for the market being served."

According to Paliwal (2005:64), supply chain management as a field of study extracts contributions from several disciplines including transaction cost economics, relationship marketing, agency theory and systems studies. SCM provides a useful structure for analysing relationships between businesses engaged in both vertical and horizontal alliances as a means of pursuing consumer awareness. In addition, SCM is also concerned with the development and nature of relationships between organisations in the supply chain.

The Supply Chain Council (Hugo et al 2004:5) proposes the following definition of a supply chain:

> "The supply chain – a term increasingly used by logistics professionals – encompasses every effort involved in producing and delivering a final product from the suppliers' supplier to the customers' customer. Four basic processes – plan, source, make, deliver – broadly define these efforts, which include managing supply and demand, sourcing, raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channels and delivery to the customer".

It is clear from the above definitions that supply chain management comprises all those activities, processes and relationships included in the flow of materials through the supply chain

Supply chain management in the manufacturing of automobiles can be regarded as the inputs needed at each level or tier of the supply chain, to be transformed into finished automotive components. Inputs include information from customers, raw materials, inventory, equipment, machinery, labour and finances. The transformation process is the management of the modification process that converts inputs (such as raw material and labour) into outputs (finished goods and services) that are distributed at the customer at the next lower level of the supply chain. This process is continued at all levels of the supply chain until the final product (motor car) reaches the final customer.

Stevenson (2007:503) contends that supply chain management is the management of all the functions, facilities and activities (both inside and outside a business organisation) comprising the *value chain*. Paliwal (2005:65), for instance, notes that the Indian traditional footwear industry has been studied from the value chain perspective, and certain initiatives have been implemented to make the industry efficient, agile and competitive.

The supply chain/value chain is dealt with in the next section.

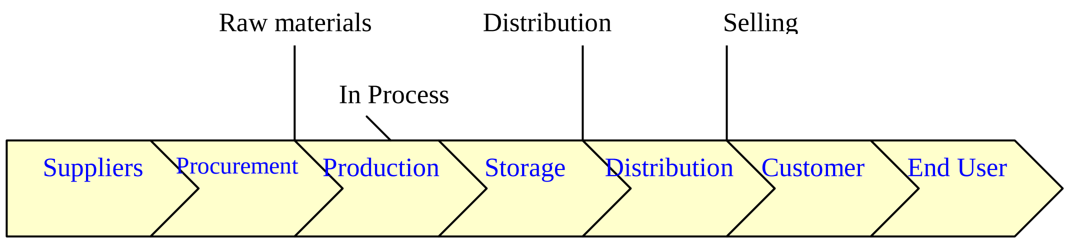
3.2.2 Supply chain/value chain

The automotive industry has experienced significant technical and organisational transformations. For example, on the assembly side, conventional Fordist techniques of production have been replaced with different mixes of Japanese lean production techniques as OEMs try to satisfy a progressively more diversified pattern of demand for motor cars. This has stimulated a leap forward in both productivity and cost and has had major consequences right through the industry value chain. Specifically, to a large extent, there is a greater co-dependency between OEMs and component manufacturers (Morris et al 2004:129; Maxton & Wormald 2004:257).

Van Biljon (1998:127) acknowledges that supply chains and value chains are not the same thing. They differ in one key respect, namely that the supply chain supports a *pull* philosophy, whereas a value chain is based on a *push* philosophy. In a *pull* philosophy, value and volume are determined by the customers – products are pulled through the system on the basis of customer requirements. In a *push* philosophy, the customer is not the trigger of product design and volume. Products are pushed through the materials flow channel on the basis of what every channel member regards as the optimum level of supply. O'Marah (2007:17) acknowledges that businesses ought to – and have started – to change from a factory-oriented push set of actions to a demand-driven approach in line with customers' requirements. The convincing reality about a demand-driven approach is that the businesses utilising it have financially outperformed others in terms of return on assets, profit margins and earnings per share.

However, according to Stevenson (2007:503), supply chains are sometimes referred to as value chains, a phrase that suggests the idea that value is added as products and services move through the chain (fig 3.1). As indicated in figure 3.1, a supply chain is the order of organisations (their facilities and functions) that are included in manufacturing and delivering a product or service. The arrangement starts with the suppliers of raw materials and extends all the way to the end customer. Facilities include warehouses, factories, processing centres, distribution centres, retail outlets and offices. Functions and activities include anticipating demand, sourcing, managing stock, information and quality, scheduling, manufacturing, distribution, delivery and customer service.

Figure 3.1: A simple supply chain



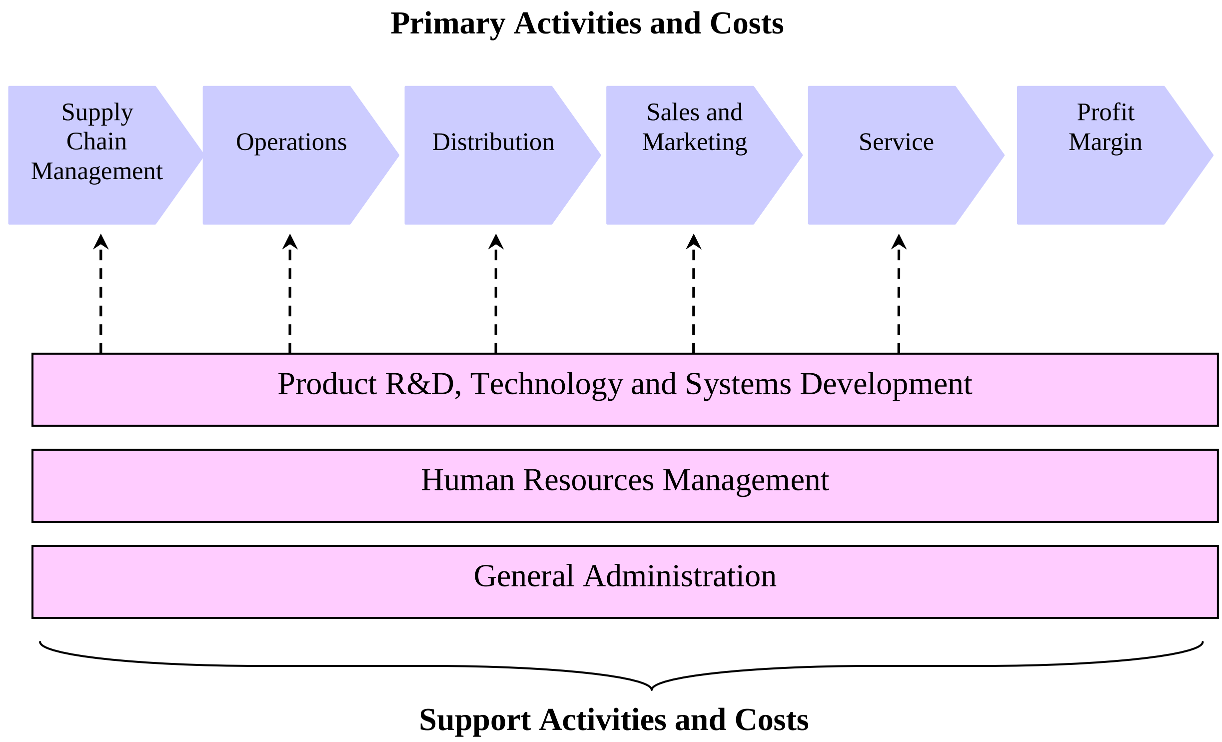
Source: Lysons & Gillingham (2003:71)

Lysons and Gillingham (2003:75) observe that supply chains are linked to value chains. Thompson et al (2006:95) acknowledge that every business involves a group of actions performed in the order of designing, manufacturing, marketing, delivering and supporting its product or service. A company's value chain distinguishes the key activities that build customer value and the related support activities.

According to Pearce and Robinson (2007:156), the term "value chain" involves a business being concerned with a chain of activities that converts inputs into outputs that customers esteem. Lysons and Gillingham (2003:75) hold that the term of '*value chain analysis*' was coined by Michael Porter. Value chain analysis is described an orderly method of establishing how a business's different activities play a role in creating value for the customer (Ehlers & Lazenby 2004:70).

Figure 3.2 is a generic value chain as illustrated in Thompson et al (2006:96). The value chain comprises two groups, namely the five primary activities that are crucial in generating value for clients and the necessary three support activities that make the function of the primary activities possible. Bartlett, Ghoshal and Beamish, (2008:308) acknowledge that the activities performed by a business in any industry can be grouped according to the primary and support activities, because every business performs them.

Figure 3.2: A generic value chain



Source: Thompson et al 2006:96

In a nutshell, the value chain consists of both primary and support activities. Most firms engage in a huge number of activities in the process of converting inputs into outputs. These activities are generally categorised as either primary or support activities which all firms perform in some way.

Primary activities in a business include manufacturing, marketing, delivering the product to the customer and offering after sales support. However, support activities in a business help it by making inputs available so that the primary activities can be achieved continuously (Pearce & Robinson 2007:159). Both primary and support activities are briefly explained as follows (Pearce & Robinson 2007:158; Thompson et al 2006:96; Lysons & Gillingham 2003:77)**:**

a. *Primary activities***:**

- *Supply chain management* includes all the costs and assets relating to the procurement of fuel, utilities, raw materials, parts and components and consumable items, as well as all the activities required for the receipt, inspection, storage and inventory control of these materials.
- *Operations* include the value-creating activities involved in the transformation process, that is, converting inputs (raw materials, parts, components and customers) into outputs (finished products and services).
- *Distribution* includes all the activities such as costs and assets relating to the physical distribution of the finished product to customers. Physical distribution includes: managing the finished goods warehouse, processing received orders, packaging orders, shipping orders, scheduling the delivery vehicle and creating and maintaining a network of wholesalers and distributors.
- *Marketing and sales* include activities such as costs and assets relating to sales. These activities include, inter alia, channel selection, advertising and pricing and distributor support.
- *Service* includes the activities required to maintain or enhance the product or service's value, inter alia, customer support, installation and repair services.

b. *Support activities* (Pearce & Robinson 2007:156; Thompson et al 2006:96; Lysons & Gillingham 2003:77; Bartlett et al 2008:309)

- *Product research and development, technology and systems development* typically involve a variety of different activities such as the costs and assets associated with product and process research and development, the design thereof, computer software development, telecommunications systems, computer assisted design and engineering, new database capabilities and development of computerised support systems.
- *Human resource management* includes all the activities such as the costs and assets associated with the recruitment, training, development and costs of all types of employees; labour relations activities; development of knowledge-based skills and core competencies. Human resource management activities thus cover the entire chain.

- *General administration* includes all the activities such as costs and assets associated with general management, accounting and finance, legal, safety and security, management information systems and other "overhead" functions.

Although the above-mentioned sources admit the importance of the procurement function in supply chain management it is clear that, in contrast to distribution and marketing, they do not mention the critical task of procurement/supply chain management in selecting and maintaining relationships with a network of suppliers.

The next section deals with Porter's value chain in more detail.

3.2.3 Porter's value chain

In 1985, Harvard Professor Michael Porter's powerful book, *Competitive advantage*, pointed out how a business could become more profitable by strategically analysing the five primary processes on which its value chain framework is built, namely inbound logistics, operations, outbound logistics, sales and marketing and service (Blanchard, 2007:10-11). Michael Porter, known as the "father" of the five forces model, also developed the value chain. His concern was how to create more value for the customer and how different organisational work activities of employees in a business contribute to the ultimate value the customer experiences (Ehlers and Lazenby 2004:71). David (2005:146) states that, according to Porter, the dealings of an organisation can be explained as a value chain in which total income less total costs of all activities performed in order to develop and market a product or service that generates profit. As such, the author recognises that all businesses in a particular industry have a similar value chain. This value chain includes activities such as procuring raw materials, designing products, setting up factories, developing partnerships and offering customer service. Porter's value chain model is dealt with in more detail below.

3.2.3.1 Porter's value chain model

According to Lysons and Gillingham (2003:75), Porter's approach to the value chain model may be summarised as follows:

(1) Within any industry many business units produce products and/or services that are similar if not identical to those of their competitors.

(2) A business unit can obtain a competitive advantage over its competitors either by cost leadership or differentiation. Cost leadership means that the business unit has a substantial cost advantage over its competitors. Differentiation means that the product or service offers something unique which customers value more than a lower price. For example, a business can achieve a competitive advantage by improving products, implementing new procedures and new technologies.

(3) The activities of an organisation unit can be classified into five main and three support activities. Everyone one of these activities play a part in contributing to the competitive advantage of the organisation and make up the value chain (see fig 3.2).

Figure 3.2 consists of five primary activities and three support activities. Originally, purchasing was recognised as a support activity and not a primary activity. The primary activity "supply chain management" was known as "inbound logistics". Many authors and academics believe that purchasing is a primary activity and should be included in inbound logistics. Hence the term has been changed to supply chain management. Value chains differ from industry to industry and by organisation because activities in individual organisations are affected by many variables. For example, the primary value chain activities in the pulp and paper industry (timber, farming, logging, pulp mills and papermaking) differ from the primary value chain activities in the automotive industry (parts and components manufacture, assembly, advertising and dealerships) (Lysons and Gillingham 2003:75; Thompson et al 2006:98). Consequently, generic value chains such as the one depicted in figure 3.2 are not absolute and have to be drawn to fit the activities of a particular business or industry. (A model of an integrated automotive supply chain is provided further on in this chapter [fig 3.7].

To better understand the critical task of supply chain management in the current business environment, and specifically in the automotive industry, at this juncture, it would be appropriate to observe the historical development of supply chain management.

3.3 HISTORICAL DEVELOPMENT OF SUPPLY CHAIN MANAGEMENT

Hugo *et* al (2004:3) acknowledge that many contemporary authors writing on the topic of supply chain management refer to this trend as a "new" or "relatively new" concept in management theory. However, Gattorna (1998:2) holds that the role of supply chain management has changed considerably over the past 30 years, thereby concluding that the concept has been around for a considerable period of time. According to Lamming (1996:2), the concept was introduced by Houlihan in 1984. Warner (2002:6278) claims that Forrester is the true father of the philosophy of supply chain management. Further, as noted in Hugo et al (2004:3), the literature often claims that supply chain management is an "extension of logistics" and also that it is a further development in managing the supply base and therefore a development of the purchasing function. Kotler (2000:551) believes that physical distribution (logistics) has been expanded into the broader concept of supply chain management. Simchi-Levi et al (2000:3) have another belief, namely that there is no distinction between supply chain management and logistics and the former is an evolutionary extension of logistics.

Although the authors cited in the above paragraph have opposing views, supply chain management is a product of the dramatic changes in business during the 1990s. Supply chain management developed over at least four decades, but the fact remains that it developed from logistics and purchasing. Besides logistics, other functional areas such as marketing, finance and operations management made an equally significant contribution (Hugo et al 2004:3).

The following is a brief overview of the developments that occurred in management after 1960:

1960: In this decade, the emphasis in management thinking was on marketing and the development of marketing strategies. During this period, the view that "the customer is king" developed and management focus was on manufacturing products to meet customer demand. Marketing strategies based on market segmentation placed the customer foremost in management thinking. The view of "the customer is king" is the cornerstone of the focus on customer service in supply chain management thinking (Hugo et al 2004:3).

1970: During this decade the emphasis was on the physical distribution of products with a view to improving the availability of products to customers. In addition, the emphasis was on optimising inventory holding and minimising inventory holding costs in the various nodal storage facilities where materials and finished goods inventories were amassed. This resulted in a growing understanding of the cost impact of inventories on the total logistics system. During this period the foundation was laid for optimising costs across the total logistics system (Hugo et al 2004:3).

1980: During the 1980s, the emphasis was on manufacturing. There was pressure on manufacturers to become more flexible and to adapt manufacturing processes quickly to changing customer demands. There was also pressure on them to find methods to minimise costs, minimise cycle times and improve forecasting techniques. The emphasis was on quality, flexibility, time-based competition and lean production. Associated with a growing software technology industry, during this period, methods such as materials requirement planning, distribution requirement planning, enterprise resources planning and systems application processes were developed. Emphasis was placed on buzzwords such as JIT, cycle time reduction and time compression and TQM (Hugo et al 2004:3; Stevenson 2007:24).

1990: During the 1990s, strategic logistics management developed into a critically important business activity. It was the period in which business experienced the most dramatic changes (Hugo et al 2004:3).

Some of the changes that impacted on the further development of the concept of supply chain management are summarised below (Hugo et al 2004:4; Leenders et al 2006:4; Hugo et al 2006:114; Thompson et al 2006: 39 & 133; Stevenson 2007:22; Ogden 2006:29).

- intensified national and global competition
- the growing number of partnerships (also known as strategic alliances) between businesses
- business structures were beginning to align with processes
- improvements in manufacturing systems by means of tools such as ERP and MRP

- growing appreciation of the total cost focus of a product from its source of consumption (the concept of total cost of ownership is of vital importance in this regard)
- supply base reduction
- the change from mass production to customised products

Some of the significant events in the development of supply chain management were identified and examined in this section. The next section deals with the objectives of supply chain management.

3.4 OBJECTIVES OF SUPPLY CHAIN MANAGEMENT

Hugo et al (2004:10) acknowledge the fact that supply chain management is a philosophy that evolved in response to the transformations in the business environment, especially during the 1990s. The emphasis in defining supply chain management is that it is a management philosophy aimed at integrating all the linkages in the supply chain into a seamless unit. This is a difficult task because so many interests have to be taken into account. Clearly the goals of managing the supply chain should include the following two levels of interest:

(1) The goals of individual firms should be included in the supply chain. One such goal could be to balance customers' demands with the need for making a profit and attaining growth objectives.

(2) The second group of goals may be associated with the integrated supply chain. Examples of such goals could be to integrate all supply chain activities, processes and organisational entities; increase the rate of flow of products and services; reduce total cost of ownership for the ultimate customer; and decrease the total cycle time of the supply chain.

Simchi-Levi et al (2008:1) acknowledge that intensified competition in global markets, the introduction of products with shorter life cycles, growing customer expectations, ongoing developments in communications and transportation technologies have compelled businesses to invest in and direct attention to their supply chains. Consequently, in order to remain competitive, there is pressure on businesses to decrease costs and enhance customer service levels. Simchi-Levi et al (2008:1) define supply chain management as follows:

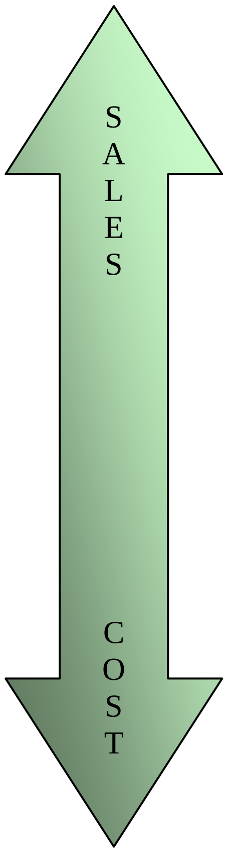
> "Supply chain management is a set of approaches utilised to efficiently integrate suppliers, manufacturers, warehouses, and stores so that merchandise is produced and distributed at the right quantities, at the right locations, and at the right time, in order to minimise system-wide costs while satisfying service level requirements."

This definition conjures up several ideas. One of these is the goal of supply chain management, namely to be efficient and cost effective across the entire system in order to minimise total system-wide costs.

Burt et al (2010:9) show, in figure 3.3, that supply chain management must be a core competency based on its impact on the bottom line. As indicated in the figure, supply chain management affects two issues that dominate the bottom line, namely total costs and sales. The objective of supply chain management is therefore to maximise a business's bottom line by driving sales up and costs down.

Figure 3.3: A graphic representation of supply chain management's impact on the bottom line

Net Income



Increased Sales

- Faster to market
- Improved quality
- Pricing flexibility
- Innovation
- Enhanced customer service
- Satisfaction
- Customer fulfilment flexibility
- Shorter cycle and lead times

Lower Total Cost

- Better product designs
- Acquisition cost
- Processing cost
- Better asset utilisation
- Quality cost
- Downtime cost
- Risk cost
- Cycle time cost
- Conversion cost
- Non-value added cost
- Supply chain cost
- Post ownership cost

Source: Burt et al (2010:9)

The activities to increase sales and lower costs in figure 3.3 can be regarded as sub-objectives to attain the main objectives of supply chain management, that is, to enhance customer satisfaction and to add value in terms of increased sales and lowering total costs. O'Marah

(2007:20) also notes that SCM is not simply about reducing costs, but is the process of enhancing value for customers and investors. The next section will deal with the dimensions of supply chain management.

3.5 DIMENSIONS OF SUPPLY CHAIN MANAGEMENT

According to Stevenson (2007:509), supply chain management comprises coordinating activities across the supply chain. Central to this is converting customer demand into related activities at each level of the supply chain. Table 3.1 lists the key dimensions in the supply chain together with a brief description of each.

Table 3.1: Dimensions of supply chain management

Element	**Typical issue**
Customers	Determining customers' wants in terms of products and/or services. Product and service design should therefore meet customer wants with the operation's capabilities.
Forecasting	Predicting customers' demands in terms of quantity and timing.
Design	Integrating customers' wants, manufacturability and time to market
Capacity planning	Matching supply and demand
Processing	Processing in each part of the supply chain. This is the focal point of each business that produces the product or service for the final customer. Two major facets of processing are controlling quality and scheduling work.
Inventory	Inventory, which is fundamental in the majority of supply chains. The main aim is to balance meeting demand requirements while managing the costs of holding inventory. For example, too little inventory causes delays, while too much inventory adds unnecessary costs.
Purchasing	Purchasing as the link between a business and its suppliers. It is responsible for obtaining goods and/or services. As such, purchasing selects and evaluates suppliers, negotiates contracts,

	establishes alliances and acts as a link between suppliers and various internal departments.
Suppliers	The supply portion of a value chain comprising of one or more suppliers, all links in the chain. Supplier quality, on-time delivery and flexibility should be monitored and supplier relations maintained.
Location	The role of location. In a number of ways, the location of suppliers can be as important as the location of processing facilities. Also, proximity to the market and/or to sources of supply may be critical since delivery time and cost are usually affected by location.
Logistics	Logistics regarding the movement of products and/or services, cash and information in a supply chain. Products could include raw materials, work in progress and support items (fuels, equipment, parts, tools and lubricants) and office supplies.

Source: Adapted from Stevenson (2007:509)

3.6 BUILDING RELATIONSHIPS

Christopher (2005:5) adopted the following definition of supply chain management: "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".

When the Harvard Business Review (HBR) organised a team of leading academics in the discipline of supply chain management, technology was not the main topic of discussion – people and relationships were identified as the major themes. For example, the opportunities and challenges of globalisation and the continued pressure for speed and cost containment are requiring businesses to establish relationships with new types of suppliers (Beth et al 2006:65).

Traditionally, the majority of businesses were of the opinion that the way which they manage suppliers is insignificant in their overall performance. Buyers play off suppliers against each other and frequently replace them. This adversarial model was not ideal and the model transformed when international competitors demonstrated that joining forces with suppliers could lead to competitive market benefits (Monczka, Trend & Handfield 2005:673). Stevenson (2005:718) confirms that maintaining good relationships with suppliers is increasingly being recognised as a critical factor in sustaining a competitive advantage. Nowadays, numerous businesses view their suppliers as partners – in other words, a stable relationship with comparatively few suppliers who can make available high-quality supplies, sustain delivery schedules and remain flexible relative to changes in specifications and delivery schedules.

Liker and Choi (2006:23) acknowledge that businesses are largely relying on their suppliers to reduce costs, enhance quality and develop innovations faster than their competitors' suppliers can. One way of achieving this is to build networks of suppliers that learn, improve and grow. Hence supplier relationships and the trust element in particular, are crucial. Liker and Choi (2006:23) cite the following in this regard:

> "The Big Three (US automakers) set annual cost-reduction targets (for the parts they purchase). To realise those targets, they'll do anything. They've unleashed a reign of terror, it gets worse every year. You can't trust anyone (in those companies)" (Director, interior systems supplier to Ford, GM and Chrysler, October 1999).

> "In my opinion, (Ford) seems to send its people to "hate school" so that they learn how to hate suppliers. The company is extremely confrontational. After dealing with Ford, I decided not to buy its cars" (Senior Executive. Supplier to Ford, October 2002).

Burt et al (2010:65) acknowledge that buyer-supplier relationships have evolved from being transactional to collaborative to alliance based. For example, the automotive assemblers in South Africa 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. However, as a result of the lifting of protection, relationships both up and down the supply chain have had to change, and today, partnerships are being created (Williams 2004:1). According to Saunders (1996:255 the outcome of an adversarial relationship is perceived in terms of "win-lose" results, whereas the outcome of a partnership relationship is perceived to result in a "win-win" situation – both sides winning at the same time through the implementation of a problem-solving approach.

The importance of relationships in supply chain management merits a more detailed discussion.

3.6.1 Development and management of supply chain relationships

A relationship can be defined as "*a connection or association*". Relationships apply when individuals, businesses and groups in a business, network (Lysons & Gillingham 2003:372). Relationships between suppliers and buyers differ a great deal – they may range from low-value, transaction-based interactions to partnerships that are of strategic and financial importance for the business (Gattorna 1998:294).

Bowersox, Closs and Cooper (2007:362) identify two beliefs to facilitate a drive for supply chain efficiency improvement and increased competitiveness:

(1) Collaborative relationships will decrease risks and improve the efficiency of the whole supply chain process. In order to achieve this collaborative relationship, it is essential for supply chain players to share strategic information. Information sharing must not only be restricted to transaction data but also information relating to future plans so that participating businesses can jointly develop the best way to satisfy customer requirements. Collaborative information is vital for businesses to jointly do the right things more rapidly and efficiently.

(2) There is an opportunity to eliminate waste and non value added processes. For example, as a result of collaboration, substantial inventory held in a traditional channel can be eliminated. In addition, supply chain collaboration can also eliminate or reduce the risk associated with inventory speculation.

3.6.2 Types of buyer-supplier relationships

Burt et al (2010:66) identify three principal classes of relationships and activities and attributes common to each. These are depicted in figure 3.4. In addition, Lysons and Gillingham (2003:378) recognise *power relationships*. The authors note that power relationships afford one company a negotiation advantage over the other. These relationships can develop from factors such as size, volume of business, environmental conditions and ownership by one party of some asset that is not on hand by the other.

Figure 3.4: Characteristics of three types of relationships

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

Source: Burt et al (2010:66)

On the whole, most types of relationships are transactional. Lysons and Gillingham (2003:378) define a transactional relationship as follows: “A straightforward relationship between buyer and seller whereby the two parties do not get closely involved with each other, but simply exchange goods or services for payment.”

Burt *et* al (2010:66) confirm this by describing this kind of relationship as neither "good nor bad" – it is merely an arm's-length relationship in which neither party is particularly concerned with the other's interests.

A collaborative relationship is viewed as crucial. Both collaborative and alliance relationships are inclined to result in lower total costs compared to transactional relationships. The main distinction between these two relationships is the existence of institutional trust. With institutional trust, both parties have access to each other's strategic plans in the area of the interface. For example, cost information and forecasts are shared and risks and incentives dealt with openly (Burt et al 2010:68-72; Lysons and Gillingham 2003:372-378; Webster 2008:94).

3.6.2.1 Transactional relationships

Lysons and Gillingham (2003:378) observe that transactional relationships could either be a one-off transaction or ongoing transactions. Usually a ***one-off transaction*** would be for a specific item for a specific use not expected to be repeated. A case in point would be capital equipment. In this instance, long-term relationships are not always beneficial. ***Ongoing transactions*** are similar to Bensaou's "market exchange" category. In this instance, buyers who are satisfied with the products and services supplied by a supplier continue using that supplier so that a solid informal relationship results.

Burt et al (2010:67) note that transactional relationships have several characteristics as highlighted below.

- There is a lack of interest by both parties about the other party's well-being – "one party's gain is another one's loss".
- There is one of a series of independent deals – little or no basis exists for collaboration.
- Costs, data and forecasts are not shared.
- Price is the main focus of the relationship.
- Minimum purchasing time and energy are required to determine prices.
- Transactional purchases lend themselves to e-procurement and reverse auctions.

In addition, the authors highlight the advantages and disadvantages of transactional relationships as follows:

The advantages of transactional relationships (Burt et al 2010:67):

- Less time and effort are 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 (Burt et al 2010:67):

- 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
- reluctance by the supplier to invest time and energy in the development of the potential buyer's products

3.6.2.2 Collaborative relationships

Monczka et al (2005:103) report that most buyers and sellers recognise a need for co-operation with suppliers, in order to achieve cost, quality, delivery, and time improvements. During the 1980s and 1990s, progressive buyers eliminated poor or marginal suppliers from their supplier database. Today, the goal of many of these buyers is to build collaborative relationships or alliances with current suppliers.

Monczka et al (2005:103) define collaboration as follows: "Collaboration is defined as the process by which two or more parties adopt a high level of cooperation to maintain a trading relationship over time".

Burt et al (2010:68) hold that the basic difference between transactional and collaborative relationships is recognition of interdependency of and necessity for cooperation. Recognition of interdependency of and the need for cooperation results in many benefits for both parties such as building trust, communicating, planning and promoting interdependency, which may result in achieving a competitive advantage. 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 these types of relationships.

3.6.2.3 Alliance relationships

In industrial markets, buying and selling can be defined as a series of events in long-standing complex relationships between suppliers and purchasers which, when examined over an extensive period, are dynamic rather than stable (Dyer 2000:42). Burt et al (2010:68) acknowledge, as discussed in section 3.6.2, that the main distinction between these two relationships is the existence of institutional trust.

Burt et al (2010:83) observe that trust in alliance relationships is not at all "blind trust" but rather a "prudent trust", which is carefully designed, planned and mutually agreed upon. When alliance relationships are first formed, this trust is usually established interpersonally between the alliance champions and the executives who create this unit.

Wisner et al (2005:62) report that alliance relationships failure rates have been reported as high as 60%. The eight main reasons for the failure of alliances are as follows (Speckman, Isabella & MacAvoy 2000, in Wisner et al 2005:62):

(1) Relationships were overly optimistic.
(2) Relationships are characterised by poor communications
(3) There is a lack of shared benefits.
(4) The payback results are slow.
(5) There is a lack of financial commitment.

(6) The operating principles are misinterpreted.
(7) There are cultural differences.
(8) There is a lack of alliance experience.

From this it is evident that building strong alliance relationships requires hard work and commitment by both purchasers and suppliers.

The discussion thus far in this section indicates that relationships in supply chain management are vital. In the current competitive environment, the trend is for companies to focus on their core competencies, which results in an ongoing increase in the level of outsourcing. Quesada, Syamil and Doll (2006:30) acknowledge that in industries such as the automotive industry, where value added by suppliers contributes significantly to the final product, the competitiveness of OEMs depends upon supplier performance in terms of cost, quality and on-time delivery. It is for this reason that businesses require their suppliers to deliver products, in "the right quality, the right quantity, at the right time, at the right place, from the right source at the right price." Consequently, "supply, sourcing and purchasing professionals in companies nationwide believe strongly that more and stronger supplier partnerships are critical to achieving competitive corporate performance" (Morgan 2001, cited in Wisner et al 2005:62). In the light of this, companies are realising the importance of developing "win-win" long-term relationships with suppliers.

3.7 SUPPLY CHAIN INTEGRATION

Kwon and Suh (2005:26) regard supply chain integration as a strategic tool aimed at reducing costs and thus increasing customer and shareholder value. Hence effective supply chain planning, built on shared information and trust among partners is a vital part of successful supply chain functioning. In the context of this research study, Monczka et al (2005:98) define integration as follows: "The process of incorporating or bringing together 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".

This section focuses on what supply chain integration is, its importance and how to achieve it – in other words, how businesses have come to integrate their material flow activities and processes with their supply chain partners.

If supply chain management is well executed it efficiently integrates suppliers, manufacturers, warehouses and other intermediate value-adding partners so that production and distribution are synchronised with customer demand, thereby reducing overall system or pipeline costs and satisfying service level requirements (Hugo et al 2004:66). This is confirmed in Wisner et al (2005:16), who acknowledge that activities in the supply chain are well coordinated when members of the supply chain work together when making delivery, inventory, production and purchasing decisions that impact on the profits of the supply chain. In other words, if one activity fails or is badly performed, supply along the supply chain is interrupted, which puts the effectiveness of the whole supply chain at risk.

Hence successful supply chain integration happens when the players realise that supply chain management must become part of all the business' strategic planning processes, in which the objectives and policies are jointly determined based on the final customers' needs and what the supply chain as a whole does well. Ultimately, businesses act together to maximise total supply chain profits by determining optimal purchase quantities, product availabilities, service levels, lead times, production quantities and technical and product support at each level in the supply chain (Wisner et al 2005:16).

According to Blanchard (2007:64-48), the key to Campbell's sales and operations planning (S&OP) programme was being able to integrate all those different departments and processes into one central plan. This strategy can be applied in any company in any industry. Blanchard (2007:63) defines S&OP as follows: "Sales and operations planning (S&OP) align all of a company's business plans (customers, sales and marketing, research and development, production, sourcing, and financial) into a single, integrated set of plans. The end goal is a plan that more accurately forecasts supply and demand".

Simchi-Levi et al (2008:14) report that in today's competitive markets, most businesses have no choice but to integrate their supply chains and engage in strategic partnering. These authors acknowledge the fact that integration can be achieved through information sharing and operational planning.

3.7.1 Information sharing

At the Harvard Business Review Panel Lee (Beth et al 2006:71) revealed that nowadays, he still finds many large businesses in which the different functions are unaware what the others are doing. For example, one of these businesses may run a promotion or have a special deal in place which has not been communicated to staff in the supply chain division. Alternatively, a supply chain manager may determine inventory levels but fail to communicate this to the sales and marketing division. The most celebrated example of this lack of communication is Volvo, which manufactured many green cars in 1995. Volvo was unable to sell these cars. In response, the salespeople secretly offered huge discounts, rebates and special deals on these green cars. The supply chain people noticed an increased demand in green cars and doubled the production plan for green cars the following year. As a result, Volvo had many green cars at year-end.

Competitive forces and an increase in environmental turbulence have forced businesses to reconsider their form, structure, linkages and models. Traditional strategies and practices have proved to be unsuitable for solving the challenges of the new business paradigm. This new paradigm calls for collaboration, business focus and pipeline-wide access to information. The lack of supply chain-wide information led to the creation of waste, information and material flow barriers and consequently poor customer service (Hugo et al 2004:67). An example of these problems is illustrated by the so-called "bullwhip effect" (Simchi-Levi, et al 2003:101).

Simchi-Levi et al (2003:101) note that the implications of available information are enormous. Supply chain gurus like to use the phrase "In modern supply chains, information replaces inventory". Although this phrase is vague, information changes the way supply chains can and should be effectively managed and these changes may, inter alia, lead to lower inventory levels.

In recent years, suppliers and retailers have noticed that while customer demand for particular products does not fluctuate much, inventory and back-order levels vary significantly across their supply chain (Simchi-Levi et al 2003:101). The so-called "bullwhip" effect implies that inconsistency in demand increases as one moves up the supply chain. This increase in variability causes significant operational inefficiencies in that it forces every link in the chain to increase inventory significantly (Hugo et al 2004:67).

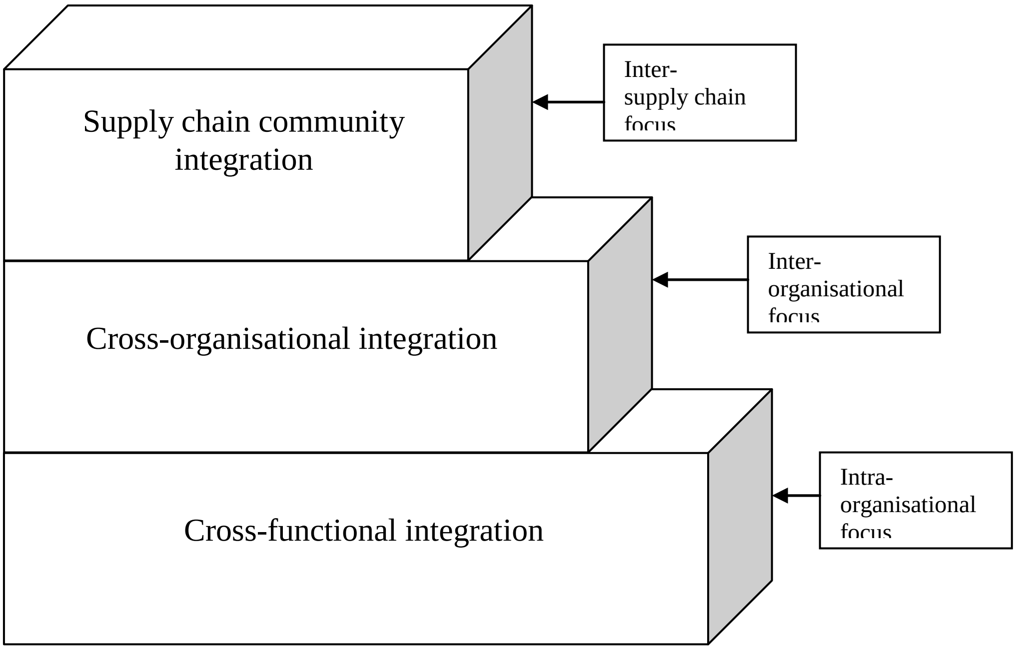
By centralising demand information and integrating business processes across the supply chain (ie supply each stage of the supply chain with complete information on the actual customer demand), the bullwhip effect can be counterbalanced (Hugo et al 2004:67 & Simchi-Levi et al 2003:104). It should be clear from this discussion that information is a critical building block and facilitator of supply chain integration.

3.7.2 Levels of integration

According to Hugo et al (2004:66), the advent of globalisation with its emphasis on global trade, market dominance, quick market response, time-based competition and information availability quickened the process of integrating business activities across both organisational and geographical borders. Stock and Lambert (2001:708) and Plenert (2007:80) acknowledge that for supply chain management to be successful, business processes with key members of the supply chain need to be integrated. This integration is vital for a business to be an effective competitor in the future.

As indicated in figure 3.5, supply chain integration generally focuses on three levels, namely cross-functional, cross-organisational and supply chain community integration.

Figure 3.5: Levels of integration



Source: Hugo et al (2004:68)

3.7.2.1 Cross-functional integration

The pressures of international competition and the demands placed on businesses to reduce costs and make better use of resources have led firms to move towards cross-functional integration. The aim of cross-functional integration is to break down all functional silos, eliminate constraints, eradicate wasteful activities inside the business and further ensure that an optimal material flow pipeline is developed (Hugo et al 2004:68). Stock and Lambert (2001:709) note that a prerequisite for successful supply chain management is to coordinate activities in a business.

3.7.2.2 Cross-organisational integration

Cross-organisational integration is sometimes referred to as external integration. Its aim is to find and eliminate obstacles in the way of external process flow between suppliers and customers throughout the supply chain (Hugo et al 2004:68). Cross-organisational integration focuses on the integration of the supplier and customer network processes. Businesses realise that in order to survive environmental instability, they need to join forces with upstream suppliers and downstream customers (Hugo et al 2004:70). Stock and Lambert (2001:709) contend that the implementation of supply management includes identifying the supply chain members, with whom it is vital to establish a linkage, what processes need to be linked with each of these key members and what type/level of integration applies to each process. The aim is to generate the most value for the whole supply chain network, including the end customer.

3.7.2.3 Supply chain community integration

In some instances, integration can take place across whole supply chains and/or an industry with the result that supply chain communities are formed. The common vision of the members of the supply chain community is to strengthen the globally competitive position of the members and the community as a whole (Hugo et al 2004:68). Hugo et al (2004:71) define a supply chain community as a “value-added network of businesses that shares processes, services and goals and has mastered supply chain operations”. These chains typically share logistics expertise, transportation capacity, warehouse space, strategic global market information and other logistics infrastructure.

Hugo et al (2004:72) cite an example of such a community in South Africa, namely the automotive industries in the Eastern Cape and Gauteng, which joined forces to form a supply chain community. The OEMs, together with their individual supply and distribution networks have formed a cluster, the goal being to improve competitiveness across all chains.

Another example is the Durban Automotive Cluster (DAC) which is a public-private partnership (PPP) between the eThekwini Municipality and 43 KwaZulu-Natal-based automotive manufacturing businesses. The members of DAC are committed to cooperating with one another in order to develop a shared competitive advantage, overcome common challenges and take advantage of mutual opportunities in the following key areas (DAC 2006:1):

(1) logistic coordination
(2) supplier development
(3) human resource development
(4) industry transformation
(5) competitive benchmarking

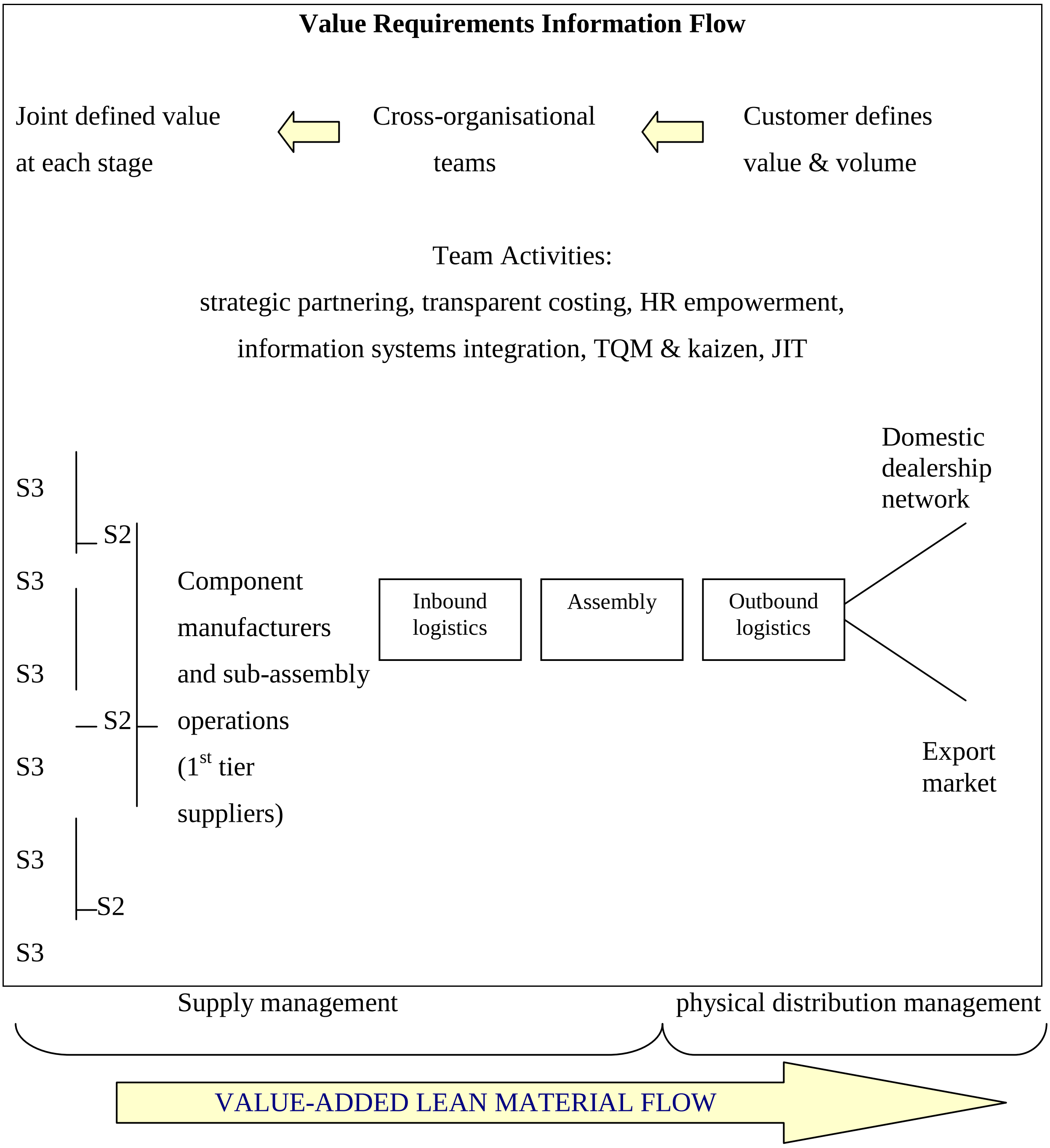
3.8 SUPPLY CHAIN DESIGN

As indicated in the previous section, supply chain integration takes place when internal functional barriers, as well as barriers between suppliers and customers are broken down. Figure 3.6 provides an example of an automotive supply chain.

In the centre of figure 3.6, the supply chain displays an automotive assembly operation. The assembly operation has three broad internal processes, namely inbound logistics, assembly and outbound logistics. All upstream activities, including assembly, are usually referred to as supply management. All downstream activities from assembly onwards are termed physical distribution management. The automotive assembler serves two markets, namely the domestic and the export market. The domestic distribution system typically consists of OEMs and the aftermarket (Hugo et al 2004:75).

Strong collaboration and integration are aspects of the assembler’s supply market operations. The supply chain shows only three tiers upstream from the assembler. However, in reality, there are more. First-tier suppliers are mainly component manufacturers and suppliers of subassemblies. Value adding in the supply chain of the assembler occurs mainly in its supply network and its own operations (Hugo et al 2004:75).

Figure 3.6: Example of an integrated automotive supply chain



Source: Hugo et al (2004:76)

The focus of this study is on automotive component manufacturers, and in the supply chain, it is the supply of components that impacts on its competitive strategy.

3.9 SUPPLY CHAIN FLOWS

According to Burt et al (2010:15), the supply chain extends from the ultimate customer back to mother earth (see fig 3.7). The chain is regarded as one unit rather than fragmented units, each performing its own task. Cash enters the supply chain only when the end customer purchases a product and/or service. Business deals in the supply chain merely distribute the end customer's money among the members of the chain. A business's supply system comprises all internal functions, including the external suppliers involved in the fulfilment of needs for materials, equipment and services in an optimised approach.

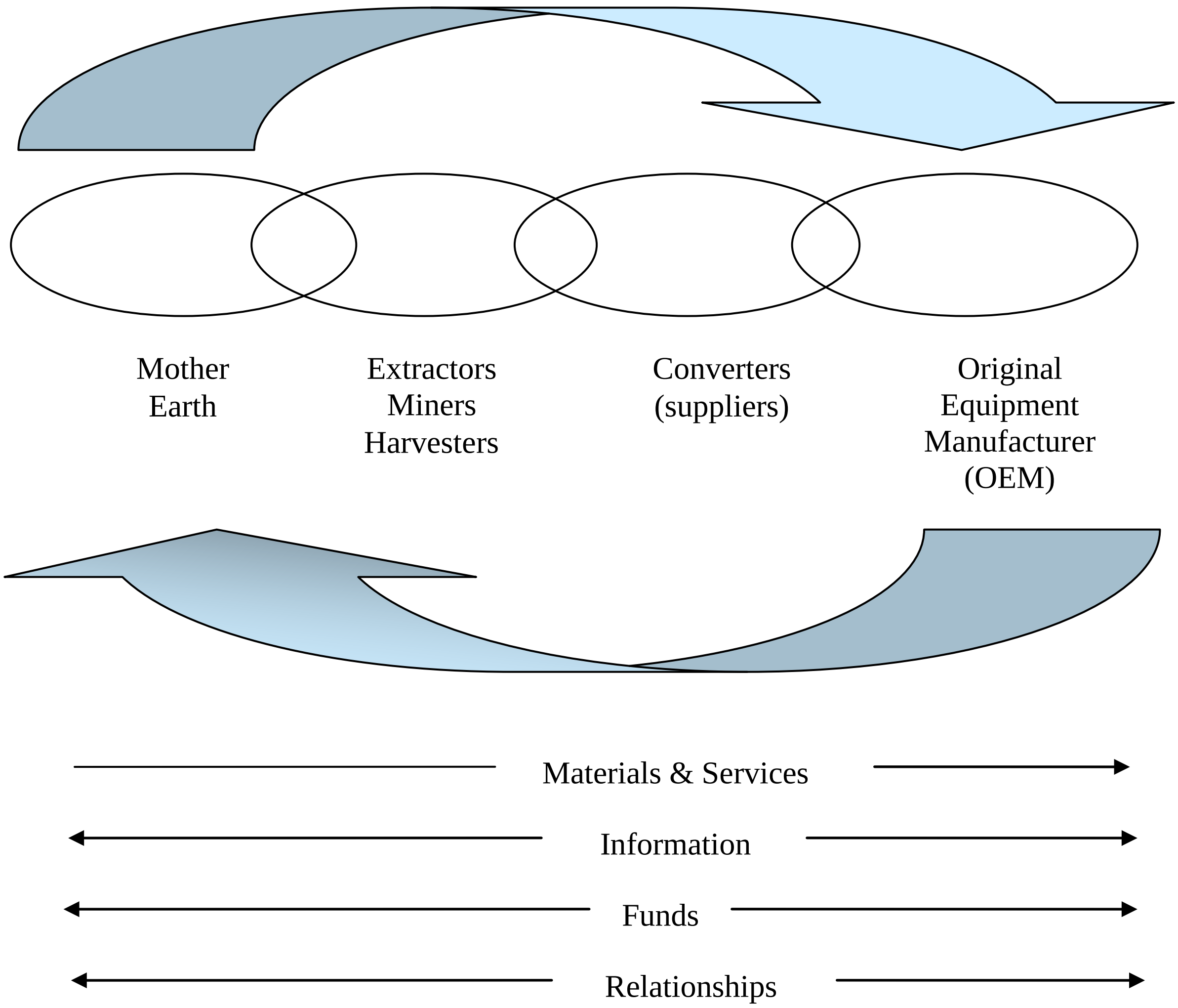
The internet allows supply chain managers to manage their supply chain collaboratively and coordinate their operations. Hence costs are reduced, time management is improved and competitiveness and profitability for all members of the chain are enhanced (Burt et al 2010:15).

Figure 3.7 shows that there are five kinds of movement flow in the supply system: (1) the physical movement of materials, usually in the direction of the end of the chain (which is the focal point of the supply chain); (2) the exchange of information; (3) the fund (money) flow; (4) the relationships flow which was dealt with in section 3.6.1; and (5) the flow back to mother earth, which would include recycling and the remanufacturing disposal of products (Stevenson 2005:492; Burt et al 2010:15).

The following flows are discussed in the next section:

- the materials flow
- the information flow
- the money flow
- the relationships flow (dealt with in sec 3.6.1)
- the "cradle-to-grave" flow (from the end user to mother earth)

Figure 3.7: The supply chain



Source: Burt et al (2010: 15)

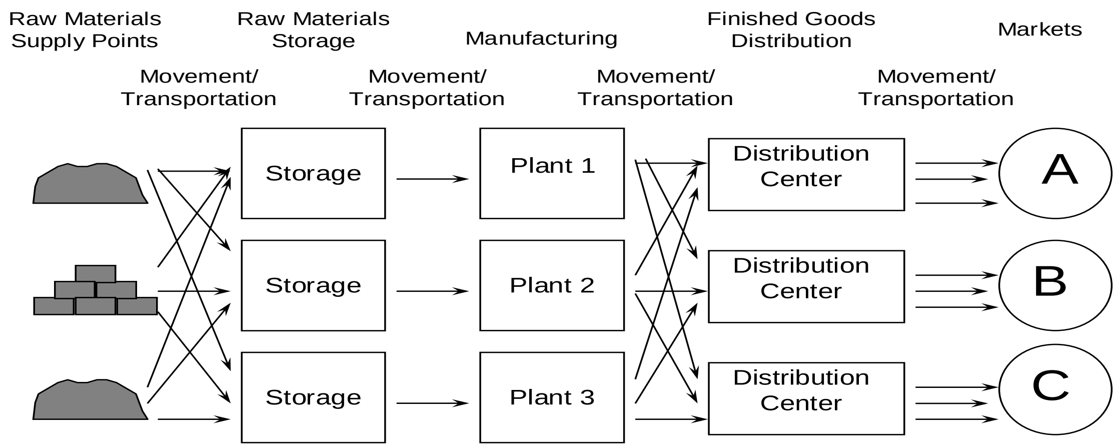
3.9.1 Materials flow (logistics activities)

Supply chain management incorporates product, information and cash flows between businesses, from the point of origin to the point of consumption with a view to of maximising customer satisfaction and minimising costs. As noted in section 3.9, the supply chain stretches from the end customer back to mother earth (see fig 3.7) (Burt et al 2010:15), and there are five flows in the supply chain of which materials flow is one.

The materials flow part is actually the domain of logistics management. Traditionally, logistics has been responsible for managing the physical flow of products among businesses (Bardi, Coyle & Novack 2006:10).

Figure 3.8 depicts the scope of logistics management, that this, the materials flow activity in supply chain management. Between each point in the supply chain, there is movement, transportation and warehousing. Logistics managers play a significant part in the success of supply chain management, in the management of transportation, storage and warehousing activities.

Figure 3.8: The scope of logistics management in supply chain management



Source: Burt et al (2003) (Slide included in instructors' manual, in chapter 27)

Vogt, Pienaar and De Wit (2005:10) acknowledge that the flow of goods (raw materials, goods-in-process and finished goods), services and information between the point of origin and the point of consumption or application involves the following activities:

- demand management
- facility site selection and design
- materials handling
- packaging
- warehouse management
- inventory management

- procurement
- logistics communications
- transport
- reverse logistics (return goods handling and waste disposal)
- customer service

These activities make up the materials flows and are discussed in chapter 4, (sec 4.2), that is, supply chain practices and tools.

3.9.2 Information flow

According to Burt et al (2010:16), “networks are flexible virtual systems linked together by communication systems and alliances. They optimise the flow of materials and services, information and money”. Strydom, Grové, Van Heerden, Nel, Van Scheers and Bothma (2005:4) state that information flows enhance supply chain relationships. In their opinion, one of the easiest ways to improve the entire system is to share demand data through sound two-way communication between suppliers and producers or retailers. For example, a retailer could share point-of-sale data and forecasts with suppliers.

3.9.3 Funds flow

The supply chain extends from the ultimate customer back to Mother Earth (see fig 3.7). According to Burt et al (2010:16), cash enters the supply chain once the end customer purchases a product and/or service. Business deals in the supply chain merely distribute the end customer’s money among the members of the chain.

Bowersox, Closs & Cooper (2007:15) acknowledge that few managers question the benefits of applying time-based strategies to supply chain operations. The financial benefits of timely response are simple. Fast delivery means less inventory and reduced need for distribution facilities. Faster delivery to customers means less working capital is required to support supply chain operations.

3.9.4 "Cradle-to-Grave" flow

The two goals of economic growth and environmental considerations are in direct conflict. Over time, manufacturing has evolved from mass production to TQM and time-based competition, and it has reached the latest and perhaps most significant driving force in society: environmental protection. Environmental protection emerged because of the rapid reduction of our worldwide stockpile of resources, the loss of clean, healthy air and increasing marine pollution. Environmental protection is a vital development that impacts on our quality of life (Burt et al 2003:57).

The main objective of environmental protection is not to promote recycling or reuse, but to focus on prevention of any kind of pollution – in other words, "zero pollution generation" (Burt et al 2003:57).

The three main groups are the driving forces, namely environmentally friendly products, packaging and production processes. Hence, in the future, businesses will be required to purchase environmentally friendly products that (www.mmd.admin.state.mn.us/envir.htm):

- contain fewer toxic materials
- minimise waste
- contain recycle content
- contain plant-based materials

3.10 FUTURE TRENDS IN SUPPLY CHAIN MANAGEMENT

O'Marah (2007:16) reports that the supply chain profession is experiencing a period of rapid change and increasing influence. AMR Research has been studying and encouraging this movement for almost 20 years. The Supply Chain Top 25 for 2007 (table 3.2) lists which large, public companies have adopted this shift and in course turned their focus to supply chain management in order to achieve competitive differentiation, financial return and demand-driven operational and innovation excellence.

Table 3.2: The AMR research supply chain top 25 for 2007

1. Nokia	14. Johnson & Johnson
2. Apple	15. Pepsico
3. Procter & Gamble	16. Johnson Controls
4. IBM	17. Texas Instruments
5. Toyota Motor	18. Nike
6. Wal-Mart Stores	19. Lowe's
7. Anheuser-Busch	20. GlaxoSmithKline
8. Tesco	21. Hewlett-Packard
9. Best Buy	22. Lockheed Martin
10. Samsung Electronics	23. Publix Super Markets
11. Cisco Systems	24. Paccar
12. Motorola	25. AstraZeneca
13. The Coca-Cola Company	

Source: O'Marah (2007:17)

As stated in section 3.3 (the historical development of supply chain management), supply chain management is a product of the dramatic changes in business during the 1990s, and it developed over at least four decades. Wisner et al (2005:18-19) acknowledge that businesses are beginning to realise the benefits and challenges that accompany an integrated supply chain. As competition intensifies, products, technology and customers change, the priorities for the supply chain must also change. These changes will require supply chains to become more flexible in order to respond quickly to changes in the business environment.

Hugo et al (2004:356) concur that it is imperative for supply chain managers and their businesses to focus on and understand developments in supply chain management in order to remain profitable in the ever-changing business environment. Hugo et al (2004:356) and Wisner et al (2005:19) have identified the following trends that are emerging as driving forces in supply chain management:

3.10.1 The knowledge revolution

Hugo et al (2004:356) acknowledge that information containing relevant facts about competitors and suppliers is easily available using electronic data transfer and internet communications media. Decision making based on facts is replacing customary negotiation methods. In the future, information and technology are expected to continue playing a major role in SCM decision making (Hugo et al 2004:356; Chopra & Meindl 2007:492).

Wisner et al (2005:18) concur that with all the advances and improvements in communication technology, manufacturing and transportation, increasingly more businesses worldwide have the capability to produce and sell high-tech components and products faster as demand develops.

3.10.2 Continuous improvement requirements

According to Leenders et al (2006:129), continuous improvement refers to the continuous quest for product and process improvement through a series of small progressive steps. This is an integral part of both JIT and TQM.

Hugo et al (2004:356) maintain that intensified competition and customer demands in the market require continuous improvement across all major performance categories. These include continuous improvements in internal and external cycle time, cost, quality and delivery performance. In addition, the reduction of time, especially during product and process, will become increasingly important.

3.10.3 Lean thinking

The majority of businesses are implementing the lean management way to ensure successful implementation of the SCM approach. In the beginning, lean principles and practices were used by the Japanese automotive industry (Toyota). These practices are generally associated with manufacturing. However, lean thinking is relevant to SCM in both manufacturing and service providers (Hugo et al 2004:356; Stevenson 2007:691). Lean thinking and JIT are dealt with in more detail in section 4.3.3.

3.10.4 Cycle and response time

According to Plenert (2007:79), time is vital in a global strategic network, because it is the key to competitive success. Supply chain management, together with lean methodologies, reduces cycle time and therefore increases response time. Burt et al (2003:107-109) and Wisner et al (2005:276) state that time value is created when customers receive their products at the right time. In this way, for example, the transportation function can create time value by determining how quickly products are delivered and how long they are held in storage, prior to delivery.

3.10.5 A values-based infrastructure

Achieving SCM objectives to the advantage of all the businesses involved in a supply chain is tough. It becomes particularly difficult when a large group of ethical structures across the world are involved. The way in which procurement staff respond to an ethical situation is determined by the following four variables:

1. *Organisational environment*. Every business has an informal and formal set of accepted ethical behaviour or norms. These norms, however, differ from business to business and even from one manager to the next (Hugo et al 2004:357).

2. *Personal experience*. Each procurement staff member's personal experience will affect his or her personal moral and ethical beliefs about what is right or wrong (Hugo et al 2004:357).

3. *Cultural environment.* Society has a profound effect on the ethical perspective of a supply business or employee. Certain behaviour may be acceptable in one culture but totally unacceptable in another (Hugo et al 2004:357).

4. *Industry environment.* Accepted or common practices in an industry also describe acceptable boundaries of behaviour for a supply business or employee (Hugo et al 2004:358).

3.10.6 The greening of supply chain management

Wisner et al (2005:18) acknowledge that producing, packaging, moving, storing, repackaging and delivering products to the final customer can pose a significant threat for the environment in terms of packaging that has to be discarded, carbon monoxide emissions, noise, traffic congestion and other types of industrial pollution. Subsequently, firms and their supply chain partners are working harder to decrease environmental difficulties and are adapting a more proactive approach to reducing negative environmental consequences in their supply chains.

Saunders (1996:174) acknowledges that one of the primary issues for society and businesses in particular, is the growing concern for the protection of the environment. Supply chain management is an area in which environmental issues can have a direct impact. Various authors have identified the following concerns supply chain professionals need to address:

1. the recovery, recycling and reuse of materials and waste products
2. the safe disposal of waste products
3. supplier selection policies to support businesses that comply with environmental standards
4. the safe testing of products and materials
5. concern about noise, spray, dirt and vibrations in the operation of transporting facilities (Saunders 1996:175; Burt et al 2003:56; Lysons and Gillingham 2003:337)

Supply chain professionals will therefore be required increasingly in the future to procure environmentally preferable products that:

- contain fewer toxic materials
- minimise waste
- contain recycle content
- contain plant-based materials

Fourie (2003:95) maintains that in light of the above, the traditional structure of the supply chain must be expanded to include methods for product recovery. This expansion therefore presents an extra level of difficulty to supply chain design and analysis because the addition of the product recovery methods will result in a number of problems affecting strategic and operational supply chain activities. This extension will thus require new performance measurement systems to be established and implemented, based on continuous improvement, in order for businesses to remain competitive while achieving sustainable processes.

As indicated in the NAAMSA Annual Report (2007:26), and in line with the above authors' views, a vital challenge facing societies globally is finding the right balance between economic progress and environmental protection. The South African automotive industry has a responsibility to be part of the solution in tackling the need for a cleaner environment and improved air quality. The solution would include challenges such as fuel economy, energy security and vehicle emissions.

3.10.7 Virtual supply chain management

Changes in the international markets are forcing businesses to continually redesign and reconstruct their supply chains in order to satisfy customers. As technology changes, so too will products and services. Just as life cycles will be brief, so too will profits. Hence the time to pull products and services through the supply chain to reach the ultimate consumers must be fast. Stevens (2006:1) observes that this requires a responsive, agile supply chain that can adapt quickly to changes in the international markets and whose span of control expands outside the four walls of the factory, deep into the supply base.

Virtual SCM includes the enormity of sharing knowledge in creating value, where EDI, email, the internet and the world wide web play a crucial role. This is possible through the establishment of intra-organisational communication in which all relevant information is available on intranet facilities. Information between businesses is shared via inter-organisational communication using the internet (Hugo et al 2004:358; Puschmann & Alt 2005:122; Stevens 2006:1)

The creation of virtual supply chains is an ongoing development. Mergers are becoming increasingly complex, which means that businesses need to be able to enter into short-term alliances without the legal entanglements of mergers or long-term contracts. Individual business reserves will be stretched thin as businesses continue to invest in opportunities in emerging global economies. Carter, Carter, Monczka, Slaight and Swan (2000:20) have predicted the following 10-year forecast:-

- Businesses will create virtual legal organisations focused on specific customers/markets.
- Risk sharing, reward sharing, resource contribution and a basis for ending the relationship will be established by participating businesses.
- Grouping of "systems suppliers" will join together to coordinate the completion of the final product/service bundle under a joint risk/reward sharing agreement.

According to Hugo et al (2004:19), this is can be achieved through the establishment of intra-organisation communication whereby all important information such as contracts and the supplier database is available by using an intranet facility with the appropriate security and authorisation in place. Information between organisations is shared via inter-organisation communication by using an extranet facility (internet based). Again, appropriate security and authorisation should be in place to avoid unauthorised viewing of data.

3.11 SUPPLY CHAIN ISSUES IN THE SOUTH AFRICAN MOTOR INDUSTRY

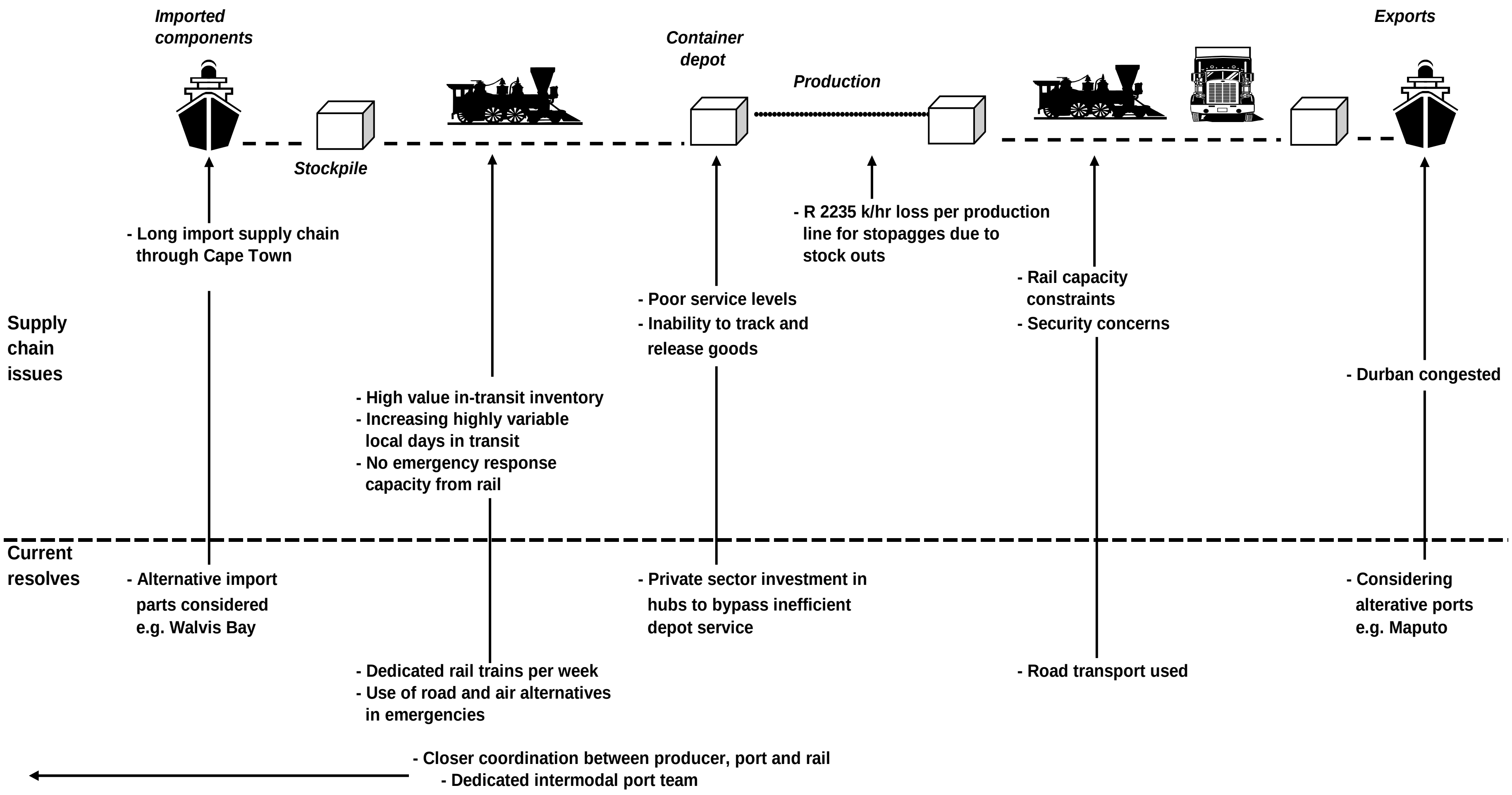
According to Strydom et al (2005:56), South Africa has become a participant in the global automotive market. Important challenges for OEMs in South Africa are to produce at a competitive cost and have the ability to respond quickly and reliably to First-World market demands. Figure 3.9 illustrates the supply chain issues in the local automotive industry, most of which are logistics issues.

These logistics issues are affirmed by Van der Merwe (2008:1) 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. Growth in trade and logistics will continue and the ability to deliver goods will become increasingly expensive.

According to the Council for Scientific and Industrial Research (CSIR) (Van der Merwe 2008:1), South Africa has the potential to become the Southern African Development Community (SADC) region's logistics hub because both imports and exports markets are growing rapidly. In view of this, Transnet plans to spend in the region of R80 billion over the next five years to expand capacity at its ports, railways and pipelines.

The supply chain in the motor industry involves many parties, nodes, links and logistical processes to deliver the final product to the end customer. The motor industry is extremely competitive and as a result world-class management practices such as JIT, TQM and CI are already in use in these supply chains. In spite of these management practices, South African motor industry supply chains are faced with realities that could hinder their competitiveness.

Figure 3.9: Supply chain issues for the local automotive industry



Source: Strydom et al (2005:57)

3.11.1 Public transport

3.11.1.1 Inefficiencies at Ports

As indicated in figure 3.9, one of the problems identified by the authors is the inefficiencies experienced at South African ports. According to Jones (2006:1), South Africa is currently experiencing high cargo volumes – both in general and automotive cargo. The efficiency of a country’s ports plays a key role in sustaining trade growth. Ports provide a vital link for OEMs and ACMs in South Africa from an export and import perspective.

The ACM industry in South Africa is experiencing problems in delays at the ports and the ineptitude of rail transport. These challenges impact on a company’s competitiveness, particularly since it makes the successful implementation of JIT delivery difficult (in general use in the motor assembly [OEMs] industry).

3.11.1.2 High port costs

Another issue is that of high port costs and cargo dues levied on all vessels that berth in South African ports. As noted by Chasomeris (2005:13), cargo dues replaced ad valorem wharfage charges in 2002. Cargo dues are levied on a unit basis for containers and on a tonnage basis for other forms of cargo.

This is affirmed in an international port benchmarking study undertaken by the Automotive Industry Development Centre and the Technical Action Group Logistics. A basket of ports, which are the most common ports used by OEMs in South Africa, was chosen and analysed for the study. These are highlighted in table 3.3. According to research conducted by this task group, it was found that (1) long lead times together with domestic inefficiencies and poor infrastructure present a situation that threatens the automotive industry’s ability to compete globally; and (2) South African Port Operations (SAPO) and National Ports Authority (NPA) container tariffs are exceeded only by the North American Port Authority (Demont 2007:v).

Table 3.3: List of ports included in the benchmarking study

PORT	LOCATION
Santos	Brazil
Vera Cruz	Mexico
Buenos Aires	Argentina
Laem Chabang	Thailand
Yokohama	Japan
Nagoya	Japan
Antwerp	Belgium
Singapore	Malaysia
Le Havre	France
Tilbury	England
Bermerhaven	Germany
Cape Town	South Africa
Durban	South Africa
Charleston	USA
Baltimore	USA
New York	USA

*Source: (*Demont, 2007:vi)

In addition, the NPA levies cargo dues on all vessels that berth in South African ports. The study revealed that of the sample group, South Africa is the only country in which ports still charge cargo dues, thus adding additional costs to imported goods (Demont 2007:v).

As mentioned above, cargo dues are levied on a unit basis for containers and on a tonnage basis for other forms of cargo (Chasomeris 2005:13). Cargo dues as indicated in the NPA tariff book, are as follows (Demont 2007:10):

Container Size	**Imports**	**Exports**
20 ft	R1 610.05	R799.69
40 ft	R3 220.09	R1 599.39

3.12 CONCLUSION

This chapter presented an overview of supply chain management; the basic objectives of supply chain management; the dimensions of supply chain management; supply chain relationships; supply chain integration; supply chain design; supply chain flows; and supply chain issues in the South African motor industry.

Supply chain management covers the steps, flows, processes, organisations and relationships involved in transforming raw materials into finished products and supplying them to customers. The main objectives described in this chapter were the maximisation of sales and the minimisation of costs. The five flows, namely material, information, funds, relationships and “cradle-to -grave” flow were also discussed.

Supply chain management was identified as a dynamic discipline because many contemporary authors writing on the subject of supply chain management refer to this trend as a “new” or “relatively new” concept in management theory. Hence a brief overview of the developments that have occurred in management since 1960 was included in this chapter. Future trends in supply chain were also dealt with.

Because of intensified competition, both locally and internationally, relationships in the supply chain have evolved/are evolving from adversarial to collaborative/alliance relationships.

Supply chain management when well executed, efficiently integrates suppliers, manufacturers, warehouses and other intermediate value-adding partners so that production and distribution are synchronised with customer demand thus reducing overall costs and satisfying service level requirements. When one activity fails or is badly performed, supply along the supply chain is interrupted, which puts the effectiveness of the whole supply chain at risk.

This concludes the literature review chapter 3. Chapter 4 deals with supply chain management practices and tools, such as EDI, e-commerce, TQM, JIT, continuous improvement, value stream mapping, total cost of ownership and early supplier involvement. It is necessary to include a chapter on all these tools because the automotive industry relies heavily on them for its success.

CHAPTER 1

Introduction

CHAPTER 2

The Global and South African automotive industry

CHAPTER 3

Supply chains, supply chain management and related concepts

CHAPTER 4

Supply chain management practices and tools

CHAPTER 5

Research design and methodology

CHAPTER 6

Problems experienced by ACMs from their customer's perspective

CHAPTER 7

Supply chain problems facing ACMs in South Africa: empirical research

CHAPTER 8

Summary, recommendations, caveats and suggestions for further research

OUTCOME

To identify problems or difficulties in the supply chain and suggest remedies to ACMs and the motor industry as a whole

CHAPTER 4

SUPPLY CHAIN MANAGEMENT PRACTICES AND TOOLS

4.1 INTRODUCTION

According to Webster (2008:3), business is simple: "you've got to sell the stuff, make the stuff, and collect the money". Clearly, much is involved in these basic business activities and each is supported by a different discipline. All these activities are closely intertwined and should not be viewed in seclusion – an idea that is central to SCM.

Lee (2006:87) indicates that building a strong supply chain is vital for business success. Many businesses work to make their chains faster or more cost effective, believing that those steps are the means to a competitive advantage. This is not true. Lee (2006:87) spent 15 years studying more than 60 companies to gain insight into this and other supply chain dilemmas. He concludes that only businesses that build supply chains that are agile, adaptable and aligned get ahead of their competitors. According to Lee (2006:87), the methods of agility are: "to promote flow of information with suppliers and customers; to develop collaborative relationships with suppliers; and to design for postponement".

The South African automotive industry is no different because businesses in it need to keep abreast of their competitors in order to sustain a competitive advantage. It is vital for these businesses to build strong supply chains that are agile, adaptable and aligned, to achieve business success.

Supply chain practices and tools include the information systems and technologies most relevant to supply chain management and the role of supply chain management in e-commerce. Supply chain foundations such as system slack, TQM and JIT and pull versus push will also be discussed together with vendor-managed inventory and various functions included in supply chain management.

Hough and Neuland (2007:109) observe that technology can be characterised as "the method or technique for transforming inputs into outputs in achieving a specific task". Webster (2008:12) affirms that information technology is advancing and creating opportunities for improvement as well as many threats − in this instance, information technology, which is dealt with in more detail in the next section.

This chapter deals with supply chain practices, principles and tools, since, according to Webster (2008:9), these are fundamental to help us understand what is happening in the world around us. Many supply chain management tools are commonly used in the motor industry. It is therefore appropriate to include this in a study of the motor industry supply chain. This chapter outlines the information systems and technologies most relevant to SCM, the role of SCM in e-commerce, as well as the supply chain foundations, principles and functions included in SCM.

4.2 INFORMATION TECHNOLOGY

Supply chain management processes essentially fall into planning or execution categories. Many of the traditional components such as managing purchase orders and updating inventory are well supported by traditional methods such as EDI (Perlstein, Peterson & Andrews 2003:1). However, EDI evolved further with the introduction of the internet. Technological advances have resulted in opportunities for increased collaboration and real-time information sharing between buyers and sellers in the supply chain. According to Webster (2008:88), various authors define EDI as computer-to-computer information via private communication lines or the internet. It is stated that EDI can increase purchasing efficiency through time savings, fewer errors and early detection of potential supply problems. In addition, EDI is playing a growing role in supplier relationships and is pivotal to vendor-managed inventory (VMI). (VMI is dealt with in section 4.3.6.)

According to Webster (2008:13), information technologies have and continue to develop rapidly and increasingly perform a dominant function in supply chain management. Simchi-Levi et al (2008:407) identify information technology as a significant facilitator, which extends the entire organisation and beyond, including suppliers upstream and customers downstream. The authors suggest that there is a linkage involving information technology and supply chain performance.

Stevenson (2007:25) defines information technology as the science and utilisation of electronic equipment and computers to gather, process and transmit information. Information technology consists, inter alia, of electronic data processing, barcodes and radio frequency identification (RFID) tags to classify and track products, acquiring point-of-sale information, transmitting data, the internet, extranet, intranet, e-commerce and e-mail.

According to Bowersox et al (2007:101), a comprehensive supply chain information system (SCIS) initiates, monitors, aids in decision making and reports on activities required to complete supply chain operations and planning. The main parts of SCIS are (1) enterprise resource planning (ERP); (2) communication systems; (3) execution systems; and (4) planning systems. These parts are depicted in figure 4.1. Webster (2008:13) considers the critical categories of information systems that have an impact on supply chain management to be (1) enterprise resource planning systems, and (2) supply chain analytical systems.

The following are being elaborated upon; EDI, ERP systems, supply chain analytical systems and emerging information technologies and their impact on supply chain management.

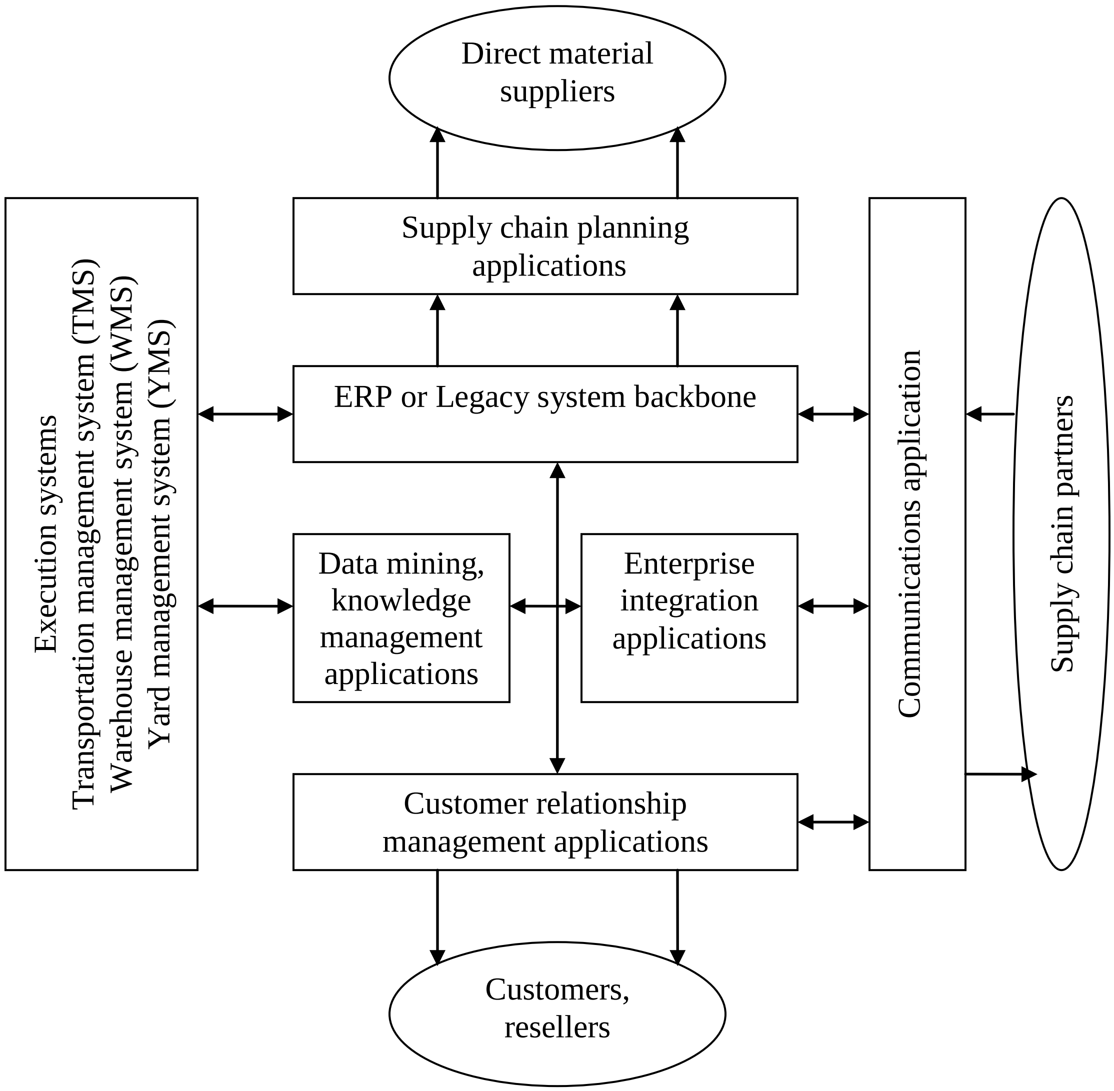
4.2.1 Electronic data interchange (EDI)

Power (2005:100) maintains that EDI is the direct computer-to-computer exchange between trading parties of agreed documents such as purchase orders, invoices and delivery notes. Mei and Dinwoodie (2005:201) concur with this definition and state that single data entry procedures offer perceived benefits of faster access to information, reduced errors and instant costs and data transfer. In addition, through the use of EDI, lead times are reduced, including the costs of document handling, especially in high-volume transactions.

4.2.2 Enterprise resource planning (ERP) systems

As indicated in figure 4.1, ERP systems are the backbone of most organisations' supply chain information systems. This backbone maintains current and historical data and processes transactions to initiate and monitor performance. Organisations' systems are complex in that various functions such as procurement, production, logistics, warehousing, sales, human resources and finance must work together to achieve the organisation's objectives. Information is known to flow freely in each function, but not between functions. The ERP system was primarily developed to improve this information sharing. ERP aims to provide a seamless integration vital for ensuring visibility and consistency across an organisation (Bowersox et al 2007:101; Stevenson 2007:656; Lysons and Gillingham 2003:49). Gartner, the consultancy firm that created the term "ERP", now uses ERPII to refer to systems that facilitate collaborative commerce (c-commerce) in which a crucial requirement is the sharing of information outside the organisation (Lysons and Gillingham 2003:293).

Figure 4.1: Supply chain integrated system modules



Source: Bowersox et al (2007:102)

Table 4.1 highlights the differences between ERP and ERPII. According to Miklovic (2003:3), "ERPII is an application and deployment strategy that expands from traditional ERP functions to achieve integration of an enterprise's key, domain-specific internal and external collaborative, operational and financial processes."

Table 4.1: Differences between ERP and ERPII

Factor	ERP	ERPII
Role	Concerned with optimising within an organisation	Concerned with optimising across the whole supply chain through collaboration with business partners
Domain	Focused on manufacturing and distribution	Cross all sectors and segments of business including service industries, government and asset-based industries such as mining.
Function	General applications	Designed to meet the needs of specific industries thereby providing steep functionality for users
Process	Internally focused	Externally focused, especially on connecting trading partners irrespective of location
Architecture	Monolithic and closed	Web-based and open to integrate and inter-operate with other systems. Built around modules or components that allow users to choose the functionality they require.
Data	Information on ERP systems is generated and consumed within the enterprise	Information available across the whole supply chain to authorised participants

Source: Lysons & Gillingham (2003:293)

The following are some of the advantages and disadvantages of ERP:

a. Advantages of ERP

The use of ERP results in the following advantage for the users (Lysons and Gillingham 2003:294; Stevenson 2007:657-660):

- Promotes quicker inventory turnover. ERP makes it possible for producers and distributors to increase inventory turns while considerably reducing the costs relating to this cycle.
- Improves customer service. An ERP system can increase the percentage of demand filled from inventory on hand by supplying the right product at the right time at the right place resulting in increased customer satisfaction.
- Improves inventory accuracy, resulting in fewer physical audits.
- Reduces set-up times by grouping similar production jobs. This ensures the coordination of people, tools and machinery with the efficient use of equipment and minimising downtime through effective maintenance.
- Ensures higher quality work. This is because an ERP system with a strong manufacturing component is able to isolate quality problems, making available the information required to improve production efficiency and reduce and/or eliminate rework.
- Collects revenue timeously. This will result in improved cash flow.

From the above it is clear that ERP can make a huge contribution to the effective management of many supply chain elements and activities.

b. Disadvantages of ERP

ERP, however, has a number of disadvantages, as highlighted below (Lysons and Gillingham 2003:294; Stevenson 2007:657-660).

- The implementation of ERP is complex.
- ERP systems are expensive.
- There are hidden costs, such as employee training, testing and integration, data conversion and analysis, and the need for many consultants.

- There are unplanned consequences such as resistance to change, employee stress and sharing of information that was protected by departments or functions.
- The focus of ERP is inclined to be on operational decisions, and the analytical capabilities of ERP systems have been reported to be relatively weak.

Table 4.2 represents the various ERPII packages currently available, indicating their SCM functionality. As indicated the largest gaps are in supply chain analytics, capable-to-promise (CTP), warehouse and transportation management and supply chain collaboration (Miklovic 2002:11).

4.2.3 Supply chain analytics (SCA) systems

As shown in table 4.2 and affirmed in Webster (2008:16), historically, ERP systems have been weak in analysis and decision support tools. Hence specialised supply analytic systems were developed by suppliers such as i2 Technologies, Manugistics and Siebel to fill this gap. Webster (2008:16) states the following: “SCA systems, which are frequently linked to ERP systems, support the detailed planning and control of material, money, and information flow through supply chains.”

According to Simchi-Levi et al (2008:417), the aptitude to work in partnership with supply chain partners is critical to an organisation’s success. This requires not only high-level alignment of IT systems, but also the integration of business processes. Webster (2008:16) indicates that there are three main groups of SCA software, namely (1) supplier relationship management (SRM); (2) collaborative planning, forecasting and replenishment (CPFR); and (3) customer relationship management (CRM). Each of these will be briefly described.

Table 4.2: ERPII packages and SCM functionality

Functionality	Demand Planning	Collaborative Planning	Inventory Planning	Manufacturing Planning	Plant Scheduling	Network Design	CTP	Transportation Management	Warehouse Management	CRM Management	Supply Chain Analytics
Baan	4	1	1	3	4	4	1	1	1	1	0
IFS	2	0	1	2	4	0	2	0	1	2	0
Intentia	2	0	1	3	4	2	0	0	4	0	0
J.D. Edwards	4	2	3	3	4	5	3	1	2	2	1
Oracle	2	1	2	2	2	0	2	0	1	1	5
Peoplesoft	3	1	3	4	0	1	3	0	3	4	3
SAP	4	1	3	4	3	2	3	2	3	1	3

Source: Miklovic (2002:11)

5 - Equal to best-in-class

4 – Close to best-in-class

3 – Adequate

2 – Developing functionality

1 – Immature

0 – Nonexistent

- *Supplier relationship management (SRM).* In order to understand the role of information flows in a supply chain, one not only takes into account the level of functionality, but also the direction of linkages. For example, the flows that link a business to its suppliers is known as SRM. This application focuses on planning and managing the business's external linkages (Monczka et al 2005:591). According to Simchi-Levi et al (2008:417-427) the ability to link and work effectively with suppliers has produced new systems called SRM. SRM provides the interface with suppliers for procurement, transaction exchange and collaborative efforts.

- *Collaborative planning, forecasting and replenishment (CPFR).* According to Simchi-Levi et al (2008:443) and Webster (2008:90), CPFR was developed by the Voluntary Interindustry Commerce Standards Association (VICS) Committee. This group comprised of retailers, manufacturers and solution providers who developed a set of guidelines and processes to facilitate CPFR in industry. The CPFR process model specifies nine suggested steps, grouped into three levels of planning, forecasting and replenishment. By integrating demand- and supply-side processes, CPFR improves efficiencies, increases sales, reduces fixed assets and working capital and reduces inventory for the entire supply chain, while satisfying customer needs.

- *Customer relationship management (CRM).* Information flows that link a business with its customers are referred to as CRM. CRM applications focus on planning and managing the business' external linkages (Monczka et al 2005:594). CRM systems are evolving to provide better contact with and understanding of customer needs. CRM involves systems that update and track interaction with customers. These systems connect to order tracking and other back-end systems to provide better information for customers and the service representatives trying to assist them (Simchi-Levi et al 2008:417 - 427).

4.2.4 Emerging information technologies and their impact on SCM

Webster (2008:22) explains that advances in technology have changed the way supply chains are managed and that this will continue in the future because of ongoing technological advances in terms of (1) broadband communication and (2) protocols for machine-to-machine communication, both within and between businesses. However, Miklovic (2002:3-18) points out that owing to its geographic isolation, Southern Africa faces special challenges because many suppliers are not equipped to engage in full-blown e-commerce. The author acknowledges that the lines between the original ERP, SCM and CRM applications will blur as emerging collections of computer applications bring components together in a single solution.

Webster (2008:22) highlights a number of emerging information technologies:

- It is estimated that the wireless phone communication transfer rate will be 30 times faster in two years' time.
- Business communication protocols are developing. For example, a business may upload specifications for a new product on the web and suppliers will respond with a quotation.
- Bluetooth wireless technology transfers data at a rate of two megabits per second over a distance of approximately 10 metres. A comparable technology known as Wi-fi transmitters are able to broadcast a broadband internet connection over a radius of 100 yards
- Radio frequency identification (RFID) technology allows wireless tracking of a product from small radio transmitter chips no larger than a pinhead. From a supply chain management perspective, RFID merits further discussion.

a. *RFID technology*

RFID is a recent development. In fact, Simchi-Levi et al (2008:436) maintain that the development of RFID is probably the principal technology development that has affected SCM. These devices are a sophisticated replacement for bar codes that are used to label a range of items, including parts and finished goods. The barcodes on RFID contain sufficient data to give each item a unique identity and can be read by a wireless radio frequency reader so that exact location can be determined. In other words, RFID tags enable the capture of real-time data on material and product movement across the supply chain (Barnes 2008:171; Monczka et al 2005:18). However, according to Simchi-Levi et al (2008:437), this technology is still in the early stages of adoption and some of its advanced features have not yet been implemented. Currently, giants such as HP, the USA Department of Defense and Wal-Mart in the USA have made use of this technology.

When the *Harvard Business Review* (HBR) convened a panel of leading academics in the field of SCM, Copacino (Beth et al 2006:69) highlighted the fact that the importance of RFID technology is growing. Three of the main reasons highlighted by the author are: (1) the cost of both tags and reader-writers is decreasing, resulting in the cost of the technology being more competitive; (2) capabilities are expanding; and (3) there is a growing need for theft protection and security.

Lee (Beth et al 2006:83), who was part of the same panel of the HBR, as mentioned above, contends that RFID will evolve as much as e-commerce has evolved. RFID is currently used mostly for tracking, whereas in the future, its primary value will lie in new applications that use the technology’s intelligence. For example, when exporting, cargoes will be equipped with tags showing the contents, to enable customs clearing to be done almost without human intervention. In terms of security, RFID tags will be able to be used to electronically seal containers and monitor the movement of these containers and any tampering.

4.3 SUPPLY CHAIN FOUNDATIONS

This section includes four concepts that are meaningful to managing the flow of material in the supply chain. Webster (2008:29) identified the concepts as (1) system slack, (2) TQM, (3) JIT and lean production, and (4) Pull versus Push. Each of these will be briefly explained below.

4.3.1 System slack

According to Webster (2008:29) "system slack is idle, underutilised, or non-value adding resources" such as inventory, underutilised money, rework or defective products, surplus or poorly deployed human resources, materials, building space and equipment. System slack is prevalent in any supply chain. The above author identified six causes of system slack, namely (1) quantity uncertainty; (2) time lags; (3) economies of scale; (4) changing supply and demand; (5) conflicting objectives; and (6) high market standards for quick response. Webster (2008:34) suggests that management's goal is to eliminate system slack. However, it is also true that "system slack is almost always essential for providing good customer service and value in supply chains." Therein lies the challenge of balance – some forms of system slack should be increased whilst other should be decreased.

4.3.2 Quality management and TQM

a. *Quality management*

Stevenson (2007:397) defines quality as the ability of a product or service to consistently meet or exceed customer expectations. According to Evans and Lindsay (2008:12), quality can be a complex concept because people view it in relation to conflicting measures based on their individual roles in the production-marketing value chain. Furthermore, as these authors observe, the meaning of quality continues to evolve as the quality profession grows and matures. According to a study in which 86 managers in the eastern USA were asked to define quality, the responses were as follows (Evans & Lindsay 2008:13):

- perfection
- consistency
- eliminating waste
- speed of delivery
- compliance with policies and procedures
- providing a good, usable product
- doing it right the first time
- delighting or pleasing customers
- total customer service and satisfaction

Hugo et al (2004:164) also state that quality can be defined from many perspectives and the authors define it as follows:

> "Conformance to requirements or fitness for use. Quality can be defined through five principal approaches: (1) Transcendent quality is an ideal, a condition of excellence. (2) Product-based quality is based on a product attribute. (3) User-based quality is fitness for use. (4) Manufacturing-based quality is conformance to requirements. (5) Value-based quality is the degree of excellence at an acceptable price."

From a supply chain viewpoint, all of the elements noted in the above definitions are suitable since all these elements of quality (in the above definitions) and the study conducted by Evans and Lindsay (2008:13) add to the final value the customer receives.

According to Hugo et al (2004:168), because quality as a concept is so complex many different approaches to managing it in industry have evolved. Furthermore, the authors indicate that the business environment is continuously changing – hence the fact that quality management approaches also change over time. Related to this, Burt et al

(2003:126) deduce that Six Sigma, TQM, continuous improvement, zero defects, quality management systems and JIT are all management systems. These systems continue to make considerable contributions to the improvement and maintenance of quality, both internally in businesses and across supply chains.

b. *Total quality management (TQM)*

As stated in Evans and Lindsay (2008:10), the concept of TQM gained recognition when businesses began to integrate quality principles into their management systems. Jacobs and Chase (2008:138) define TQM as "managing the entire organisation so that it excels on all dimensions of products and services that are important to the customer." Various authors agree that TQM is based on the following three principles:

(1) *A focus on customers and stakeholders*. This relates to exceeding customer expectations. Since the customer is the prime judge of quality, to meet or exceed customer expectations, businesses must understand all product and service elements that contribute to customer value and lead to customer satisfaction and loyalty.

(2) *Participation and teamwork by everyone in the organisation*. Employees who are allowed to play a part in the decision making process that affect their jobs and their customers, both individually and in teams can make substantial contributions to quality. Employee empowerment means that decision-making authority and responsibility are moved to lower levels in the business. In some instances, employee empowerment is a natural response to an increasingly educated workforce and advancing information systems, which make it easier to control and coordinate activities without "over the shoulder" supervision.

(3) *A process focus supported by continuous improvement and learning*. A process is a series of activities intended to achieve some result. Continuous improvement is a philosophy that aims to make infinite improvements to the process of transforming inputs into outputs. The old saying "if it ain't broke, don't fix it" becomes "just because it isn't broke doesn't mean it can't be improved" (Jacobs

& Chase 2008:138; Stevenson 2007:417; Evans & Lindsay 2008:19; Webster 2008:35).

As can be seen from the principles, TQM reflects a new attitude towards quality. The above authors state that it is all about the "culture" of a business, and in order to truly reap the benefits of TQM, the business needs to change its culture. The differences between the cultures of a traditional organisation and a TQM organisation are depicted in table 4.3.

Table 4.3: A comparison of the cultures in a traditional and a TQM organisation

Aspect	**Traditional**	**TQM**
Overall mission	Maximise return on investment	Meet or exceed customer expectations
Objectives	Emphasis on short term	Balance of long term and short term
Management	Not always open; sometimes inconsistent objectives	Open, encourages employee input; consistent objectives
Role of manager	Issue orders; enforce	Coach, remove barriers; build trust
Customer requirements	Not highest priority; may be unclear	Highest priority; important to identify and understand
Problems	Assign blame; punish	Identify and resolve
Problem solving	Not systematic; individuals	Systematic; teams
Improvement	Erratic	Continuous
Suppliers	Adversarial	Partners
Jobs	Narrow, specialised, much individual effort	Broad, more general, much team effort
Focus	Product oriented	Process oriented

Source: Stevenson (2007:418)

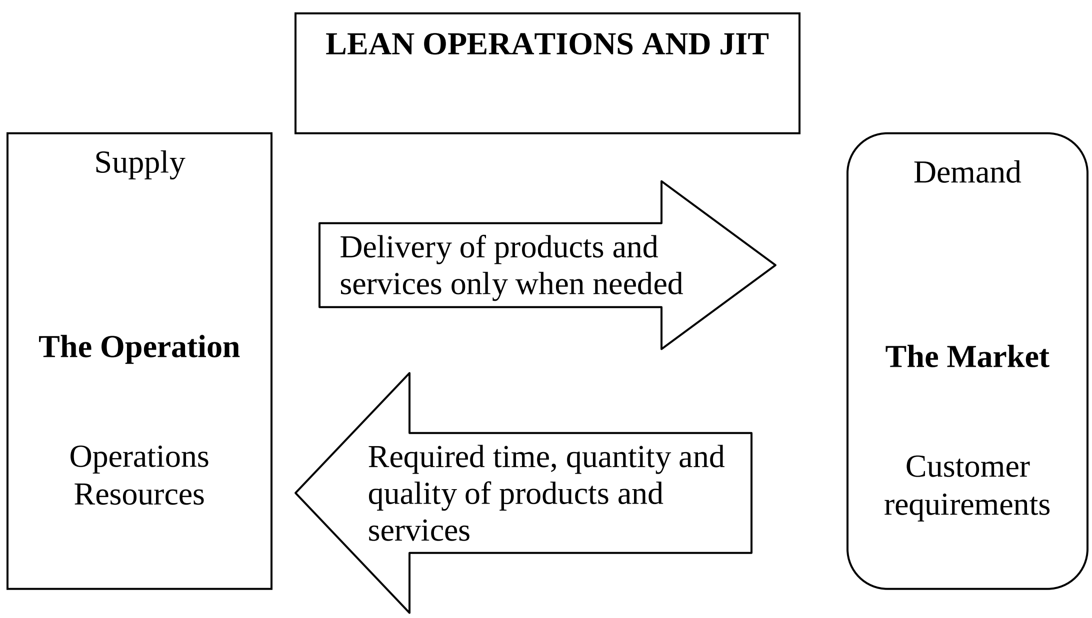
This concludes the discussion of the second concept (quality) in the supply chain foundation. The next section explains the third concept – lean production and JIT.

4.3.3 Lean and Just in Time

The term "*lean production*" has evolved from the JIT production concepts pioneered in Japan at Toyota. Interestingly, JIT gained prominence in the 1970s, but some of its philosophy can be traced back to the 1900s when Henry Ford used JIT concepts as he streamlined his assembly lines to make motor cars (Jacobs et al 2009:404). Plenert (2007:xiii) defines lean as a tool that facilitates the elimination of waste. According to Jacobs et al (2009:404), in the past 50 years, *lean* or *JIT* has proved to be the most significant production management approach. In the context of supply chains, *lean* production refers to a focus on eliminating waste.

Figure 4.2, depicts lean operations and JIT, whose aim is to meet demand immediately, with perfect quality and no waste.

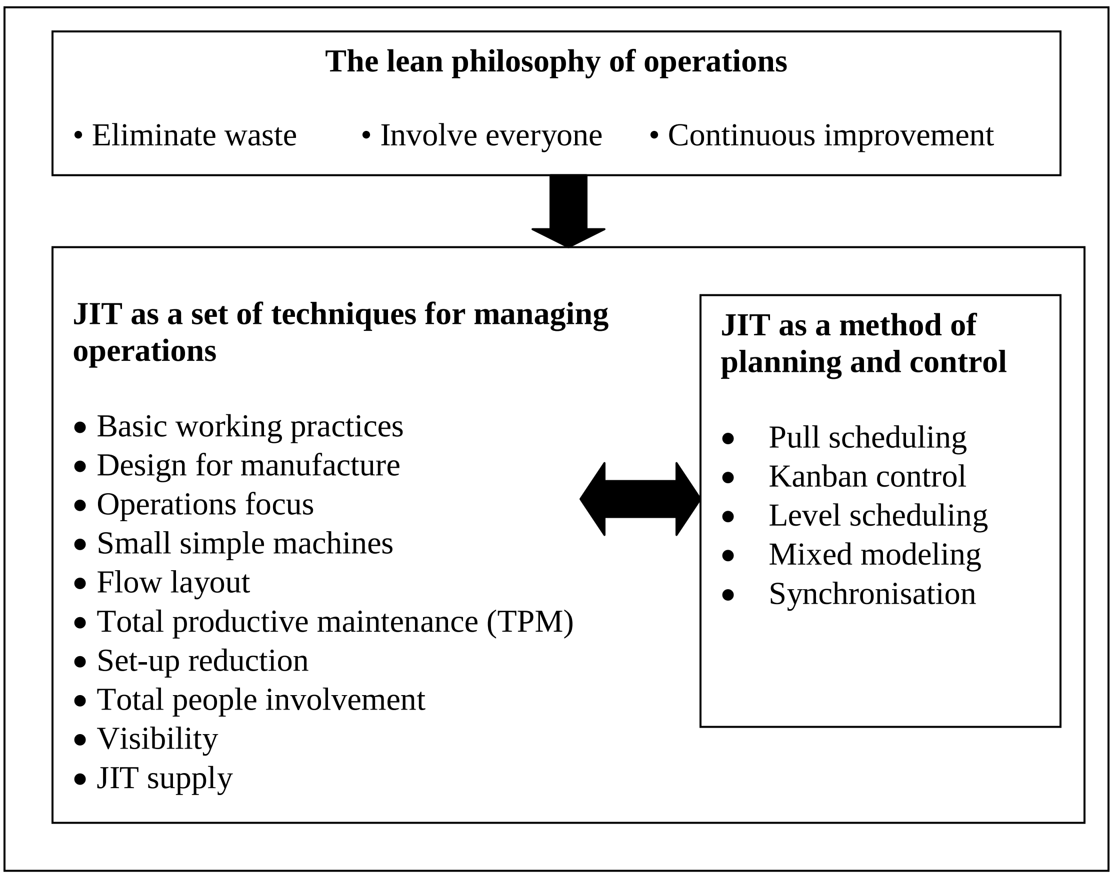
Figure 4.2: Lean operations and JIT



Source: Slack et al (2004:518)

Slack et al (2004:519) observe that the principle of lean operations implies a shift towards the elimination of all waste in order to develop an operation that is quicker and more reliable, with the ability to manufacture improved quality products and services at a lower cost. JIT means manufacturing "goods and services" precisely when they are called for. Slack et al (2004:519) define JIT as follows: "JIT aims to meet demand instantaneously, with perfect quality and no waste." Generally, lean can be regarded as a philosophy of operations management. In this philosophy there is a set of many tools and techniques that both implement and support the lean philosophy (Wisner et al 2005:210-218). The tools are generally referred to as JIT techniques as indicated in figure 4.3.

Figure 4.3: The lean philosophy of operations as the basis for JIT



Source: Slack et al (2004:522)

According to Evans and Lindsay (2008:508), a basic method of describing lean production is "getting more done with less." The process entails the identification and removal of nonvalue-added activities right through the whole supply chain in order to realise quicker customer response, reduced inventories, better quality and improved human resources.

Some of the vital tools used in lean production and lean thinking are as follows (Evans & Lindsay 2008:509; Stevenson 2005:626-634; Spear & Bowen 2006:117-145):

- *The five S's.* Housekeeping is often referred to as the five S's. These stem from the Japanese terms, *seri* (sort), *seiton* (set in order), *seiso* (shine), *seiketsu* (standardise) and *shitsuke* (sustain).
- *Visual controls*. These are displays for tools, parts and production activities that are positioned for all workers so that everyone is aware of the status of the system at a glance.
- *Efficient layout and standardised work*. This is devised in line with the best operational arrangement.
- *Pull production*. Upstream suppliers do not produce until the downstream customer signals a need for components.
- *Single minute exchange of dies (SMED)*. This refers to quick change-overs of tooling and fixtures in machine shops in order to run various components in smaller lots on the same equipment.
- *Total productive maintenance*. The aim of total productive maintenance is to ensure that the equipment is operational and readily available when it is required.
- *Source inspection.* Inspection and control are carried out by operators to ensure that the components conform to specifications before being passed on to the next production stage.
- *Continuous improvement*. It has been observed that in order for lean production to work, the root cause of problems must be found and eliminated. Teamwork is thus a fundamental part of continuous improvement in lean environments, because workers are expected to be involved in problem solving and continuous improvement.

4.3.4 Pull versus Push

According to Stevenson (2007:694), the words "*push and pull*" are used to describe two different systems for moving work through a production process. As discussed in section 3.2.2 (2nd par), in a ***pull*** philosophy, value and volume are determined by the customers – products are pulled through the system on the basis of customer requirements. In a ***push*** philosophy, the customer is not the trigger of product design and volume. Products are pushed through the materials flow channel on the basis of what every channel member regards as the optimum level of supply.

As observed in Simchi-Levi et al (2008:188), traditional supply chains strategies are often classified as ***push*** or ***pull*** strategies. It is believed that this evolved from the manufacturing revolution of the 1980s, where manufacturing systems were classified into these strategies. In the past few years, businesses have started using the hybrid approach "*push-pull*" supply chain theory. Each of these strategies is dealt with below.

a. Push based supply chain

According to Stevenson (2007:694), a push system is used in traditional production environments where work is pushed to the next station as it is completed. Once the work is complete, it is pushed on to the final inventory.

b. Pull-based supply chain

Plenert (2007:259) acknowledges that in JIT, nothing is produced until the customer requests it, and subsequently, nothing is purchased until the production process begins and materials are requested from the supplier. Materials are therefore "pulled" from their source and never "pushed" into the process. A pull system works on feedback from the user before materials and components are introduced into the process. Obviously all elements of the supply chain system must be ready and in perfect synchronisation in order to make the "pull" supply chain work. Plenert (2007:259) cites an example in which the production lead time for a typical US car assembler can be reduced from three to four months, to four hours at Toyota.

According to Wisner et al (2005:14), the objectives of a pull system are to create a flexible system capable of delaying final assembly until a customer places an order. The benefits of such a system are quicker delivery times, reduced inventory levels and improved quality.

c. Push-pull supply chain

According to Simchi-Levi et al (2008:190), in a "*push-pull*" strategy, the preliminary phases are conducted in a push manner, where the remaining phases make use of a pull-based strategy. The authors cite an example of a PC manufacturer who builds to stock and makes all production and distribution decisions on the basis of forecast – a typical push system. In comparison, a PC manufacturer who builds to order manages inventory on forecast but final assembly takes place when a specific customer places an order – a push-pull strategy. Dell Computers uses this strategy. Wisner et al (2005:14) cite the following example: a customer contacts Dell Computers on its Website and custom-configures his computer. Once the order has been placed, Dell Computers assembles the computer from in stock mass-produced parts and components and delivers the computer in a few days.

Postponement or delayed differentiation is another example of a push-pull strategy. Stevenson (2007:134) observes that delayed differentiation is a postponement tactic. He defines delayed differentiation as "the process of producing, but not completing a product or service until customer preferences are known". He cites the example of Hewlett-Packard printers made in the USA but intended for foreign markets. These are mostly completed in domestic assembly plants, but finalised closer to the country of use. The result is a product with customised features.

4.3.5 Line balancing

Stevenson (2005:236) explains line balancing as the process of allocating tasks to workstations in such a way that the workstations have approximately equal time requirements. Line balancing applies only to line processes that do assembly work or to work that can be packaged in several ways to create the jobs for each workstation in the line. Line balancing must be performed when a line is initially set up, when a line is rebalanced to change its hourly output rate or when the product or process changes. The goal is to obtain workstations with well-balanced workloads eg every station takes approximately three minutes per unit processed (Krajewski et al 2007:328; Pycraft et al 2001:246).

4.3.6 Vendor managed inventory (VMI)

Lysons and Gillingham (2003:302) observe that VMI is a JIT technique in which inventory replacement decisions are centralised with upstream manufacturers. The main goal of VMI is to enable manufacturers to eliminate the need for customers to reorder, reduce or exclude inventory and prevent stockouts. In VMI, customers no longer pull inventory from suppliers, but inventory is automatically pushed to customers as suppliers check the customers' inventory levels and replenish inventory as and when required. Monczka et al (2005:619) agree with this description. They state that VMI refers to an agreement whereby the supplier is responsible for keeping and administering inventory levels of its manufactured goods at the customer's facility. This system is already in process in many automotive companies.

4.4 FUNCTIONS INCLUDED IN SUPPLY CHAIN MANAGEMENT

The functions discussed below form part of supply chain management.

4.4.1 Demand management

Demand management entails laying down marketing and sales plans on the basis of forecast demand and available products. Demand management is generally performed on a regional basis, of which communication is a vital part in order for supply chain management to be successful (Simchi-Levi et al 2003:157).

According to Burt et al (2003:625), demand management endeavours to estimate, control, smooth, coordinate, balance and influence the demand for and supply of a firm's products and services in an attempt to reduce total costs for the firm and its supply chain. Demand management receives estimates from other functions and updates them on the basis of actual real-time demand. Demand management also works with the procurement side to modify the inflow of materials and products. Demand may change daily, weekly or monthly. Demand managers should have alternative plans in place for unforeseen events with supply chain members to allow for modifications to short-term schedules when necessary. The objective of demand management is to analyse the usage of the sales forecast by the actual sales order rate on a continual basis.

Demand forecasting refers to the process of establishing how much of product and related information consumers will need at some point, be it in the short or long term (Vogt et al 2005:11). Simchi-Levi et al (2003:127) acknowledge that a demand forecast is a process in which historical demand data are used to develop long-term estimates of expected demand.

4.4.2 Inventory management

Simchi-Levi et al (2003:45) acknowledge that managing inventory in complex supply chains is challenging and may have a significant impact on the level of customer service and the supply chain system-wide cost. A normal supply chain consists of suppliers, manufacturers (who convert raw materials into finished products) and warehouses (from which finished goods are distributed to customers). The implication is that inventory appears in the supply chain in many forms such as raw materials, work-in-progress and finished products.

Inventory management has been identified as a critical issue in supply chain management by many different authors in different academic texts and journals. The needs of both manufacturing and marketing have to be met on an ongoing basis. One of the challenges is that large volumes of inventory (1) occupy capital intensive warehouse space, and (2) have a value, both of which translate into an opportunity cost. As such, it has been noted that a trade-off should be made between this opportunity cost and the negative impact of a stockout (Vogt et al 2005:12).

4.4.3 Facility site selection and design

Facility site selection is an area of strategic importance. Here one could consider the type of facility, type of layout, possible location and the number and capacity of facilities. It has been proven that the selection of facility location impacts directly on transportation costs – from the location of raw materials or primary producers through the supply chain to the consumer. Critical factors that have been identified when selecting a site are labour costs and the availability of skills; transport costs; land and construction costs; property rates and taxes; the cost and availability of utilities, services and infrastructure; security; legal concerns; and local factors such as the attitude of the community towards the new facility (Vogt et al 2005:11)

According to Bowersox et al (2007:298), in terms of logistical planning, transportation offers the potential to link geographically dispersed manufacturing, warehousing and market locations into an integrated system. Logistical system facilities include all locations at which materials, work-in-progress or finished goods are handled or stored.

4.4.4 Materials handling

Materials handling is described as the movement or flow of raw materials, semifinished goods and finished goods at premises in a warehouse. Materials handling is a vital function in the warehouse. Products must be received, moved, stored, sorted and assembled to meet customer order requirements (Bowersox et al 2007:29). Successful materials handling contributes towards smooth manufacturing operations, reduced inventory, lowered processing, storage and transshipment costs and increased productivity in facilities (Vogt et al 2005:12).

4.4.5 Packaging

Bowersox et al (2003:408) observe that packaging can be viewed as two functions – that of marketing and logistics. In terms of marketing the package assumes the function of the silent seller (a type of advertising). In terms of the logistics, packaging serves a dual role. (1) The package protects the product and ensures that it is delivered in a usable form to the customer. (2) Packaging facilitates the storing and movement of products, which lowers materials handling and distribution costs (Vogt et al 2005:12).

However these are not the only objectives of packaging. Additional objectives include the following (Hugo, Badenhorst-Weiss & Van Biljon 2006:206):

- providing distributors and the user with information on the contents of the package (this is achieved through a proper coding and marking system that utilises bar-coding and scanning technology)
- conforming to health and safety regulations by displaying the ingredients, warning messages, directions for use and other important information to consumers or users
- changing the shape and density of a product
- providing the user or customer with packaging that can be reused for a range of purposes (eg storing or transporting liquids).

- facilitating the storage and handling of products and materials in a way that will improve efficient palletisation of products, containerisation and loading into transport equipment

4.4.6 Warehouse management

Vogt et al (2005:12) note that warehousing entails the activities relating to managing the space needed to hold and maintain inventories. Specific warehouse management decisions include the following:

- where to locate the warehouse, and its capacity and design
- whether the warehouse should be owned or rented
- whether to mechanise or automate the warehouse
- the mix of product
- the types of security and maintenance
- the level of personnel training
- how to measure productivity
- setting operations standards
- the range of services to offer

4.4.7 Procurement

According to Van Weele (2005:10), procurement is the acquisition of raw materials, supplies, other consumable items and services as well as assets such as machinery, laboratory equipment, office equipment and buildings to ensure that the business's manufacturing and marketing processes operate effectively. According to the above author (2005:14), procurement differs from purchasing in that procurement includes all the activities required to get the product from the supplier to the final destination. In this instance, it includes the purchasing function, stores, traffic and transportation, incoming inspection and quality control and assurance.

Hugo et al (2006:14) acknowledge that the purchasing cycle consists of a series of successive steps or purchasing activities/procedures to be performed for each purchasing transaction. Monczka et al (2005:34) identify these steps as follows:

- origin of the need
- specification
- source identification
- selection of suppliers
- bidding and negotiation
- placing the order
- following up and expediting
- receipt, inspection and distribution
- inspection of incoming goods
- handling faulty consignments and rejections
- analysing the invoice
- closing the order (payment)
- maintaining files and records
- measuring supplier performance

In light of the above, one of the strategic roles of procurement in supply chain management is determining, managing and maintaining relationships with suppliers to achieve the basic objective of business to operate efficiently and effectively – in other words to obtain the highest possible profit at the lowest possible cost (Hugo et al 2006:1). This can be achieved by purchasing materials and services in "the right quality and the right quantity, from the right supplier delivered at the right place at the right price."

4.4.8 Logistics communication

Bowersox et al (2007:103) observe that communication systems facilitate the information flow across the supply chain. Logistics information consists of real-time data on company operations and inbound material, production, inventory, customer shipment and new customer orders. From a supply chain viewpoint, businesses need to make available to order, shipment and billing information to suppliers. This information also has to be supplied to financial institutions, carriers and customers.

Vogt et al (2005:13) acknowledge that the basis of successfully integrated and coordinated logistics management is accurate and timely communication.

4.4.9 Transport

Bowersox et al (2007:167) contend that transportation is a highly visible element of logistics and provides two major services, namely product movement and storage. According to Vogt et al (2003:13), the transportation of goods is a crucial activity of supply chain management and in most cases, has proven to be the largest cost element. It includes decisions such as the following (Vogt et al 2005:13):

- whether to own or outsource vehicles
- the selection of the mode, carrier and service
- the method of freight consolidation
- vehicle routing and crew and trip scheduling
- the selection, replacement and purchase of equipment

4.4.10 Reverse logistics

Reverse logistics deals with return goods handling and waste disposal. The handling of return goods is an integral part of the supply chain process. Customers return goods to the seller for various reasons, such as defects, excesses, exchanges or simply because they received the wrong goods (Johnsson 2008:29).

Waste is a side effect of manufacturing and consumption. If waste cannot be recycled or reused, it must be properly disposed of. In the case of hazardous materials, a business needs to conform to special disposal standards and environmental regulations (Vogt et al

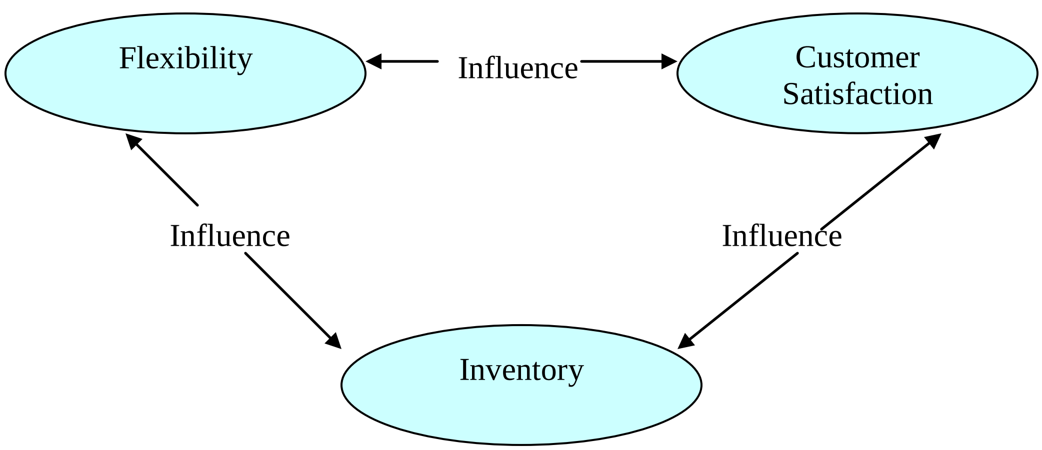
2005:14). Reverse logistics and waste is dealt with under “Cradle to grave” flow, in section 3.9.4.

4.4.11 Customer service

Waller (2003:793) acknowledges that the customer is king! Organisations are in business to make a profit provided there is a satisfactory return on capital employed. This implies satisfying the customer with the desired products and expected quality, and meeting the promised delivery dates. It is the customer who is pulling the products through the supply chain. A satisfied customer, whether he or she is purchasing products or consumer goods, is the one who increases market share and therefore increases activity at the operational level.

Strydom et al (2005:6) maintain that customer service is a key principle in SCM. A satisfied customer is the desired end result of any SCM strategy, and the basis for effective customer service is flexibility and inventory, as illustrated in figure 4.4.

Figure 4.4: The basis for good customer service



Source: Strydom et al (2005:7)

Hugo et al (2004:117) state that, in essence SCM has two primary objectives, namely increasing shareholder value and optimising customer value. However, these authors stress that delivering customer value is not the only area of value creation in the supply chain, and neither is optimising customer service. Delivering customer service is probably the main interface between marketing and SCM. Delivering customer service is an example of the integrated supply chain process which crosses functional borders in order to create value.

4.5 VALUE STREAM MAPPING (VSM)

Essentially, according to Plenert (2007:121) value stream mapping (VSM) is a lean manufacturing tool. As such, it is a sound foundational visualisation tool (developed by Toyota) known as materials and information flow mapping. The idea is to develop a detailed diagram of a process that clearly shows those activities that add value, activities that do not add value, and steps that involve simply waiting. Jacobs and Chase (2008:226) acknowledge that the aim of VSM is to recognise, determine and reduce waste in the process. Waste is defined as any process that does not add value to the final product. VSM can therefore serve as a starting point to help managers, engineers, production associates, schedulers, suppliers and customers recognise waste and identify its causes.

Plenert (2007:121) defines value as the amount a customer is willing to pay for a product or service. Kotler and Keller (2006:25) define value as the perceived tangible and intangible benefits and costs to customers. Elements of value include items such as durability, quality, utility, price, capacity, functionality, timeliness, aesthetics and availability (Plenert 2007:121; Kotler et al 2006:25).

The ***value stream*** includes all the occurrences and actions in a product or a process's supply chain that would affect those items to which the customer assigns "value". Hence the need to distinguish between value added and nonvalue added as noted in Plenert (2008:234). In VSM, the aim is to try to differentiate between value-added and non value-added activities.

- ***Value-added activity.*** This would be any activity that directly increases the value of the product or service being performed. For example, drilling a hole would be value added (Penert 2008:234).

- ***Non-value-added activity***. This would be any support activity that does not directly add value to the product or service. For example, drilling a hole is value added, but positioning the item to be drilled, changing the drill bit, cleaning the workstation and moving the item to inventory would all be non value-added steps (Plenert, 2008:234).

As shown in table 4.4, Hines and Rich (1997:50) suggest the following seven value stream mapping tools which indicate their origin.

Table 4.4: The seven value stream mapping tools and their origin

Mapping tool	**Origin of mapping tool**
1. Process activity mapping	Industrial engineering
2. Supply chain response matrix	Time compression/logistics
3. Production variety funnel	Time compression/logistics
4. Quality filter mapping	Time compression/logistics
5. Demand amplification mapping	New tool
6. Decision point analysis	Systems dynamics
7. Physical structure mapping	Efficient consumer response/logistics
	New tool

Source: Hines & Rich (1997:50)

Hines and Rich (1997:59) note that a range of value stream mapping tools can be used with any selected approach. Once the mapping process is complete, in order to improve the value stream, the user can conduct a more detailed analysis of the value stream by using each individual tool with its related benefits. According to Hines and Rich (1997:59) the kaizen (continuous improvement) approach is generally used for the removal of non-value adding waste. However, it has been proven that a more revolutionary strategy such as business process re-engineering may be more appropriate where the removal of necessary but non-value adding waste is concerned.

4.6 TOTAL COST OF OWNERSHIP (TCO)

Hugo et al (2004:188) acknowledge that the emphasis of the SCM philosophy is on customer satisfaction at the lowest total cost of acquisition, ownership and use. Hence TCO has become a powerful tool for creating a competitive advantage in the marketplace. Monczka et al (2005:364) define TCO as the present value of all costs associated with a product, service or capital equipment that is incurred over its expected life. These costs can be broken down into four broad categories as follows (Monczka et al 2005:365):

(1) purchase price – the amount paid to the supplier for the product, service or capital item
(2) acquisition costs – all costs related to bringing the product, service or capital item to the customer's place, for example, sourcing, administration, transport and taxes
(3) usage costs – all costs associated with converting the purchased material into the finished product, for example, inventory, conversion, scrap, warranty, installation, training, downtime and opportunity costs
(4) end-of-life costs – all costs incurred when a product reaches the end of its usable life or salvage value (eg obsolescence, disposal, clean-up and project termination costs)

According to Leenders et al (2006:237), broadly speaking TCO includes all relevant costs, namely administration, follow-up, expediting, inbound transportation, inspection and testing, rework, storage, scrap, warranty, service, downtime, customers' returns and lost sales. Hence, the acquisition cost plus all other related costs becomes the total cost of ownership. The above authors go on to say that this approach requires the support of engineering, quality, manufacturing and purchasing to coordinate specifications and tolerances that affect the purchasing decision. In order to achieve cost effectiveness, early supplier involvement is also vital. Hugo et al (2004:190) concur with Leenders et al

(2006:237) stating that their list of factors clearly takes the TCO process of determining costs through the whole input transformation process and then beyond to include customer service and satisfaction factors.

4.7 EARLY SUPPLIER INVOLVEMENT (ESI)

ESI occurs when a strategic supplier provides product and process technology and knowledge to support the buyer's operation (Wisner et al 2005:480). According to Burt et al (2003:211), supply management professionals and selected key suppliers are moving to ESI in the new product development process because suppliers are able to make vital contributions in the areas of quality, cost and timely market availability.

Benton (2007:186) cites an example of the importance of supply chain partnerships in early supplier involvement. The Daimler-Chrysler Corporation is a leader in developing close collaborations with suppliers. When the company's team designed its new LH line and new compact sedans, Daimler-Chrysler outsourced 70% of its parts to a few suppliers. In order to achieve this, Chrysler invited a few key suppliers into the early stages of the development process. Early supplier involvement at Daimler-Chrysler resulted in the development of the LH line in 39 months as opposed to the usual five to six years, and it also resulted in cost savings because the plant carries smaller stock of components. This is evidenced in the following statement by Burt et al (2003:212): "by involving supply management and suppliers in cross functional engineering teams at an early stage, research and development gets the chance to improve efficiency". ESI helps to shorten engineering time and increase engineering quality.

4.8 CONCLUSION

The field of supply chain management is extremely complex because it deals with firms, departments and individuals linked by flows of resources, namely material, information and money. One way to think of the flow of resources is in terms of five basic groups, buy, make, move, store and sell. The aim of chapters 3 and 4 was to (1) define SCM and explain its importance; (2) define SCM and related concepts and dimensions; and (3) define SC practices and tools.

This chapter dealt with supply chain practices and tools such as information systems – the technologies most relevant to SCM and the role of SCM in e-commerce. In addition, system slack, TQM, JIT, push versus pull and vendor-managed inventory were examined. The discussion of these tools is vital because the automotive industry relies heavily on such tools for their success.

Functions included in supply chain management that were described in this chapter were demand management, electronic data interchange, vendor-managed inventory, inventory management, materials handling, warehouse management, procurement, logistics communication, transport, reverse logistics, customer service, quality, early supplier involvement and value stream mapping.

Since the aim of this study is to identify supply chain difficulties facing ACMs in South Africa, this literature overview was necessary because it lays the groundwork for the empirical study. Both chapters 3 and 4 covered many concepts, principles, tools and functions included in supply chain management. Chapter 5 deals with the research methodology for this study.

CHAPTER 1

Introduction

CHAPTER 2

The global and South African automotive industry

CHAPTER 3

Supply chains, supply chain management and related concepts

CHAPTER 4

Supply chain management practices and tools

CHAPTER 5

Research design and methodology

CHAPTER 6

Problems experienced by ACMs from their customer's perspective

CHAPTER 7

Supply chain problems facing ACMs in South Africa: empirical research

CHAPTER 8

Summary, recommendations, caveats and suggestions for further research

OUTCOME

To identify problems or difficulties in the supply chain and suggest remedies to ACMs and the motor industry as a whole

CHAPTER 5

RESEARCH DESIGN AND METHODOLOGY

5.1 INTRODUCTION

The preceding chapters dealt with the introduction to the study, an overview of the global and South African automotive industry and a literature review of supply chain management. The aim of this chapter is to outline the research methodology of the empirical study. An appropriate research strategy for the stated research question is formulated. The research should be relevant to and appropriate for the nature of the topic and research question. In order to achieve this aim, an overview of the various research methods is given, together with the rationale for why a particular strategy was selected.

This chapter starts by explaining the meaning of research and design in order to develop a framework for the research design process. Secondly, a theoretical overview of the process is provided, after which each of the process steps is related to the research study.

The nature of the research question, the objectives of the research study and the proposed methodology point the research strategy in the direction of both qualitative and quantitative research.

5.2 THE MEANING OF RESEARCH DESIGN

According to Van Biljon (1998:28), *research design* comprises two distinct elements, namely research and design. Firstly, a brief explanation of each is given, after which the meaning of the combined term "research design" is dealt with and related to this research study.

5.2.1 The meaning of research

Cooper and Schindler (2001:15) state that reporting, descriptive, explanatory, or predictive studies can be termed "research". They define it as a methodical study intended to provide information in order to solve problems. Saunders, Lewis & Thornhill (2003:3) note that research has a number of characteristics highlighted below:

- Data are collected methodically.
- Data are interpreted methodically.
- There is a clear objective, namely to "find out things".

Saunders et al (2003:3) therefore describe research as something that people start in order "to find out things" in a methodical manner, and in so doing, enhance their knowledge.

However, Van Biljon (1998:28) notes that there are various definitions of the concept of research. A summary of definitions gives a broad view of research. Of importance is the fact that some authors do not give a clear and succinct definition of research (Hook, Mkhize, Kiguwa & Collins 2003:525; Jankowicz 1995:87; Locke, Silverman & Spirduso 1998:21; Riley, Wood, Clark, Wilkie & Szivas 2000:2) but represent it in combination with other terms such as design, process, approach, philosophy and dimensions. This clearly shows that research is not easy to describe and is not commonly understood.

An investigation and analysis of the definitions and descriptions from various research sources indicate the commonality of themes between these sources as follows (Van Biljon 1998:28):

- Research is systematic.
- Research is a human activity.
- Research should answer a question or solve a problem.
- Research promotes critical thinking.

Table 5.1: Selected definitions and descriptions of research

- A systematic exploration to determine facts or principles or to gather information on an area under debate (*Collins English Dictionary* 2003:1376).
- A systematic approach to answering questions (Coon 2004:G14).
- An organised, methodical, data-based, critical, impartial, scientific analysis or study into a specific problem or issue with the aim of finding solutions or shedding light to the problem or issue (Cavana, Delahaye & Sekaran 2000:5).
- A scholarly enquiry involving a careful and diligent search (Remenyi, Williams, Money & Swartz 2005:289).
- Research is basically a thought process, surrounding accumulated facts and data, which seeks to determine what the facts "*say*" and what the data means (Leedy 1989:4-8).
- Research is a procedure or scientific enquiry by means of which an endeavour is made to obtain answers to questions and to solve identified problems in a systematic manner with the support of verifiable facts (Brynard & Hanekom 2006:3)

Source: Adapted from Van Biljon, 1998:29

This research study adheres to the above themes because it intends solving the research question by means of a well-defined and careful process of investigation and analysis, controlled and managed by the researcher.

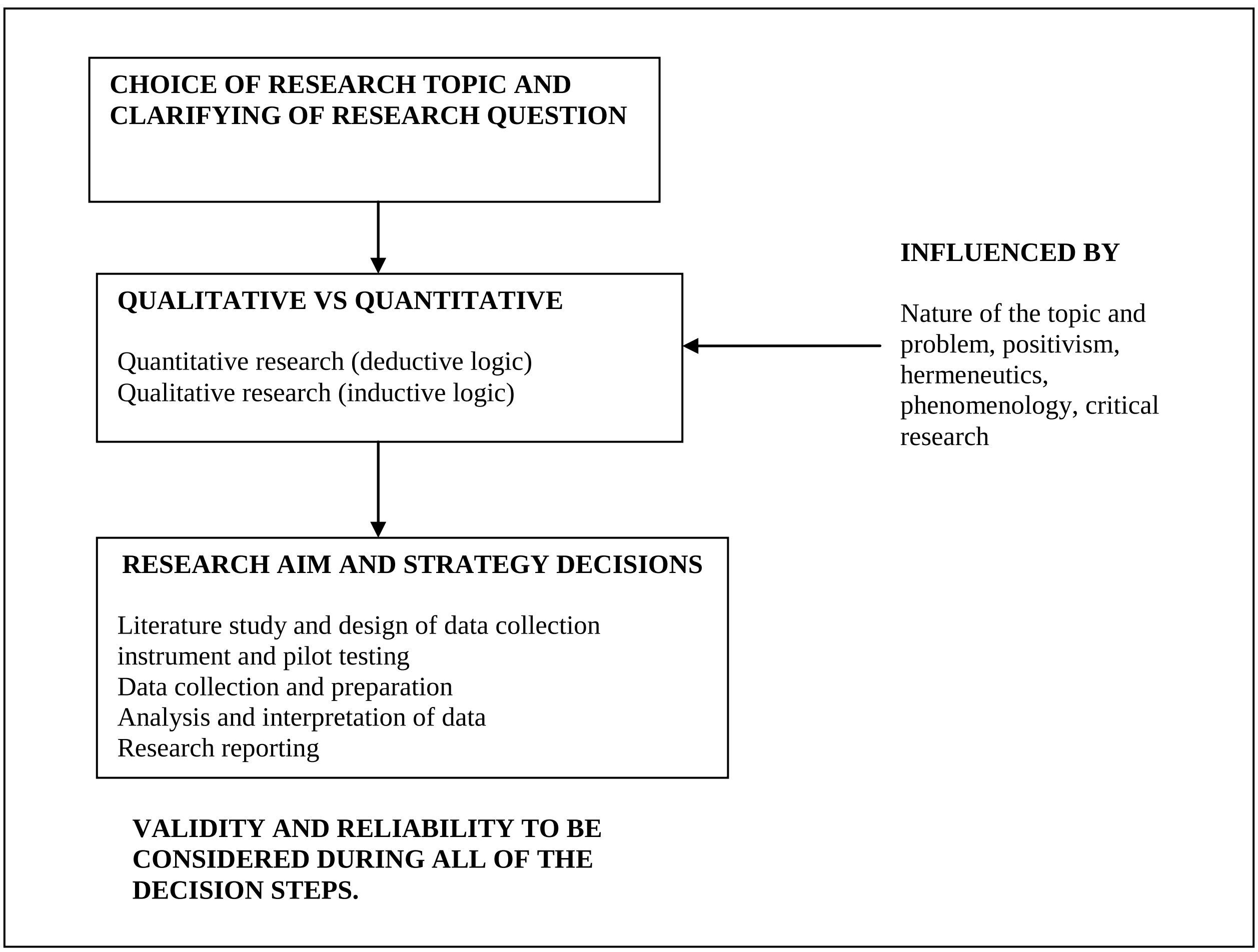
5.2.2 The meaning of design

Collins English Dictionary (2003:450) defines design, inter alia, as to intend, as for a specific purpose, plan or project. Cooper and Schindler (2006:716) define research design as the outline for accomplishing research objectives and answering research questions.

Various authors (Jankowicz 2000:178; Jankowicz 1995:93; Cavana et al 2000:107) note that design has been described as the conscious planned "arrangement of conditions for analysis and collection of data in a manner that aims to combine relevance to the research purpose with economy of procedure”. The principle of design is that different kinds of issues logically demand different kinds of data-gathering arrangements to ensure that the data will be relevant to the study, valid and reliable and capable of providing findings that can be generalised to situations other than those of one’s immediate organisation.

The views of these authors have been combined into a conceptual framework of decision steps in the research process. This framework (fig 5.1) forms the groundwork on which the research design for this research study has been based. As indicated in figure 5.1, selecting a research topic and preparing the research question is the first step to consider. Once the research topic has been decided upon and the research question formulated, the researcher must decide on the research methodology that should be adopted.

Figure 5.1: A conceptual framework for research design



Source: Adapted from van Biljon (1998:31) & Cooper et al (2006:55)

5.3 PROBLEM STATEMENT AND OBJECTIVES OF THE STUDY

As noted in chapter 1, section 1.6, the research question was formulated as follows:

What are the supply chain management problems that ACMs in South Africa face and how can these be overcome?

To achieve the research question, the following primary and secondary objectives are formulated.

5.3.1 Primary Objectives

(1) to identify the supply chain problems South African ACMs face
(2) to identify and suggest remedies to overcome these problems

5.3.2 Secondary Objectives

(1) to obtain a perspective of the automotive industry, both in South Africa and internationally as the industry and environment within which ACMs operate
(2) to give an overview of the scope, concept and philosophy of supply chain management
(3) to identify important best practices in SCM (which will serve as guidelines to investigate the ACMs' supply chain)
(4) to give an overview of the automotive supply chains from the ACMs' perspective in South Africa
(5) to describe the enabling environment of automotive component manufacturers in South Africa
(6) to identify supply chain problems
(7) to determine the extent of the supply chain problems experienced (through a qualitative investigation including in-depth semi-structured interviews and a quantitative investigation by means of a survey)

(8) to compare the supply chain problems faced in the provinces and determine possible geographic-related problems

(9) to compare these problems with regard to age and size of an ACM in order to determine whether age or size impacts on an ACM's problems

(10) to determine relationships (correlations) and their significance in the supply chain

(11) to refine, pinpoint and explain the reasons for these problems (through a qualitative section included in the questionnaire)

(12) to identify and suggest remedies to ACMs and the motor industry as a whole to overcome the problems identified.

The first five secondary objectives were achieved through the literature review and objective six through both the literature review and the in-depth semi-structured interviews at both Ford and Toyota.

In order to achieve secondary objectives 8, 9 and 10, the following hypotheses were formulated to guide the research.

5.4 HYPOTHESES

Hypothesis 1

H_{01}: From a geographic perspective, ACMs in South Africa at national level face the same supply chain problems.

$H_{a1:}$ From a geographic perspective, ACMs in South Africa at national level face different supply chain problems.

Hypothesis 2

H_{02}: There is no relationship between supply problems and internal operations problems and between supply problems and customer problems.

H_{a2}: There is a relationship between supply problems and internal operations problems and between supply problems and customer problems.

Hypothesis 3

H_{03}: Relationships between ACMs and their suppliers are not a significant SCM problem.

H_{a3}: Relationships between ACMs and their suppliers are a significant SCM problem.

Hypothesis 4

$H_{04:}$ Relationships between ACMs and their customers are not a significant SCM problem.

H_{a4}: Relationships between ACMs and their customers are a significant SCM problem.

Hypothesis 5

H_{05}: Technological advancement/or outdated processes are not a significant supply chain problem for ACMs.

$H_{a5:}$ Technological advancement/or outdated processes are a significant supply chain problem for ACMs.

Hypothesis 6

H_{06}: The number of years a business has been supplying its target market has no bearing on the supply challenges it faces.

H_{a6}: The number of years a business has been supplying its target market has a bearing on the supply chain challenges it faces.

Hypothesis 7

H_{07}: The size of a business (in terms of the number of employees it has) has no bearing on the supply challenges it faces.

H_{a7}: The size of a business (in terms of the number of employees it has) does have a bearing on the supply chain challenges it faces.

5.5 VALIDITY AND RELIABILITY CONSIDERATIONS

Saunders et al (2003:100) state that in order to reduce the possibility of not finding the correct answer to the research problem, one has to focus on two particular areas of research design, namely validity and reliability. According to Van Biljon (1998:32), the researcher's peers and research examiners will judge research in terms of these two variables.

5.5.1 Validity

Validity is the degree to which the empirical measure sufficiently reflects the true meaning of the concept (Hook et al 2004:530). According to Saunders et al (2003:101), in terms of validity, the concern is whether the "findings are really about what they appear to be about". Validity is an attribute of measurement that determines whether a test measures what the researcher actually wants to measure and that differences found in a measurement tool reflect true differences between the respondents (Cooper & Schindler 2006:720; Remenyi et al 2005:291).

Cavana et al (2000:212) note that numerous types of validity tests are utilised to test the goodness of measures. Validity tests can be classified under four broad headings:

(1) *Face validity*. This is a basic and nominal index of validity. It shows that the items included in the questionnaire are clear and understandable to the respondents.
(2) *Content validity*. This ensures that the measures include a sufficient and representative set of items that draw on the concept.
(3) *Criterion-related validity*. This is determined when the measure separates people in terms of a criterion the measure is expected to predict.
(4) *Construct validity*. This confirms how well the results derived from the use of the measure fit the theories around which the test is devised.

Credibility is a critical factor in this research study. One of the objectives of this study was to analyse and interpret data from qualitative data obtained through semi-structured interviews at Ford and Toyota. In other words, possible supply chain problems facing ACMs in South Africa were identified through both the literature review and semi-structured interviews. These problems were then tested by means of a questionnaire. The questionnaire contained all the identified problems and included a comments section to determine from respondents why they were experiencing certain problems (problems they felt particularly strongly about). The questionnaire was sent to all NAACAM members to (1) determine whether they agreed that these were in fact problems; and (2) to what extent the respondents perceived these to be problems.

In this research study, both ***face validity*** and ***content validity tests*** were used.

5.5.2 Reliability

Reliability is another significant factor to consider in this research project because the aim of the research was to identify the supply chain problems facing South African ACMs, and identify and suggest strategies to overcome these difficulties. Two methods used to determine these problems were the literature review and semi-structured interviews with respondents at two leading automotive assembly plants, the Ford Motor Company in Pretoria and Toyota SA in Durban.

The empirical research study comprised two phases. The first phase of the empirical research involved interviews at Ford and Toyota. The results are dealt with in chapter 6.

The second phase of the empirical research dealt with the quantitative study. A questionnaire was drawn up encompassing the problems that had been identified in the literature review and qualitative study. The questionnaire was sent to the respondents. The results are discussed in chapter 7.

The results discussed in chapters 6 and 7 had to satisfy the requirements for reliability.

Cooper and Schindler (2006:716) define reliability as a characteristic of measurement concerned with accuracy, precision and consistency – a vital but not adequate condition for validity (if the measure is not reliable, it cannot be valid). Remenyi et al (2005:289) confirm this and define reliability as the degree to which observations or measures are consistent or stable.

Cavana et al (2000:210) observe that the reliability of a measure indicates the stability and consistency with which the instrument measures the concept that helps assess the so-called "*goodness*" of a measure.

To achieve this, a recording device was used as a primary tool for ensuring reliability during the interviews. A copy of all completed questionnaires was kept on file together with all the email correspondence. The researcher was personally responsible for data collection.

5.6 THE METHODOLOGICAL APPROACH ADOPTED FOR THIS RESEARCH PROJECT

This study is both descriptive and exploratory and contains quantitative as well as qualitative elements. There are two reasons for this approach:

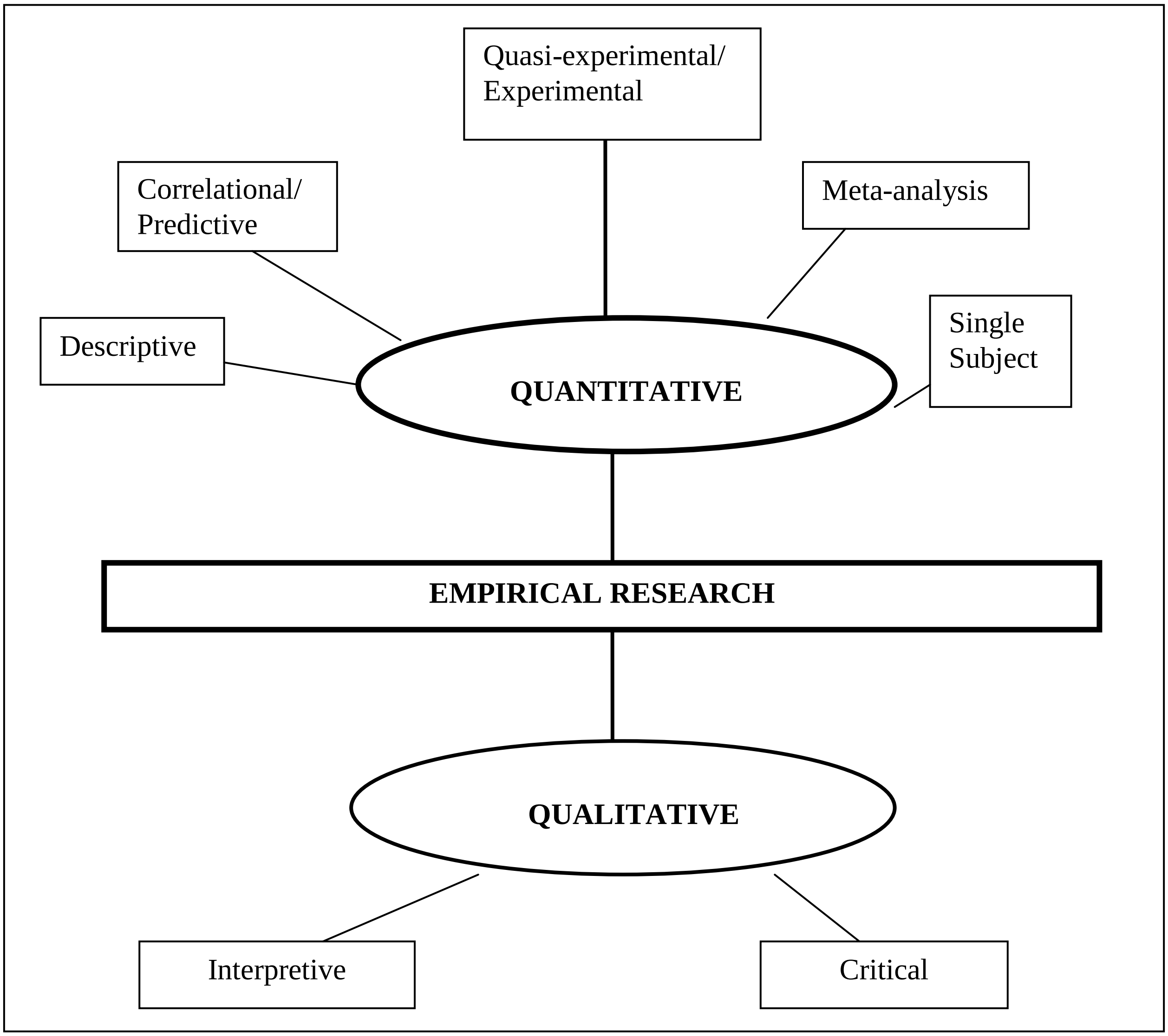
(1) Important aspects of the study are based on existing research and literature data on the automotive industry and supply chain management approaches.

(2) Primary sources have to be explored to determine the supply chain problems facing South African ACMs.

Quantitative projects are usually associated with positivism and qualitative projects with hermeneutics. Locke et al (1998:121-123) observe that research can be conducted in many different ways, and each researcher makes wider use of some methods more than others. However, most of the basic problems in conducting sound research remain the same universally. During the last two decades, the complexity of research methods has increased dramatically. Years ago, only a few forms of enquiry were available and acceptable. Today there are many options. This increase in options makes it possible to better match research tools to the demands of each particular question.

Figure 5.2 classifies the type of research into two broad categories and some of their subcategories.

Figure 5.2: Organisation of empirical research



Source: Locke et al (1998:123)

This research study leans towards the methodological approaches, because it is more closely linked to the interpretative and critical approach than to the positivist approach. The data collected are more qualitative, and the researcher envisaged that this would create opportunities for improved supply chain performance by automotive component manufacturers.

5.7 QUANTITATIVE VERSUS QUALITATIVE RESEARCH

According to Van Biljon (1998:37), it is best to picture the distinction between quantitative and qualitative research as a continuum. All research methods fall somewhere between the extremes of pure quantitative and pure qualitative research. However, it is possible to indicate whether a research study is more quantitative or qualitative. This will impact on the decision about what process to follow and what measuring instruments to select.

A basic review of the main differences between qualitative and quantitative research is provided in table 5.2. This table shows how quantitative and qualitative researches differ in terms of reality, theory, hypotheses, concepts, measures, data and procedures. It will be confirmed that this study is more qualitative than quantitative.

Table 5.2: Differences between quantitative and qualitative research

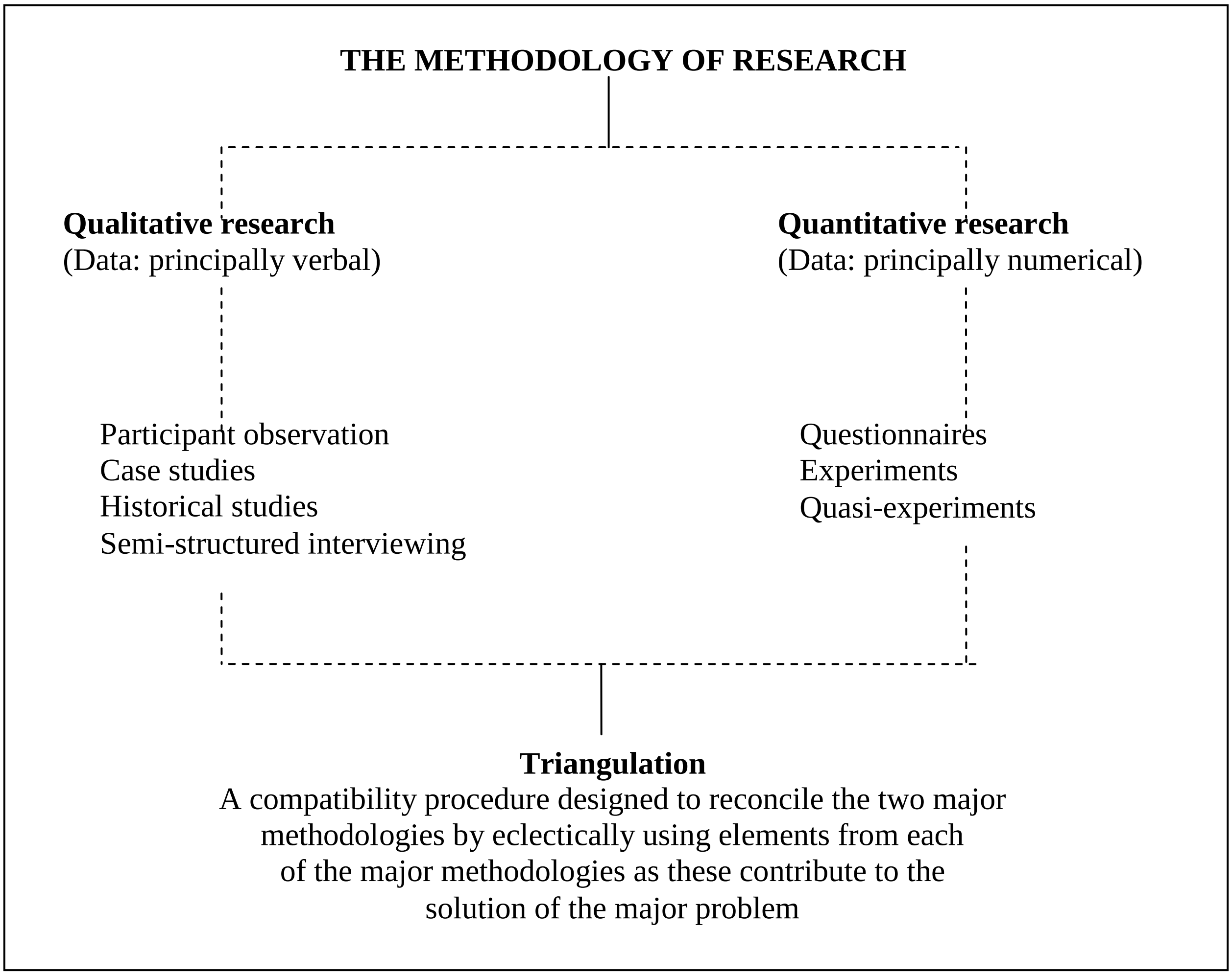
Quantitative research	Qualitative research
Reality is objective and singular and separate from the researcher.	Reality is subjective and varied, as viewed by participants in a study.
The researcher is independent of what is being researched.	The researcher interrelates with what is being researched.
Research is assumed to be value free and unbiased.	Research is value laden and biased, with values generally made explicit.
Theory is largely causal and deductive.	Theory may be causal or noncausal, and is often inductive.
The researcher begins with hypotheses that are tested.	Meaning is captured and discovered once the researcher becomes engrossed in the data.
Concepts are in the form of distinct variables.	Concepts are in the form of themes, patterns, generalisations and taxonomies.
Measures are systematically created before data collection and are standardised.	Measures are created in an ad hoc manner and are often specific to the individual setting or researcher.

Data are in the form of numbers from exact measurement.	Data are in the form of words from documents, observations and transcripts taken.
Many cases or subjects are generally involved	There are usually few cases or subjects.
Procedures, standards and duplication are assumed.	Research procedures are particular, and duplication is rare.
Analysis proceeds by using statistics, tables or charts, and discussing how what they show relates to hypotheses.	Analysis proceeds by extracting themes or generalisations from evidence and organising data to present a coherent consistent picture.

Source: Adapted from Cresswell (1994:5); Neuman, in Cavana et al (2000:35)

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. This approach is known as triangulation. Jankowicz (2005:32) defines triangulation as "the use of one method or technique to cross-check the results of another". Triangulation is useful in all cases, and essential in qualitative work. Figure 5.3 illustrates the interactions between methods.

Figure 5.3: Interaction between quantitative and qualitative research



Source: Van Biljon (1998:39)

After examining table 5.2 and considering the nature of the problem statement and objectives of this study, it would appear that it is more closely associated with qualitative research than quantitative research. To prove this statement, each of the two research types is discussed in the next sections, together with their applicability to this research study.

5.7.1 Qualitative research

Cooper and Schindler (2006:716) define qualitative research as "non-quantitative data collection used to increase understanding of a topic". Unlike quantitative data (Davis 2005:307), qualitative research should be viewed as a complement to quantitative research in that some qualitative approaches can be quantified and statistically analysed.

As indicated by Jankowicz (2005:223), in the qualitative approach, every question the researcher wishes to investigate needs to be expressed as clearly as possible; the researcher is required to familiarise himself or herself thoroughly with the situation; themes need to be identified together with potential explanations; these explanations be used to search for additional evidence; and lastly, alternative explanations need to be considered.

In this research study, data for the first phase of the empirical research consisted of semi-structured interviews with management at both executive and senior levels at Ford and Toyota in order to clarify information and identify possible supply chain problems facing ACMs in South Africa. Supply chain problems are a contemporary phenomenon in the automotive industry. The activities and functions associated with supply chain management were described in their real-life settings. Numerous variables were studied and the desired information could only be obtained from multiple sources in the chosen automotive industry.

Once these potential problems had been identified in the qualitative research, a questionnaire was designed which included all the problems identified in the literature review and the semi-structured interviews. This questionnaire was then sent out to all ACMs who were members of NAACAM, in order to cross-check the results. This represents triangulation as indicated in figure 5.3.

5.7.2 Quantitative research

Cooper and Schindler (2006:198 & 716) define quantitative research as the accurate sum of some behaviour, knowledge, opinion or attitude. This type of research endeavours to measure something accurately. For example, in business research, quantitative methodologies generally measure consumer behaviour, knowledge, opinions or attitudes. The aim of these types of methodologies is to answer questions dealing with how much, how often, how many, when and who. According to Davis (2005:306), purely quantitative research is used to measure specific characteristics through structured data collection procedures, often with samples of more than 100 in order to project the results to the entire population.

For this research study in the South African motor industry, the data collected through empirical research included descriptions, explanations, concepts, strategies, applications and processes in order to determine supply chain problems facing South African ACMs. A quantitative survey was undertaken to determine the extent of the supply chain problems experienced by ACMs. Hence, in addition to a qualitative research strategy a quantitative research strategy in this research study was deemed to be appropriate.

The next section provides a detailed description of each phase of the empirical research.

5.8 FIRST PHASE OF THE EMPIRICAL RESEARCH

The first phase of this study comprised various steps, namely preparing for data collection, collecting the actual data, analysing the collected data and writing up the results.

5.8.1 Preparing for data collection

According to Yin (2003:58), conducting interviews is far more demanding than quantitative research on one's intellect, ego and emotions. The author identifies the following five skills required by a researcher to conduct interviews:

- The researcher should have the ability to ask the right questions and to interpret the answers to these questions.
- The researcher should be a good listener and not be restricted by his or her own biases and ideas.
- The researcher should be able to change and be flexible, so that when new circumstances are encountered, he or she will view these as opportunities and not threats.
- The researcher should have a sound understanding of the study and the issues involved.

- The researcher should be not prejudiced or biased by predetermined views, including those obtained from theory.

Initial telephonic contact was made with management at executive level in order to elicit assistance to conduct the study and set up a time to interview potential respondents at Ford and Toyota. Both assembly plants granted permission, and after submitting a copy of the interview guide, assigned people to assist with the interviews. The interview schedule (table 5.3) shows the following respondents who assisted with the study:

Table 5.3: Interview schedule

	RESPONDENTS	**POSITION**	**DATE**	**TIME**
TOYOTA	Dr J van Zyl	CEO and President	5 August 2008	11:30
TOYOTA	Mr N Ward	Vice President: Purchasing and Engineering	5 August 2008	11:30
TOYOTA	Mr H Pretorius	Senior Vice President: Manufacturing Support Group	5 August 2008	11:30
FORD	Mr R van der Bergh	Supply Chain Manager	30 June 2008	13:00
FORD	Mr D Brent	Materials Handling, Warehouse, Synchronous Materials Flow and Launch Manager	30 June 2008	16:00

The main reason for using Ford and Toyota were because (1) Ford pioneered mass production; and (2) Toyota promoted lean production.

5.8.2 Data collection

An interview guide containing details of the topics to be addressed with interviewees was designed (see appendix A**)**. The guide was used as a checklist to ensure that all the relevant subjects would be addressed during the interviews. The main aim of the interviews was to extract qualitative data from the interviewees in order to determine the supply chain management problems ACMs face in the industry.

5.8.3 Analysing data

Saunders et al (2003:380) outline a number of distinct strategies to analyse qualitative data, each of which share several features. One specific facet, which is common to the five precise methods, involves disaggregating the main bulk of qualitative data collected into meaningful and related parts or categories (Yin 2003:109-140).

5.8.3.1 Categorisation

According to Saunders (2003:381), the first activity when analysing qualitative data involves organising the data in meaningful categories which can be obtained from the data. The categories initially developed are likely to be essentially descriptive.

5.8.3.2 Unitising Data

The next activity in the analytical process, as noted in Saunders et al (2003:381), is to attach relevant units of data to the appropriate categories that have been devised. According to these authors, a unit of data could mean “a number of words, a sentence, number of sentences, a complete paragraph or some other chunk of textual data that fits the category”.

In this research study, the interviews were recorded during the interview phase and later transcribed. Once transcribed, the data were read through carefully and classified into meaningful categories. Respondents were also contacted to clarify certain information that was not clear to the researcher, to ensure that the findings were accurate and indicated what the respondents really meant. It was also found that certain problems identified by the respondents compelled the researcher to conduct further research in order to gain a clearer understanding of the facts. At times this meant that further informal discussions with stakeholders had to be conducted in the automotive industry. Further research and informal discussions ensured that the data were both valid and reliable.

5.8.3.3 Writing up the findings

Chapter 6 includes the description (and results) of the empirical results of the interviews at both Ford and Toyota assembly plants. The chapter includes the rationale for using Ford and Toyota and then deals with the findings. The chapter concludes with a summary of the identified challenges.

The literature review as well as semi-structured interviews at both these assembly plants provided inputs for identifying supply chain problems for ACMs as seen from their customer's point of view. Once these had been identified, a mail survey was conducted among ACMs (members of NAACAM, some of whom were suppliers to Ford and Toyota) to determine (1) whether respondents agreed that these were problems; and (2) to what extent they perceived these to be problems.

The next section deals with the second phase of the empirical research study.

5.9 SECOND PHASE OF THE EMPIRICAL RESEARCH STUDY

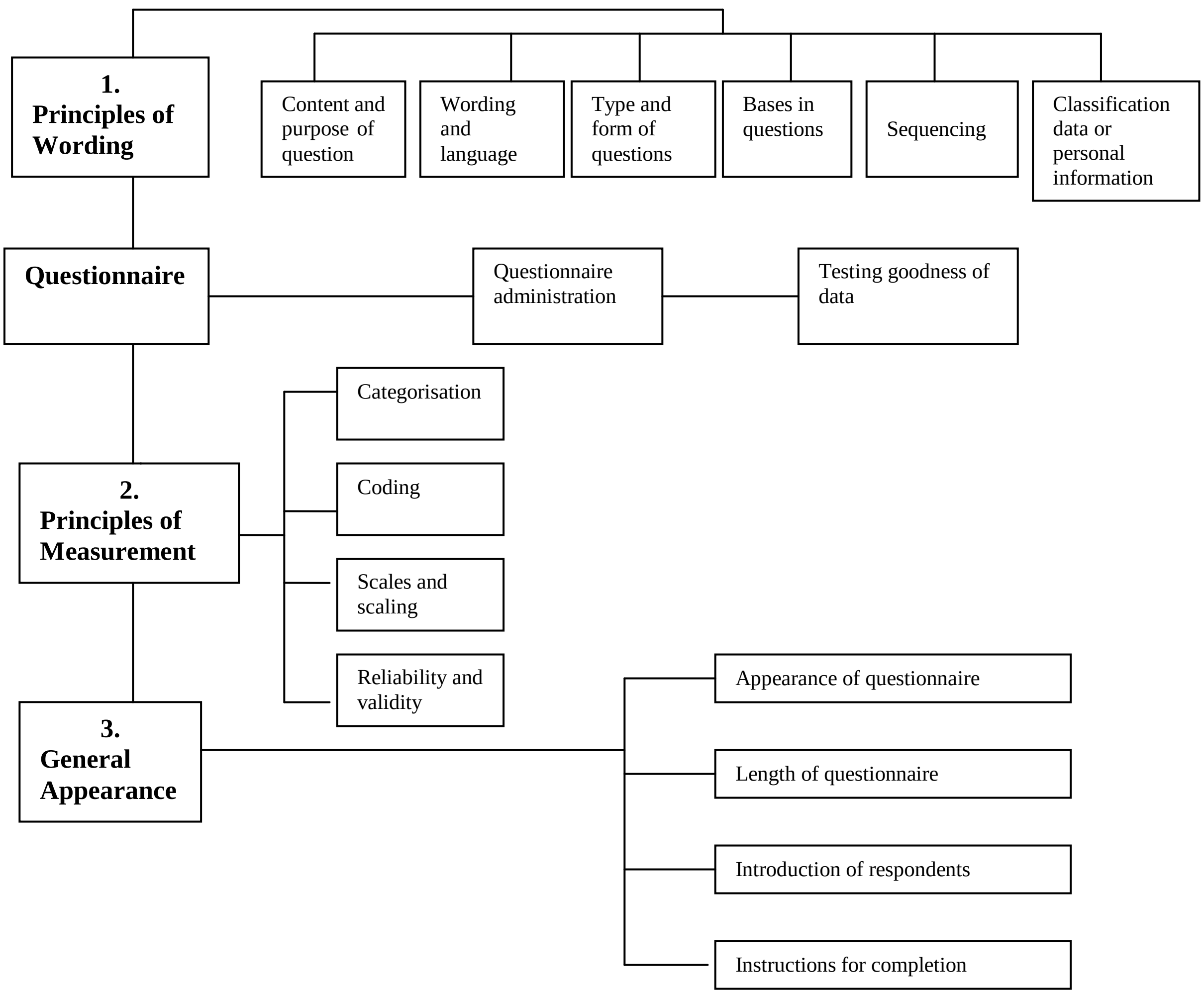
As noted earlier in section 5.7.2, this study consists of two stages: (1) semi-structured interviews with respondents at Ford and Toyota; and (2) a mail survey to test the identified problems facing automotive component manufacturers. This included both quantitative and qualitative questions in order to refine, pinpoint and explain the reasons for and consequences of these problems**.** This section deals with the collection of primary data by means of questionnaires.

5.9.1 Designing the questionnaire

According to Cavana et al (2000:227) when designing questionnaires, the focus should be on the following three factors: (1) the way the questions are worded; (2) planning the questionnaire in such a way to enable the variables to be categorised, scaled and coded after receipt of the responses; and (3) the general layout and appearance of the questionnaire. These factors are illustrated in figure 5.4 below.

As highlighted in May (2006:126), it takes time, effort and money to conduct research. In the light of this, when designing the questionnaire, the researcher needs to address the issue of obtaining as much of the information required and to keep the questionnaire simple and clear. Next, the researcher needs to elicit the willingness of the respondents to complete the questionnaires honestly and return them to the researcher. Hence, the construction of questionnaires requires skills and an understanding of the key issues and objectives of the research study (May 2006:127).

Figure 5.4: Principles of questionnaire design



Source: Cavana et al (2000:228)

In this research study, the questionnaire (appendix B) consisted of section A and B, indicated below.

- Section A consisted of the company profile such as the company name, name and position of the person (to ensure validity and reliability regarding who completed the questionnaire – the respondents' names, however, would remain confidential); who had completed the questionnaire; the number of employees working for the company; the total amount of annual sales; the proportion of sales to OEMs, OESs and aftermarket; and, lastly, the quality accreditations the company had in place. The data obtained in this section were used to categorise companies for analysis purposes.

- Section B consisted of a number of questions determined from the literature review. The questions related to the part of the research problem: “What are the supply chain problems that ACMs in South Africa face?”

  This was achieved by including the various possible supply chain management problems identified in both the literature review and the semi-structured interviews at Ford (Pretoria) and Toyota (Durban), in the questionnaire. In addition, the extent of these difficulties was determined by asking respondents to rank the importance of the problems on a scale from 1 to 7.

  To determine why companies are experiencing problems, the following statement was included before each section:

  > Please provide more information in the comments block when you want to clarify something or feel particularly strong about one of the issues.

A copy of the questionnaire is attached as appendix B to this thesis. A detailed discussion of the results of the study is included in chapter 7, which deals with the analysis of the findings, draws the conclusions and makes recommendations.

5.9.1.1 Pilot study

Saunders et al (2003:308) acknowledge that before using one’s questionnaire to gather data, it should be pilot tested. The rationale behind this is to (1) fine-tune the questionnaire so that respondents will know what is being asked and have no problem answering the questions; (2) eliminate the majority of difficulties in recording the data; and (3) enable the researcher to have the validity and reliability of the data to be collected, evaluated. Initial analysis of the data collected from the pilot test data can be undertaken to ensure that data will address the research question (Jankowicz 2005:250; Cooper & Schindler 2006:76; Welman, Kruger & Mitchell, 2007:148).

As noted earlier in section 5.9.1, a questionnaire was compiled containing all the relevant issues identified in the semi-structured interviews at Ford and Toyota to determine and rank the supply chain problems faced by ACMs in South Africa.

An initial questionnaire was used to conduct a pilot study on five respondents (table 5.4) to test the questionnaire and its reliability. Also, the questionnaire needed to appear professional and branching instructions needed to be user friendly and unambiguous. Once the questionnaire had been returned and tested, it was refined before being sent out to the selected sample of ACMs.

Table 5.4: List of respondents included in the pilot testing of the questionnaire

RESPONDENT	POSITION	COMPANY
Mr A Turner	Managing Director	Ramsay Engineering (Pty)Ltd
Mr H van der Merwe	Director	Auto Tube Manufacturing
Dr A Piro	Managing Director	Faurecia Interior Systems South Africa (Pty)Ltd
Mr S Soni	Lecturer	University of KwaZulu-Natal

The respondents suggested various changes, which were made in the questionnaire. These changes were as follows:

Section 1 and Section 2:

The words "company", "business unit", "firm" and "organisation" were used. The researcher decided to use the generic term "company".

Section 2.1.1: Supplier relationship problems

- **Trust between you and your suppliers**

It was noted that suppliers were rated as 10 worst and 10 best. There was no general relationship and the respondents indicated that they would respond with their worst supplier in mind. Since this would give a skew answer, the question was formulated as two questions indicating "best 10% of" suppliers and "worst 10% of" suppliers.

- **Financial stability**

It was noted that because of the recent financial crisis, companies that might have been deemed stable in 2007, could at the time of the research have been experiencing insufficient cash flows. The question was therefore formulated as two questions, incorporating the financial stability of suppliers (prior to the recent economic crisis and after the recent economic crisis). The words "after the recent economic crisis" were used to emphasise the distinction before the onset of the global economic crisis and after the onset of the global economic crisis. In no way were the words meant to imply that the crisis was over at the time of testing the questionnaire.

- **Suppliers are not environmentally oriented**

It was indicated that this question was not sufficiently defined. The question was reworded to read: "Suppliers do not have ISO14001 accreditation."

- **BBBEE: Achieving and verifying BEE scorecards**

It was noted that every OEM has different requirements in its supply base. The question was formulated to read as follows: BBBEE: achieving and verifying BEE scorecards (in respect of OEMs' target requirements).

Following discussions with and recommendations made by the respondents, the following problems were included:

- "Material lead times – too long, resulting in risk of obsolescence." One of the respondents noted that raw material lead time is long (8 weeks). As a result, flexibility suffers and there is a risk of obsolescence.

Section 2.1.2: Incoming transportation

It was suggested that an extra column be added which the respondent could tick if the question was not applicable. For example, a mode is not used at all. This column was added.

- **Delays in off-loading vessels**

It was indicated that most delays are caused by weather conditions. The respondent who made the comment was located in Port Elizabeth, “the windy city”. The question was therefore subdivided into two questions, that is delays in off-loading vessels either because of weather conditions or congestion at the Port.

Section 2.2.1: Operations process problems

- **Output based on rigid marketing forecasting**

It was indicated that forecasts for JIT suppliers are not created internally; they are received from the OEM customer. The question therefore was reworded and now consisted of two questions, that is: (1) output based on rigid marketing forecasting; and (2) output based on customer forecasts to plan (suppliers to OEMs)

- **Sub-processes difficult to alter**

This question was not understood and when explained, it was noted to be irrelevant to the study. The question was therefore deleted.

- **Coordination of sub-processes**

This question was not understood and when explained, it was noted to be irrelevant to the study. The question was therefore deleted.

- **No cooperation between functions in the company**

It was noted that the respondent’s company would not function if there were no cooperation between functions in the company. It was thus suggested that the word “no” be eliminated. This was done.

- **Labour problems: industrial action**

It was suggested that these problems should be broken down per region. The question was reworded to read: "labour problems – industrial action (in the region in which your company is situated)".

- **Capacity limitations**

It was indicated that capacity problems could have a multitude of causes. This question was subdivided into four parts to include capacity limitations: (1) due to availability of skilled labour; (2) due to customer order fluctuations; (3) due to outdated machinery; and (4) due to capital funding.

As per discussions with and suggestions by the respondents, the following problems were included: labour problems – time consuming.

Section 2.2.2: Internal movement/transportation

- **Design of materials flow system**

It was noted that a respondent could think that his or her company had optimum material flow, but based on best international practice, it could be the worse. The question was thus reworded as follows: Design of materials flow system (based on international best practice).

Section 2.3.1: Distribution-side problems

- **Relationship with customers**
- **Trust between you and your customers**

It was noted that as with suppliers, customers are rated as 10 worst and 10 best. Hence, there is no general relationship, and the respondents indicated that they would respond with their worst customer in mind. Since this would give a skew answer, the questions were formulated as four questions indicating "best 10% of" customers and "worst 10% of" customers.

- **Unfair changes in orders**
- **Unfair pressure on price reductions**

The respondents indicated that it was not clear what exactly the researcher deemed to be unfair. It was suggested that the term be better defined. Also it was mentioned that in terms of changes in orders, this had not been problematic until the recent economic crisis. ACMs now carry excess inventory which is slow moving. The questions were therefore revised as follows: (1) order fluctuations (prior to the recent economic crisis); (2) cancellation of orders (after the recent economic crisis); (3) excessive slow-moving inventory due to cancellation of orders; and (4) pressure by OEMs to reduce prices. The words “after the recent economic crisis” were used to emphasise the distinction before the onset of the global economic crisis and after the onset of the global economic crisis. In no way were the words meant to imply that the crisis was over at the time of testing the questionnaire.

- **Quality requirements are too high**

This question was reworded to read: “difficulty in meeting quality requirements”.

- **Rapid changes in demand patterns**

This question was reworded to include the words: “in terms of quantity”.

Section 2.3: Outbound transportation

It was suggested that an extra column be added to enable the respondent to make a tick if the question was not applicable. This column was added.

Once all the changes had been made, the questionnaire was proofread and sent out to ACMs for completion.

5.9.1.2 Preparing for data collection

a. Research population and sample

The population of this study was the automotive components industry in South Africa. As indicated earlier in chapter 1, there are currently 300 ACMs who supply the automotive industry (sec 1.4).

According to the guidelines provided by Leedy and Ormrod (2005:2007), if the population is between 250 and 500, the authors recommend that a random sample of 70% of the population should be included in the survey. NACAAM indicated that approximately 60% of South African component manufacturers are members of their association. In support of this, Barnes (2001:56) claims that the largest and most important ACMs in South Africa are members of NAACAM**.**

Therefore, since 60% (181) of these ACMs are members of NACAAM, and in line with the guidelines and recommendations provided by Leedy and Ormrod (2005:2007), a complete census rather than a sample was used and all members of NACAAM (component manufacturers) were included in the study. A list of automotive component manufacturers who are members of NAACAM was obtained from this association. Because only NACAAM members were included in this study and not all ACMs in South Africa, no generalisations about the South African automotive and component industry as a whole were made. The response rate for this study was 30.6%

Table 5.5 provides a summary of all component manufacturers that are members of NACAAM, as provided by the association. As indicated, NACAAM has classified component manufacturers into groups A, B, C, D and E

Table 5.5 Breakdown of NAACAM members

Code	Classification	Number of firms	% of total number of firms
A	Manufacturers and suppliers of OE components to vehicle assembly plants only	34	18.8%
B	Manufacturers and suppliers of OE as well as P&A and aftermarket/replacement components	122	67.4%
C	Manufacturers of accessories and replacement parts	6	3.3%
D	Manufacturers of allied products supplied to vehicle assembly plants and other sectors of industry, (eg steel, paint, glass, abrasives, fasteners, upholstery, tooling, pallets, packaging, identification/marking)	16	8.9%
E	Suppliers of related/support products to the motor industry	3	1.6%
	TOTAL	181	100%

5.9.1.3 Data collection

According to Davis (2005:291), no one data collection method is best for all situations. It is up to researchers to appraise the data needs of each problem, together with the time and cost limitations of the study to achieve the best results. Saunders et al (2003:310) identify the following five methods for administering questionnaires: "(1) on-line questionnaires; (2) postal questionnaires; (3) delivery and collection of questionnaires; (4) telephone questionnaires; and (5) structured interviews".

One of the options chosen for this research study was the "mail survey" option, because of the overall cost compared to with that of personal and telephone interviews. Once the questionnaire had been pilot tested and refined, respondents were prenotified of the study. The researcher contacted each potential respondent telephonically in order to enhance the response rate (this is dealt with in sect 5.9.1.4). The questionnaire together with a letter was either faxed or emailed to the ACMs who were the potential respondents in the survey. The letter informed the potential respondents of the research study and requested their assistance in completing the survey by a predetermined date and returning the completed questionnaire via facsimile or email.

After the date of return of these questionnaires had lapsed, respondents, who had not completed the original survey, were contacted telephonically and additional questionnaires were faxed or emailed to these respondents in an effort to improve the response rate.

a. Aim of selected data collection methods

The aim of the semi-structured interviews at Ford and Toyota and the mail survey to ACMs was to augment the empirical research the outcome of which was

- to gain an understanding of the operations involved in the distribution of automotive components
- identify and rank supply chain management problems facing automotive component manufacturers (eg poor railway services, fluctuating fuel costs, poor condition of roads and inefficient ports) and the possible causes of this
- compare the supply chain problems faced in the provinces and determine possible geographic-related difficulties
- determine relationships (correlations) between problems experienced through the chain (e.g. between supply-side problems, operations and distribution)
- suggest remedies on how ACMs could overcome these difficulties.

It was envisaged that the input of the respondents in the different businesses that formed part of the research and the semi-structured interview would provide valuable input in achieving the objectives of the study.

5.9.1.4 Response rates

As indicated in May (2006:135), the choice of a data collection method is vital to ensure a positive response rate. According to Saunders et al (2003:158), estimating the likely response rate from the sample to which the questionnaire is sent is difficult, and one way of doing this is to look at response rates received in similar questionnaires that have already been undertaken. Response rates vary considerably when collecting primary data. For example, Saunders et al

(2003:159) indicate that during one of the mail questionnaires they undertook, the response rate was 52%. However, the authors indicate that the type of questionnaire will affect the number of people who respond and that a response rate of 30% for questionnaires that are emailed would be reasonable. Babbie and Mouton (2001:261) maintain that a response rate of 50% can be regarded as being adequate for analysis and reporting.

According to Hair, Wolfingbarger, Ortinau and Bush (2008:116), researchers have developed various ways to increase response rates such as prenotification, offering an incentive, delivering the questionnaires personally and using social influence. As noted in section 5.9.1.2, 181 questionnaires were sent out, with each respondent being prenotified of the study telephonically. A second telephone call and email follow-up were made to increase the response rate. The response rate of this study was 30,6% and is dealt with in chapter 7, section 7.2.

5.9.1.5 Analysing Questionnaires

There are four basic scales, namely nominal, ordinal, interval and ratio. Nominal scales can only be analysed using frequency distribution. It is the simplest type of scale (Hair et al 2008:154). May (2006:131) indicates that the purpose of this type of scale is usually used to profile respondents, say, to classify the size of firms. According to Welman et al 2007:139-140), ordinal scales represent numbers or letters to rank items. Interval scales have all the characteristics of both nominal and ordinal scales, but differ in that they provide addition information. Ratio scales are noted to be the most powerful because only in ratio measurement is there a fixed and absolute zero point. For possible statistical analysis and tests relating to the various scales, see to table 5.6.

Table 5.6: Types of measurement scale

Scale	Basic Empirical Operations	Typical Use	Typical Statistics* Descriptive	Inferential
Nominal	Determination of equality	Classification: Male-Female Purchaser-non-purchaser Social Class	Percentages Mode	Chi-square Binomial test
Ordinal	Determination of greater or less	Rankings: Preference data Market position Attitude measures Many psychological measures	Median	Mann-Witney U Friedman two-way ANOVA Rank-order Correlation
Interval	Determination of equality of intervals	Index numbers Attitude measures Level of knowledge of brands	Mean Range Standard deviation	Product-moment Correlation T-test Factor analysis ANOVA
Ratio	Determination of equality of ratios	Sales Units produced Number of customers Costs		Coefficient of variation

Source: Tull & Hawkins,cited in May (2004:132)

In terms of the research study, a combination of scales was used in order seek the required information needed for analysis purposes. For example, section 1 in the questionnaire (appendix B) makes use of nominal and ratio scales to profile the companies included in this study. Section 2 of the questionnaire utilises a seven-point Likert scale (ordinal scale) varying from 1 to 7 from a lesser to a greater extent and the hypotheses set make use of the interval scales.

This concludes the empirical research section. Through these two phases of the empirical research, the first of the primary objectives (also outcomes) of this study were achieved and are dealt with in chapter 7.

To recap, the primary objectives (outcomes) of this study were:

(1) to identify the supply chain problems South African ACMs face
(2) to identify and suggest remedies to overcome these problems

The second primary objective of this study is dealt with in chapter 8, the conclusions and recommendations.

5.10 RESEARCH PURPOSE

The research purpose provides an indication of what the researcher aims to achieve with his or her research. The researcher needs to determine whether the purpose of the project is to describe, explain (or predict) or explore (Saunders et al 2003:96-97; Cavana et al 2000:107:109; Cooper & Schindler 2006:143:151). Each of these research aims will be explained in the subsections below.

5.10.1 The research aims of this project

The supply chain problems facing ACMs in South Africa were investigated and remedies were suggested on how to overcome these problems. Potential problems were identified from both the literature review and semi-structured interviews at Ford and Toyota. A questionnaire dealing with these problems was then designed and sent out to ACMs in South Africa who were members of NACAAM to ascertain whether these were problems and the extent thereof.

Chapter 1 dealt with the background on and introduction to the study. Chapter 2 provided an overview of the global and local automotive industry in order to obtain a perspective of the automotive industry both in South Africa and internationally because this is the industry and environment in which ACMs operate. A detailed and critical analysis of the theory of supply chain management and the principles and tools was dealt with in chapters 3 and 4. This led to the identification of important best practices in SCM (which will serve as guidelines to investigate the ACMs supply chain).

The intention of this research study was, therefore, to ***describe*** the various supply chain problems facing ACMs in South Africa and ***explain*** the reasons for the problems. Since no quantitative variables were set for this research study, any explanation in this context does not refer to the establishment of causal relationships between variables.

The research study involved semi-structured interviews with Ford and Toyota. In this research project, explanations were sought about why these supply chain problems exist. Once possible supply chain problems had been identified in the literature review and the findings from Ford and Toyota, they were tested by ACMs to determine whether these really are problems and the respondents were afforded an opportunity to comment (if they wished to) on why they were experiencing certain problems. Once the findings emerged, remedies were suggested on how these problems could be overcome.

5.11 RESEARCH STRATEGIES

Saunders et al (2003:90) suggest that the research strategy is the proposal outlining how the researcher will arrive at the answers to the research question that has been formulated. The authors stress the importance of clearly defining the research question. A research strategy should also include clear objectives which have been developed from the research question, the sources from which the intended data are to be collected should be specified and any constraints mentioned such as access to data, time, location, money and ethical issues.

In this research study, the research question was clearly defined and contained clear objectives that were developed from the question. The sources the researcher used to collect the data were outlined in this chapter together with the potential constraints. This research strategy of the study clearly reflects why a particular strategy was adopted.

5.12 CONCLUSION

A formal, systematic approach to research design is vital to ensure that a research study corresponds to the principles of validity and reliability. This is essential where qualitative data are collected by the researcher. The aim of the research design decisions made should guide the researcher in effectively addressing the research problem.

A combination of a qualitative approach through semi-structured interviews and a quantitative approach using the survey method were deemed the most appropriate research strategies for this research study. Interviews, observations and questionnaires were the main methods of data collection. The aim of the research was to explain and describe the phenomena at hand and to put the findings in perspective. As indicated earlier in section 5.8.1.2 (3rd par), because the sample consisted of NAACAM members only, no generalisations about the South African automotive and component industry were possible.

The main research design decisions relating to this research study are summarised in table 5.7. This concludes the research methodology chapter. Subsequent chapters deal with the empirical research in which the research problem and objectives of this research study are conceptualised and operationalised. The next chapter, chapter 6, deals with problems experienced by ACMs from their customers' point of view (outcome of the semi-structured interviews at both Ford and Toyota).

Table 5.7: Summary of main research design decisions

Research problem

What are the supply chain management difficulties that ACMs in South Africa face and how can these be overcome?

Unit of analysis

- Ford Motor Company Pretoria
- Toyota South Africa
- ACMs who are members of NACAAM, comprising 60% of the population (ACMs)

Research methodology

- Research approach: both qualitative and quantitative
- Process logic: inductive and deductive
- Qualitative research method: in-depth semi-structured interviews
- Quantitative research method: survey
- Sources of data: multiple sources within assemblers, ACMs; supplemented by historical data such as benchmarking data, industry and government reports and statistics, research reports, newspaper and magazine/journal articles
- Primary data collection instruments: observation and interviewing followed by surveys (triangulation).
- Data analysis: categorisation, unitising data and statistical techniques

Research goal

Explanatory and descriptive

Research strategy

Contextualise in the unit of analysis only

Source: Researcher's own design derived from Van Biljon (1998:59)

CHAPTER 1

Introduction

CHAPTER 2

The Global and South African automotive industry

CHAPTER 3

Supply chains, supply chain management and related concepts

CHAPTER 4

Supply chain management practices and tools

CHAPTER 5

Research design and methodology

CHAPTER 6

Problems experienced by ACMs from their customer's perspective

CHAPTER 7

Supply chain problems facing ACMs in South Africa: empirical research

CHAPTER 8

Summary, recommendations, caveats and suggestions for further research

OUTCOME

To identify problems or difficulties in the supply chain and suggest remedies to ACMs and the motor industry as a whole

CHAPTER 6

PROBLEMS EXPERIENCED BY ACMS FROM THEIR CUSTOMER'S PERSPECTIVE

6.1 INTRODUCTION

For any contemporary business to compete successfully in a business environment it has to be involved in the way its suppliers and customers do business. Owing to intensified global competition, businesses need to be more aware of where their suppliers' material comes from, how their suppliers design and assemble their products and services, and finally how they store and distribute their finished products (Wisner et al 2005:4).

Palmer and Hartley (2002:xvii) acknowledge that no business exists in a vacuum – it operates in an environment which is becoming increasingly complex and competitive. This is confirmed in Ferrell et al (2006:200), who observe that every business must acquire resources namely people, raw materials, equipment, money and information and resources in order to turn out a final product or service. Domestic and global competition has made firms all over the world realise that their survival depends on producing more top-quality sophisticated products. Hence businesses are under constant pressure to optimise their resources (Evans & Lindsay 2008:11; Van Biljon 1998:61). As a result, businesses are finding that they need to develop international management expertise.

According to Kanter (1997:27) and David (2005:8), the organisational sources of competitive advantage include core competence, time compression, continuous improvement and closer relationships with key partners. They state that it is not enough to simply obtain a competitive advantage, but to strive to achieve a *sustained competitive advantage.* Thus, companies that are focused, fast moving, flexible and dependable are more likely to sustain their ability to endure market shifts and even establish new markets.

These and other changes in the environment are forcing businesses to re-examine their objectives and strategies. The automotive industry in South Africa is no exception, with the industry having developed considerably during the past 55 years and having evolved from an importing industry into a self-sufficient industry of vehicle distribution, servicing and maintenance (Mbiko 2008: 1).

Compared to automotive industries in other countries, the industry in South Africa faces some unique challenges. For example, at the time of conducting this research study, the challenges were not only “load shedding” (blackouts) by Eskom (South Africa’s electricity provider), compounded by massive tariff increases by this provider, but also the threat of strikes from organised labour because of the escalating cost of food and basic services and a shortage of skills. These issues will ultimately impact negatively on costs (Klein 2008: 15).

This chapter deals with the findings of interviews conducted at Ford and Toyota in South Africa. In line with the research question of this research study,

What are the supply chain management problems that ACMs in South Africa face and how can these be overcome?

the purpose of this chapter was to identify the supply chain problems that ACMs in South Africa face in the automotive industry, particularly from a distribution or customers’ perspective (ACMs who supply OEMs). As noted previously in this study, the supply chain problems would be identified from the literature review and in-depth semi-structured interviews with participants at two OEMs who are major customers of ACMs in South Africa.

This chapter also explains why Ford and Toyota in particular were chosen to participate in this study, includes an analysis of the data, and an outline of the problems identified in the interviews, and concludes with a summary.

6.2 INTERVIEWS WITH FORD MOTOR COMPANY SOUTHERN AFRICA AND TOYOTA MOTOR COMPANY SOUTH AFRICA

As indicated in section 5.8.1, Ford and Toyota were chosen because (1) Ford pioneered mass production; and (2) Toyota promoted lean production. In addition, different supply chain problems were identified, for example: (1) Ford uses the port of Port Elizabeth for exports/imports, whereas Toyota uses the port of Durban; and (2) Ford makes use of rail whereas Toyota makes use of road transport. Also, between both OEMs core products are purchased from approximately 120 local ACM suppliers. These suppliers were included in the second stage of the empirical research, namely the survey study.

It should be pointed out, however, that the intent of this study was not to compare analyses or data gathered at either Ford or Toyota, but to ascertain what the two OEMs perceived to be supply chain problems experienced by them (as customers) through the ACMs. In this instance, opinion-related questions, from a supply chain perspective, were asked of the participants (the two OEMs), relative to the ACMs who supply them with parts. This chapter contains the responses of both OEMs.

The purpose of the interviews with the OEMs was to identify the supply chain problems that ACMs in South Africa experience, which influence their supply performance (ACMs who supply OEMs). As explained in chapter 5, section 5.8.2, an interview guide was drawn up and is attached as appendix A. Both participants were presented with the same open-ended questions. Permission was granted to use a recording device during the interviews. The interviews took approximately one hour and each participant suggested that should any more information be needed for this study, the researcher could email further questions to the participant. This was done in order to (1) clarify some points that were made and/or were not quite clear to the researcher; and (2) to ensure that the findings were accurate and reliable in that they indicated exactly what the participants meant.

The interview guide consisted of three sections, namely:

- section 1, a company profile;
- section 2, a general opinion-related section; and
- section 3, which dealt with various issues in supply chain management and their suppliers (ACMs).

The area which the participants were not prepared to answer were the financial questions.

Interviews were conducted with participants at executive and senior management level. The findings are discussed below and each section of the questionnaire is dealt with independently.

6.3 ANALYSIS OF DATA: SECTION 1 COMPANY PROFILE OF BOTH OEMs

Ford Motor Company currently exports 20% of its vehicle production, but it was found that by 2010, the assembly plant would be heavily focused as an export operation with 90% of its vehicle production being exported. In the light of this, the threat to the company of cheap imported motor cars into the local South African markets (from countries such as China and India) should not have a significant impact on the company's operations.

Toyota South Africa has been a market leader in South Africa for the past 27 years. The plant has committed to producing 220 000 units per annum by 2009 – 147 000 of which will be for the export market to Europe and Africa. These exports will account for 60% of South Africa's total vehicle exports (Erasmus 2008:1)

The fact that Ford and Toyota will be increasing the exports of motor vehicles has a direct impact on their suppliers. OEMs' suppliers must be able to compete in the international market – the pressure on ACMs to perform in terms of cost and flexibility will increase.

In addition, both OEMs combined employ a total of 13 554 employees. Both plants have ISO 14001 environmental accreditation and ISO/TS16949:2002. In addition, Ford has Q1 accreditation and Toyota the Toyota Environmental Management System (EMS).

6.4 ANALYSIS OF DATA: SECTION 2 GENERAL

The aim of this section was to find out from the participants (OEMs) what they perceived to be the supply chain problems ACMs face as seen from their customer's point of view. Various supply chain problems were identified. In addition, the challenges posed by the fluctuating oil price, BBBEE and load shedding were noted. Even though the focus of this study is to identify problems of ACMs that influence their ability to perform in terms of supplying OEMs, the last three challenges have an impact on ACMs' ability to supply OEMs.

Because participants at the plants consisted of different levels of management – executive and senior management – different problems were highlighted. The following are the major supply chain problems identified:

6.4.1 Lack of local supplier base

Deficiencies in the local ACM supplier base were identified, and because of this, both OEMs need to import too many of their parts requirements. These deficiencies relate to the ACMs' ***lack of technology***, ***global supply capability*** and ***cost competitiveness***. The challenge is that parts that are imported from Europe, North America and South East Asia, are used to manufacture motor vehicles, and a considerable percentage of these motor cars are exported back, competitively, into Europe. This results in additional costs which could be prevented if more parts could be procured locally.

According to Maile (2008:8) the playing field for the ACMs has changed over the last number of years, because, OEMs are now sourcing components globally. OEMs are able to source components at the lowest possible cost. Hence, South African ACMs need to compete with the best in the world from a cost and quality perspective.

6.4.2 Interconnectivity with regards to MRPs

Ford Motor Company Southern Africa currently has a programme Material Management Operating Guidelines (MMOG), in place which contains the company's supplier performance standards. Ford wants to have all its suppliers (ACMs) meet these standards. One of the criteria in the MMOG assessment is the complete electronic interface between both Ford and its suppliers (ACMs). To date, this is not happening and this "interconnectivity between MRPs" has been identified as one of Ford's greatest challenges.

OEMs and ACMs operate completely different ERP systems, Toyota uses the Global Toyota System and SAP; Ford, uses a system called CCMS3; and ACMs use completely different ERP systems (some do not even have ERP systems but operate Excel files). From a material supply perspective, all releases, advanced shipping notices, data, requirements and packaging through all the various MRPs that OEMs use, are submitted by OEMs through the Collaborative Xchange system. Through this system, all data are converted to a readable format and then transmitted to the respective suppliers (ACMs). (At the time of the interview, Toyota did not use the Collaborative Xchange system).

The following two problems were identified: (1) a number of the suppliers (ACMs) did not understand the releases – various suppliers to Ford operated personal computers; and (2) the suppliers (ACMs) needed to share the release data with their tier 2, 3 and 4 suppliers via a common platform.

A main supply chain management problem ACMs experience is therefore electronic/systems integration with their customers which also resulted in their not communicating essential demand information effectively with their suppliers.

6.4.3 Supplier inflexibility

Supplier inflexibility was identified as the next challenge. It was noted that suppliers that manufacture materials tend to ship according to original order dates (information provided by OEMs to suppliers in advance, based on estimates) or production availability – according to their own production capacity output and timing instead of reacting to the customer's (Ford's) real requirements. While certain suppliers are unable to interpret Ford's order releases, the problem is exacerbated by these suppliers not submitting advance shipping notifications. This is a particular problem for Ford because of the targets it has set to reduce inventories and keep unwanted or mistimed inventory out of the pipeline.

6.4.3.1 Supplier performance

According to Ford, suppliers (ACMs) do not always meet ***delivery commitments***, which could be caused by suppliers (ACMs) not shipping according to order releases (as discussed above), delays in shipping, rail transport, off-loading of vessels and road delays. According to Ford, the suppliers also do not always meet ***quality commitments*** or standards, resulting in the company having to reject the components. This is dealt with in more detail in section 6.5.1.7.

6.4.4 Geographic location of suppliers (ACMs)

Seat subassemblies are delivered to Ford on a JIT basis by a supplier (ACM) who has a manufacturing plant on site at Ford. The seats are delivered directly to the line. The geographic proximity makes the implementation of JIT – in this case (seats) easy.

The geographical spread of suppliers poses a problem for both OEMs in implementing a JIT system, because it would be ideal for both Ford and Toyota to have suppliers located around their automotive plants. This would make it much easier to manage their supply chain. However, the supplier base in South Africa is scattered across the country with the greatest concentration being in Gauteng and Port Elizabeth. According to the participants, the reason for this is that the industry grew organically over a considerable time. The motor assembly plants or OEMs in South Africa are based in Port Elizabeth, East London, Durban and the Pretoria area. Since the supply and the manufacturing volumes in South Africa are small, one cannot expect the local ACMs to set up small plants all over the country, adjacent to the OEMs' plants.

The implication therefore from the ACMs' perspective, in terms of the whole logistics supply chain, is to determine how many days' finished inventory and work-in-process inventory to hold. A larger stock holding impacts negatively on the ACMs' overall costs, which in turn impacts on the ACMs' performance in terms of cost.

6.4.5 Supplier stability

The participants identified the challenge of supplier stability for OEMs. An example was given of a tyre and alloy rims manufacturer who was bought out by a European company. When the European holding company went bankrupt it pulled the South African company under as well. This occurred over a one-week period, and in the short term, impacted on Ford's production of motor cars. Because of this problem Ford was unable to obtain alloy rims for a particular pick-up, resulting in the airfreight importation of the required rims.

A further example of this problem involved a supplier of aerials to Ford. This particular supplier had only two major customers, namely Ford and Toyota. When Toyota found an alternative source of supply for the aerial, it was no longer economically viable for it to deliver to Ford only and it was compelled to close down. Ford had to find an alternative supplier.

This case emphasises the risks attached to a captive supplier, which is problematic from the ACMs' perspective if they are dependent on one or two customers.

6.4.6 Supplier capacity

A further challenge identified by Ford is the tendency by many suppliers to overcommit themselves in terms of what they can deliver. One example cited was a supplier to Ford, Toyota and General Motors SA. The supplier was unable to meet the demand for this product to all its customers. It was only when General Motors SA found an alternative source of supply that the supplier was able to meet the demand, and Ford started to receive its requirements timeously.

Capacity constraints could therefore be a problem for ACMs.

6.4.7 Low-revenue target markets

For many product types, the tyre suppliers (ACMs) achieve better margins and returns when supplying to the aftermarket versus the OEMs, and therefore give priority to supplying this market. The supply of tyres was therefore a constraint for Ford in 2008. To exacerbate this situation, because tyres fall under the antidumping law, Ford cannot readily import tyres. Should the company wish to import certain tyres, it needs to apply for an import permit, justifying the reasons for the importation of these products. Ford does import a limited number of the "space tyres" or tyres for vehicles supplied with a smaller thinner spare. Currently, all four tyre manufacturers in South Africa are suppliers to Ford.

This example shows that out of necessity (in order to improve their revenue) ACMs do not regard OEMs as priority customers and therefore do not comply fully with the supply chain's expectations.

6.4.8 Possible improvements in the supply chain

During the interviews, the participants noted that there is scope and opportunity for significant improvement in all parts of the supply chain. The OEMs identified certain key areas, namely the “pull” philosophy and line balancing.

6.4.8.1 Pull philosophy

Toyota works on a pull system which requires parts to be pulled into and through the production process in line with the requirement of each section or process. The challenge is how to shorten this pull chain. Many of Toyota’s suppliers do not understand the pull system and tend to follow push methodologies through their processes and their section of the supply chain. The push-pull philosophy is explained in section 3.2.2, paragraph 2.

ACMs appear to base their outputs on rigid marketing forecasting and/or base their outputs on customer forecasts to plan.

6.4.8.2 Line balancing

Historically, the production pattern in the South African plants tended to be batch oriented. This production pattern has changed dramatically and has shifted to line balancing. Although the interviews revealed that this poses a challenge because this change requires a mindset change on the part of the suppliers, it was indicated in TISA (2003:41) that one of the reasons that South African ACMs have a competitive advantage over ACMs in other counties is that from a flexibility point of view, local ACMs are able to produce lower volumes at relatively short notice. This is because, in other countries, production is set up for long high production runs. Batch production is best suited to ACMs producing low volumes and high variety. The views appear to be contradictory in this area of the supply chain. Line balancing is explained in section 4.3.5.

6.5 ANALYSIS OF DATA: SECTION 3

This section in the interview guide dealt with the specific supply chain areas which had been identified in the literature review, that is, supplier relationships, BBBEE; supply chain flows, and external factors.

6.5.1 Supplier relationships

6.5.1.1 Number of suppliers

Both OEMs procure core components from various suppliers, both locally and internationally. Both companies have a database of approximately 85 to 120 local suppliers. Both OEMs also procure parts from international suppliers, but do not deal with these suppliers directly.

6.5.1.2 Supplier assessment criteria

Toyota suppliers are assessed using the standard key performance indicators (KPIs). These are cost, quality, delivery and environmental issues. The key driver for the use of a supplier is competitiveness or cost. Toyota notes that while cost competitiveness is non-negotiable, it can work on improving the issues of quality and delivery with a supplier. Even though the participants did not indicate that ACMs do not perform, the challenge for the ACM is that not only does the ACM have to be competitive in terms of cost, but also meet quality standards and deliver in terms of continuous improvement and JIT.

The fourth dimension of environmental issues has become a major issue. Under this KPI, no “substances of concern” are allowed in any of Toyota’s parts and supplies and supplier ISO14001 compliance is therefore vital. The challenge is that in order to be a supplier to Toyota, one has to have the ISO14001 accreditation.

Toyota noted that the sustainability of a supplier was also important. Sustainability means firstly, that the supplier must be a viable business and the business must be able to adapt and survive into the future. It was noted that a decision to purchase components from a local supplier is a challenge because in many cases, South African ACMs' equipment and technology are old. This equipment and technology cannot be replaced easily because of the capital outlay involved. The challenge for the "older" ACM is to replace its equipment in order to keep up to date with technology, which is costly. As a result the "older" small ACMs are disappearing because they cannot survive as suppliers to an OEM. The pressure is considerable.

6.5.1.3 Supplier development

Toyota does not merely purchase parts from suppliers, but in fact develops the suppliers' capabilities. Toyota uses "learning by doing and experiencing". There are two legs to this training, namely the classroom leg, which is conducted by the Toyota Academy for Learning South Africa, and a supplier school. The general manager is in charge of the supplier school and teaches suppliers the Toyota Production System (TPS) in the classroom. According to Liker and Meier (2006:287), the preferred method for teaching TPS is to undertake a project at the supplier's plant. During the classroom education, suppliers are provided with a toolbox and the supplier development teams show these suppliers how the use the toolbox on the shop floor.

This could be a problem for ACMs supplying various OEMs in that they have to adopt the OEM's respective methodology and therefore require adaptable and agile supply chains.

6.5.1.4 Supplier innovation

The participants at Toyota stated that there has been a shift from an independent supply base to a global supply base. Previously when new products were designed and developed, suppliers were given drawings against which they quoted, and after the approval process, the business was awarded. Now at the concept stage, Toyota Motor

Company asks for the design concepts from the suppliers. Hence, unless a local supplier has the technical know how he or she will find it difficult to become involved at the concept stage, which means that an independent South African supplier with no technology, will find it difficult to obtain new business from Toyota.

6.5.1.5 Type of supplier relationships

Supplier relationships with service providers were described as "collaborative/ partnership" relationships. However, where material/part/component suppliers are concerned, Ford tends to "dictate" to these suppliers about what is expected of them. Despite this, Ford does not view its relationships with materials suppliers as "dictatorial/adversarial", because the OEM adopts a long-term view on supplier relationships and views relationships with its ACMs as so-called "partnership" relationships. Owing to previous mishaps with suppliers, Ford's sees itself, by necessity, as the senior, more influential and directive partner in the relationship. The relationships between ACMs and OEMs were tested in the questionnaire and dealt with in chapter 7.

At Toyota, suppliers are referred to as business partners (suppliers and dealers) and Toyota works with them through long-term relationships in an effort to realise mutual growth based on mutual trust (Liker 2004:81). The emphasis is on long-term relationships.

During the interviews, neither participant indicated that they had experienced problems with ACMs' relationships. However, supplier relationships were identified as a challenge in the preceding extensive literature review. This challenge was tested in the questionnaire from the ACMs' perspective.

6.5.1.6 Quality accreditations

One of the critical quality accreditation requirements for Ford is Q1. Currently, not all suppliers have Q1 accreditation but **all** Ford suppliers comply with Ford's Material

Management Operating Guidelines (MMOG). Ford's aim by the end of 2008, was to raise 85% of its suppliers up to a level where they would be Q1 accredited through their MMOG assessments, and through the supplier delivery performance (SDP) ranking tool. Ford does not deal with suppliers that are not MMOG compliant.

The MMOG were introduced towards the end of 2007. MMOG is Ford's internal quality accreditation and the first step towards a supplier achieving the Q1 accreditation. Besides MMOG, a supplier also needs to achieve an 81% delivery performance ranking. The remaining 19% is for conformance to quality. However, if suppliers are on site, ISO14001, TS16949 and ISO9002 are compulsory accreditations. The problem for ACMs that currently do not have Q1 accreditation is that they have to achieve a level at which they are Q1 accredited by the end of 2008.

One of Toyota's requirements was that all suppliers and service providers should be ISO14001 certified by March 2006. At the time of the interview, this target had not been reached, with a few outstanding, but the expectation was that all suppliers would be ISO14001 accredited by the end of 2008. According to the participants, the few non accredited suppliers had focused on production instead of accreditation. They also indicated that problems had arisen because the South African accreditation agencies had lacked experience and capacity.

Even though most OEMs' suppliers are required to be ISO14001 accredited, a challenge for ACMs is that OEMs require different accreditations (Q1 and TS16949) even though they are similar but different in the sense that they have different emphases. Achieving various quality accreditations is a costly and time-consuming exercise for those ACMs that currently do not have the various required accreditations.

6.5.1.7 Nonconformance with quality standards

Ford's quality metric is driven from the supply technical assistance department. The number of stoppages the plant experienced during 2008 as a result of quality concerns was minimal. When quality problems arise the company's reaction time is rapid. If a batch of nonconforming parts is delivered to the plant, the company is able to obtain "conforming" replacement parts delivered fairly quickly. Suppliers are requested to solve the problem and the parts are returned using Ford's own transport. When suppliers deliver defective parts, this affects their Supplier Information Management System (SIMS) ranking and Q1 rating. The interview revealed that not many problems are experienced in this regard.

Toyota deals with any nonconformances on a face-to-face basis with the supplier. This is done at monthly supplier meetings. Even though suppliers referred to such meetings as "name and shame" sessions, the aim of such meetings is for Toyota to create awareness that certain suppliers are not meeting the quality or delivery targets. At such meetings all the suppliers see each other's performance. If a supplier continually defaults, it will first receive a yellow card followed by another if the problem persists. Once this supplier has two yellow cards, and it defaults again, it will receive a red card. This means that it will no longer be a Toyota supplier. Should the same problem recur, it would indicate problems for ACMs.

6.5.2 Supply chain concepts

6.5.2.1 Demand management and forecasting

Local forecasting and planning are conducted by Toyota South Africa on the basis of local demand. This complex forecast and plan are then sent to Toyota Japan. Demand management is globally managed by Toyota Japan. Toyota South Africa receives a production plan which is broken down into various parts and made available to suppliers electronically.

Since the plant in South Africa is global, production must be balanced in terms of manufacturing requirements for Europe, South Africa and Africa. Production is balanced for three months ahead, and the production schedule is prepared on the basis of this.

The problem for ACMs is that they base their forecasting on this schedule, and with the current downturn in the economy and reduced car sales, they may be holding excess stock because of the cancellation of orders.

6.5.2.2 Production stoppages

The participants at both OEMs reported that the loss per production line for stoppages due to stock outs was minimal and measured in minutes (an exception being in circumstances of power outages). Few such stoppages occur. Should a stoppage occur because a supplier is not delivering on time, and this is found to be a serious issue of neglect, the supplier is held responsible for the stoppages.

Although this does not seem to be a problem, the implication for the ACM's supply chain is that it must ensure that parts are delivered on time to prevent a stoppage on the OEM's production line.

6.5.2.3 Transportation

Both OEMs use mainly sea freight to import the majority of their parts and export motor cars. In South Africa, the majority of Toyota stock is transported via road with a small portion (10%) conveyed by rail. As far as Ford is concerned, once containers have been cleared by the port authorities, the shipment is forwarded to Ford using rail transport. Ford has a sound partnership with Safmarine, and because the company constructed its own railway siding at its plant, there is a triangulation of containers. This means that Ford "*ring-tracks*" its trains and is guaranteed use of its wagons because of the bidirectional flow of traffic. It was noted that prior to the OEM having access to its own railway siding, the availability of wagons was a problem.

One of the areas of potential risk that was identified in the literature review was that of "security" during transportation of parts. Both OEMs stated that they had not experienced any security problems during the transportation of parts – deliveries from local ACM suppliers.

The implications of the above problem in terms of this research study is that ACM also face the potential risk of "security" during the transportation of parts as the majority of ACMs import parts that are used in the final component.

6.5.2.4 Reverse logistics

It was found that at both plants, defective components were identified upon inspection on the receiving side. There are minor instances of defective parts actually getting through to the assembly line. Defective components are returned to the supplier with the returned reusable dunnage.

Although the participants did not see this as a major problem, the implication for ACMs is the challenge on how returns from customers are dealt with.

6.5.2.5 Information flow

Ford uses the Common Material Management System (CMMS3) which is its unique MRP system used worldwide in all Ford locations. Data with suppliers are shared through the Collaborative Xchange (as indicated in sec 6.4.2), web access and electronic direct data link (EDDL). Ford does not experience problems with ACMs in this regard. However, ACMs that supply Ford have to subscribe to Colloborative Xchange.

Toyota uses the Global Toyota System and SAP. SAP is used for commercial applications such as the control of finance and human resources. Data with suppliers are shared through a domestic website portal and global information such as forecasts and prices are available to the relevant suppliers. Toyota does not experience problems with ACMs in this regard. However, ACMs who supply Toyota have to subscribe to Toyota's website portal.

Hence, the challenge for ACMs supplying both OEMs is that they not only have to subscribe to Toyota's website portal but also Collaborative Xchange, which is costly.

6.5.2.6 "Cradle-to-grave" flow

Three main areas of particular concern in environmental management are the driving forces, namely environmentally friendly products, packaging and production processes.

a. Environmentally friendly products

Products are designated in the design stage by Toyota Motor Company (Japan) and Toyota South Africa and local ACMs are instructed on the materials used in the design. Suppliers (ACMs) must produce per specification. When it comes to new designs, Toyota Motor Company (Japan) explores opportunities to make the components lighter, more cost effective, more environmentally friendly. Specifications in this regard are provided to ACMs.

The problem for ACMs is that parts will be supplied to OEMs as per their specifications. As noted in chapter 1, ACMs not only supply OEMs but also OESs and the aftermarket. ACMs therefore have to take into consideration "environmental" issues when purchasing the materials that go into parts.

b. Packaging

According to the participants at Ford, 99% of packaging is returned to local suppliers and reused. Only 10% of international packaging is returned and the balance scrapped because of the higher cost of return. However, returnable packaging with international suppliers is becoming more prevalent with a steady round tripping on the increase. This is also a requirement in terms of ISO14001.

At Toyota, waste management has priority via the Fourth Environmental Action Plan, through the effective use of resources. Toyota also strives to reduce landfill waste as a result of its production processes to zero (Toyota Executive Performance Summary Report, 2006:13). For Toyota, like Ford, one significant success area has been the elimination of polystyrene for packaging. Recycled cardboard is now used for all packaging inserts. Most local suppliers now use returnable packaging and work is under way to quantify nonrecyclable packaging.

The implication for ACMs in South Africa is in line with ISO14001, namely that waste management, environmental policies and procedures have to be complied with. This may be a problem in terms of increased cost, at the same time sustaining a competitive advantage by remaining cost effective.

6.6 EXTERNAL FACTORS

The challenges highlighted below fall outside the control of the supplier and the customer in the automotive supply chain. However, these do impact on the supplier's and customer's supply chain.

6.6.1 The impact of load shedding

Both Ford and Toyota plants did not experience load shedding because they were effectively excluded from the formal load-shedding process. Their suppliers were exposed to load shedding on a regionalised basis and the impact on them was significant. Suppliers had to change shipping times (inbound and receiving processes). In addition, these suppliers had to build in safety stocks because the load-shedding schedules were unreliable.

Toyota, in turn experienced stoppages as a result of supply problems from suppliers arising from the load shedding with production being stopped on occasion. The plant lost a minimal amount of production because measures were taken to stabilise their production. Ford, however, managed to work its way around this problem and did not experience any production losses.

In conclusion, suppliers were negatively affected by load shedding. This was identified as a possible supply chain problem and was tested in the questionnaire, and dealt with in chapter 7.

6.6.2 The rising oil price

The reason for this question was that at the time of the interviews, the oil price was US$145 per barrel. Two areas relating to the rising oil price were noted, namely the impact on resin suppliers and logistics costs.

6.6.2.1 Resin suppliers (polypropolene)

The rising oil price has impacted on the resin suppliers and their products because these products are linked to the price of oil. Toyota had adapted a pragmatic view, recognising that it cannot hide from international commodity price increases. Toyota believes that it had adopted a firm but fair view when meeting with its suppliers at the designated price review times. During these sessions, Toyota reviews the commodity prices lists, and awards price increases accordingly. However, to offset these price increases, Toyota expects process and yield improvement from their suppliers. Toyota management constructively engages its suppliers regarding cost-down initiatives to offset adverse price adjustments arising from the commodity price increases.

6.6.2.2 Logistics costs

Increases in logistics costs impact both on the OEMs and ACMs. Ford imports on average 300 to 350 (40 ft) containers per week, whereas its suppliers import an average of 1 to 1,5 containers per month and use shipping agents. Owing to the relatively low volumes, the suppliers tend to end up paying more because they lack the negotiation power of Ford on the basis of high volumes.

The ultimate impact of the oil price increase is that suppliers' costs have increased, and since consumers are purchasing fewer new vehicles, this affects both OEMs and their suppliers in revenue decreases.

As noted at the beginning of this section, at the time of the interviews (5 August 2008), the oil price was US$145 per barrel and peaked at US$147 per barrel. As at 3 November 2008, the oil price was US$61.61 (Companies & Markets, 2008). Hence the problem in the questionnaire dealt with the fluctuating as opposed to the rising oil price.

6.6.3 BBBEE

Both Toyota and Ford indicated a positive attitude towards BBBEE. However, their specific circumstances have made it difficult to comply with targets. This could also be a problem for their suppliers (ACMs), because BBBEE is also applicable to first-, second- and third-tier suppliers.

6.7 PROBLEMS IDENTIFIED

Table 6.1 is a summary of the problems identified in the interviews conducted at the companies.

Table 6.1: Identified problems

SECTION	PROBLEMS IDENTIFIED
Section 2: General	Interconnectivity with MRPs Supplier inflexibility • Ability to interpret order releases • Delivery to ACMs' own production capacity instead of reacting to OEMs' customer requests Supplier performance • Not meeting delivery commitments • Capacity constraints Geographic location of suppliers • Length of supply chain • Small supply and manufacturing volumes Supplier stability • Captive customer/supplier Pull philosophy • Suppliers not understanding the "pull system" and using "push" methodology • Move to supplier-managed inventory
Section 3: **Supplier relationships** **Supply chain concepts**	 Supplier relationships • Adversarial/partnership/collaborative • Quality accreditations • Sustainability of suppliers Demand management and forecasting • Output based on OEMs' forecasts to plan Production stoppages • Material availability Transportation

External factors	• Security risks during transportation Reverse logistics • Reducing the use of packaging material with respect to local and international supplies Impact of load shedding • Impact on suppliers in terms of production, cost, and deliveries Rising oil price • Impact of logistics on costs (both inbound and outbound costs) • Impact on raw material costs BBBEE • Difficulty complying with targets

6.8 CONCLUSION

The aim of the qualitative empirical research discussed in this chapter was to determine, from the OEM's perspective, the supply chain problems that ACMs in South Africa face. The chapter commenced with an introduction, which included a discussion of the reasons why these two particular OEMs were selected to participate in the research study.

Both senior and executive management at the respective plants were interviewed and numerous supply chain problems identified. The following problems were identified: (1) the lack of a local supplier base; (2) the geographic location of suppliers; (3) interconnectivity with MRPs; (4) supplier inflexibility (since many suppliers tend to over commit themselves, because of insufficient capacity), and to a lesser extent not conforming to quality standards; (5) the fluctuating oil price; and (6) BBBEE.

All the problems and challenges are summarised in table 6.1 and were included in the questionnaire sent out to the ACMs who are members of NAACAM. This concludes the first stage of the empirical research. The next chapter deals with the second stage of the empirical research, namely the supply chain problems experienced by South African ACMs.

CHAPTER 1

Introduction

CHAPTER 2

The global and South African automotive industry

CHAPTER 3

Supply chains, supply chain management and related concepts

CHAPTER 4

Supply chain management practices and tools

CHAPTER 5

Research design and methodology

CHAPTER 6

Problems experienced by ACMs from their customer's perspective

CHAPTER 7

Supply chain problems facing ACMs in South Africa: empirical research

CHAPTER 8

Summary, recommendations, caveats and suggestions for further research

OUTCOME

To identify problems or difficulties in the supply chain and suggest remedies to ACMs and the motor industry as a whole

CHAPTER 7

SUPPLY CHAIN PROBLEMS FACING ACMS IN SOUTH AFRICA: EMPIRICAL RESEARCH

7.1 INTRODUCTION

The empirical research for this study involved of two phases. Once the literature review and the first stage of the empirical study (interviews with OEMs) had been concluded, the researcher was able to compile the questionnaire for the second phase of the empirical study. Chapter 6 dealt with the first phase of the research study, namely the problems experienced by ACMs from their customers' (OEMs') perspective. These were identified through in-depth semi-structured interviews with participants at Ford South Africa and Toyota South Africa.

This chapter deals with the second phase of the empirical research. The aim of the second phase of the empirical research study was (1) to determine the extent and significance of the supply chain problems experienced by ACMs; (2) to compare the problems faced in the provinces nationally to determine possible-geographic related problems; (3) to compare these problems with regard to the age and size of the business in order to determine whether the age or size impacts on an ACM's problems; (4) to determine relationships (correlations) and their significance in the supply chain; and (5) to refine, pinpoint and explain the reasons for these problems. The process and methodology followed to design the research instrument and collect the data were dealt with in detail in section 5.9.

This chapter presents the results of the analysis of the data obtained from the questionnaires. These results were obtained using the statistical methods explained in chapter 5, table 5.6. The results of the questionnaire are split into three groups, namely (1) profiles of the responding ACMs; (2) the descriptive statistics of the problems currently being experienced; and (3) hypothesis testing.

The next section deals with the response rate.

7.2 RESPONSE RATE

The NAACAM database was used as the sample frame. As indicated in chapter 5, this database was selected because according to Barnes (2001:56), the largest and most important ACMs in South Africa are members of this association**.** Of these ACMs, 181 were members of (NACAAM), and they were all included in the study. Since a pilot study was conducted at three ACMs, only 178 questionnaires were sent out. As indicated in chapter 5 (sec 5.9.1.2) only NACAAM members were included in this study and not all ACMs in South Africa. The data does not represent the entire automotive industry and therefore is not necessarily typical of the South African automotive component industry.

A list of all members was obtained from NAACAM. Each respondent was contacted telephonically prior to sending out the questionnaire which was either emailed or faxed to the respondents. The questionnaire included a cover sheet and a cover letter (attached as appendix B). As recommended in Saunders et al (2003:312), a second follow-up email was sent to those who had not responded after three weeks. The follow-up email included a copy of the questionnaire. After the closing date, a third follow-up was conducted – those respondents who had not yet completed the questionnaire were contacted again in an effort to increase the response rate.

A total of 53 ACMs responded. Five of the respondents indicated that because of the global economic downturn, their firm had closed down. These ACMs were therefore classified as non eligible firms, and were subtracted from the original total of 178 to calculate the actual response rate. In addition, 15 respondents indicated that they did not have the capacity to participate in this study. They were therefore viewed as non response firms.

A response rate of 30.6% was arrived at using the following formula provided by Welman et al (2007:74):

$$\text{Response rate} = \frac{\text{Number of firms that cooperated}}{\text{Total number of eligible ACMs}} = \frac{53}{173} = 30.6\%$$

The total of eligible ACMs was calculated as being equal to 173, being the sample size less three ACMs included in the pilot study, and five ACMs that had closed down (181 – (3 + 5)).

As indicated in Jankowicz (2005:298), response rates may be high for the email medium – a 76% email questionnaire compared with the very best rate for the postal questionnaire of 20 to 25%. Saunders et al (2003:284) indicate that the type of questionnaire will affect the number of people who respond, and they maintain a response rate of 30% for questionnaires that are emailed is reasonable.

At the time of this study, the automotive industry was experiencing significant problems caused by the global economic crisis, and as far as the response rate is concerned, this crisis needs to be taken into consideration. A significant number of respondents who were contacted prior to emailing the questionnaire indicated that they (1) were working a four-day week because of a significant decline in volumes; (2) were dealing with retrenchments and downsizing and/or; (3) were too busy as a result of working under extreme challenges and pressures; (4) felt that the questionnaire was too long; and (5) felt that, at that time, there had been too many requests by other researchers to complete questionnaires. In all likelihood, these challenges may have impacted on the response rate of this study.

Given the aforementioned response rate statements, the response rate of 30.6% in this study is deemed as acceptable.

7.3 DATA PROCESSING

The completed questionnaires were coded and the responses captured in Excel and then exported into SPSS 17 (a statistical software program) by the statistician. This software program was used to analyse the data. The results of the data are provided below.

7.4 RESEARCH RESULTS

The purpose of this section is to present the results of the empirical research conducted to achieve the objectives of the study as set out in section 1.6, which were not achieved during the secondary data research, namely the literature review. The results are presented in the same format as in the questionnaire.

Section 7.4.1 provides a profile of responding ACMs in terms of general information on them.

7.4.1 Profile of the responding ACMs

The results pertaining to the general information on ACMs as obtained from section 1 of the questionnaire (appendix B), are outlined below.

7.4.1.1 Position of respondents

Table 7.1 provides details of the employment positions of the respondents in the ACMs that participated in this study. As indicated in table 7.1, most of the respondents were managing directors (26.2%) or director/general manager operations (13.0%). An almost equal split was obtained at other levels involved in supply chain issues.

Table 7.1: Employment position of respondents

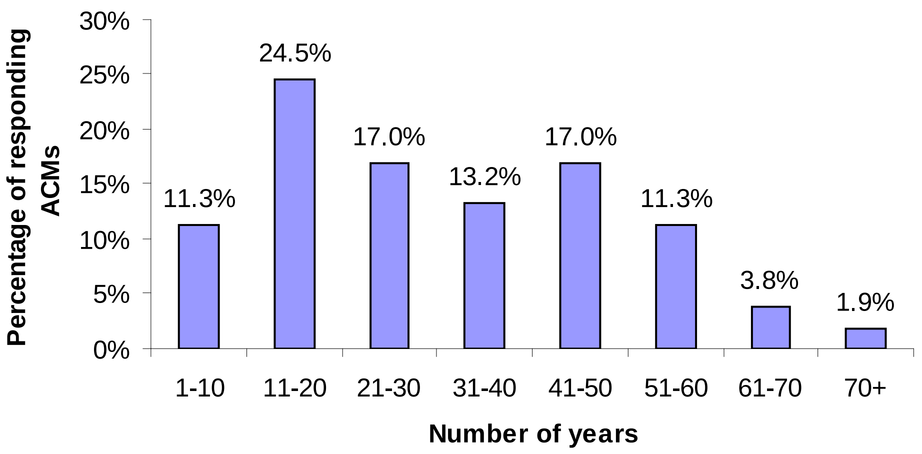
Managing director	26.2%
Director/general manager operations	13.0%
Logistics manager	5.7%
Sales & marketing director	5.7%
Commercial director	3.8%
CEO	3.8%
Operations manager	3.8%
Sales & marketing manager	3.8%
Purchasing manager	3.8%
Commercial manager	1.9%
Financial director	1.9%
Director	1.9%
National sales manager	1.9%
Business development director	1.9%
Supply chain director	1.9%
Logistics director	1.9%
Sole member	1.9%
Business development manager	1.9%
Customer admin assistant	1.9%
National sales & marketing manager	1.9%
Manufacturing coordinator	1.9%
Skills development facilitator	1.9%
Business & operations director	1.9%
Director	1.9%
Business intelligence analyst	1.9%
	100.0%

7.4.1.2 Number of years in operation

The number of years that the responding ACMs had been in operation is outlined in table 7.2.

Most of the responding ACMs (24.5%) had been operating between 11 and 20 years, and 17% for 21 to 30 years and another 17% for 41 to 50 years. The remainder of ACMs had been operating for 1 to 10 years or 51 to 60 (11.3% each). One could therefore say that the responding ACMs were mature and well established (88.7% were older than 10 years), which ties in with the theory that the automotive market is mature.

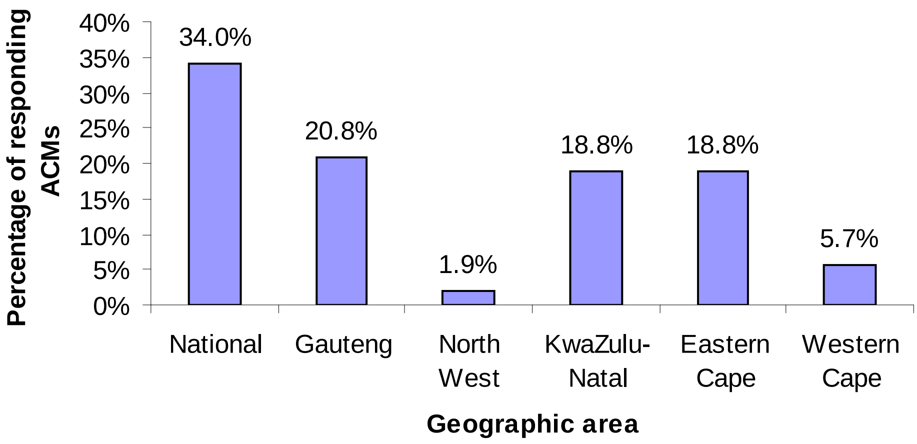
Table 7.2: Number of years (N=53)



7.4.1.3 Location of responding ACMs

Table 7.3 shows the percentage of respondents located in each of the provinces of South Africa. “National” includes those responding ACMs who had a branch or independent unit in more than one location. Most respondents were located in more than one geographic area (34%), followed in number by those located in Gauteng (20.8%), KwaZulu-Natal and Eastern Cape (18.8% each).

Table 7.3: Location of responding ACMs (N=53)



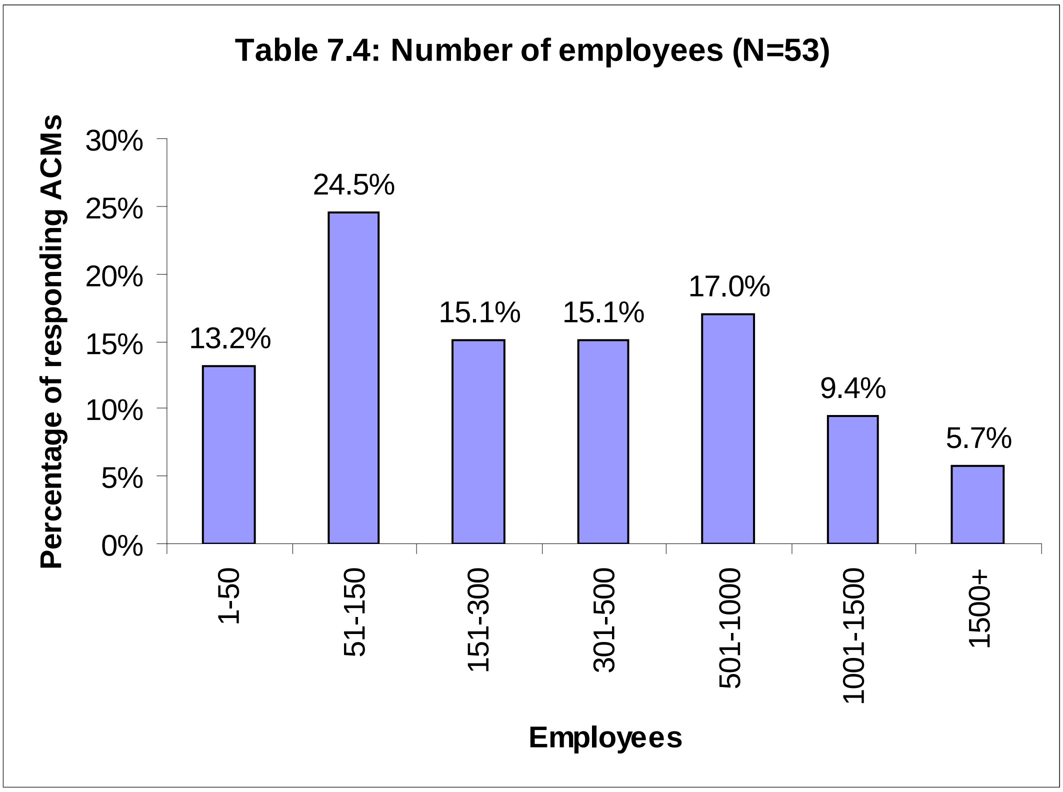
7.4.1.4 Size of responding ACMs

The size of ACMs measured in terms of number of employees is illustrated in table 7.4. The responding ACMs employed 29 346 workers in total. As indicated in tables 1.1 and 2.6, component manufacturers in South Africa employed a total of 81 500 employees as at June 2008. However, the industry reported that more than 16 000 jobs (± 20% of the total) were lost in the component manufacturing sector between November 2008 and March 2009. Hence as at March 2009, employment was estimated to have declined to 65 500 employees (*NAACAM Newsletter*, March 2009:1). As at 25 March 2009, the responding ACMs employed 29 346 employees, which represents 44.8% of all employees in the South African automotive component market.

The following formula was used to calculate this percentage:-

$$\text{Percentage} = \frac{\text{number of responding ACMs' employees}}{\text{total number of employees employed in the industry}} =$$

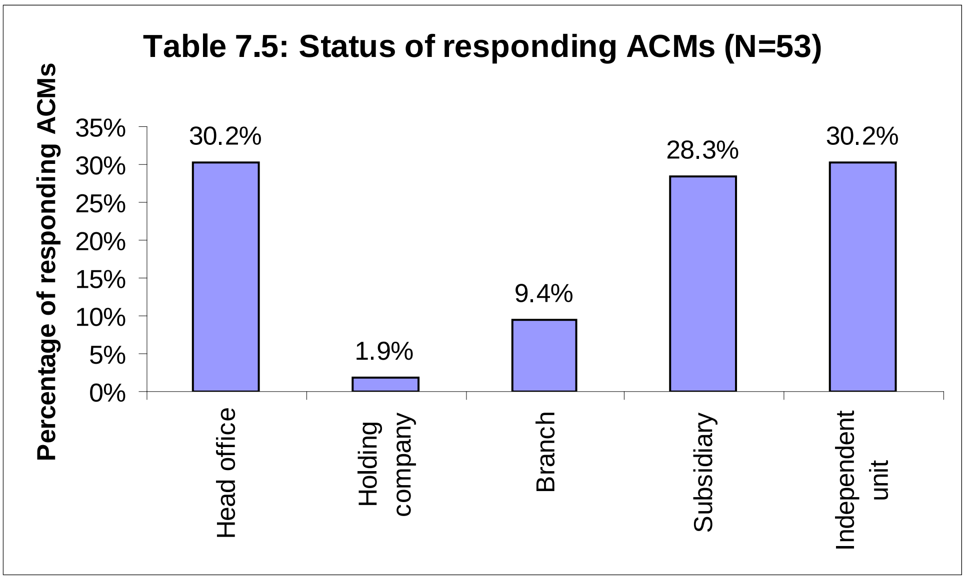
$$44.8\% = \frac{29\ 346}{65\ 500}$$



It is clear from table 7.4 that 37.7% of the responding ACMs employed between 1 and 150 employees and 47.2% between 151 and 1 000 employees. It is important to note that 9.4% of responding ACMs employed between 1 001 and 1 500 employees and 5.7% more than 1 500 – making it impossible to generalise the findings as being applicable only to, say, small to medium or large ACMs.

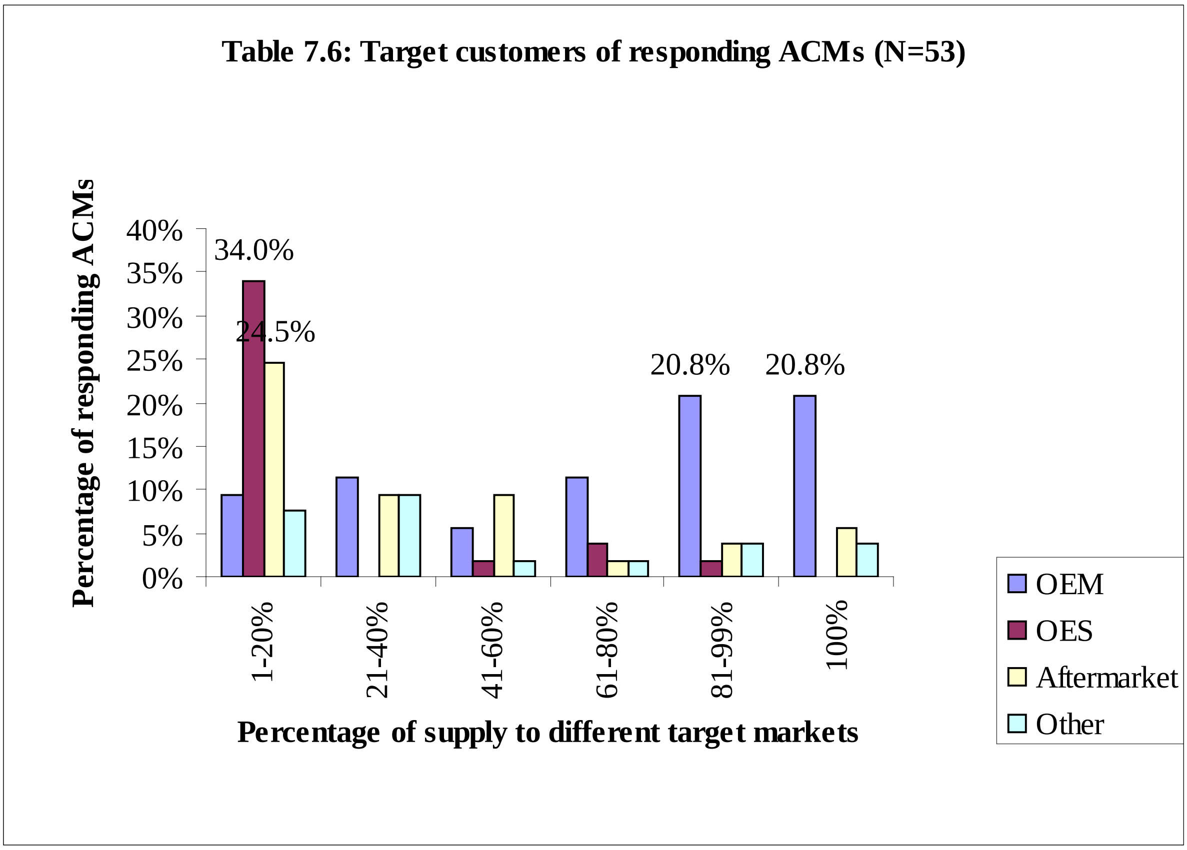
7.4.1.5 Status of responding ACMs

Table 7.5 represents the status of the responding ACMs. Most were either head offices (30.2%) or independent companies (30.2%). Of the remaining ACMs, 28.3% were subsidiaries, 9.4% branches and 1.9% holding companies.



7.4.1.6 Target customers of responding ACMs

In response to the question on target customers/markets, the ACMs could indicate more than one option, resulting in the percentage provided in table 7.6 not totalling 100%.



As indicated in table 7.6, the majority of responding ACMs' target customers were OEMs. Of the responding ACMs, 20.8% supplied to OEMs, with another 20.8% supplying between 81% and 99% of their total sales to OEMs. The inclusion of OEMs in the empirical study on ACMs (the first phase) was therefore valuable to gain insight into the distribution side of the supply chain. Of the responding ACMs, 34% and 24.5% supplied between 1% and 20% of their sales to OESs and the aftermarket respectively.

This concludes section 1 of the questionnaire pertaining to the general information on ACMs in South Africa. Most of the responding ACMs were in fact branches located in different parts of the country (34%), while 20.8% were located in Gauteng. The combined number of employees employed by responding ACMs was 29 346, and the majority of them were either head offices or independent companies. These ACMs primarily supplied components to OEMs, OESs and the aftermarket.

The next section deals with the ranking of problems currently experienced by ACMs.

7.5 RANKING OF SUPPLY CHAIN PROBLEMS CURRENTLY EXPERIENCED

Section 2 of the questionnaire was compiled to measure the extent of which the responding ACMs were experiencing various supply chain management problems outlined therein. This section of the questionnaire used seven-point Likert scale items (ordinal scale) varying from 1 (to a lesser extent) to 7 (to a greater extent). The questionnaire included a qualitative section to determine why companies were experiencing problems, and if the respondents wished to clarify an issue, or felt particularly strongly about one of the issues, they could do so.

Alternatively, if the various supply chain problems listed in the questionnaire were not experienced by ACMs, they had the option to tick the "not a problem" (ranking 0 in coding) column. In addition, in sections 2.1.2 (incoming transportation) and 2.3.2 (outbound transportation) a "not applicable" (ranking -1 in coding) column was included to cover the possibility of a particular supply chain problem not applying to the responding ACM.

Descriptive statistics were used to explore the data collected and to summarise and describe these data. These included mean, median and quartile analysis, which gave an adequate perspective on and insight into the results.

As indicated in section 5.9.1.1 in the questionnaire, in two questions (see tables 7.7 and 7.11) the words “after the recent economic crisis” were used to emphasise the distinction between “before the onset of the global economic crisis” and “after the onset of the global economic crisis”. In no way was this meant to imply that the crisis was over at the time (March/April 2009) the questionnaire was tested.

Section 2 of the questionnaire contained questions relating to possible supply chain management problems experienced by South African ACMs. The problems were categorised into three sections and subsections, namely *supply-side problems* (sec 7.5.1), *problems with internal operations* (sec 7.5.2), and *distribution-side problems* (sec 7.5.3). Each section concluded with a qualitative section in which each respondent was asked to comment if he or she chose 5 to 7 on the scale, in order to determine the reasons for the ACMs experiencing this/these problem/s. The results of each section and their subsections are highlighted below.

7.5.1 Supply-side problems

In the first part of this section, the respondents were asked to indicate on a scale from 1 to 7, if they experienced a particular problem and the extent to which their operations experienced these problems.

The problems were based on (1) secondary information gathered in the literature study, and (2) data gathered from the first stage of the empirical research, and were incorporated as items in the questionnaire (sec 2.1).

Problems relating to the supply side were categorised into supplier relationships and incoming transportation problems. Each subsection is dealt with below.

7.5.1.1 Supplier relationship problems

The problem areas associated with suppliers were identified and are listed and ranked accordingly in table 7.7. Ranking is based on the mean.

Table 7.7: List and ranking of supply-side problems (N=53)

	Problem	**Mean**	**Median**	**Quartiles**		**No. of valid cases**	**% of valid cases**
				25	**75**		
1	Purchasing price of the materials	4.38	4.50	3.00	6.00	50	94.34
2	BBBEE – achieving targets and verifying BEE scorecards (in respect of OEMs' target market)	4.29	4.00	3.00	6.00	41	77.36
3	Financial stability of suppliers (after the onset of the recent economic crisis)	4.09	4.00	3.00	5.00	43	81.13
4	Material lead times too long	4.02	4.50	2.00	6.00	46	86.79
5	Trust between you and your "worst 10%" of suppliers	3.73	4.00	3.00	5.00	44	83.02
6	Suppliers do not have ISO14001 accreditation	3.34	3.00	1.00	5.00	35	66.04
7	Flexibility of suppliers	3.33	3.00	2.00	4.00	46	86.79
8	Delivery of the right quality	3.28	3.00	2.00	4.25	40	75.47
9	On-time delivery	3.12	3.00	2.00	4.00	42	79.25
10	Financial stability of suppliers (prior to the recent economic crisis)	3.06	2.50	2.00	4.00	36	67.92
11	Supplier capacity limitations	3.05	3.00	2.00	4.00	39	73.58
12	Material availability	2.98	3.00	2.00	4.00	41	77.36
13	Trust between you and your "best 10%" of suppliers	2.78	2.00	1.00	4.00	27	50.94
14	Poor communication between you and your supplier	2.57	3.00	2.00	3.00	37	69.81
15	Use of correct packaging material	2.46	2.00	1.50	3.00	35	66.04

The price of materials proved to be a significant problem (with a mean ranking of 4.38). The qualitative findings (in the comments part of the questionnaire) indicate that local raw material suppliers were usually monopolies, which resulted to inflexibility relative to price and volume.

In terms of BBBEE (a mean ranking of 4.29), the findings indicate that OEMs expected ACMs to achieve BBEEE targets they could not meet. This would continue to make things difficult for ACMs.

A possible problem that was identified in the literature review was on-time delivery and material availability. However, this proved to be less of an issue for the respondents (a mean ranking of 3.12 and 2.98 respectively). The respondents indicated that because volumes were contracted a year before, on-time delivery and material availability had not proved to be problematic during the economic crisis. This correlates with the findings in the literature review in that the industry is currently experiencing a severe slump in new vehicle sales from a local and global perspective. This has had a knock-on effect on OEMs' core suppliers (first tier), and in turn on their suppliers (second tier), which would indicate that there is no materials supply shortage.

Lastly, mention should be made of the problems of trust between the ACM and its "worst 10%" of suppliers and trust between the ACM and its "best 10%" of suppliers (a mean ranking of 3.73 and 2.78 respectively). As indicated in section 5.9.1.1, an initial questionnaire was used to conduct a pilot study on five respondents (listed in table 5.4) to test the questionnaire and its reliability. The respondents suggested that this supplier question should be reworded to include "10 worst" and "10 best" since the respondents indicated that ACMs were more than likely to respond with their worst supplier in mind. This would give a skewed answer. Hence, as the findings indicate, trust between the ACM and its "worst 10%" of suppliers was a greater problem than trust between the ACM and its "best 10%" of suppliers.

7.5.1.2 Incoming transportation

The problem areas relating to incoming transportation are listed and ranked accordingly in table 7.8.

Table 7.8: List and ranking of incoming transportation problems (N=53)

	Problem	Mean	Median	Quartiles		No. of valid cases	% of valid cases
				25	75		
1	High cost of South African ports	4.05	4.00	3.00	6.00	38	71.70
2	Inefficiency of South African port authorities	3.40	3.00	2.00	4.50	35	66.04
3	Inefficient infrastructure at South African ports	3.21	3.00	2.00	5.00	34	64.15
4	Inefficient clearing of containers at South African ports	3.20	3.00	2.00	5.00	35	66.04
5	Processes at ports and borders	3.03	3.00	2.00	4.00	35	66.04
6	Delays in off-loading vessels (due to congestion at ports)	2.94	3.00	2.00	3.75	34	64.15
7	Road delays	2.86	2.00	1.00	4.00	36	67.92
8	Delays in off-loading vessels (due to weather conditions)	2.27	2.00	1.00	3.00	33	62.26

In terms of the inefficiency of the South African port authorities and the clearing of containers at South African ports, a mean ranking of 3.40 and 3.20 respectively was obtained. The respondents indicated in the comments section in the questionnaires that, at times, cargo was stopped for customs inspections, even though, on a continual basis, the responding ACMs, were importing the same product in all consignments. This resulted in increased lead times – which is reflected in table 7.7 as a problem.

The high cost, inefficiencies and poor infrastructure emerged as the major supply transport problem. This concurs with the findings and conclusions of other studies, as indicated in the literature review in section 3.11.1.

Another finding stemming from the comments section in the questionnaires was that South African ports are inefficient and congested compared to their Asian and European counterparts. This congestion is not only caused by high volumes of containers but also by the poor work ethic and attitude of the workers. Although respondents commented on the inefficiency and congestion of South African ports, the mean for this problem is only 2.94 and is not a significant problem.

7.5.2 Problems in internal operations

This section deals with problems in internal operations. Problems in this section include process problems and internal movement/transportation problems in operations. Each subsection is dealt with below.

7.5.2.1 Operations process problems

The problem areas relating to incoming transportation are listed and ranked accordingly in table 7.9.

Table 7.9: List and ranking of operations process problems (N=53)

	Problem	Mean	Median	Quartiles		No. of valid cases	% of valid cases
				25	75		
1	Cost of replacing outdated technology	4.79	5.00	4.00	6.00	39	73.58
2	Capacity limitations due to capital funding	4.21	4.00	3.00	6.00	28	52.83
3	Output based on customer (OEM) forecasts to plan	4.20	4.00	3.00	5.00	41	77.36
4	Labour problems – availability of skills	4.16	4.00	3.00	6.00	43	81.13
5	Labour problems – time consuming to resolve	4.08	4.00	3.00	5.00	37	69.81
6	Capacity limitations due to customer order fluctuations	4.05	4.00	3.00	5.25	40	75.47
7	Reducing cycle times	3.97	4.00	3.00	5.00	34	64.15
8	Balancing inventory levels	3.91	4.00	3.00	5.00	43	81.13
9	Integrating information systems in the company	3.88	4.00	3.00	5.00	40	75.47
10	Capacity limitations due to availability of skilled labour	3.75	4.00	2.00	5.00	36	67.92

11	Integrating technology with suppliers and customers	3.67	3.00	2.50	5.00	39	73.58
12	Continuous improvement	3.45	3.00	2.00	5.00	31	58.49
13	Output based on rigid marketing forecasting	3.39	3.00	2.00	5.00	38	71.70
14	Reducing energy consumption	3.38	3.00	2.00	4.75	34	64.15
15	Outdated technology	3.38	3.00	2.00	5.00	32	60.38
16	Reducing waste	3.36	3.00	2.00	4.00	36	67.92
17	Capacity limitations due to outdated machinery	3.34	3.00	2.00	4.00	29	54.72
18	Labour problems – industrial action (in the region your company is situated in)	3.11	2.00	2.00	5.00	36	67.92
19	Design of production process	3.03	3.00	2.00	3.00	30	56.60
20	Shortage of a key material	3.03	3.00	2.00	4.00	38	71.70
21	Cooperation between functions in the company	2.65	2.00	2.00	3.00	37	69.81

In the first stage of the empirical study (interviews with OEMs), it was indicated that there were deficiencies in the local ACM supplier base. As a result, the OEMs needed to import too many of their parts requirements. These deficiencies related, inter alia, to the ACMs' *lack of technology***.** In this regard, as indicated in table 7.9, outdated technology was a problem (mean ranking of 3.38) with the cost of replacing it being an even more significant problem (mean ranking of 4.79). Thus, owing to high costs, technology is not replaced, and this has a knock-on effect, as previously highlighted.

In terms of labour problems, the availability of skills (mean ranking of 4.16) and labour problems, time consuming to resolve (mean ranking of 4.08), it emerged in the respondents' comments that the work ethic and attitude of the workforce in South Africa is problematic, and that this needs to change. Both skilled and unskilled staff lack a sense of urgency to execute their tasks efficiently and effectively, which results in lower productivity, when compared with labour in regions such as Asia. Many manufacturers thus resort to producing parts in the Far East because it is often cheaper. This importation of cheaper parts from the Far East translates in increased imports, congestion in South African ports, and ultimately, increased unemployment in the country.

Further comments made by responding ACMs were that some products were made to order, and that the ACMs, that produced them experienced variability in customer demand and the customers' ability to forecast. This is a major problem from the perspective of balancing supply and demand.

7.5.2.2 Internal movement/transportation

The problem areas relating to internal movement/transportation are listed and ranked accordingly in table 7.10.

Table 7.10: List and ranking of internal movement problems (N=53)

	Problem	**Mean**	**Median**	**Quartiles**		**No. of valid cases**	**% of valid cases**
				25	**75**		
1	Design of materials flow system (based on international best practice)	3.52	4.00	2.00	5.00	31	58.49
2	Warehouse capacity	3.45	3.00	2.00	5.00	29	54.72
3	Warehouse security	3.06	3.00	2.00	4.00	33	62.26
4	Outdated warehouse equipment	2.72	3.00	1.00	4.00	29	54.72
5	Outdated transport equipment	2.70	2.00	1.50	4.00	27	50.94
6	Warehouse maintenance	2.56	2.00	1.00	3.00	25	47.17
7	Warehouse safety	2.46	2.00	1.25	3.00	26	49.06

Three problems listed in table 7.10, namely design flow system (3.52), warehouse capacity (3.45) and warehouse security (3.06) proved to be significant supply chain problems. The remaining problems of outdated warehouse equipment (2.72), outdated transport equipment (2.70), warehouse maintenance (2.56) and warehouse safety (2.46) proved to be less serious supply chain problems.

7.5.3 Distribution-side supply chain problems

This section deals with supply chain problems on the distribution side and includes supply chain problems relating to customer relationships and outbound transportation. Each subsection is dealt with below. When examining the number of problems with a mean rating above 4, (tables 7.11 and 7.12) and comparing this number with the mean ratings of the problems on the supply-side (tables 7.7 and 7.8) and operations process (tables 7.9 and 7.10) with a mean rating above 4, it is clear that the primary problems of ACMs were on their marketing or distribution side – with their customers who were largely OEMs.

7.5.3.1 Customer relationships

The problem areas relating to customer relationships are listed and ranked accordingly in table 7.11.

Table 7.11: List and ranking of customer relationship problems (N=53)

	Problem	Mean	Median	Quartiles		No. of valid cases	% of valid cases
				25	75		
1	Pressure by OEMs to reduce prices	5.51	6.00	4.00	7.00	49	92.45
2	Cancellation of orders (after the recent economic crisis)	5.02	5.00	4.00	6.00	49	92.45
3	Excessive slow-moving inventory due to cancellation of orders	4.83	5.00	3.50	6.00	47	88.68
4	Rapid changes in demand (in terms of quantity) patterns	4.18	4.00	3.00	5.00	44	83.02
5	Advance communication about market demand	4.15	4.00	3.00	5.00	41	77.36
6	Too dependent on the business of a particular customer	4.15	4.00	2.00	6.00	41	77.36
7	Trust between you and your “worst” customers	4.13	4.00	3.00	6.00	39	73.58
8	Relationship with “worst 10%” of customers	4.12	4.00	3.00	6.00	34	64.15
9	Little/no assistance from	3.79	4.00	2.50	5.00	43	81.13

	customers to comply with their requirements						
10	Order fluctuations (prior to the recent economic crisis)	3.68	3.00	2.00	5.00	44	83.02
11	Expectations of customers to comply with new technology are too high	3.30	3.00	2.00	5.00	33	62.26
12	Incompatible information systems	3.06	3.00	2.00	4.00	36	67.92
13	Relationship with "best 10%" of customers	2.50	2.00	2.00	3.00	26	49.06
14	Trust between you and your "best" customers	2.36	2.00	1.00	3.00	25	47.17
15	Difficulty meeting quality requirements	2.32	2.00	1.00	3.00	31	58.49

In this section of customer relationships, pressure by OEMs to reduce prices proved to be the most significant problem (mean ranking of 5.51). This issue was also the most significant of all the identified supply chain problems. It is interesting to note that the next most significant problem on the supply side (secs 7.5.1 and 7.7) was that of the price of materials (mean ranking 4.38). This is logical because in order to keep prices down (due to the pressure of OEMs), ACMs would need to reduce costs and therefore to put pressure on their suppliers to reduce the cost of products. In turn, since most of the ACMs' products contain commoditised raw materials (eg steel), these prices tend to be internationally priced, that is, fixed by the London Metal Exchange, and they are therefore non-negotiable.

As indicated in table 7.11, the majority of responding ACMs supply to OEMs and they (ACMs) indicated that they are too dependent on the business of a particular customer (mean ranking of 4.15). OEMs experienced cancellations of orders which, in turn, had a knock-on effect on their suppliers (ACMs) because orders were cancelled upstream. Hence the responding ACMs indicated that cancellation of orders (after the recent economic crisis) (mean ranking of 5.02) was a significant supply chain problem. The result of cancellation of orders was excessive stock which also proved to be a significant problem (mean ranking 4.83). Essentially, this stock was slow moving because the production of motor cars had declined significantly and until production picked up, this excess would remain.

7.5.3.2 Outbound transportation

The problem areas relating to outbound transportation are listed and ranked accordingly in table 7.12.

Table 7.12: List and ranking of outbound logistics problems (N=53)

	Problem	**Mean**	**Median**	**Quartiles**		**No. of valid cases**	**% of valid cases**
				25	**75**		
	Rail transport						
1	Unreliability of rail transport	4.80	5.50	2.75	7.00	10	18.87
2	Rail capacity problems in terms of inefficient infrastructure and technology	4.50	4.50	2.75	7.00	8	15.09
3	Increasing high variable local days in transit	3.43	3.00	1.25	5.00	14	26.42
4	Cargo loss and damage	2.53	2.00	1.00	3.00	15	28.30
	Road transport						
1	Congestion on the roads	2.96	3.00	1.00	4.00	25	47.17
2	Accidents	2.64	2.00	1.75	3.00	28	52.83
3	Cargo loss and damage	2.60	2.00	1.25	3.00	30	56.60
4	Dependability/reliability of shipper	2.57	2.00	1.25	3.00	30	56.60
5	Trust between you and your shipper	2.42	2.00	1.00	3.75	26	49.06

Table 7.12 indicates that the supply chain problems included in the road transport section, according to the responding ACMs, were not major problems – the highest mean ranking was 2.96.

As indicated in the comments section in the questionnaire, the responding ACMs noted that road transportation was the only real option for ACMs in South Africa because rail transportation is not even considered. According to the respondents, rail is so inefficient (mean ranking of 4.80) that it is not considered a viable option for transporting components and meeting JIT customer demands.

Of the responding ACMs, (81%) indicated that the unreliability of rail transport was neither not applicable nor a problem, indicating that they did not use rail transport. Of those that did use rail transport (19%), this was regarded as a supply chain problem. Hence the problems relating to rail transport are difficult to determine because the findings show that the majority of ACMs did not use rail transport.

This concludes the second part of the analysis of the questionnaires, namely the problems currently being experienced. The next section deals with the hypotheses testing.

7.6 HYPOTHESES TESTING

Three of the objectives of this research study were (1) to compare the supply chain problems faced in the provinces on a national level and determine possible geographic-related problems; (2) to compare these problems with regard to the age and size of an ACM in order to determine whether age or size impacts on an ACM's problems; and (3) to determine the significance of relationships between problems in the supply chain. In order to address three of these secondary objectives, seven hypotheses were formulated to guide the research. The aim of the empirical data was to either accept or reject the individual hypotheses.

The statistical nonparametric tests that were conducted were the Kruskal-Wallis one-way analysis of variance by rank, Spearman's rank order correlation coefficients and binomial tests. The reason why only nonparametric analysis was conducted was that the response group could not be classified as being representative of all ACMs. Hence no assumption could be made that the "sample" was random and representative – a prerequisite for parametric techniques. In addition, the data were ordinal. The results were valid only for the group of respondents, and no generalisations could be made.

Appendices C, D, E, and F provide the output results for the hypotheses. The results of each hypothesis are dealt with below.

7.6.1 Hypothesis 1

Hypothesis 1

H_{01}: From a geographic perspective, ACMs in South Africa at national level face the same supply chain problems.

H_{a1}: From a geographic perspective, ACMs in South Africa at national level face different supply chain problems.

The Kruskal-Wallis test was used to determine whether the geographic location of the businesses had an effect on the extent of supply chain problems they faced. The Kruskal-Wallis test identified only two significant problems, namely on-time delivery and materials availability. This is indicated in Table 7.13.

Table 7.13: Hypothesis 1: Kruskal-Wallis results (N=53)

Test statistics[a,b]

	2.1.1.4 On-time delivery
Chi-square	13.360
Df	5
Asymp sig	.020

	2.1.1.5 Material availability
Chi-square	13.972
Df	5
Asymp sig	.016

a Kruskal-Wallis test

b Grouping variable: geographical distance

The Kruskal-Wallis table gives the Chi-square value, degree of freedom and significance (Coakes, Steed & Dzidic 2006:168). The values indicate that on-time delivery and material availability do significantly differ across the geographic areas at a 5% level of significance ($P < 0.05$).

These supply chain problems scored the following mean ranking in the frequency tests:

- on-time delivery (table 7.7) **3.12**
- material availability (table 7.7) **2.98**

It should be noted, however, that the hypothesis only tests whether there is a statistically significant difference between the geographic regions with regard to the extent of the supply chain problems, not if the problems per se are significant.

On the basis of the literature review and the first stage of the empirical research study, one could argue that in terms of material availability and on-time delivery statistically these problems differ nationally for the following reasons:

The participants indicated in section 6.4.4 that the geographic location of suppliers posed a problem because both the OEMs' and the ACMs' supplier base was scattered across the country. Hence closeness to suppliers, distance from key industrial areas, and excessive distance from the ports could be a reason for the problems of on-time delivery and material availability differing significantly from region to region.

Another reason could have been the capacity of suppliers who tend to over commit themselves in terms of what they can actually deliver. This emerged as a problem in the first stage of the empirical research, where one of the participants indicated that from an OEM's perspective, there was a tendency among many suppliers to over commit themselves in terms of what they could deliver. As a direct result, these suppliers were unable to meet the demand for a certain product to all their customers. The perception of over commitment by ACMs could be caused by (1) the ACMs' suppliers, who are not able to deliver on time because of the geographic spread of suppliers; or (2) the required material to produce the components ordered may not available.

In view of the fact that of all the identified supply chain problems faced by responding ACMs, the Kruskal-Wallis test identified only two problems to be statistically significant between geographic areas, the conclusion could be drawn, that in general, from a geographic perspective, the extent to which ACMs in South Africa face supply chain problems is the same. (The test results are included as appendix C.)

7.6.2 Hypothesis 2

Hypothesis 2

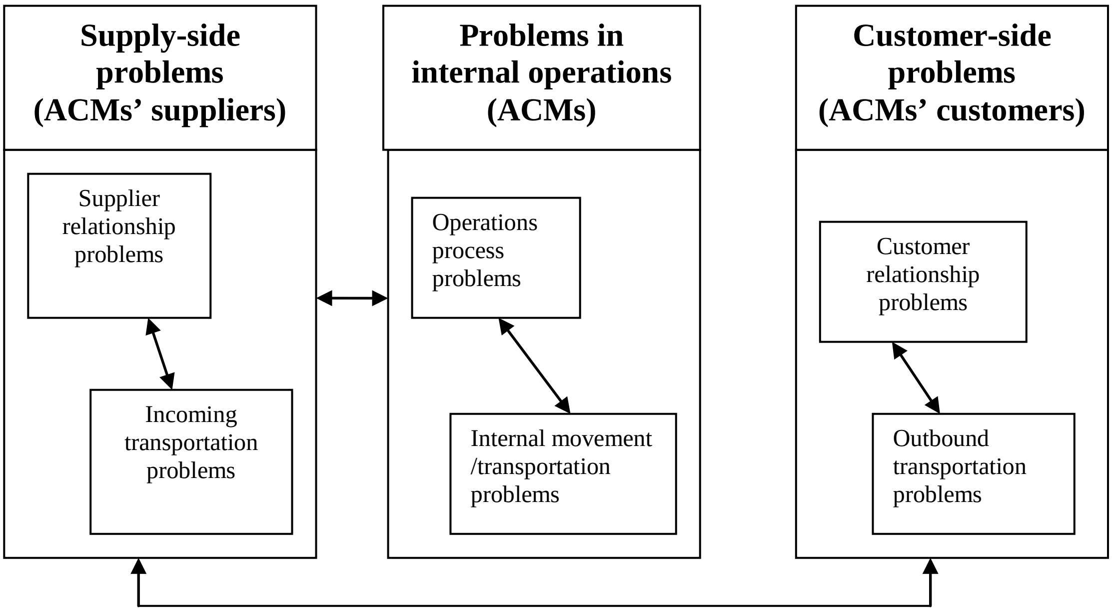
H_{02}: There is no relationship between supply problems and internal operations problems and between supply problems and customer problems.

H_{a2}: There is a relationship between supply problems and internal operations problems and between supply problems and customer problems

The aim of this hypothesis was to determine whether there was a correlation between supply-side problems and internal operations problems and supply-side problems and customer-side problems. In order to determine this correlation, Spearman correlation coefficients were calculated and tested for significance.

Figure 7.1 demonstrates the groups of supply chain factors/problems that may have had relationships (correlations) between them (supply-side problems and problems in internal operations and supply-side problems and distribution-side problems). The questionnaire (appendix B) was designed using this conceptual model, where the problems were categorised into three sections and subsections, namely *supply-side problems*, *problems with internal operations*, and *distribution- side problems*.

Figure 7.1: Possible relationships (correlations) in the supply chain



Source: Compiled by researcher

The findings are represented in tables. The problems on the supply-side were only used to determine whether there is a relationship between the supply chain problems experienced in the chain. Each supply side problem has a separate table in the supply-side problem section of the questionnaire. In section 2.1.1, supplier problems, there are 15 problems, which are listed from tables 7.14a to 7.14n. Section 2.1.2 incoming transportation problems, has eight 8 problems, listed from tables 7.14o to 7.14t. Each table indicates those problems in which a statistically significant correlation exists throughout the chain (internal operations problems and distribution-side problems).[1]

Table 7.14a: Hypothesis 2: trust between ACMs and their "best 10%" suppliers (2.1.1.1) (N=respondents)

Problem	Spearman's rank-order correlation	Sig (2-tailed)	N
Customer-side problems			
Rapid changes in demand (in terms of quantity) patterns	.486*	.012	26
Too dependent on the business of a particular customer	.468*	.024	23

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 7.14a indicates a statistically significant correlation between the problem of trust between ACMs and their "best 10%" suppliers and rapid changes in demand and trust and dependency on the business of a particular customer (in terms of quantity patterns).

Customer-side problems

One could argue that the rapid changes in demand patterns and the "captivity" of the ACMs on the customer side overflow and influence the ACMs relationships with their suppliers.

[1] Some of the correlations are logical and/or explicable, while others are not. These could be coincidental. Further research is needed to explain these correlations. The discussion in this study will focus on the correlations that are logical and explicable.

It is possible that when OEMs change quantity orders, ACMs would need (on their supply side) reliable and flexible suppliers who would be able to adapt quickly to changes. There is pressure on the supplier – hence the need for a relationship of trust.

Business risk increases when ACMs are more dependent on one customer's business. When ACMs are more dependent on one customer, they need more trustworthy suppliers to ensure that they (the ACMs) provide the best products and services to their customers.

Table 7.14b: Hypothesis 2: trust between ACMs and their "worst 10%" of suppliers (2.1.1.2) (N=respondents)

Problem	Spearman's rank-order correlation	Sig (2-tailed)	N
Customer-side problems			
Relationship with "worst 10%" of customers	.366*	.047	30
Trust between you and your "worst" customers	.384*	.023	35
Pressure by OEMs to reduce prices	.395*	.011	40

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 7.14b indicates a statistically significant correlation between the problem of trust between the ACMs and the "worst 10%" of their suppliers and other related supply chain problems, namely customer relationship problems and outbound logistics problems.

Customer-side problems

These problems might be significant in terms of supply chain for various reasons. For example, the statistically significant correlation between the relationship and trust between ACMs and their "worst 10%" suppliers and relationship between the ACM and his "worst 10%" of customers could be explained as follows: a negative relationship characterised by a lack of trust between an organisation and its suppliers directly influences the relationship with customers down the supply chain, and vice versa.

The statistically significant correlation between trust between the ACMs and their "worst 10%" of suppliers and pressure by OEMs to reduce prices, could be explained as follows: the pressure on ACMs by OEMs to reduce prices impacts on the trust, and therefore relationships with suppliers higher up in the supply chain.

Table 7.14c: Hypothesis 2: delivery of the right quality from the ACMs' suppliers (2.1.1.3) (N=respondents)

Problem	Spearman's rank-order correlation	Sig (2-tailed)	N
Operations process problems			
Output based on rigid marketing forecasting	.386*	.038	29
Balancing inventory levels	.361*	.046	31
Customer-side problems			
Advance communication about market demand	.449*	.006	36
Order fluctuations (prior to the recent economic crisis)	.375*	.027	35

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 7.14c indicates a statistically significant correlation between the problem of delivery of the right quality from the ACM's suppliers and other related supply chain problems such as operations process problems and customer relationship problems.

Operations process problems

In the context of output based on rigid forecasting and balancing inventory levels, it was found, in the first stage of the empirical study, that one of the participating OEMs balances its production loading three months ahead. Based on this, the production schedule is prepared, and ACMs, in turn base their forecasting on this schedule and provide this information to their suppliers. When market demand is expected to increase or decrease it should be communicated early to suppliers higher up in the supply chain. One could therefore argue that should the OEMs' expected or real demand change and this is not communicated timeously to the ACMs, the product quality received by ACMs from their suppliers could suffer. In addition, changes in demand will make it difficult to balance the ACMs' inventory levels.

Customer-side problems

In the context of advance communication about market demand, as discussed in the previous section, should OEMs' expected or real demand change, this should be communicated timeously. The communication of real-time data and expected changes is therefore necessary to ensure quality in the supply chain.

Closely related to clear communication are *order fluctuations*. Order fluctuations bring insecurity in the supply chain, which impacts on service and product quality. Smoothing the demand and clear advance communication about demand and consequential order fluctuations are therefore critical.

Table 7.14d: Hypothesis 2: on-time delivery to the ACMs from their suppliers (2.1.1.4) (N=respondents)

Problem	**Spearman's rank-order correlation**	**Sig (2-tailed)**	**N**
Operations process problems			
Output based on customer (OEM's) forecasts to plan.	.386*	.024	34
Design of materials flow system (based on international best practice)	.407*	.031	28
Internal movement problems			
Warehouse security	.417*	.020	31
Warehouse safety	.416*	.035	26
Customer-side problems			
Trust between you and your "best" customers	.484*	.023	22
Little/no assistance from customers to comply with their requirements	.387*	.020	36
Cancellation of orders (after the recent economic crisis)	.476**	.003	36
Excessive slow-moving inventory due to cancellation of orders	.379*	.016	40

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 7.14d indicates a statistically significant correlation between the problem of on-time delivery and other related supply chain problems on both the operations and distribution side.

Operations process problems

As indicated in section 4.4.1, forecasting refers to the process of establishing how much of a product consumers would need at some point. ACMs receive information from OEMs and pass it on to their suppliers. These should be as timely and accurate as possible, and if understated, could impact negatively on ACM suppliers' ability to meet on-time deliveries.

Internal movement problems

In the context of warehouse security and safety, one could infer that if inventories are received at the right time, the warehouse will be fully prepared for the receipt, checking, capturing, distributing and placing and safekeeping of inventory.

Customer-side problems

Failure to achieve on-time delivery by the ACM's supplier, could impact negatively on the trust between the ACM and its customer. One could argue that an ACM's supplier's failure in meeting delivery deadlines could result in the ACM experiencing a shortage of a key material. This, in turn, could impact on the ACM meeting its customer's delivery lead times, which would negatively influence the trust between the parties.

One could also argue that the failure of an ACM's supplier to achieve delivery deadlines could result in the ACM experiencing a shortage of a key material. This, in turn, could impact negatively on the ACM's production and delivery deadlines, and the ACM would receive little/no assistance from its customers to comply with their (the customer's) requirements.

The correlation of the on-time delivery of the ACM's suppliers could not be explained in terms of excessive inventory and cancellation of orders on the customer side. Further research would be needed to explain these correlations.

Table 7.14e: Hypothesis 2: material availability by ACMs' suppliers (2.1.1.5) (N=respondents)

Problem	Spearman's rank-order correlation	Sig (2-tailed)	N
Operations process problems			
Shortage of a key material	.485**	.004	34
Cooperation between functions in the company	.387*	.032	33
Customer-side problems			
Trust between you and your "best" customers	.511*	.013	23
Rapid changes in demand (in terms of quantity) patterns	.344*	.003	36
Excessive slow-moving inventory due to cancellation of orders	.379*	.016	40

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 7.14e indicates a statistically significant correlation between the problem of material availability and other supply chain problems on both the operations and distribution side.

Operations process problems

Regarding the statistically significant correlation between the problem of material availability by an ACM's supplier and the shortage of a key material during the operations stage, it is logical that that when material by an ACM's supplier is unavailable, this would result in a materials shortage during the ACM's transformation stage.

In order to manage this, cooperation between functions in the company (ACM) and particularly inter company cooperations (between the ACM and its supplier) are vital in terms of material availability.

Customer-side problems

Material availability is not a major problem (mean 2.98 in table 7.7) facing ACMs. Material availability may be influenced by rapid changes in demand (in terms of quantity) patterns. If there is a rapid increase in demand on the customer side, ACMs' suppliers might not be able to meet delivery deadlines, which is further aggravated by the long lead times experienced from the supply side. This, in turn, could impact on the trust between the customer and the ACM.

The correlation of material availability by ACM's suppliers could not be explained in terms of excessive slow-moving inventory due to cancellation of orders which is slow moving on the customer side. Further research would be needed to explain these correlations.

Table 7.14f: Hypothesis 2: material lead times too long (from the ACMs' suppliers) (2.1.1.6) (N=respondents)

Problem	Spearman's rank-order correlation	Sig (2-tailed)	N
Operations process problems			
Output based on rigid marketing forecasting	.367*	.022	39
Shortage of a key material	.358*	.032	36
Capacity limitations due to customer order fluctuations	.436**	.006	39
Customer-side problems			
Order fluctuations (prior to the recent economic crisis)	.440**	.004	40
Cancellation of orders (after the recent economic crisis)	.323*	.033	44
Difficulty in meeting quality requirements	.387*	.038	29
Incompatible information systems	.487**	.005	32
Rapid changes in demand (in terms of quantity) patterns	.546**	.000	40

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 7.14f indicates a statistically significant correlation between the problem of material lead times being too long from the ACM's supplier and other supply chain problems on both the operations and distribution side. One respondent indicated that his company's raw material lead time was eight weeks, and that this impacted negatively on the company's flexibility – hence the risk of obsolescence.

Operations process problems

Regarding the statistical correlation between long material lead times and output based on rigid marketing forecasting, it should be noted that the correlation could not be explained and could therefore have been coincidental. Further research would be needed to explain this correlation.

As indicated in section 3.10.4, time is critical to competitive success. One of the objectives of supply chain management together with lean methodologies is to reduce cycle time and therefore increase response time. It could be argued that a shortage of a key material used in a required component could be as a direct result of material lead times being too long (from the ACMs' suppliers).

In the context of capacity limitations due to customer order fluctuations, one could infer that these limitations could have been exacerbated by material lead times being too long (from the AMCs' suppliers).

Customer-side problems

Rapid changes and cancellation of orders by OEMs should be communicated timeously to the ACMs, who in turn should communicate them timeously to their suppliers. The communication of real-time data and expected changes is vital, particularly when the ACMs' supplier lead times are lengthy. For example, if demand increases, the ACM's quick response could suffer and if demand decreases, the ACM could face the risk of obsolescence, should changes in demand not be communicated timeously. Closely related to this is the problem of incompatible information systems which are vital to the effective communication of real-time data and expected changes.

In the context of meeting quality requirements, it is noted that if lead times are too long ACMs might produce their products/service hastily, and this could impact on the ACMs' service and product quality. Smoothing demand and clear advance communication about demand and consequential order fluctuations are crucial, particularly when the lead times of ACMs' suppliers are lengthy.

Table 7.14g: Hypothesis 2: price of materials from the ACMs' suppliers (2.1.1.7) (N=respondents)

Problem	Spearman's rank-order correlation	Sig (2-tailed)	N
Operations process problems			
Capacity limitations due to customer order fluctuations	.339*	.035	39
Output based on (OEMs') customer forecasts to plan	.332*	.039	39
Customer-side problems			
Cancellation of orders (after the recent economic crisis)	.296*	.044	47
Pressure by OEMs to reduce prices	.462**	.001	46
Relationship with "worst 10%" of customers	.452**	.008	33
Little/no assistance from customers to comply with their requirements	.362*	.020	41

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 7.14g indicates a statistically significant correlation between the problem of the price of materials and other supply chain problems on both the operations and distribution side.

Operations process problems

There is a statistically significant correlation between the price of materials from ACMs' suppliers and capacity limitations due to customer order fluctuations. As indicated in table 7.14f, order fluctuations bring insecurity in the supply chain, which impacts on the ACMs' available capacity. Capacity problems due to order fluctuations may influence price. If demand increases rapidly a shortage of material may be experienced and this will increase material prices. Hence the capacity may be impaired by the shortage of material. When the orders decrease, this could also influence the purchase price of materials. For example, if the customer orders decrease, the ACM may not be able to take advantage of economies of scale, smaller order sizes will be placed at suppliers, which may result in higher prices (no quantity discounts) and more frequent deliveries, which will increase the price of materials.

The correlation of price of materials from the ACM's suppliers cannot be explained in terms of output based on (OEMs') customer forecasts to plan on the operations side. Further research would be needed to explain this correlation.

Customer-side problems

The statistically significant correlation between the price of materials from ACMs' suppliers and cancellation of orders may be explained as follows: cancellation of orders impacts negatively on an ACM's inventory levels and may influence its subsequent orders from its suppliers. If these decrease, the ACM may not be able to take advantage of economies of scale, smaller order sizes will be placed at suppliers, which may result in higher prices (no quantity discounts) and more frequent deliveries, which tend to increase the price of materials.

There is a statistically significant correlation between the price of materials from the ACMs' suppliers and pressure by OEMs to reduce prices. If an ACM wishes to reduce selling prices to OEMs, it needs to reduce its costs, which in turn would put pressure on its (the ACM's) suppliers to reduce the price of materials. However, this pressure on suppliers might not lead to price reduction since most of the products that ACMs purchase from their suppliers contain commoditised raw materials (eg steel). These prices tend to be internationally priced, that is, fixed by the London Metal Exchange and are therefore non-negotiable – hence their impact on the price of materials. ACMs are therefore in a difficult position and regard both the prices paid and pressure from OEMs to reduce selling prices to customers as significant problems.

Closely related to this is the relationship between the ACM and its customers. The inability of the ACM's supplier to reduce the price of materials may impact directly on the relationship between the ACM and its customers, who expect the ACM to reduce prices. This is evident from the fact that there is a relationship between material prices from suppliers and little/no assistance from customers to comply with their requirement.

Table 7.14h: Hypothesis 2: use of correct packaging material (by the ACM's suppliers) (2.1.1.8) (N=respondents)

Problem	Spearman's rank-order correlation	Sig (2-tailed)	N
Operations process problems			
Shortage of a key material	.379*	.042	29

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 7.14h indicates a statistically significant correlation between the problem of the use of correct packaging material and other supply chain problems on the operations side.

Operations process problems

From a logistics perspective, as indicated in section 4.4.5, packaging serves a dual role. The first role of packaging is to protect the product and ensure it is delivered in a usable form to the customer. The second function facilitates the storage and movement of products, which lowers material handling and distribution costs.

Regarding the statistically significant correlation between the problem of the use of correct packaging material and the shortage of a key material, an ACM may experience a stock out of a key material because (1) the ACM's supplier may not have the correct packaging material available or (2) goods could have been damaged in transit because of incorrect packaging. It should be noted that the problem of "use of correct packaging material by an ACM's supplier" had a mean ranking of 2.46, and therefore was not considered to be a significant problem.

Table 7.14i: Hypothesis 2: flexibility of (ACM's) suppliers (2.1.1.9) (N=respondents)

Problem	Spearman's rank-order correlation	Sig (2-tailed)	N
Operation process problems			
Balancing inventory levels	.419**	.008	39
Customer-side problems			
Incompatible information systems	.370*	.034	33

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 7.14i indicates a statistically significant correlation between the problem of flexibility of suppliers and other supply chain problems on both the operations side (balancing inventory levels) and the distribution side (incompatible information systems).

Operation process problems

Regarding the statistically significant correlation between the problem of the flexibility of the ACM's suppliers and the ACM balancing its inventory levels, one could argue that the more flexible an ACM's supplier is, less inventory the ACM has to carry, because "a flexible supplier" could also be "a reliable supplier". A flexible supplier is one that is able to react quickly to demand changes.

Customer-side problems

Regarding the statistically significant correlation between the problem of flexibility of the ACM's suppliers and incompatible information systems (customer side), one could infer that to be flexible and reliable the whole supply chain needs compatible information systems. This was identified as a significant problem among OEMs and ACMs during the first stage of the empirical research (sec 6.4.2) because OEMs and ACMs operate completely different ERP systems (some do not even have ERP systems but use Excel files). A main supply chain management problem for ACMs is the electronic/systems integration with customers and suppliers. This results in the ACM not being able to communicate vital demand information effectively and timeously to its suppliers.

Table 7.14j: Hypothesis 2: financial stability of (ACM's) suppliers (prior to the recent economic crisis) (2.1.1.10) (N=respondents)

Problem	**Spearman's rank-order correlation**	**Sig (2-tailed)**	**N**
Operations process problems			
Output based on rigid marketing forecasting	.470**	.008	31
Output based on customer (OEMs') forecasts to plan	.480**	.005	32
Capacity limitations due to customer order fluctuations	.442*	.013	31
Customer-side problems			
Order fluctuations (prior to the recent economic crisis)	.352*	.041	34
Little/no assistance from customers to comply with their	.581**	.000	32

requirements			
Rapid changes in demand (in terms of quantity) patterns	.402*	.022	32
Too dependent on the business of a particular customer	.372**	.047	29

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 7.14j indicates a statistically significant correlation between the problem of suppliers' financial stability (prior to the recent economic crisis) and other supply chain problems on both the internal operations and distribution side.

Operations process problems

There is a statistically significant correlation between the financial stability of the ACM's supplier (prior to the economic crisis), the output, based on rigid marketing forecasting (on the ACM side) and the output, based on customer forecasts to plan (supplier to OEMs). These correlations may be explained as follows. OEMs are the dominant parties in automotive supply and balance their production loading in advance. Based on this production loading, OEMs prepare a production schedule which is communicated to their suppliers (ACMs). ACMs, in turn, base their forecasting on this schedule and provide their supplier with this information. The findings of the first stage of the empirical research indicate that the financial viability of a supplier is vital. For example, the ACMs' output is based on the OEMs' forecast and rigid marketing forecasting. Should an ACM's supplier close down or not able to deliver because of a shortage of operational assets, this could impact on the ACM's production of parts and, in turn, result in the ACM not being able to meet its customers' orders.

There is a statistically significant correlation between the financial stability of ACM's suppliers and capacity limitations due to customer order fluctuations. As indicated previously, order fluctuations make the supply chain insecure, which impacts on the ACMs' available capacity. It could be argued that an ACM's supplier financial stability could be negatively affected when orders decrease.

Customer-side problems

For a supplier to survive in the future, it must have a viable business. The first stage of the empirical research study indicated (sec 6.4.1), that the playing field for the ACMs has changed over the last few years, because OEMs are now sourcing components globally at the lowest possible cost. One could therefore argue that South African ACMs need to compete with the best in the world from a cost and quality perspective (Maile 2008:8).

One could infer that order fluctuations and rapid changes in demand (in terms of quantity) patterns from OEMs may impact negatively on the financial stability of ACMs' suppliers. Order fluctuations influence the ACMs' order sizes for their suppliers. The problem of little/no assistance by the OEMs to comply with their requirements may be indicative of the fact that the ACM is left on a limb to fend for itself, should its (ACMs) suppliers find themselves unable to meet delivery commitments because of financial instability. OEMs do not become involved enough in the supply chain to assure the well-being of the whole supply chain, in this case, the well-being of second-tier suppliers.

The findings indicate that ACMs that are first-tier suppliers only are too dependent on the business of OEMs. The business risk increases when ACMs are more dependent on one customer's business. In this case, when ACMs are more dependent on one customer, they and their suppliers are at risk if a customer (OEM) closes down or cancels orders. This could lead to the financial bankruptcy of the first- and second-tier supplier.

Table 7.14k: Hypothesis 2: financial stability of (ACM's) suppliers (after the recent economic crisis) (2.1.1.11) (N=respondents)

Problem	**Spearman's rank-order correlation**	**Sig (2-tailed)**	**N**
Customer-side problems			
Incompatible information systems	.371**	.003	33

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 7.14k indicates a statistically significant correlation between the problem of the financial stability of suppliers (after the recent economic crisis) and customer-side problems. As indicated in section 7.5, the words "after the recent economic crisis" were used to emphasise the distinction before the onset of the global economic crisis and after the onset of the global economic crisis. In no way was it meant to imply that the crisis was over at the time (March/April 2009) of testing the questionnaire.

Customer-side problems

There are fewer statistically significant correlations between the financial stability of suppliers after the onset of the global economic crisis compared to the financial stability of suppliers before the onset of the global economic crisis, as outlined in table 7.14j. This could be attributed to the fact that the number of car sales have decreased significantly since the start of the economic crisis. OEMs have experienced order cancellations and they in turn have cancelled existing orders with their suppliers. Owing to the long lead time, ACMs could not cancel orders in time from their suppliers. As a direct result, ACMs held excessive inventory. Only then did ACMs realise the importance of a compatible information system in their supply chain. This may explain the statistically significant correlation between the financial stability of the ACMs' suppliers (after the onset of the global economic crisis) and incompatible information systems between the ACM and its customer. It emphasises the fact that communication of real-time data and expected changes in demand are necessary in the supply chain.

Table 7.14l: Hypothesis 2: supplier capacity limitations (2.1.1.12) (N=respondents)

Problem	**Spearman's rank-order correlation**	**Sig (2-tailed)**	**N**
Operations process problems			
Output based on rigid marketing forecasts	.473*	.006	32
Continuous improvement	.596**	.001	27
Customer-side problems			
Trust between you and your "best" customers	.514*	.012	23
Little/no assistance from customers to comply with their requirements	.391*	.020	35

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 7.14l indicates a statistically significant correlation between the problem of supplier capacity limitations and other supply chain problems on both the operations and distribution side.

Operations process problems

The problem of capacity limitations was dealt with in section 6.4.6 where it was indicated that there is a tendency among many suppliers to over commit themselves in terms of what they can actually deliver.

As indicated in table 7.14l, there is a statistically significant correlation between supplier capacity limitations and output based on rigid forecasts. One could infer that if a supplier faces capacity problems, this could impact on its ability to meet order deadlines. This, in turn, will impact on the ACM's output, which is based on rigid marketing forecasts.

There is a statistically significant correlation between supplier capacity limitations and continuous improvement. (Continuous improvement [CI] examines areas in which a business can make improvements.) CI, by its very nature, should involve the whole supply chain process, including all parties and activities in the supply chain. If the supplier experiences capacity problems, this could limit its ability to participate in and contribute to CI in the supply chain.

Customer-side problems

There is a statistically significant correlation between supplier capacity limitations and trust between the ACM and its customers. When customer demand increases (OEMs have to produce more motor cars), this will impact on their suppliers (ACMs) receiving additional orders to supply components/parts and will have a knock-on effect on their suppliers. One could argue that since ACMs and their suppliers cannot afford to lose any market share, rather than admit that they do not have the capacity to deliver in the short term, they will accept the order. This could impact negatively on their capacity limitations and also influence the ACMs' suppliers not being able to meet delivery deadlines to the ACMs. Ultimately, this could impact negatively on the trust between the ACM and its customer. The correlation between supplier capacity and little or no assistance from customers to comply with their requirements could be an indication that OEMs do not really become involved in all supply tiers (consult with them and collaborate to help them achieve an objective), particularly when their requirements/needs change.

Table 7.14m: Hypothesis 2: poor communication between ACMs and suppliers (2.1.1.13) (N=respondents)

Problem	Spearman's rank-order correlation	Sig (2-tailed)	N
Operations process problems			
Output based on rigid marketing forecasting	.431*	.017	30
Cooperation between functions in the company	.460*	.009	31
Customer-side problems			
Difficulty in meeting quality requirements	.508**	.005	29

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 7.14m indicates a statistically significant correlation between the problem of poor communication between ACMs and their suppliers and other supply chain problems on both the operations and distribution side.

Operations process problems

The statistically significant correlation between poor communication between the ACMs and its suppliers and output based on rigid marketing forecasting may be an indication that ACMs do not properly communicate changes in forecasts quickly enough to their suppliers.

The strong relationship/statistically significant correlation between poor communication between the ACM and its suppliers and cooperation between functions in the company may be an indication of poor communication throughout the supply chain, or at least in ACMs internally, and between ACMs and their suppliers. Communication is a basic requirement of the supply chain management philosophy.

Customer-side problems

Not only will poor communication between the ACMs and suppliers impact on the ACMs' service delivery to their customers, but the quality requirements of OEMs may also suffer.

ACMs do not effectively communicate their customers' quality requirements to their suppliers.

Table 7.14n: Hypothesis 2: BBBEE – achieving targets and verifying BEE scorecards (in respect of OEMs' target requirements) (2.1.1.15) (N=respondents)

Problem	**Spearman's rank-order correlation**	**Sig (2-tailed)**	**N**
Operations process problems			
Output based on customer (OEMs) forecasts to plan	.334*	.050	35
Reducing waste	-.390*	.027	32

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

OEMs as the major players in the automotive industry have BBBEE agreements with the government (Le Roux 2009:118). In terms of the agreements they must not only comply with BEE measures and targets but must also involve their suppliers and their suppliers' suppliers in this process. ACMs and their supplies must therefore also comply with BEE targets and use BEE scorecards. As indicated in section 2.4.4, the implementation of BBBEE and the use of the BEE scorecard can add to the cost of a product.

Table 7.14n indicates a statistically significant correlation between the problem of achieving targets and verifying BEE scorecards and the problem of output based on customer forecasts to plan as well as a statistically negative significant correlation between the BBBEE problem and reducing waste. The negative correlation with reducing waste could be explained by the fact that (1) it is time consuming to find BEE suppliers and verify scorecards; and (2) ACMs often pay price premiums by using BEE suppliers (because of preference points, possible delivery risks, quality problems and inefficiency in processes).

The correlation with output based on customer (OEMs') forecast to plan could be explained by the fact that it may be difficult and time consuming to find the ***right*** BEE suppliers and this may impact on the ACM's output on account of possible delivery risks, quality problems and inefficiency in the supplier's processes.

Table 7.14o: Hypothesis 2: incoming transportation – delays in off-loading vessels (due to congestion at the ports) (2.1. 2.1) (N=respondents)

Problem	Spearman's rank-order correlation	Sig (2-tailed)	N
Outbound logistics problems			
Increasingly high variable local days in transit	.629*	.021	13

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 7.14o indicates a statistically significant correlation between the problem of delays in off-loading vessels (due to congestion at the ports) and increasingly high variable local days in transit. However, as indicated in table 7.14o, (N=13), only 13 of the 53 respondents indicated increasingly high variable local days in transit to be a problem, on the ACM's distribution side. The problem relating to inefficiencies at ports was dealt with in section 3.11.1.2. It stands to reason that delays in off-loading vessels would increase local days in transit throughout the whole supply chain.

Table 7.14p: Hypothesis 2: incoming transportation – inefficient infrastructure at South African ports (2.1. 2.3) (N=respondents)

Problem	Spearman's rank-order correlation	Sig (2-tailed)	N
Outbound logistics problems			
Increasingly high variable local days in transit	.660*	0.10	14

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 7.14p indicates a statistically significant correlation between the problem of inefficient infrastructure at South African ports and increasingly high variable local days in transit. Table 7.14p, (N=14) shows that only 14 out of the 53 respondents indicated increasingly high variable local days in transit to be a problem, on the ACM's distribution side. The problem relating to inefficiencies at ports was dealt with in section 3.11.1.2. It stands to reason that inefficient infrastructure at ports would increase local days in transit throughout the whole supply chain.

Table 7.14q: Hypothesis 2: incoming transportation – inefficiency of South African port authority (2.1. 2.4) (N=respondents)

Problem	**Spearman's rank-order correlation**	**Sig (2-tailed)**	**N**
Customer-side problems			
Difficulty in meeting quality requirements	.420*	.033	26

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

The table 7.14q indicates a statistically significant correlation between the problems of the inefficiency of the South African port authority on the customer side. The port authority's inefficiency may delay incoming shipments. This will impact negatively on the ACMs in that they may have to rush to complete their customers' orders so that these can be delivered at the right time. Ultimately this could have a negative effect on quality. Another explanation could be the deterioration of materials because of delays at ports.

Table 7.14r: Hypothesis 2: incoming transportation – inefficient clearing of containers at South African ports (2.1. 2.5) (N=respondents)

Problem	**Spearman's rank-order correlation**	**Sig (2-tailed)**	**N**
Customer problems			
Difficulty in meeting quality requirements	.481*	.013	26

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

The table 7.14r indicates a statistically significant correlation between the supply chain problem of inefficient clearing of containers at South African ports and difficulty meeting quality requirements. The inefficient clearing of containers at South African ports increases lead time because additional time is wasted before imported goods can be received, unloaded and utilised in the production process. This has a negative impact on the ACMs' production processes in that they may rush to complete their customers' orders in order to meet delivery deadlines. This may have a negative effect on quality. Another explanation may be the deterioration of materials as a result of delays at ports.

Table 7.14s: Hypothesis 2: incoming transportation – processes at ports and borders (2.1. 2.6) (N=respondents)

Problem	Spearman's rank-order correlation	Sig (2-tailed)	N
Outbound logistics problems			
Increasingly high variable local days in transit	.667**	.009	14

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

The table 7.14s indicates a statistically significant correlation between the problem of processes at ports and borders and other related supply chain problems on the distribution side.

Outbound logistics problems

The problem relating to inadequate processes at ports for incoming goods from suppliers was dealt with in section 3.11.1. It stands to reason that inadequate processes at ports would increase local days in transit.

Table 7.14t: Hypothesis 2: incoming transportation – road delays (2.1. 2.8) (N=respondents)

Problem	Spearman's rank-order correlation	Sig (2-tailed)	N
Internal movement/ transportation problems			
Warehouse capacity	.465*	.033	21
Warehouse security	.651**	.000	26
Warehouse safety	.567**	.004	24
Warehouse maintenance	.431*	.045	22

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 7.14t indicates a statistically significant correlation between the problem of road delays of incoming goods from the supplier and other supply chain problems in ACMs' operations.

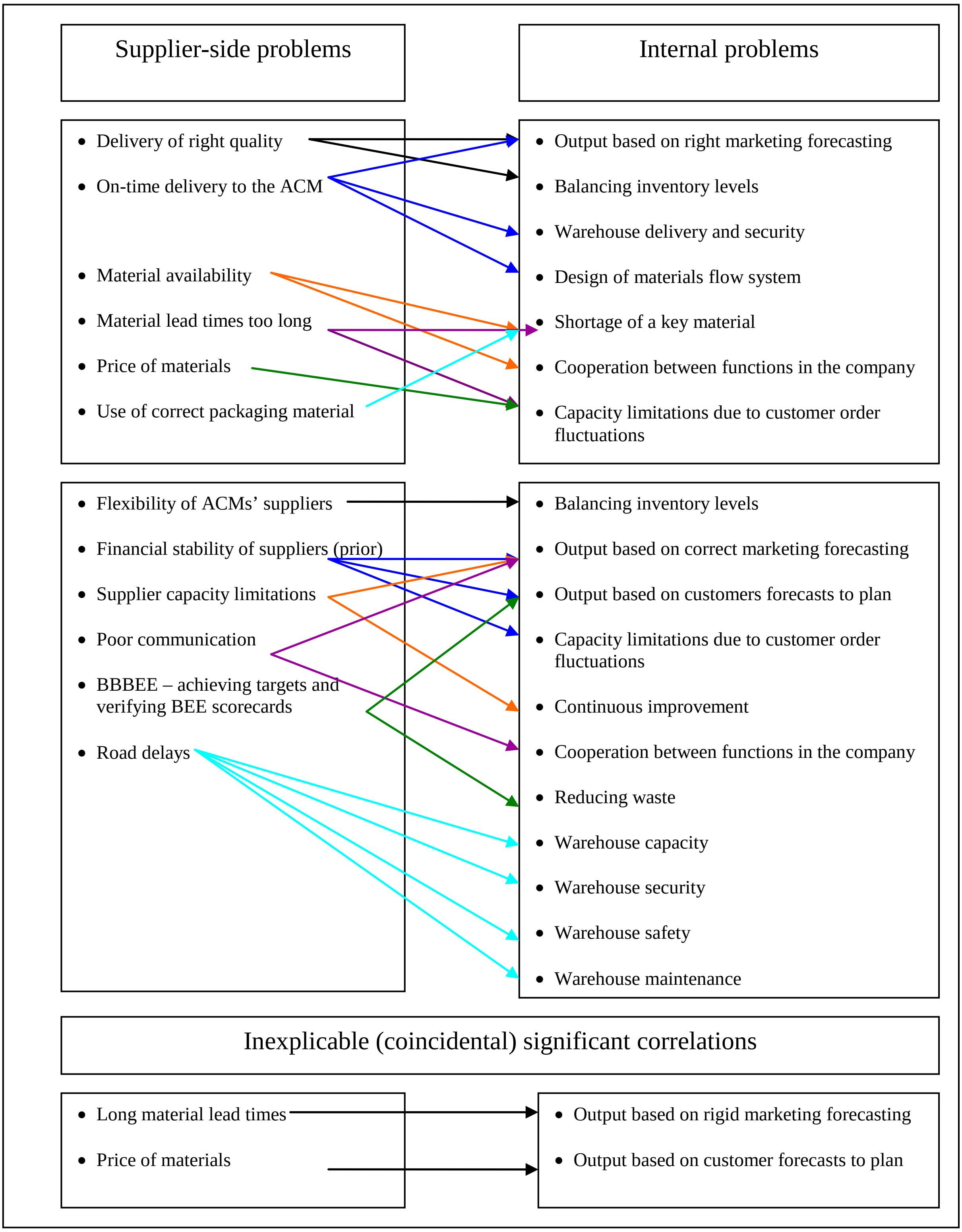
Internal movement/transportation problems

Warehouse management is one of the functions of supply chain management and is dealt with in section 4.4.6. The statistically significant correlation between road delays affecting incoming goods and warehouse capacity, security, safety and maintenance could be explained by the fact that deliveries to warehouses are generally scheduled. When there are delays on the roads, consignments may arrive late and thus miss their assigned delivery time. This, in turn, causes congestion at the warehouse and has a negative impact on the capacity of and security and safety at warehouses.

In conclusion, tables 7.14a to 7.14t indicate that there are statistically significant correlations between problems on the supply-side and internal operations and problems on the supply-side and customer-side.

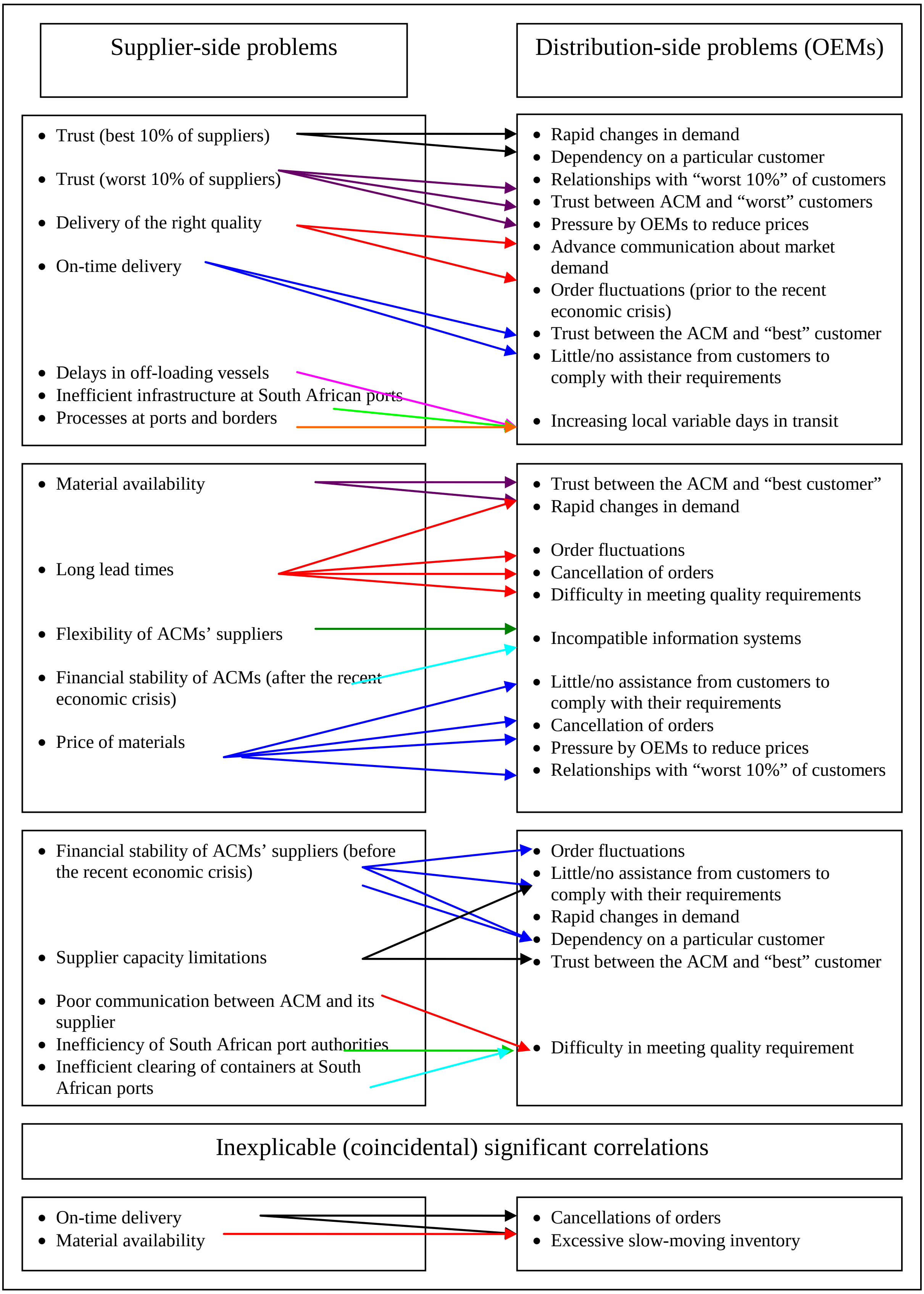
Figures 7.2, 7.3 and 7.4 highlight the significant correlations that are meaningful in this study. For the sake of clarity, figures 7.2 and 7.3 are replicated and split into two sections, grouping the correlations together. Figure 7.4 indicates the problems on the supply-side that correlate with problems in internal operations and problems on the customer-side.

Figure 7.2: Correlations between suppliers and ACM internal supply chain problems



Source: Compiled by researcher

Figure 7.3: Correlations between suppliers and customer problems of ACMs



Source: Compiled by researcher

Figure 7.4: Correlations between supply chain problems, ACMs and customers[2] (including problems' mean ranking)

Supply-side problems (ACMs' suppliers)	Problems in internal operations (ACM)	Customer-side problems (ACMs' customers)
Delivery of right quality (3.28)	Output based on rigid forecasting (3.39) Balancing inventory levels (3.91)	Advance communication about market demand (4.15) Order fluctuations (3.68)
On-time delivery (3.12)	Output-based customer forecasts to plan (4.20) Design of materials flow system (3.52) Warehouse security (3.06) Warehouse safety (2.46)	Trust "best" customers (2.36) Little/no assistance from customers (3.79) Cancelation of orders (5.02) Excessive inventory (4.83)
Material availability (2.98)	Shortage of a key material (3.03) Cooperation between functions (2.65)	Trust "best" customers (2.36) Rapid changes in demand (4.18) Excessive inventory (4.83)
Long lead times (4.02)	Output based on rigid forecasting (3.39) Shortage of a key material (3.03) Capacity limitations – order fluctuations (4.05)	Order fluctuations (3.68) Cancellation of orders (5.02) Meeting quality requirements (2.32) Incompatible information systems (3.06) Rapid changes in demand (4.18)
Purchasing price of materials (4.38)	Capacity limitations due to customer order fluctuations (4.05) Output based on customer forecasts (4.20)	Cancelation of orders (5.02) Reducing prices (5.51) Relationship "worst" customers (4.12) Little/no assistance from customers (3.79)
Financial stability of suppliers (prior to the recent economic crisis) (3.06)	Output based on marketing forecasting (3.39) Output based on customer forecasts to plan (4.20) Capacity limitations (4.05)	Order fluctuations (3.68) Little/no assistance from customers (3.79) Rapid changes in demand (4.18) Dependency on a particular customer (4.15)
Supplier capacity limitations (3.05)	Output based on marketing forecasting (3.39) Continuous improvement (3.45)	Trust between ACM and "best" customers (2.36) Little/no assistance from customers (3.79)

Source: Compiled by researcher

[2] The figure above indicates that items on the supply-side (ACMs' suppliers) correlate with problems in internal operations and customer-side problems.
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7.6.3 Hypothesis 3

H_{03}: Relationships between ACMs and their suppliers are not a significant SCM problem.

H_{a3}: Relationships between ACMs and their suppliers are a significant SCM problem.

A binomial test was used to test whether the problems relating to the relationships between ACMs and their suppliers were significant. The test determines whether the proportion of respondents in two groups was equal or significantly different. In table 7.7, the problems were ranked from a greater to a lesser extent. The two groups were formed by grouping responses 1 and 2 (lesser extent) together, coded as a 1 (category 1), and 3, 4, 5, 6 and 7 (greater extent) together, coded as a 2 (category 2). In this way it was possible to determine whether a problem was perceived as being significant (the proportion of "greater extent" responses) or not, as indicated in table 7.15. The test results are included as appendix D.

The problems identified on the supply side (from the ACMs' suppliers) under the subsection dealing with supplier relationship problems were used to test the hypothesis.

Table 7.15: Hypothesis 3: binomial results supplier-side problems (N=53)

	Frequency testing	**Mean**
	Supplier-side problem	
2.1.1.1	Trust between you and your "best 10%" of suppliers	2.78
2.1.1.2	Trust between you and your "worst 10%" of suppliers	3.73
2.1.1.3	Delivery of the right quality from suppliers	3.28
2.1.1.4	On-time delivery from suppliers	3.12
2.1.1.5	Material availability from suppliers	2.98
2.1.1.6	Material lead times (too long) from suppliers	4.02
2.1.1.7	Price of materials from suppliers	4.38
2.1.1.8	Use of correct packaging material from suppliers	2.46
2.1.1.9	Flexibility of ACMs' suppliers	3.33
2.1.1.10	Financial stability of suppliers (prior to the recent economic crisis)	3.06
2.1.1.11	Financial stability of suppliers (after the recent economic crisis)	4.09
2.1.1.12	Supplier capacity limitations	3.05
2.1.1.13	Poor communication between the ACM and its supplier	2.57
2.1.1.14	Suppliers do not have ISO14001 accreditation	3.34
2.1.1.15	BBBEE – achieving and verifying BEE scorecards by ACMs	4.29

Binomial tests

	Category	N	Observed prop	Test prop	Asymp Sig (2-tailed)	Statistical significance (p < 0.05)
2.1.1.1	1	16	.59	.50	.442[a]	Not significant
	2	11	.41			
Total		27	1.00			
2.1.1.2	2	34	.77	.50	.000[a]	Significant
	1	10	.23			
Total		44	1.00			
2.1.1.3	1	15	.38	.50	.154[a]	Not significant
	2	25	.63			
Total		40	1.00			
2.1.1.4	1	16	.38	.50	.164[a]	Not significant
	2	26	.62			
Total		42	1.00			
2.1.1.5	1	19	.46	.50	.755[a]	Not significant
	2	22	.54			
Total		41	1.00			
2.1.1.6	1	14	.30	.50	.011[a]	Significant
	2	32	.70			
Total		46	1.00			
2.1.1.7	2	39	.78	.50	.000[a]	Significant
	1	11	.22			
Total		50	1.00			
2.1.1.8	2	15	.43	.50	.500[a]	Not significant
	1	20	.57			
Total		35	1.00			
2.1.1.9	2	29	.63	.50	.104[a]	Not significant
	1	17	.37			
Total		46	1.00			
2.1.1.10	1	18	.50	.50	1.000[a]	Not significant
	2	18	.50			
Total		36	1.00			

2.1.1.11	2	36	.84	.50	.000[a]	Significant
	1	7	.16			
Total		43	1.00			
2.1.1.12	2	24	.62	.50	.200[a]	Not significant
	1	15	.38			
Total		39	1.00			
2.1.1.13	2	19	.51	.50	1.000[a]	Not significant
	1	18	.49			
Total		37	1.00			
2.1.1.14	1	16	.46	.50	.736[a]	Not significant
	2	19	.54			
Total		35	1.00			
2.1.1.15	2	32	.78	.50	.000[a]	Significant
	1	9	.22			
Total		41	1.00			

Only the results in table 7.15 that were statistically significant will be dealt with below.

- **Trust between the ACMs and their worst 10% of suppliers**

Regarding trust between the ACMs and their worst 10% of suppliers (3.73), 23% of responding ACM companies indicated this problem to be to a lesser extent and 78% to a greater extent. The conclusion can therefore be drawn that trust between ACMs and their worst 10% of suppliers is a significant problem.

Supplier relationships were dealt with in section 3.6. There are three types of relationships, namely transactional, collaborative and alliance. As shown in figure 3.4, the level of trust in transactional relationships was identified as low. One could argue that the reason for trust between the ACM and its worst supplier could be the transactional basis of the relationship (discussed in sec 3.6.2.1). Also, it could be reasoned that the supplier may have been ranked as “worst” because of its lack of performance in terms of cost, quality, reliability and/or meeting environmental requirements.

- **Long material lead times from suppliers**

Regarding material lead times from suppliers being too long (4.02), 70% of responding companies indicated this problem to be to a greater extent. Lead time is the period taken to obtain a product from the time the need is recognised to when it is delivered. Lysons and Gillingham (2003:281) argue that consistency of lead time is more important than its actual length. Hence in the context of this study, if suppliers do not deliver consistently this could result in ACMs increasing their safety stock holding. Excessive stock holding, in turn could lead to obsolescence. The empirical study revealed that ACMs tend to carry excessive slow-moving stock which could become obsolete because demand is currently low.

- **Price of materials from suppliers**

In terms of the price of materials (4.38) purchased from suppliers, 78% of the responding companies indicated this problem to be to a greater extent. As discussed in the literature review, (sec 2.2.2) in order to survive, it is vital for OEMs to keep costs down. Currently, OEMs face a mature market, with stagnant demand, an oversupply of motor vehicles and tough price competition. OEMs therefore have to lower their production costs. Hence OEMs are putting pressure on ACMs to reduce prices (which ranked 5.51 in table 7.11). This may explain why the problem of the price of materials from suppliers (identified by ACMs) is so significant.

- **Financial stability of suppliers (before and after the recent economic crisis)**

The financial stability of suppliers (after the recent economic crisis) was perceived to be a greater problem than (before the recent economic crisis) because the groups changed their rating from category 1 (50%) to 16% and category 2 (50%) to 84%. This result indicates that the economic crisis has had a significant impact on suppliers' financial stability. The stability and viability of suppliers in the supply chain was identified as vital by OEMs during the first stage of the empirical research (sec 6.4.5).

- **BBBEE – achieving and verifying BEE scorecards by ACMs**

With regard to the BBBEE – achieving and verifying BEE scorecards by ACMs (4.29), 22% of the responding companies indicated this problem to be to a lesser extent and 78% to a greater extent. As discussed in the literature review (sec 2.4.4) and the first stage of the empirical research (sec 6.6.3), OEMs (ACMs' customers) require their suppliers (ACMs) to meet certain BBBEE compliance criteria as per the codes laid down. A key element is the BBBEE rating of suppliers according to the BEE scorecard. In order to achieve the compliance criteria, ACMs, in turn, need to put pressure on their suppliers and require them to provide BEE scorecards. These scorecards' measurements have to be verified by a rating agency that simply audits the scorecard and supporting documentation. OEMs have engaged rating agencies to verify their scorecards and can therefore only count ACMs' BBBEE compliance if their scorecard has been verified by a rating agency.

To conclude this section, (table 7.15), it is interesting to note that five out of the 15 supplier relationship problems were perceived by a majority of the respondents to be a significant problem. (The binomial tests are included as appendix D.)

7.6.4 Hypothesis 4

$H_{04:}$ Relationships between ACMs and their customers are not a significant SCM problem.
H_{a4}: Relationships between ACMs and their customers are a significant SCM problem.

A binomial test was used to test whether the problems relating to the relationships between ACMs and their customers were statistically significant. The test determines whether the proportion of respondents in two groups was equal or significantly different. In table 7.11, the problems were ranked in order of "to a greater extent" to "to a lesser extent". The two groups were formed by grouping responses 1 and 2 (lesser extent) together, coded as a 1 (category 1), and 3, 4, 5, 6 and 7 (greater extent) together, coded as a 2 (category 2). The test makes it possible to determine whether a problem was perceived to be significant (the proportion of "greater extent" responses) or not as indicated in table 7.16. (The test results are included as appendix D.)

Table 7.16: Hypothesis 4: binomial results customer-side problems (N=53)

	Frequency testing	**Mean**
	Customer-side problems	
2.3.1.1	Relationship with "best 10%" of customers	2.50
2.3.1.2	Relationship with "worst 10%" of customers	4.12
2.3.1.3	Trust between you and your "best" customers	2.36
2.3.1.4	Trust between you and your "worst" customers	4.13

2.3.1.5	Advance communication about market demand	4.15
2.3.1.6	Order fluctuations (prior to the recent economic crisis)	3.68
2.3.1.7	Cancellation of orders (after the recent economic crisis)	5.02
2.3.1.8	Excessive slow-moving inventory due to cancellations of orders	4.83
2.3.1.9	Difficulty in meeting quality requirements	2.32
2.3.1.10	Pressure by OEMs to reduce prices	5.51
2.3.1.11	Little/no assistance from customers in complying with their requirements	3.79
2.3.1.12	Incompatible information systems	3.06
2.3.1.13	Expectations of customers to comply with new technology are too high	3.30
2.3.1.14	Rapid changes in demand (in terms of quantity) patterns	4.18
2.3.1.15	Too dependent on the business of a particular customer	4.15

Binomial tests

		Category	N	Observed prop	Test prop	Asymp sig (2-tailed)	Statistical significance (p < 0.05)
2.3.1.1		1	15	.58	.50	.557[a]	Not significant
		2	11	.42			
	Total		26	1.00			
2.3.1.2		1	6	.18	.50	.000[a]	Significant
		2	28	.82			
	Total		34	1.00			
2.3.1.3		1	15	.60	.50	.424	Not significant
		2	10	.40			
	Total		25	1.00			
2.3.1.4		1	9	.23	.50	.001[a]	Significant
		2	30	.77			
	Total		39	1.00			
2.3.1.5		1	7	.17	.50	.000[a]	Significant
		2	34	.83			
	Total		41	1.00			
2.3.1.6		1	16	.36	.50	.096[a]	Not significant
		2	28	.64			
	Total		44	1.00			
2.3.1.7		2	44	.90	.50	.000[a]	Significant
		1	5	.10			
	Total		49	1.00			

2.3.1.8	1	6	.13	.50	.000[a]	Significant
	2	41	.87			
Total		47	1.00			
2.3.1.9	1	20	.65	.50	.150[a]	Not significant
	2	11	.35			
Total		31	1.00			
2.3.1.10	2	45	.92	.50	.000[a]	Significant
	1	4	.08			
Total		49	1.00			
2.3.1.11	1	11	.26	.50	.002[a]	Significant
	2	32	.74			
Total		43	1.00			
2.3.1.12	2	22	.61	.50	.243[a]	Not significant
	1	14	.39			
Total		36	1.00			
2.3.1.13	1	12	.36	.50	.163[a]	Not significant
	2	21	.64			
Total		33	1.00			
2.3.1.14	1	8	.18	.50	.000[a]	Significant
	2	36	.82			
Total		44	1.00			
2.3.1.15	2	29	.71	.50	.012[a]	Significant
	1	12	.29			
Total		41	1.00			

a Based on Z approximation

Only the results in table 7.16 that were statistically significant are dealt with.

- **Relationship with "worst 10%" of customers**
- **Trust between you and your "worst" customers**
- **Little/no assistance from customers in complying with their requirements**

Regarding the problem of the relationship with "worst 10%" of customers (4.12), 82% of the responding ACMs indicated that this was a problem to a greater extent. Regarding the problem of trust between the ACM and its "worst" customers (4.13), 77% of the responding

ACMs indicated that this was a problem to a greater extent. Regarding the problem of little/no assistance from customers in complying with their requirements (3.79), 74% of the responding ACMs indicated that this was a problem to a greater extent.

- **Advance communication about market demand**

As for the problem of advance communication by OEMs to ACMs about required market demand (4.15) is concerned, 83% of the responding ACMs indicated that this was a problem to a greater extent. Since OEMs are the dominant parties in the automotive supply chain and therefore drivers of the supply chain, they operate closely with the final consumer in the supply chain. They conduct research on technology, market trends and economic indicators, and should communicate this information continuously to their supply chain partners higher up in the supply chain.

- **Cancellations of orders**

Cancellation of orders (after the recent economic crisis) was a significantly (5.02) greater problem than order fluctuations (prior the recent economic crisis) (3.68). These two problems were compared and indicate that the cancellation of orders had become a greater problem since the start of the global economic crisis. As indicated in table 7.16, the binomial tests show that the percentage of responding ACMs' responses changed from 64% to 90% and that this was a problem to a greater extent. This indicates that as a direct result of the economic crisis, ACMs' customers had cancelled orders.

- **Excessive slow-moving inventory**

Excessive slow-moving inventory due to cancellation of orders was a significant supply chain problem (4.83) because 87% of responding ACMs indicated that this was a problem to a greater extent. Inventory is fundamental in the majority of supply chains. As indicated in the literature review (sec 3.5), one of the dimensions of supply chain management is inventory. The main aim of inventory holding in the supply chain is to keep the inventory as low as possible throughout the supply chain in order to limit the total cost of ownership in the supply chain.

- **Pressure by OEMs to reduce prices**

Regarding pressure by OEMs (ACMs' customers) to reduce prices (5.51), 92% of responding ACMs indicated that this was a problem to a greater extent. As discussed in the literature review (sec 2.2.2), OEMs face a mature market, with stagnant demand, an oversupply of motor vehicles and tough price competition. It is thus imperative for them to keep costs down, and as a direct result, OEMs put pressure on ACMs to reduce the prices of purchased goods. As discussed in hypothesis 3, ACMs, in turn, put pressure on their suppliers to purchase at a lower cost, materials that go into the components they assemble/manufacture.

- **Rapid changes in demand**

The problem of rapid changes in demand is also a significant supply chain problem (4.18). As discussed in the literature review (sec 3.5) and the first stage of the empirical research (sec 6.5.2.1), one of the participating OEMs indicated that it needs to balance production three months ahead, and on the basis of this, the production schedule is prepared. ACMs base their production schedules on the OEM's production schedule. ACMs and their suppliers therefore work on these three months ahead of schedule. If the demand for motor cars suddenly declines, the OEMs cancel orders immediately while the suppliers are in the process of working three months ahead. This leads to excessive pipeline inventory which is to the detriment of all parties higher up in the supply chain.

- **Too dependent on the business of a particular customer**

The risks attached to a captive supplier, from the OEMs' perspective, were briefly dealt with in section 6.4.5. The examples emphasise the risks attached to a captive supplier, which are also problematic or risky from the ACMs' perspective because they are too dependent on one or two customers. As shown in table 7.16, the problem of ACMs being too reliant on business of a particular customer had a mean ranking of 4.15. As indicated in table 7.6, the majority of responding ACMs' target customers were OEMs (20.8% supplying between 81% and 99% of their total sales to OEMs). As shown in table 7.16, 82% of the responding ACMs indicated this problem to be to a greater extent.

To conclude this section, (table 7.16), it is interesting to note that nine out of the 15 customer relationship problems were perceived by the majority of respondents to be significant problems. On the whole, one could assume that, in general, relationships between ACMs and their customers are a statistically significant SCM problem because 12 out of the 15 factors scored a mean of well above 3. For nine of the 15 problems, the proportions were statistically significant at the 5% level, with the highest portion in the second group. Worth mentioning are the supply chain problems of (1) pressure by OEMs to responding ACMs to reduce selling prices; (2) cancellation of orders by customers because of the decline in demand of car sales; and (3) because of cancellations by customers, responding ACMs were holding excessive slow-moving inventory.

7.6.5 Hypothesis 5

H_{05}: Technological advancement/or outdated processes are not a significant supply chain problem for ACMs.

$H_{a5:}$ Technological advancement/or outdated processes are a significant supply chain problem for ACMs.

A binomial test was used in order to test whether the problems relating to technological advancement/or outdated processes were a significant problem for ACMs. The test determines whether the proportion of respondents in two groups is equal or significantly different. Table 7.9 and 7.10 ranked these problems in descending order. The two groups were formed by grouping responses 1 and 2 (lesser extent) together, coded as a 1 (category 1), and 3, 4, 5, 6 and 7 (greater extent) together, coded as a 2 (category 2). The test enables one to determine whether a problem was perceived as being significant (the proportion of "greater extent" responses) or not, as indicated in table 7.17. (The test results are included as appendix D.)

Table 7.17: Hypothesis 5: binomial results technology-related problems (N=53)

	Frequency testing	**Mean**
	Technology-related problem	
2.2.1.7	Outdated technology	3.38
2.2.1.8	Cost of replacing outdated technology	4.79
2.2.1.10	Integrating technology with suppliers and customers	3.67
2.2.1.17	Capacity limitations due to outdated machinery	3.34
2.2.1.18	Capacity limitations due to capital funding	4.21
2.2.2.2	Outdated transport equipment	2.70
2.2.2.3	Outdated warehouse equipment	2.72

Binomial tests

	Category	N	Observed prop	Test prop	Asymp sig (2-tailed)	Statistical significance (p < 0.05)
2.2.1.7	2	19	.59	.50	.377[a]	Not significant
	1	13	.41			
Total		32	1.00			
2.2.1.8	2	33	.85	.50	.000[a]	Significant
	1	6	.15			
Total		39	1.00			
2.2.1.10	2	29	.74	.50	.003[a]	Significant
	1	10	.26			
Total		39	1.00			
2.2.1.17	2	20	.69	.50	.061[a]	Not significant
	1	9	.31			
Total		29	1.00			
2.2.1.18	2	24	.86	.50	.000[a]	Significant
	1	4	.14			
Total		28	1.00			
2.2.2.2	1	14	.52	.50	1.000[a]	Not significant
	2	13	.48			
Total		27	1.00			
2.2.2.3	1	13	.45	.50	.711[a]	Not significant
	2	16	.55			
Total		29	1.00			

a Based on Z approximation.

Only results in table 7.17 that are statistically significant are dealt with. The findings in table 7.17 indicate that the ***cost*** of replacing outdated technology (mean ranking 4.79) and capacity limitations due to capital funding (mean ranking 4.21) were significant problems. As shown in table 7.17, regarding the cost of replacing outdated technology, 15% of the responding companies indicated this problem to be to a lesser extent and 85% to a greater extent. Regarding the problem of capacity limitations due to capital funding, the binomial test indicated that 14% of the responding companies indicated this problem to be to a lesser extent and 86% to a greater extent.[3]

In terms of the problem of integrating technology with suppliers and customers (3.67), 26% of the responding companies indicated this problem to be to a lesser extent and 74% to a greater extent. From table 7.17 it is clear that this is a significant problem. This problem was also identified during the first stage of the empirical research study and was dealt with in section 6.4.2, with OEMs indicating that ACMs operate completely different ERP systems, which was a problem for them.

However, table 7.16 indicated that ACMs did ***not*** regard "incompatible information systems with their customers (OEMs)" as a significant problem. By contrast, ACMs also indicated in table 7.16 that "advanced communication about market demand" was a significant problem. It would appear that ACMs did not regard information systems as an important tool for communication. This could also explain why ACMs did not regard "poor communication with suppliers" as a significant problem (see table 7.15).

To conclude this section (table 7.17), it is interesting to note that the respondent groups perceived three out of eight problems relating to technology to be significant.

7.6.6 Hypothesis 6

H_{06}: The number of years a business has been supplying its target market has no bearing on the supply challenges it faces.

H_{a6}: The number of years a business has been supplying its target market does have a bearing on the supply chain challenges it faces.

The objective of hypothesis 6 was to determine whether the age of a company plays a significant role in the type of supply chain problems it faces. The Kruskal-Wallis test was used to determine whether the age of the businesses had an effect on the extent of supply chain problems ACMs face. The test identified two significant problems, namely "Output

[3] Outdated technology was not a significant problem (table 7.17).

based on rigid marked forecasting" and "integrating technology with suppliers and customers". This is indicated in Table 7.18. (The test results are included as appendix E.)

Table 7.18: Hypothesis 6: Kruskal-Wallis results (N=53)

Test Statistics[a,b]

	2.2.1.1 Output based on rigid marketing forecasting
Chi-square	13.362
Df	6
Asymp sig	.038

	2.2.1.9 Integrating technology with suppliers and customers
Chi-square	12.914
Df	6
Asymp sig	.044

a Kruskal-Wallis test
b Grouping variable: age cat

The Kruskal-Wallis table gives the chi-square value, degree of freedom and significance (Coakes et al 2006:168). The values indicate that "Output based on rigid marked forecasting" and "Integrating technology with suppliers and customers" did differ significantly across the age of a business at the 5% level of significance ($p < 0.05$).

These supply chain problems scored the following mean ranking in the frequency tests:

- output based on rigid marketing forecasting (table 7.9) **3.39**
- integrating technology with suppliers and customers (table 7.9) **3.67**

It should be noted that the hypothesis only tests whether there was a statistically significant difference between the age of a business in relation to the extent of the supply chain problems facing the business.

In view of the fact that out of all the identified supply chain problems faced by responding ACMs, the Kruskal-Wallis test identified only two problems that differed statistically significantly with regard to the age of a business. One could conclude that, in general, the age of a business does not impact on the supply chain challenges it faces. However, this result should also be viewed in the light of the profile of the responding companies, where 88.7% were older than ten years, 62.2% older than 20 years and 45.2% older than 30 years.

7.6.7 Hypothesis 7

H_{07}: The size of a business (in terms of the number of employees it has) has no bearing on the supply challenges it faces.

H_{a7}: The size of a business (in terms of the number of employees it has) does have a bearing on the supply chain challenges it faces.

The objective of hypothesis 7 was to determine whether the size of a business (the number of employees) impacts on the supply chain challenges it faces. The Kruskal-Wallis test was used to determine whether the size of a business does have an effect on the extent of supply chain problems it faces. The test results are included as appendix F. As indicated in this appendix, the Kruskal-Wallis test identified no statistically significant difference between the business size categories with regard to the extent the businesses perceive problems.

One could therefore conclude that, in general, the number of employees or the size of a business does not impact on the extent of the supply chain challenges it faces.

This concludes the third part of the analysis of data, namely the testing of the hypotheses formulated.

7.7 CONCLUSION

This chapter gave an in-depth discussion of the analysis and validation of the data collected from the questionnaires. The data were analysed by means of descriptive statistics and nonparametric analysis. Sections 7.4 and 7.5 summarised the findings with regard to the objectives of the study and the hypotheses that were formulated.

The findings indicate that 39.6% of respondents were employed at executive level and the remainder at other levels of management, but all involved in supply chain issues.

According to the findings, the responding ACMs were mature and well established and located in various geographic areas such as Gauteng, KwaZulu-Natal, the North West, the Eastern Cape and the Western Cape. The majority of their target customers were OEMs followed by OESs and the aftermarket.

In terms of ranking the problems, the findings indicate that the main problems facing ACMs were as follows: pressure by OEMs to reduce prices (5.51), table 7.11; cancellation of orders (after the economic crisis) (5.02), table 7.11, which resulted in excessive inventories (4.83), table 7.11; the cost of replacing outdated technology (4.79), table 7.9; the purchasing price of materials from suppliers (4.38), table 7.7; achieving BEE scorecards (4.29), table 7.7; and the non reliability of rail transport (4.80), table 7.12.

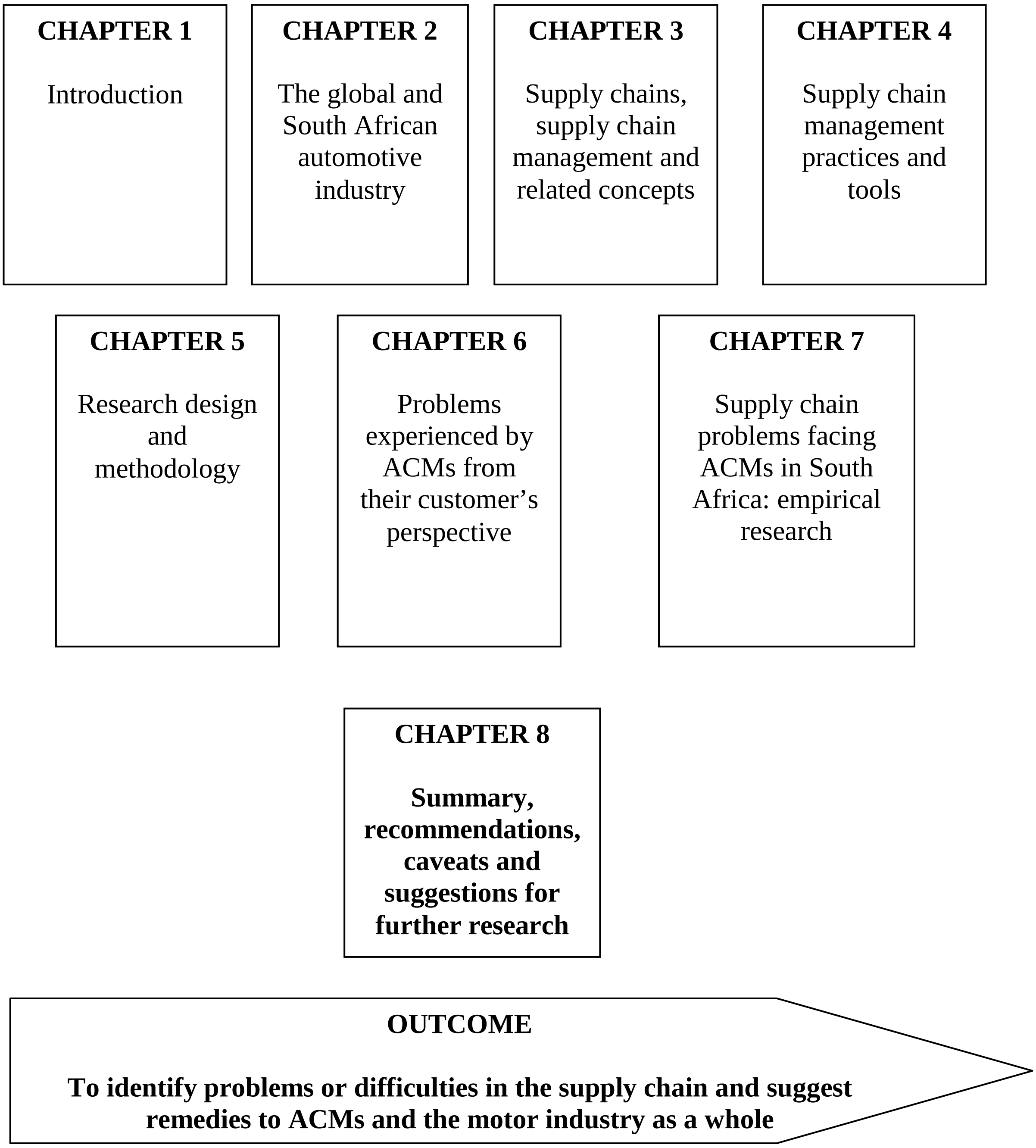
In terms of the hypothesis testing, the findings indicate that from a geographic perspective, one could conclude that the responding ACMs faced supply chain problems to the same extent. In general, the number of years a business had been supplying the target market had no bearing on the supply chain problems facing it. One could also conclude that the size of a business did not impact on the supply chain challenges ACMs face.

The findings further revealed significant problem areas in the relationships between ACMs and their suppliers and between ACMs and their customers. The following problem areas were evident on the supply side (table 7.15): trust between the ACMs and their suppliers (3.73); long material lead times (4.02); the price of materials (4.38); the financial stability of suppliers (after the recent economic crisis) (4.09); and achieving and verifying BEE scorecards (4.29). On the customer side (table 7.16), the following problem areas emerged: pressure by OEMs to reduce prices (5.51); cancellation of orders (after the recent economic crisis (5.02); relationships with worst customers (4.12); trust between the ACM and its "worst" customers (4.13); advance communication about market demand (4.15); excessive slow-moving inventory due to cancellations of orders (4.83); rapid changes in demand (4.18); and dependency on the business of a particular customer (4.15).

In addition, one could conclude that there were statistically significant correlations between certain problems experienced throughout the supply chain.

Once all secondary objectives had been achieved, the researcher was able to identify and suggest remedies to ACMs and the motor industry as a whole to overcome the problems identified (the outcome of the study). Recommendations will be made and final conclusions drawn in chapter 8.

This concludes the analysis of the findings section. Chapter 8 deals with the recommendations based on the findings of the research study, the limitations of the study, directions for future research and the contribution of research study.


CHAPTER 1
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OUTCOME
To identify problems or difficulties in the supply chain and suggest remedies to ACMs and the motor industry as a whole

CHAPTER 8

SUMMARY, RECOMMENDATIONS, CAVEATS AND SUGGESTIONS FOR FUTURE RESEARCH

8.1 INTRODUCTION

The primary objective of this research study was to identify the supply chain problems facing South African ACMs. Once the supply chain problems had been identified, (1) the extent and significance of these problems was determined by using descriptive statistics and rankings; and (2) the significance of the relationships (correlations) between problems in the supply chain was determined and further explained where possible. The Kruskal-Wallis test was used to (1) determine whether the geographic locations of the ACMs had an effect on the extent of the supply chain problems facing them, (2) these problems were compared with regard to the age and size of the business in order to determine whether the factors had an impact on an ACM's problems.

The aim of this chapter is to identify and suggest possible solutions to ACMs and the motor industry as a whole to overcome the problems identified. The findings of the ranking of supply chain problems faced by ACMs are highlighted below, including suggested recommendations to ACMs and the motor industry as a whole on how these problems could be resolved. Important correlations will also be highlighted to show the impact of decisions or problems in one part of the supply chain on other parts or problems in the supply chain.

The limitations of the study will be discussed and the way forward for future research in terms of the findings.

8.2 DISCUSSION OF AND RECOMMENDATIONS REGARDING THE MAIN IMPORTANT FINDINGS AS RANKED IN THE STATISTICAL ANALYSES

8.2.1 Findings on the most significant supply chain problems

The primary aim of this study was to identify and determine the extent of the supply chain problems facing South African ACMs. Chapter 7 presented the results of the analysis of the data obtained from the questionnaires and discussed the findings. This section includes recommendations on how these issues could be addressed.

A binomial test was used to determine whether a problem was perceived as being significant (the proportion of "greater extent" responses) or not. It is deemed that all problems with a mean ranking of above 4 have been tested significant. These are listed in table 8.1.

Table 8.1: Supply chain problems with a mean ranking of >4

	Problem	Mean
1	Pressure by OEMs to reduce prices	5.51
2	Cancellation of orders (after the recent economic crisis)	5.02
3	Excessive slow-moving inventory due to the cancellation of orders	4.83
4	Unreliability of rail transport	4.80
5	Cost of replacing outdated technology	4.79
6	Rail capacity problems in terms of inefficient infrastructure and technology	4.50
7	Purchasing price of materials	4.38
8	BBBEE – achieving and verifying BEE scorecards (in respect of OEMs' target market)	4.29
9	Capacity limitations due to capital funding	4.21
10	Output based on customer (OEMs) forecasts to plan	4.20
11	Rapid changes in demand (in terms of quantity patterns)	4.18
12	Labour problems – availability of skills	4.16
13	Advance communication about market demand	4.15

14	Too dependent on business of a particular customer	4.15
15	Trust between you and your “worst” customers	4.13
16	Relationship with “worst 10%” of customers	4.12
17	Financial stability of suppliers (after the recent economic crisis)	4.09
18	Labour problems – time consuming to resolve	4.08
19	Capacity limitations due to order fluctuations	4.05
20	High cost of South African ports	4.05
21	Material lead times too long resulting in obsolescence	4.02

8.2.2 Recommendations on how supply chain problems could be overcome

The problems listed in table 8.1 were grouped together according to the external environment, the supply chain environment and the internal environment in order to make holistic recommendations. These categories are reflected in tables 8.2, 8.3 and 8.4 respectively. Each environment will be dealt with individually and appropriate recommendations made.

8.2.2.1 The external environment

The problems identified in the external environment are listed in table 8.2. Recommendations for the problems in this table are set out below.

Table 8.2: Problems in the external environment

4	Unreliability of rail transport
5	Rail capacity problems in terms of inefficient infrastructure and technology
8	BBBEE – achieving and verifying BEE scorecards (in respect of OEMs’ target market)
20	High cost of South African ports

- **Unreliability of rail transport**
- **Rail capacity problems in terms of inefficient infrastructure and technology**

It was beyond the scope of this study to determine the problems and shortcomings of Transnet. Hence all the causes of their underperformance or inefficiency are not clear. However, the following issues could be identified from the literature review:

- poor service levels (Strydom *et al* 2005:57) leading to delivery delays (interview with participants at Ford)
- rail capacity constraints (Strydom et al 2005:57)
- inability to track and release goods (Strydom et al 2005:57)
- availability of wagons (interview with participants at Ford)
- security concerns (Strydom et al 2005:57)

It is clear that the inefficiencies at Transnet impact on industries and individual businesses in South Africa. It is recommended that Transnet investigates various possibilities of improving their efficiency and effectiveness of service quality. One such way could be an investigation to identify gaps or deficiencies within the knowledge and skills base of the employees of the operation. This gap analysis could be used to offer training to the employees to eliminate such deficiencies.

It is also recommended that the existing railway lines between (1) Port Elizabeth and Johannesburg and (2) Durban and Johannesburg be upgraded, as indicated in Demont (2007:23). Upgrading the Durban – Johannesburg line is imperative as a large portion of container freight through the Port of Durban is destined for Gauteng, the economic hub of South Africa. This could result in more goods being sent via rail, which would help to alleviate road congestion, decrease the number of accidents caused by trucks and reduce damage to the roads.

It is anticipated that once the railway system in South Africa starts to gain a reputation for improved reliability, more goods will be sent via rail rather than via road, and thus will help alleviate the existing problem of congestion on South African roads. The automotive industry, and certainly the whole economy, would benefit from an efficient rail service.

- **BBBEE – achieving targets and verifying BEE scorecards (in respect of OEMs' targets)**

As indicated in NAACAM (2009:8), during the economic crisis, ACMs are focusing on survival and thus are not placing great importance on their BBBEE compliance.

It is recommended that whilst ACMs are struggling to survive and retain market share during the economic crisis, the time span for achieving BBBEE targets and verifying BEE scorecards could be extended for a longer period until the economic crisis stabilises. The organised industry, NAACAM and NAAMSA, need to take this up with government because they have entered into an agreement with government regarding the implementation of BEE and timelines.

- **High cost of South African ports**

The high cost of using South African ports was discussed in the literature review in section 3.11.1.2. As indicated, South Africa is the only country whose ports still charge cargo dues. This is the main reason for South African ports being globally uncompetitive. Cargo dues are used to build up cash reserves for infrastructure investments (Demont 2007:21). It is recommended that the possibility of reducing or eliminating cargo dues be investigated. This investigation would include the identification of alternative sources of funds for the financing of infrastructure and could be facilitated through NAACAM and NAAMSA, the major players in the motor industry.

8.2.2.2 The supply chain environment

The problems identified in the supply chain environment are listed in table 8.3. Recommendations for the problems in this table are set out below.

Table 8.3: Problems in the supply chain environment

1	Pressure by OEMs to reduce prices
2	Cancellation of orders (after the recent economic crisis)
3	Excessive slow-moving inventory due to cancellation of orders
7	Purchasing price of materials
10	Output based on customer (OEMs) forecasts to plan
11	Rapid changes in demand (in terms of quantity patterns)
13	Advance communication about market demand
14	Too dependent on business of a particular customer
15	Trust between you and your “worst” customers
16	Relationship with “worst 10%” of customers
17	Financial stability of suppliers (after the recent economic crisis)
21	Material lead times too long resulting in obsolescence

- **Pressure by OEMs to reduce prices**

The most significant problem facing ACMs, as identified in this research, is the pressure by OEM’s to reduce prices. This pressure clearly indicates the problem of power in supply chains. The more powerful party expects the “weaker” party to contribute more to the relationship. It is thus recommended that ACMs seek assistance from and develop closer working relationships with OEMs. The creation of the closer working relationship between the parties would enable them to work together on the reduction of waste. A more collaborative relationship between the parties could also motivate OEMs to be more careful in making and implementing decisions that impact on ACMs, such as forecasting, planning and cancelling orders.

It is recommended that OEMs together with ACMs vigorously examine their (ACMs’) processes through value stream mapping of the supply chain in an effort to eliminate waste, thereby generating cost savings. Value stream mapping is dealt with section 4.2.4, and as indicated by Hugo et al (2004:80), it involves the mapping of processes and actions in order to identify wasteful and unnecessary activities that can be eliminated. In addition, lean manufacturing principles, including value analysis, business process re-engineering and the JIT philosophy could be introduced. The aim of JIT is to eliminate excess stock from the pipeline. In addition, ACMs could benchmark their processes against those of other ACMs in both the domestic and global market.

ACMs should also endeavour to reduce their conversion costs, that is, the labour and overheads costs incurred in the process of converting raw material into manufactured products. In a highly regulated and unionised labour market such as that in South Africa there is always upwards earnings pressure, which tends to increase instead of reduce labour costs. Hence the opportunity to reduce labour costs is somewhat slim (unless there is greater automation with its required capital investment – also a significant problem for ACMs). The ACMs should focus on achieving efficiencies by increasing manufacturing or throughput rates. Inefficiencies would come to light in the proposed value stream mapping exercise.

ACMs should also focus on reducing the overhead portion of their conversion costs, with the cost of electricity being a more significant cost. With the current and anticipated huge increase in electricity costs, ACMs should focus on reducing their electricity usage. This could be achieved by fitting consumption levelling devices to machinery or equipment that consume significant amounts of electricity. This type of equipment regulates the initial draw of power on the start up of the equipment and reduces the peak demand usage (KVA) of the manufacturing ACM process, as well as regulating and levelling the power pull of the equipment during the day from “peaks” and “troughs” to a more level consumption pattern. This will reduce the electricity cost of the ACM, particularly in geographic regions of South Africa where a significant portion of the electricity bill is based on the peak usage or KVA usage. It is also suggested that ACMs negotiate with Eskom for subsidisation of power-saving devices.

In many instances, if ACMs cannot reduce their material and conversion costs the only way they can pass on cost reductions to their customers is by reducing their margins. This affects ACMs’ profitability and makes them financially unviable.

- **Purchasing price of materials**

Besides a reduction in conversion costs, a key aspect of cutting costs for ACMs is in the area of purchased material cost reduction. The problem of the price of materials ranked seventh as the most significant problem facing ACMs in South Africa. It is recommended that procurement departments in ACMs focus on opportunities to negotiate better prices. In this regard, it is suggested that buyers be trained to improve their negotiation skills and to focus their skills on investigating and estimating costs more accurately. These skills would help to ensure that the buyer is equipped to obtain the best prices possible for its employer. As indicated in Liker and Meier (2006:292), cost models can be used to estimate what supplier costs should be and to design the product to meet the target cost. Each buyer could devise creative improvement plans, challenge material costs and designs, critically review packaging and transportation and warehousing costs and identify potential ways of reducing inventory levels. As indicated by Burt et al (2003:416), this approach is commonly used by leading-edge firms with the technical resources available.

The previous suggested value stream mapping exercise should be extended to the supply-side of the supply chain. Inefficiencies could be identified and eliminated.

- **Cancellation of orders (after the recent economic crisis)**
- **Excessive slow-moving inventory due to cancellation of orders**
- **Output based on (OEMs') customer forecasts to plan**
- **Rapid changes in demand (in terms of quantity patterns)**
- **Advance communication about market demand**

The second most significant problem is that of cancellation of orders (after the economic crisis) which has resulted in the holding of excessive slow-moving inventory (the third most significant problem). The motor industry, more than most, has been particularly hard hit by the global economic crisis. Annual vehicle sales have decreased significantly since their peak in 2007. OEMs are thus holding excessive levels of final product inventory which has had a knock-on effect on ACMs.

It is recommended that ACMs reduce the selling price of their excessive stock to their original equipment customers, and in some instances, the aftermarket, in order to generate cash flow. ACMs could offer stock clearance specials to eliminate the accumulation of slow-moving stock.

A significant problem from the perspective of balancing supply and demand is the issue of output based on customer forecasts to plan. This issue was dealt with in section 6.5.2.1. It is recommended that communications be improved between ACMs and OEMs in order to encourage the latter to agree to the process of reviewing and altering their forecasts on a shorter interval basis in line with fluctuating sales demand. This change would mean that once the ACMs have their three-month forward forecasts from the OEMs, they stay close to their customers to obtain monthly updates based on actual, real-time demand. This would help ACMs to adjust the inflow of materials and parts and ultimately prevent an accumulation of inventories of raw materials and finished goods. In addition, monthly reviews, for example, would improve forecasting models and refine the information gathering process. Further, stock levels need to be closely examined and continuously reviewed.

It is also suggested that OEMs, ACMs and second- and third-tier suppliers work closer together, according to the supply chain management philosophy, to reduce inventories throughout the supply chain. This could be done by introducing JIT, continuous replenishment programmes (CRP) and collaborative planning, forecasting and replenishment (CPFR) and complete visibility of inventory through the supply chain.

The above problems indicate a lack of close cooperation between ACMs and their suppliers. It would appear that the supply chain management philosophy has not yet been adapted and implemented to its fullest extent in the South African automotive industry.

- **Too dependent on business of a particular customer**

It is recommended that ACMs expand their customer base away from dependency on the OEMs, into the direct part sales market and the export market. However, to be able to export, ACMs need to become more competitive, and all the other problems and inefficiencies need to be addressed.

- **Trust between you and your “worst” customers**
- **Relationship with “worst 10%” of customers**

These problems indicate problems in the relationship between certain ACMs and some of their customers. Regarding trust and the relationship with the “worst” customers, it is recommended that ACMs determine the importance of their customers to them. If the “worst” 10% of customers is not important (eg a small percentage of sales), ACMs should not make a special effort to improve relations. However, if they are important customers, purposeful efforts need to be made. An improvement in the relationship between the two parties and a renewed commitment to meet each other’s expectations improve the level of trust between the parties.

If the “worst” 10% of customers is important, a purposeful effort to improve could be achieved by implementing customer relationship management (CRM). As indicated in Brink and Berndt (2005:3), a shift has taken place from transactional marketing to building long-term relationships with customers through customer relationship management (CRM). This is all about building relationships with customers. Section 2.2.2 indicates that the automotive industry is a mature market, with stagnant demand (and since the economic crisis, reducing demand), an oversupply of motor vehicles, and tough price competition. Hence, customer retention has become crucial.

ACMs could gain a competitive advantage by building relationships with their primary customers (whether “best” or “worst”), and this could increase the overall profitability and success of ACMs. The implementation of CRM could improve relationships and trust between ACMs and their “worst” customers.

- **Financial stability of suppliers (after the recent economic crisis) (after the onset of the global economic crisis)**

The financial viability of a supplier (ACM) is vital to an OEM as well as the future sustainability of this supplier. The insolvency of a supplier clearly impacts on the production of motor vehicles while an alternate supplier is found. In turn, the financial stability of a supplier is important to the ACM because the insolvency of a supplier has an impact on the supply of materials. The financial stability of these ACM suppliers has been negatively influenced by the current economic crisis. The question, "before" and "after" the economic crisis was included in the questionnaire, and dealt with in section 7.5.1.1, table 7.7.

As indicated in NAACAM (2009:1), the automotive industry has been affected globally. Governments in other countries have identified the need to take short-term measures to avoid the collapse of industries and have injected financial resources into their motor industries. The South African government, however, does not have the financial resources to do the same. The banking sector has also been reluctant to allow credit facilities to those in the motor industry affected by the economic crisis and in fact, have cut back on credit extension to these companies. Banks are nervous about the risks involved, thus making the situation even tougher.

In South Africa, more than 16 000 jobs have been lost in the component (ACM) industry and some key ACMs have closed down. The Minister of Trade and Industry and his department are aware of the magnitude of the problem (NAACAM 2009:1). As indicated in a further NAACAM report, this has resulted in the IDC providing bridging finance to ACMs with financial difficulties. In addition, government recently announced a R2.4 billion scheme through the Department of Labour. ACMs who elect to work short-time instead of retrench can have up to 50% of their equivalent wages during downtime, paid. However, as indicated in the report, these measures are simply not enough (NAACAM 2009:1, Issue 12)

It is thus recommended that the industry encourage the government to further intervene and provide relief to those ACMs that are in financial difficulties as a result of the economic crisis. This could take the form of low interest-bearing loans, based on a level of internal business restructuring, until the economic situation and the economy improve.

- **Material lead times too long resulting in obsolescence**

When material lead times are too long, one way to ensure a continued supply to customers is to increase stock levels. However, holding excessive stock may result in the additional cost of holding stock and the stock becoming obsolete. Excessive stock was identified as a significant problem in the empirical research.

ACMs should work with their suppliers to reduce lead times. Two factors need to be considered when analysing lead times: (1) the time it takes to manufacture the item; and (2) the time it takes to transport the item from supplier to ACM. ACMs could also proactively analyse final customer demand patterns to match their supplier's production levels with the ultimate customer or OEM's demand. ACMs could also review their order systems to ensure that they are efficient and that their requirements are being reordered at the most appropriate time.

A real-time information system (such as CRP and CPFR suggested earlier) between ACMs, their customers and their suppliers would alleviate both lead time and inventory problems.

8.2.2.3 The internal environment

The problems identified in the internal environment are listed in table 8.4.

Table 8.4: Problems in the internal environment

5	Cost of replacing outdated technology
9	Capacity limitations due to capital funding
10	Output based on customer (OEMs') forecasts to plan
12	Labour problems – availability of skills
18	Labour problems – time consuming to resolve
19	Capacity limitations due to order fluctuations

- **Cost of replacing outdated technology**
- **Capacity limitations due to capital funding**

The ACMs indicated that the cost of replacing outdated technology was a significant issue as was the problem of capacity limitations. In both of these issues, the limitation for the ACM is the cost of financing for plant and machinery. The problem of outdated technology was also identified during interviews with OEMs' participants (see sec 6.4.1), where it was indicated that ACMs' deficiencies lay in their lack of technological advancement, their inability to achieve global supply capability and their poor cost effectiveness.

As indicated in a NAACAM report, the IDC is providing bridging finance to ACMs who are facing financial difficulties. NAACAM, however, contend that these measures are inadequate (NAACAM 2009:1).

In order to assist ACMs to replace their outdated technology and equipment, it is recommended that NAACAM request government assistance in the form of low interest, bearing loans rates. This would help ACMs to be more effective, improve the supply to the local market and perhaps even help to obtain additional sales volumes in other countries and continents, on the basis of being more cost competitive, that is, greater volume allowing for reduced prices because the ACMs' fixed overhead is spread over a larger production volumes. As indicated in Naude (2005:6), ACMs have a competitive advantage from a flexibility perspective as their operations are more labour intensive than capital intensive (automated). ACMs are therefore able to produce lower or higher volumes compared to other countries where production is oriented towards long, fixed, automated, high production runs.

- **Labour problems – availability of skills**
- **Labour problems – time consuming to resolve**

South Africa has a high unemployment rate. However, ironically there is a lack of certain specialist skills with some industries which are struggling to source the correct skills. In the automotive component industry, the scarce skills include tool making, fitting and turning and welding.

It is recommended that further research be undertaken to investigate at operational level, whether ACMs have increased their focus on training and developing their employees through the various industry SETAs – effectively utilising the 1% training levy. The training levy could become more of a developmental tool used by the ACMs rather than the current situation (as indicated in NAACAM 2009:8) where some ACMs see the levy as simply another "tax".

As recommended by NAACAM, during the economic crisis, ACMs could concentrate on introducing learnerships in their businesses, using the appropriate "tax breaks" provided by tax legislation and the MERSETA programme (NAACAM 2009:8). Under this scheme, the ACMs would pay a basic stipend to the learner, with "other costs" being borne by the MERSETA programme. Hence additional costs to the business would be minimal. This focus on learnerships would ensure that the automotive industry skills base continues to develop.

At national level, it is suggested that government should be encouraged to further look at ways of developing skills and improving, re establishing first-class technical colleges, revitalising and enhancing the apprenticeships training programme to make them more effective.

Although identified as a supply chain problem faced by ACMs, it was beyond the scope of this study to determine the ***types of labour problems*** that exist and to recommend solutions to these problems. While the labour problems encountered by ACMs are not clear, they could be explored in a further qualitative study. However, the following is recommended:

ACMs should examine the quality of and relationship between management and their employees. In most industries in South Africa, there is an "us versus them" culture, between labourers and management. This is aggravated by some labour unions. The depth of the divide could be ascertained through climate/employee surveys. However, as was evident in subsequent informal discussions with executives at one ACM, the current overpoliticised environment could prevent such surveys from getting to the real root causes, because certain agendas might come to the fore versus the real issues. When the root causes are known, interventions such as trust building, team building and organisational development programmes could be implemented to address the problem areas identified.

- **Capacity limitations due to order fluctuations**

It was found that capacity limitations due to order fluctuations were a problem for ACMs. The term "capacity limitations" means that ACMs sometimes lack the capacity to produce. This is certainly not a problem in the current economic crisis.

However, once the economic crisis has passed and ACMs face capacity limitations due to order fluctuations, it is recommended that ACMs improve and enhance their demand management systems to make them more effective. As indicated by Burt (2010:530), demand management can be used to estimate, control, smooth and coordinate and balance the demand and supply of a business' products and services. As such, ACMs could also analyse customer demand characteristics such as their different order patterns. Demand forecasting involves establishing the number of components customers will require at a future time, and this involves the marketing, manufacturing, purchasing and logistics departments. Improved systems and controls and thus better communication regarding future demand would lead to better planning and help ACMs to be better prepared to plan and meet increased capacity demands.

As recommended previously, improved relationships with suppliers and customers and integrated systems and inventory visibility would also greatly improve information the flow between the parties.

In conclusion, ACMs could alleviate most of the problem areas in their supply chain environment through better co-operation with other supply chain partners (both customers and suppliers), skilling their workers and investing in new technology. The latter would require government assistance. The industry as a whole needs to communicate more clearly to government the plight of ACMs.

8.3 THE MOST SIGNIFICANT CORRELATIONS

The relationship between ACMs and their suppliers (hypothesis 3) was found to be a significant problem. From an ACM perspective, the following issues were identified: their suppliers' material lead times are too long; the purchasing price of materials is too high; the financial stability of suppliers has become an issue (after the onset of the economic crisis); and achieving and verifying BEE scorecards are problematic.

The relationship between ACMs and their customers (OEMs) (hypothesis 4) was found to be even more problematic. On the ACM side, the following problems were identified: the relationship and trust with the "worst 10%" of customers; a lack of advance communication about market demand; and rapid changes in demand create difficulties, as do the cancellation of orders and the holding of excessive inventory. There are also the issues of continuing pressure to reduce prices; the fact that there is little or no assistance to comply with OEM requirements; and extreme dependency on a particular customer. Some of the correlations are logical and explicable but others are not and could be coincidental. Further research would be needed to establish the explanation of these correlations.

Figure 8.1 depicts the most significant correlations stemming from hypothesis 2.

Figure 8.1: Correlations between supply chain problems, ACMs and customers[4]

Supply-side problems (ACMs' suppliers)	Problems in internal operations (ACM)	Customer-side problems (ACMs' customers)
Delivery of right quality (3.28)	Output based on rigid forecasting (3.39) Balancing inventory levels (3.91)	Advance communication about market demand (4.15) Order fluctuations (3.68)
On-time delivery (3.12)	Output-based customer forecasts to plan (4.20) Design of materials flow system (3.52) Warehouse security (3.06) Warehouse safety (2.46)	Trust "best" customers (2.36) Little/no assistance from customers (3.79) Cancelation of orders (5.02) Excessive inventory (4.83)
Material availability (2.98)	Shortage of a key material (3.03) Cooperation between functions (2.65)	Trust "best" customers (2.36) Rapid changes in demand (4.18) Excessive inventory (4.83)
Long lead times (4.02)	Output based on rigid forecasting (3.39) Shortage of a key material (3.03) Capacity limitations – order fluctuations (4.05)	Order fluctuations (3.68) Cancellation of orders (5.02) Meeting quality requirements (2.32) Incompatible information systems (3.06) Rapid changes in demand (4.18)
Purchasing price of materials (4.38)	Capacity limitations due to customer order fluctuations (4.05) Output based on customer forecasts (4.20)	Cancelation of orders (5.02) Reducing prices (5.51) Relationship "worst" customers (4.12) Little/no assistance from customers (3.79)
Financial stability of suppliers (prior to the recent economic crisis) (3.06)	Output based on marketing forecasting (3.39) Output based on customer forecasts to plan (4.20) Capacity limitations (4.05)	Order fluctuations (3.68) Little/no assistance from customers (3.79) Rapid changes in demand (4.18) Dependency on a particular customer (4.15)
Supplier capacity limitations (3.05)	Output based on marketing forecasting (3.39) Continuous improvement (3.45)	Trust between ACM and "best" customers (2.36) Little/no assistance from customers (3.79)

Source: Compiled by researcher

[4] The figure above indicates that items on the supply side (ACMs' suppliers) correlate with problems in internal operations and customer-side problems.

The conclusion can be made that decisions made and/or problems experienced between (1) supply problems and internal operations problems and (2) supply problems and customer problems, impact on the supply chain.

It is therefore recommended that the parties mentioned in the paragraph above embrace the supply chain management philosophy to its fullest extent and take into account the impact of decisions on the other parties.

The next section deals with the limitations of the study and the way forward for future research.

8.4 LIMITATIONS OF THE STUDY AND THE WAY FORWARD FOR FUTURE RESEARCH

The research study consisted of two phases to collect the data, namely in-depth semi-structured interviews at both Ford and Toyota and a questionnaire that was emailed to all NAACAM members. The aim of the interviews with OEMs was to try to determine ACMs' supply chain problems from their customers' perspective. As expected, there was an overlap in the findings between the interviews with OEMs and survey with ACMs, which, to some extent, indicated the validity of the findings. Not all OEMs in South Africa were included because they are geographically dispersed and the focus of the study was not on OEMs but on ACMs.

In terms of the questionnaires sent to the ACMs, a common shortcoming of mailed questionnaires is that the researcher does not know whether the person who completed the questionnaire understood all the questions. The questionnaires were emailed to all the respondents who were dispersed across South Africa. Personal interviews would have been a more effective method to gather data, but personal interviews are time consuming and expensive to conduct, particularly since the respondents were geographically dispersed throughout the country.

The response rate of the questionnaires was another challenge. It was found that when contacting various respondents prior to emailing the questionnaire, many of them were working under extreme pressure and challenges because of the onset of the economic crisis. A number of respondents declined to participate of the study and others indicated that they would try but could not make any promises. Further comments were that the questionnaire was too long, and that at the time, too many people were conducting studies on the automotive industry, and that there had simply been too many questionnaires to complete. Despite this, an acceptable response rate of 30,6% was achieved.

The qualitative facet of the ACMs' response was limited to the qualitative section in the questionnaire. Further, not all respondents provided information in the comments block. If personal interviews had taken place, this would have provided more scope for probing respondents and obtain more qualitative information.

Although a large number of supply chain problems were investigated, it was not possible to identify all supply chain difficulties. In addition, it should be noted that not all problems in the automotive industry can be linked solely to supply chain management.

As a way forward, it is suggested that further research be undertaken to include all role players in the automotive industry and identify supply chain problems facing all role players both upstream and downstream of the supply chain. Alternatively, a similar study could be conducted in a different sector, say the mining industry, to determine whether industries in South Africa are facing similar supply chain problems.

8.5 CONTRIBUTION OF THE RESEARCH STUDY

The research study contributes to the application of supply chain management theory in the dynamic motor industry with particular emphasis on supply chain problems experienced by ACMs. The supply chain problems of ACMs identified in the study have a significant impact on the operations and the competitiveness of the business. ACMs play a key role in the South African motor industry and the overall economy.

Recommendations were made to ACMs and the motor industry as a whole on how the problems that were identified could be overcome. These recommendations could either be standardised or further developed in future research studies.

In addition, a questionnaire, to enhance the knowledge base on supply chain problems, was created which could be used as a guide or model for additional studies in other industries besides the automotive industry.

The field of SCM is extremely dynamic. The study of literature, trends, new developments and the empirical research contribute to another perspective on the body of knowledge. For example, this study explored the question of whether or not cooperation, trust and transparency are an "ideal" of supply chain theory that is not practised in real life business. The motor industry, which purports to be at the forefront of best supply chain management practices, is certainly lacking in this area. Related to this is the issue of power of the strongest/dominant partner in a supply chain and its expectations with regard to concessions from the other "weaker" parties. This question justifies further research.

8.6 CONCLUSION

While the study provided a number of insights, these should be viewed in terms of the limitations discussed. This study can be classified as both descriptive and exploratory. Through the literature research, it was established that various automotive component manufacturers face supply chain problems. This was further evidenced in the interviews with executive/senior management at both Ford and Toyota. These problems are mainly as a direct result of rapid developments in supply chain management, technological advancements, globalisation, intensified global competition and the current global economic recession.

The second stage of the empirical research consisted of a survey, using the questionnaires. The identified supply chain problems were tested and ranked by the responding ACMs. The findings indicated that the responding ACMs had been keeping a close eye on both their customers and suppliers. Over half of them indicated that the financial stability of suppliers (after the onset of the recent economic crisis) had deteriorated, and order fluctuations from customers (after the onset of the economic crisis) had also increased significantly. Therefore, the responding ACMs had no choice but to adapt their strategies to combat this phenomenon. More than half of the responding ACMs indicated that they were too dependent on the business of a particular customer (particularly OEMs) and had taken proactive measures to shield themselves from the recession and ensure their survival and sustainability in the longer term. Some ACMs identified opportunities amidst the uncertainty and had diversified and broadened their customer base. Others had downsized and/or were operating on short time (ie a four-day week) and some unfortunate ACMs had been forced to close down.

To conclude, this study was completed over a four-year period. At the start of the study, the automotive industry was booming and towards the end of it, a global economic crisis had started (midway through 2008). This global economic crisis has impacted adversely on the automotive industry both globally and locally in South Africa. This in turn, has influenced automotive component manufacturers, which, in turn, have experienced pressure by OEMs to reduce selling prices and have experienced cancellation of orders. This has resulted in the holding of excess inventory, which is slow moving as the production of motor vehicles has significantly reduced. Until the production volumes of motor vehicles increases, this excess stock is expected to remain.

Despite these challenges, leaders in the automotive component industry remain positive that business will improve. As one respondent aptly stated:

"Sooner or later, even a tortoise sticks his head out of his shell!"

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ANNEXURE A: INTERVIEW GUIDE

Date: ____

Company: ____

Person interviewed: ____

Capacity: ____

INTERVIEW GUIDE

1. INTRODUCTION

The introduction explains the purpose of the study and the role of the respondents. In addition, the aim is to assure the participants' confidentiality and request permission to use a tape recorder.

2. SECTION 1: COMPANY PROFILE

- Name of respondent:
- Position:
- What is your total number of employees?
- What quality accreditations do you have?
  ……………………………………………………………………………….….
- What is your total value of purchased goods and services? ……………………
- What is the percentage of purchased goods and services of total turnover? ....
- What is your total annual turnover? ……………………………………………
- What is the percentage of total sales exported? ………………………………..

3. SECTION 2: GENERAL

The aim of this section is to ascertain from the respondent what he or she perceives to be the supply chain problems the OEM faces from the supply side.

- What are the major supply chain problems you face (from a supply viewpoint, ACMs who supply OEMs)?
- What part of the SC are you concerned about? (Where do you face problems?)
- In what part of the SC do you feel improvement is possible?
- With oil costing in the region of ±USD140 per barrel, how will suppliers cope?
- Will there be an international shift from an “air to sea” mode of transportation?
- If so, what impact will this have on stock holdings?
- What impact will this have on JIT deliveries?
- Will this result in a shift towards supplier-managed inventory for local/international suppliers?

4. SECTION 3

4.1 SUPPLIER RELATIONSHIPS

- What is your total number of suppliers? ……………………………………….
- What is your total number of domestic suppliers? ……………………………..
- What is your total number of international suppliers? …………………………
- Is it your aim to reduce your supplier data base? Why? How?
- How do you select suppliers? How do you assess your suppliers?
- What is the nature and scope of the supplier development activities of the assembler?
- Are suppliers involved in the design and development processes?
- What is the level of supplier innovation? How are suppliers encouraged to innovate and how is this communicated in your company?
- How would you describe your relationships with your suppliers (eg traditional/partnership/collaborative)?
- Has load shedding impacted on your suppliers’ production deadlines and subsequently delivery deadlines?
- What quality accreditation do you expect your suppliers to have?
- Do all suppliers have this accreditation?
- How do you handle nonconformance by suppliers (eg quality, meeting specs and delivery deadlines)?

- How many shifts do you have?
- How many deliveries do you have during shifts?
- Do suppliers deliver during each shift?

4.2 BROAD BASED BLACK ECONOMIC EMPOWERMENT (BBBEE)

Integrated automotive supply chain aims at eliminating all activities that do not add value in the flow of products and services to the ultimate customer.

- What is your procurement policy in terms of BBBEE?
- What amount of your total purchases is spent with BBBEE suppliers?
- Have you set a target percentage to be spent with BBBEE suppliers?
- Have you achieved this target?

4.3 SUPPLY CHAIN FLOWS

- How do you handle your demand management?
- How do you forecast your demand? (What indicators do you use, eg PMI, BER?)

4.3.1 Production

- What is the loss per production line for stoppages due to stock outs (per hour)?
- Are your suppliers responsible for this cost if the stoppage occurred because they did not deliver on time?
- How has Eskom's load shedding impacted on your suppliers?
- Has this impacted on your production?

4.3.2 Transportation

- What transport mode do your international suppliers use – sea/air, then road/rail?
- What are the challenges dealing with international suppliers?
- Does this result in increased cost of inventory in transit?
- Which port do your international suppliers use (ORT, DBN, PE, Richards Bay, Maputo)?
- Are local components delivered via road and/or rail transport?
- What are the challenges using road/rail transport (ie capacity and security)?

- What are the security constraints?
- What type of containers are used?
- Is packaging returned to suppliers? If "yes", does this act as a Kanban?

4.3.3 Reverse logistics

- If and when would you pick up that defect components have been delivered?
- How do you handle returns to suppliers?
- How do you handle defects (if any)? Are suppliers penalised? If so, how are they penalised?

4.3.4 Information flow

- What type of ERP systems do you use?
- How do you share data (demand and work flow data) with suppliers in the supply chain?
- Do your suppliers operate on a supplier management inventory system?
- Do you use EDI systems to exchange data with suppliers?

4.3.5 "Cradle-to-grave" flow

Three main groups are the driving forces, namely "environmentally friendly" products, packaging and production processes.

- Is the packaging material your suppliers use recyclable/reusable?
- Do suppliers use substitute inputs (ie steel versus plastic)?
- Do your suppliers recycle certain components? If so, how many and which components?
- Do your suppliers remanufacture certain components? If so, how many and which components?

APPENDIX B: QUESTIONNAIRE

QUESTIONNAIRE RETURN COVER PAGE

SUPPLY CHAIN PROBLEMS EXPERIENCED BY AUTOMOTIVE COMPONENT MANUFACTURERS (ACMs)

TO:

ATTENTION: MICHELINE NAUDE

FAX NUMBER: 033 260 5219

EMAIL: **naudem@ukzn.ac.za**

PHONE NUMBER: 033 260 6181

CELL NUMBER: 083 381 6078

REFERENCE: EXPLORATION OF SUPPLY CHAIN PROBLEMS

FROM:

NAME (optional): ____

COMPANY: ____

FAX NUMBER: ____

PHONE NUMBER: ____

THE TIME AND EFFORT YOU HAVE PUT INTO COMPLETING THIS QUESTIONNAIRE ARE GREATLY APPRECIATED.
THANK YOU.

QUESTIONNAIRE

GENERAL INFORMATION

Dear Respondent

I am a lecturer in the School of Management at the University of KwaZulu-Natal. I am currently conducting research for my DCom under the supervision of Prof JA Badenhorst-Weiss at Unisa. The focus of my study is the exploration of supply chain management problems experienced by South African automotive component manufacturers (ACMs). The aim of the study is to identify these supply chain problems and the scope of problems facing South African ACMs.

Instructions on the completion of this questionnaire will follow before each section. The questionnaire is designed to make completion as easy and fast as possible. Most of the questions can be answered by simply making a tick in a box.

Note the following important points:

- This is an independent research study and participation is voluntary. Your responses will be treated as **strictly confidential** and the **anonymity** of companies and respondents is assured.
- No person or firm will have access to your completed questionnaire.

If any part of the questionnaire is not clear, or if you have any queries, please contact me, Mrs M Naude, at 033 260 6181 or 083 381 6078.

Once you have completed your questionnaire, please return it to me via fax to number 033 260 5219 or email it to: naudem@ukzn.ac.za. Alternatively, the completed questionnaire may be posted to: Mrs M Naude, 19 Highlevel Place, Oak Park, Pietermaritzburg 3201. It would be appreciated if you could return the completed questionnaire to me by no later than 25 March 2009.

Should you require a copy of the abbreviated report of the findings please write your name, email address or telephone number in the box below.

I look forward to your response.

Yours sincerely

MICHELINE NAUDE

THANK YOU FOR YOUR COOPERATION

SECTION 1: GENERAL INFORMATION

1.1 Name of company: ____

1.2 Position/title of person who completed the questionnaire:

1.3 When was your company established?

____

1.4 In which province is your company situated? (Can be in more than one province – if more than one, circle as appropriate.)

PROVINCE	**CIRCLE (0) CHOICES**
Western Cape	01
Eastern Cape	02
Northern Cape	03
Free State	04
KwaZulu-Natal	05
North West	06
Gauteng	07
Mpumalanga	08
Limpopo	09

1.5 How many employees are there in your company?

____

1.6 Which option best describes the status of the company you work for?

STATUS	**CIRCLE (0) ONE**
Head office	01
Holding company	02
Branch	03
Subsidiary	04
Independent unit	05

1.7 Indicate which of the following in the automotive industry is/are your target customer(s)/market(s) and the number of years your company has been supplying this market.

TARGET CUSTOMER(S)/ MARKET(S)	**INDICATE WITH AN X**	**NO. OF YEARS**	**PERCENTAGE***
Original equipment manufacturers (OEMs)			
Original equipment suppliers (OESs)			
Automotive retail and aftermarket			
Other: specify (…………………..)			
TOTAL			100%

* **In terms of sales (financial year 2007/2008), indicate the percentage you supply to your different target customer(s)/market(s).**

SECTION 2:	SUPPLY CHAIN MANAGEMENT PROBLEMS EXPERIENCED BY SOUTH AFRICAN AUTOMOTIVE COMPONENT MANUFACTURERS

2.1 SUPPLY-SIDE PROBLEMS

2.1.1 Supplier relationship problems

Indicate to what extent your company experiences the following supplier relationship problems. Please provide more information in the comments block if you wish to clarify something or feel particularly strongly about one of the issues.

		TICK IF NOT A PROBLEM	IF A PROBLEM AREA, PLEASE CIRCLE (0) TO WHAT EXTENT						
	Problem areas with suppliers		**Lesser extent**						**Greater extent**
1	Trust between you and your “best 10%” of suppliers		1	2	3	4	5	6	7
2	Trust between you and your “worst 10%” of suppliers		1	2	3	4	5	6	7
3	Delivery of the right quality		1	2	3	4	5	6	7
4	On-time delivery		1	2	3	4	5	6	7
5	Material availability		1	2	3	4	5	6	7
6	Material lead times – too long resulting in risk of obsolescence		1	2	3	4	5	6	7
7	Price of the materials		1	2	3	4	5	6	7
8	Use of correct packaging material		1	2	3	4	5	6	7
9	Flexibility of suppliers		1	2	3	4	5	6	7
10	Financial stability of suppliers (prior to the recent economic crisis)		1	2	3	4	5	6	7
11	Financial stability of suppliers (after the recent economic crisis)		1	2	3	4	5	6	7
12	Supplier capacity limitations		1	2	3	4	5	6	7
13	Poor communication between you and your suppliers		1	2	3	4	5	6	7
14	Suppliers do not have ISO14001 accreditation		1	2	3	4	5	6	7
15	BBBEE - achieving and verifying BEE scorecards (in respect of OEMs’ target requirements)		1	2	3	4	5	6	7

Comments:

____

____

2.1.2 Incoming transportation problems

Indicate to what extent your company experiences the following incoming transportation problems. Please provide more information in the comments block if you wish to clarify something or feel particularly strongly about one of the issues.

		*N/A	TICK IF NOT A PROBLEM	IF A PROBLEM, CIRCLE (0) TO WHAT EXTENT						
	Problem areas with incoming transportation			**Lesser extent**						**Greater Extent**
1	Delays in off-loading vessels (due to congestion at the port)			1	2	3	4	5	6	7
2	Delays in off-loading vessels (due to weather conditions)									
3	Inefficient infrastructure at South African ports			1	2	3	4	5	6	7
4	Inefficiency of South African port authority			1	2	3	4	5	6	7
5	Inefficient clearing of containers at South African ports			1	2	3	4	5	6	7
6	Processes at ports and borders			1	2	3	4	5	6	7
7	High cost of South African ports			1	2	3	4	5	6	7
8	Road delays			1	2	3	4	5	6	7

Comments:

____

____

*** N/A = not applicable**

2.2 PROBLEMS IN INTERNAL OPERATIONS

2.2.1 Operations Process Problems

Indicate to what extent your company experiences the following problems in internal operations. Please use the comments block for further comments/explanations.

		TICK IF NOT A PROBLEM	IF A PROBLEM AREA, PLEASE CIRCLE (0) TO WHAT EXTENT						
	Problem areas in operations		**Lesser extent**						**Greater extent**
1	Output based on rigid marketing forecasting		1	2	3	4	5	6	7
2	Output based on customer forecasts to plan (suppliers to		1	2	3	4	5	6	7

	OEMs)								
3	Continuous improvement		1	2	3	4	5	6	7
4	Reduce cycle times		1	2	3	4	5	6	7
5	Balancing inventory levels		1	2	3	4	5	6	7
6	Shortage of a key material		1	2	3	4	5	6	7
7	Outdated technology		1	2	3	4	5	6	7
8	Cost of replacing outdated technology		1	2	3	4	5	6	7
9	Integrating information systems in the company		1	2	3	4	5	6	7
10	Integrating technology with suppliers and customers		1	2	3	4	5	6	7
11	Cooperation between functions in the company		1	2	3	4	5	6	7
12	Labour problems – availability of skills		1	2	3	4	5	6	7
13	Labour problems – time consuming		1	2	3	4	5	6	7
14	Labour problems – industrial action (in the region your company is situated)		1	2	3	4	5	6	7
15	Capacity limitations due to availability of skilled labour		1	2	3	4	5	6	7
16	Capacity limitations due to customer order fluctuations		1	2	3	4	5	6	7
17	Capacity limitations due to outdated machinery		1	2	3	4	5	6	7
18	Capacity limitations due to capital funding		1	2	3	4	5	6	7
19	Design of production process		1	2	3	4	5	6	7
20	Reducing energy consumption		1	2	3	4	5	6	7
21	Reducing of waste		1	2	3	4	5	6	7

Comments:

____

____

____

2.2.2 Internal movement/ transportation problems

Indicate to what extent your company experiences the following problems in internal movement/transportation. Please use the comments block for further comments/explanations.

		TICK IF NOT A PROBLEM	**IF A PROBLEM AREA, PLEASE CIRCLE (0) TO WHAT EXTENT**						
	Problem areas		**Lesser extent**						**Greater extent**
1	Design of materials flow		1	2	3	4	5	6	7

	system (based on international best practice)								
2	Outdated transport equipment		1	2	3	4	5	6	7
3	Outdated warehouse equipment		1	2	3	4	5	6	7
4	Warehouse capacity		1	2	3	4	5	6	7
5	Warehouse security		1	2	3	4	5	6	7
6	Warehouse Safety		1	2	3	4	5	6	7
7	Warehouse maintenance		1	2	3	4	5	6	7
Comments: ______________________________ ______________________________									

2.3.1 DISTRIBUTION-SIDE PROBLEMS

2.3.1 Customer relationships problems

Indicate to what extent you experience problems with the following **customer-related** issues. Please use the comments block for further comments/explanations.

		TICK IF NOT A PROBLEM	**IF A PROBLEM AREA, PLEASE CIRCLE (0) TO WHAT EXTENT**						
	Problem areas with customer relationships		**Lesser extent**					**Greater extent**	
1	Relationship with "best 10%" of customers		1	2	3	4	5	6	7
2	Relationship with "worst 10%" of customers		1	2	3	4	5	6	7
3	Trust between you and your "best" customers		1	2	3	4	5	6	7
4	Trust between you and your "worst" customers		1	2	3	4	5	6	7
5	Advance communication about market demand		1	2	3	4	5	6	7
6	Order fluctuations (prior to the recent economic crisis)		1	2	3	4	5	6	7
7	Cancellation of orders (after the recent economic crisis)		1	2	3	4	5	6	7
8	Excessive slow-moving inventory due to cancellation of orders		1	2	3	4	5	6	7
9	Difficulty meeting quality requirements		1	2	3	4	5	6	7
10	Pressure by OEMs to reduce prices		1	2	3	4	5	6	7
11	Little/no assistance from customers to comply with their requirements		1	2	3	4	5	6	7

12	Incompatible information systems		1	2	3	4	5	6	7
13	Expectations of customers to comply with new technology are too high		1	2	3	4	5	6	7
14	Rapid changes in demand (in terms of quantity) patterns		1	2	3	4	5	6	7
15	Too dependent on business of a particular customer		1	2	3	4	5	6	7
Comments: ___ ___									

2.3.2 Outbound transportation problems

Please indicate to what extent you experience problems with the following outbound transportation issues. Please use the comments block for further comments/explanations.

		***N/A**	**TICK IF NOT A PROBLEM**	**IFA PROBLEM, CIRCLE (0) TO WHAT EXTENT**						
	Problem areas with outbound transportation			**Lesser extent**				**Greater extent**		
	Rail transport									
1	Unreliability of rail transport			1	2	3	4	5	6	7
2	Rail capacity problems in terms of inefficient infrastructure and technology			1	2	3	4	5	6	7
3	Increasing high variable local days in transit			1	2	3	4	5	6	7
4	Cargo loss and damage			1	2	3	4	5	6	7
	Road transport									
5	Congestion on the roads			1	2	3	4	5	6	7
6	Accidents			1	2	3	4	5	6	7
7	Cargo loss and damage			1	2	3	4	5	6	7
8	Dependability/reliability of shipper			1	2	3	4	5	6	7
9	Trust between you and the shipper			1	2	3	4	5	6	7
Comments: ___ ___										

*** N/A = not applicable**

Once again, thank you for your time and assistance in completing this questionnaire. It is greatly appreciated.

APPENDIX C: TEST RESULTS FOR HYPOTHESIS 1

NPAR TESTS

Test statistics[a,b]

	2.1.1.1	2.1.1.2	2.1.1.3	2.1.1.4	2.1.1.5	2.1.1.6	2.1.1.7
Chi-square	6.480	2.643	7.165	13.360	13.972	4.027	2.361
df	5	5	5	5	5	5	5
Asymp sig	.262	.755	.209	.020	.016	.546	.797

a. Kruskal-Wallis test

b. Grouping variable: geographic distance

Test statistics[a,b]

	2.1.1.8	2.1.1.9	2.1.1.10	2.1.1.11	2.1.1.12	2.1.1.13	2.1.1.14
Chi-square	4.969	3.275	8.047	5.277	3.314	5.457	5.024
df	5	5	5	5	5	5	5
Asymp sig	.420	.658	.154	.383	.652	.363	.413

a. Kruskal-Wallis test

b. Grouping variable: geographic distance

Test statistics[a,b]

	2.1.1.15	2.1.2.1	2.1.2.2	2.1.2.3	2.1.2.4	2.1.2.5	2.1.2.6
Chi-square	4.112	2.962	5.116	7.302	7.588	4.587	1.251
df	5	5	5	5	5	5	5
Asymp sig	.533	.706	.402	.199	.180	.468	.940

a. Kruskal-Wallis test

b. Grouping variable: geographic distance

Test statistics[a,b]

	2.1.2.7	2.1.2.8	2.2.1.1	2.2.1.2	2.2.1.3	2.2.1.4	2.2.1.5
Chi-square	8.602	3.139	3.429	4.843	7.784	5.704	2.223
df	5	5	5	5	5	5	5
Asymp sig	.126	.679	.634	.435	.169	.336	.817

a. Kruskal-Wallis test

b. Grouping variable: geographic distance

Test statistics[a,b]

	2.2.1.6	2.2.1.7	2.2.1.8	2.2.1.9	2.2.1.10	2.2.1.11	2.2.1.12
Chi-square	5.257	5.066	6.639	3.819	2.952	4.178	3.273
df	5	5	5	5	5	5	5
Asymp sig	.385	.408	.249	.576	.707	.524	.658

a. Kruskal-Wallis test

b. Grouping variable: geographic distance

Test statistics[a,b]

	2.2.1.13	2.2.1.14	2.2.1.15	2.2.1.16	2.2.1.17	2.2.1.18	2.2.1.19
Chi-square	7.781	9.922	5.129	6.209	4.549	5.199	6.671
df	5	5	5	5	5	5	5
Asymp sig	.169	.077	.400	.286	.473	.392	.246

a. Kruskal-Wallis test

b. Grouping variable: geographic distance

Test statistics[a,b]

	2.2.1.20	2.2.1.21	2.2.2.1	2.2.2.2	2.2.2.3	2.2.2.4	2.2.2.5
Chi-square	8.726	7.726	5.968	5.172	2.935	7.680	6.438
df	5	5	5	5	5	5	5
Asymp sig	.120	.172	.309	.395	.710	.175	.266

a. Kruskal-Wallis test

b. Grouping variable: geographic distance

Test statistics[a,b]

	2.2.2.6	2.2.2.7	2.3.1.1	2.3.1.2	2.3.1.3	2.3.1.4	2.3.1.5
Chi-square	7.113	8.355	1.787	5.561	6.145	4.268	2.829
df	5	5	4	5	5	5	5
Asymp sig	.212	.138	.775	.351	.292	.511	.726

a. Kruskal-Wallis test

b. Grouping variable: geographic distance

Test statistics[a,b]

	2.3.1.6	2.3.1.7	2.3.1.8	2.3.1.9	2.3.1.10	2.3.1.11	2.3.1.12
Chi-square	5.393	6.295	4.186	3.683	9.659	4.839	4.136
df	5	5	5	5	5	5	5
Asymp sig	.370	.279	.523	.596	.086	.436	.530

a. Kruskal-Wallis test

b. Grouping variable: geographic distance

Test statistics[a,b]

	2.3.1.13	2.3.1.14	2.3.1.15	2.3.2.1	2.3.2.2	2.3.2.3	2.3.2.4
Chi-square	1.118	8.964	3.096	4.728	4.375	.851	2.942
df	5	5	5	3	3	3	4
Asymp sig	.952	.110	.685	.193	.224	.837	.568

a. Kruskal-Wallis test

b. Grouping variable: geographic distance

Test statistics[a,b]

	2.3.2.5	2.3.2.6	2.3.2.7	2.3.2.8	2.3.2.9
Chi-square	2.469	8.465	2.942	2.315	4.798
df	4	4	4	4	4
Asymp sig	.650	.076	.568	.678	.309

a. Kruskal-Wallis test

b. Grouping variable: geographic distance

APPENDIX D: TEST RESULTS FOR HYPOTHESIS 3, 4 AND 5

NPAR TESTS

Binomial test

		Category	N	Observed prop	Test prop	Asymp sig (2-tailed)	Exact sig. (2-tailed)
2.1.1.1	Group 1	1	16	.59	.50	.442[a]	
	Group 2	2	11	.41			
	Total		27	1.00			
2.1.1.2	Group 1	2	34	.77	.50	.000[a]	
	Group 2	1	10	.23			
	Total		44	1.00			
2.1.1.3	Group 1	1	15	.38	.50	.154[a]	
	Group 2	2	25	.63			
	Total		40	1.00			
2.1.1.4	Group 1	1	16	.38	.50	.164[a]	
	Group 2	2	26	.62			
	Total		42	1.00			
2.1.1.5	Group 1	1	19	.46	.50	.755[a]	
	Group 2	2	22	.54			
	Total		41	1.00			
2.1.1.6	Group 1	1	14	.30	.50	.011[a]	
	Group 2	2	32	.70			
	Total		46	1.00			
2.1.1.7	Group 1	2	39	.78	.50	.000[a]	
	Group 2	1	11	.22			
	Total		50	1.00			
2.1.1.8	Group 1	2	15	.43	.50	.500[a]	
	Group 2	1	20	.57			
	Total		35	1.00			
2.1.1.9	Group 1	2	29	.63	.50	.104[a]	
	Group 2	1	17	.37			
	Total		46	1.00			

2.1.1.10	Group 1	1	18	.50	.50	1.000[a]	
	Group 2	2	18	.50			
	Total		36	1.00			
2.1.1.11	Group 1	2	36	.84	.50	.000[a]	
	Group 2	1	7	.16			
	Total		43	1.00			
2.1.1.12	Group 1	2	24	.62	.50	.200[a]	
	Group 2	1	15	.38			
	Total		39	1.00			
2.1.1.13	Group 1	2	19	.51	.50	1.000[a]	
	Group 2	1	18	.49			
	Total		37	1.00			
2.1.1.14	Group 1	1	16	.46	.50	.736[a]	
	Group 2	2	19	.54			
	Total		35	1.00			
2.1.1.15	Group 1	2	32	.78	.50	.000[a]	
	Group 2	1	9	.22			
	Total		41	1.00			
2.1.2.1	Group 1	2	20	.59	.50	.392[a]	
	Group 2	1	14	.41			
	Total		34	1.00			
2.1.2.2	Group 1	1	23	.70	.50	.035[a]	
	Group 2	2	10	.30			
	Total		33	1.00			
2.1.2.3	Group 1	2	20	.59	.50	.392[a]	
	Group 2	1	14	.41			
	Total		34	1.00			
2.1.2.4	Group 1	2	23	.66	.50	.090[a]	
	Group 2	1	12	.34			
	Total		35	1.00			
2.1.2.5	Group 1	2	22	.63	.50	.175[a]	
	Group 2	1	13	.37			
	Total		35	1.00			

2.1.2.6	Group 1	1	14	.40	.50	.311[a]	
	Group 2	2	21	.60			
	Total		35	1.00			
2.1.2.7	Group 1	2	30	.79	.50	.000[a]	
	Group 2	1	8	.21			
	Total		38	1.00			
2.1.2.8	Group 1	1	19	.53	.50	.868[a]	
	Group 2	2	17	.47			
	Total		36	1.00			
2.2.1.1	Group 1	1	17	.45	.50	.627[a]	
	Group 2	2	21	.55			
	Total		38	1.00			
2.2.1.2	Group 1	1	7	.17	.50	.000[a]	
	Group 2	2	34	.83			
	Total		41	1.00			
2.2.1.3	Group 1	1	10	.32	.50	.071[a]	
	Group 2	2	21	.68			
	Total		31	1.00			
2.2.1.4	Group 1	2	26	.76	.50	.003[a]	
	Group 2	1	8	.24			
	Total		34	1.00			
2.2.1.5	Group 1	2	34	.79	.50	.000[a]	
	Group 2	1	9	.21			
	Total		43	1.00			
2.2.1.6	Group 1	2	23	.61	.50	.256[a]	
	Group 2	1	15	.39			
	Total		38	1.00			
2.2.1.7	Group 1	2	19	.59	.50	.377[a]	
	Group 2	1	13	.41			
	Total		32	1.00			
2.2.1.8	Group 1	2	33	.85	.50	.000[a]	
	Group 2	1	6	.15			
	Total		39	1.00			

2.2.1.9	Group 1	1	9	.23	.50	.001[a]	
	Group 2	2	31	.78			
	Total		40	1.00			
2.2.1.10	Group 1	2	29	.74	.50	.003[a]	
	Group 2	1	10	.26			
	Total		39	1.00			
2.2.1.11	Group 1	2	17	.46	.50	.743[a]	
	Group 2	1	20	.54			
	Total		37	1.00			
2.2.1.12	Group 1	2	33	.77	.50	.001[a]	
	Group 2	1	10	.23			
	Total		43	1.00			
2.2.1.13	Group 1	2	28	.76	.50	.003[a]	
	Group 2	1	9	.24			
	Total		37	1.00			
2.2.1.14	Group 1	2	17	.47	.50	.868[a]	
	Group 2	1	19	.53			
	Total		36	1.00			
2.2.1.15	Group 1	2	25	.69	.50	.029[a]	
	Group 2	1	11	.31			
	Total		36	1.00			
2.2.1.16	Group 1	2	32	.80	.50	.000[a]	
	Group 2	1	8	.20			
	Total		40	1.00			
2.2.1.17	Group 1	2	20	.69	.50	.061[a]	
	Group 2	1	9	.31			
	Total		29	1.00			
2.2.1.18	Group 1	2	24	.86	.50	.000[a]	
	Group 2	1	4	.14			
	Total		28	1.00			
2.2.1.19	Group 1	2	20	.67	.50	.099[a]	
	Group 2	1	10	.33			
	Total		30	1.00			

2.2.1.20	Group 1	2	20	.59	.50	.392[a]	
	Group 2	1	14	.41			
	Total		34	1.00			
2.2.1.21	Group 1	2	24	.67	.50	.065[a]	
	Group 2	1	12	.33			
	Total		36	1.00			
2.2.2.1	Group 1	1	10	.32	.50	.071[a]	
	Group 2	2	21	.68			
	Total		31	1.00			
2.2.2.2	Group 1	1	14	.52	.50	1.000[a]	
	Group 2	2	13	.48			
	Total		27	1.00			
2.2.2.3	Group 1	1	13	.45	.50	.711[a]	
	Group 2	2	16	.55			
	Total		29	1.00			
2.2.2.4	Group 1	1	10	.34	.50	.136[a]	
	Group 2	2	19	.66			
	Total		29	1.00			
2.2.2.5	Group 1	1	14	.42	.50	.487[a]	
	Group 2	2	19	.58			
	Total		33	1.00			
2.2.2.6	Group 1	1	15	.58	.50	.557[a]	
	Group 2	2	11	.42			
	Total		26	1.00			
2.2.2.7	Group 1	1	14	.56	.50		.690
	Group 2	2	11	.44			
	Total		25	1.00			
2.3.1.1	Group 1	1	15	.58	.50	.557[a]	
	Group 2	2	11	.42			
	Total		26	1.00			
2.3.1.2	Group 1	1	6	.18	.50	.000[a]	
	Group 2	2	28	.82			
	Total		34	1.00			

2.3.1.3	Group 1	1	15	.60	.50		.424
	Group 2	2	10	.40			
	Total		25	1.00			
2.3.1.4	Group 1	1	9	.23	.50	.001[a]	
	Group 2	2	30	.77			
	Total		39	1.00			
2.3.1.5	Group 1	1	7	.17	.50	.000[a]	
	Group 2	2	34	.83			
	Total		41	1.00			
2.3.1.6	Group 1	1	16	.36	.50	.096[a]	
	Group 2	2	28	.64			
	Total		44	1.00			
2.3.1.7	Group 1	2	44	.90	.50	.000[a]	
	Group 2	1	5	.10			
	Total		49	1.00			
2.3.1.8	Group 1	1	6	.13	.50	.000[a]	
	Group 2	2	41	.87			
	Total		47	1.00			
2.3.1.9	Group 1	1	20	.65	.50	.150[a]	
	Group 2	2	11	.35			
	Total		31	1.00			
2.3.1.10	Group 1	2	45	.92	.50	.000[a]	
	Group 2	1	4	.08			
	Total		49	1.00			
2.3.1.11	Group 1	1	11	.26	.50	.002[a]	
	Group 2	2	32	.74			
	Total		43	1.00			
2.3.1.12	Group 1	2	22	.61	.50	.243[a]	
	Group 2	1	14	.39			
	Total		36	1.00			
2.3.1.13	Group 1	1	12	.36	.50	.163[a]	
	Group 2	2	21	.64			
	Total		33	1.00			

2.3.1.14	Group 1	1	8	.18	.50	.000[a]	
	Group 2	2	36	.82			
	Total		44	1.00			
2.3.1.15	Group 1	2	29	.71	.50	.012[a]	
	Group 2	1	12	.29			
	Total		41	1.00			
2.3.2.1	Group 1	2	7	.70	.50		.344
	Group 2	1	3	.30			
	Total		10	1.00			
2.3.2.2	Group 1	2	6	.75	.50		.289
	Group 2	1	2	.25			
	Total		8	1.00			
2.3.2.3	Group 1	1	5	.36	.50		.424
	Group 2	2	9	.64			
	Total		14	1.00			
2.3.2.4	Group 1	2	5	.33	.50		.302
	Group 2	1	10	.67			
	Total		15	1.00			
2.3.2.5	Group 1	2	13	.52	.50		1.000
	Group 2	1	12	.48			
	Total		25	1.00			
2.3.2.6	Group 1	1	15	.54	.50	.851[a]	
	Group 2	2	13	.46			
	Total		28	1.00			
2.3.2.7	Group 1	1	17	.57	.50	.585[a]	
	Group 2	2	13	.43			
	Total		30	1.00			
2.3.2.8	Group 1	1	16	.53	.50	.856[a]	
	Group 2	2	14	.47			
	Total		30	1.00			
2.3.2.9	Group 1	1	15	.58	.50	.557[a]	
	Group 2	2	11	.42			
	Total		26	1.00			

a. based on Z approximation.

APPENDIX E: TEST RESULTS FOR HYPOTHESIS 6

NPAR TESTS

Test statistics[a,b]

	2.1.1.1	2.1.1.2	2.1.1.3	2.1.1.4	2.1.1.5	2.1.1.6	2.1.1.7
Chi-Square	3.563	7.776	5.006	7.267	11.341	7.814	3.724
df	6	6	6	6	6	6	6
Asymp sig	.736	.255	.543	.297	.078	.252	.714

a. Kruskal-Wallis test

b. Grouping variable: age cat

Test statistics[a,b]

	2.1.1.8	2.1.1.9	2.1.1.10	2.1.1.11	2.1.1.12	2.1.1.13	2.1.1.14
Chi-Square	3.252	1.720	8.169	7.519	5.778	5.181	1.309
df	6	6	6	6	6	6	6
Asymp sig	.777	.944	.226	.276	.448	.521	.971

a. Kruskal-Wallis test

b. Grouping variable: age cat

Test statistics[a,b]

	2.1.1.15	2.1.2.1	2.1.2.2	2.1.2.3	2.1.2.4	2.1.2.5	2.1.2.6
Chi-Square	2.148	6.351	4.404	6.589	7.328	7.244	5.387
df	6	5	6	5	6	6	5
Asymp sig	.906	.274	.622	.253	.292	.299	.371

a. Kruskal-Wallis test

b. Grouping variable: age cat

Test statistics[a,b]

	2.1.2.7	2.1.2.8	2.2.1.1	2.2.1.2	2.2.1.3	2.2.1.4	2.2.1.5
Chi-Square	9.045	6.564	13.362	6.031	7.766	8.777	7.844
df	6	6	6	6	6	6	6
Asymp sig	.171	.363	.038	.420	.256	.187	.250

a. Kruskal-Wallis test

b. Grouping variable: age cat

Test statistics[a,b]

	2.2.1.6	2.2.1.7	2.2.1.8	2.2.1.9	2.2.1.10	2.2.1.11	2.2.1.12
Chi-Square	10.522	7.247	4.762	12.914	4.665	5.789	2.154
df	6	6	6	6	6	6	6
Asymp sig	.104	.299	.575	.044	.587	.447	.905

a. Kruskal-Wallis test

b. Grouping variable: age cat

Test statistics[a,b]

	2.2.1.13	2.2.1.14	2.2.1.15	2.2.1.16	2.2.1.17	2.2.1.18	2.2.1.19
Chi-Square	8.202	8.099	5.938	7.817	4.897	1.174	1.464
df	6	6	6	6	6	6	6
Asymp sig	.224	.231	.430	.252	.557	.978	.962

a. Kruskal-Wallis test

b. Grouping variable: age cat

Test statistics[a,b]

	2.2.1.20	2.2.1.21	2.2.2.1	2.2.2.2	2.2.2.3	2.2.2.4	2.2.2.5
Chi-Square	2.283	4.708	3.009	8.391	11.079	4.617	2.211
df	6	6	6	6	6	6	6
Asymp sig	.892	.582	.808	.211	.086	.594	.899

a. Kruskal-Wallis test

b. Grouping variable: age cat

Test statistics[a,b]

	2.2.2.6	2.2.2.7	2.3.1.1	2.3.1.2	2.3.1.3	2.3.1.4	2.3.1.5
Chi-Square	5.573	1.943	7.594	4.968	10.722	6.919	6.311
df	6	6	6	6	6	6	6
Asymp sig	.473	.925	.269	.548	.097	.328	.389

a. Kruskal-Wallis test

b. Grouping variable: age cat

Test statistics[a,b]

	2.3.1.6	2.3.1.7	2.3.1.8	2.3.1.9	2.3.1.10	2.3.1.11	2.3.1.12
Chi-Square	2.753	6.137	9.558	1.765	7.660	8.998	7.921
df	6	6	6	6	6	6	6
Asymp sig	.839	.408	.145	.940	.264	.174	.244

a. Kruskal-Wallis test

b. Grouping variable: age cat

Test statistics[a,b]

	2.3.1.13	2.3.1.14	2.3.1.15	2.3.2.1	2.3.2.2	2.3.2.3	2.3.2.4
Chi-Square	5.832	9.249	8.942	4.647	4.463	5.274	3.416
df	6	6	6	4	3	5	4
Asymp sig	.442	.160	.177	.325	.216	.383	.491

a. Kruskal-Wallis test

b. Grouping variable: age cat

Test statistics[a,b]

	2.3.2.5	2.3.2.6	2.3.2.7	2.3.2.8	2.3.2.9
Chi-Square	7.406	10.400	3.138	8.632	11.632
df	6	6	6	6	6
Asymp sig	.285	.109	.791	.195	.071

a. Kruskal-Wallis test

b. Grouping variable: age cat

APPENDIX F: TEST RESULTS FOR HYPOTHESIS 7

Test statistics[a,b]

	2.1.1.1	2.1.1.2	2.1.1.3	2.1.1.4	2.1.1.5	2.1.1.6	2.1.1.7
Chi-square	1.032	6.516	3.480	3.841	4.827	3.296	1.537
df	6	6	6	6	6	6	6
Asymp sig	.984	.368	.747	.698	.566	.771	.957

a. Kruskal-Wallis test

b. Grouping variable: employment group

Test statistics[a,b]

	2.1.1.8	2.1.1.9	2.1.1.10	2.1.1.11	2.1.1.12	2.1.1.13	2.1.1.14
Chi-square	2.216	2.533	1.822	2.018	4.079	9.474	5.755
df	6	6	6	6	6	6	6
Asymp sig	.899	.865	.935	.918	.666	.149	.451

a. Kruskal-Wallis test

b. Grouping variable: employment group

Test statistics[a,b]

	2.1.1.15	2.1.2.1	2.1.2.2	2.1.2.3	2.1.2.4	2.1.2.5	2.1.2.6
Chi-square	12.130	3.902	2.553	5.590	2.615	4.356	3.232
df	6	6	6	6	6	6	6
Asymp sig	.059	.690	.863	.471	.855	.629	.779

a. Kruskal-Wallis test

b. Grouping variable: employment group

Test statistics[a,b]

	2.1.2.7	2.1.2.8	2.2.1.1	2.2.1.2	2.2.1.3	2.2.1.4	2.2.1.5
Chi-square	7.480	1.204	3.469	3.326	7.937	7.270	4.508
df	6	6	6	6	6	6	6
Asymp sig	.279	.977	.748	.767	.243	.297	.608

a. Kruskal-Wallis test

b. Grouping variable: employment group

Test statistics[a,b]

	2.2.1.6	2.2.1.7	2.2.1.8	2.2.1.9	2.2.1.10	2.2.1.11	2.2.1.12
Chi-square	7.432	6.438	1.511	9.773	5.827	4.519	2.793
df	6	5	5	5	6	5	6
Asymp sig	.283	.266	.912	.082	.443	.477	.834

a. Kruskal-Wallis test

Test statistics[a,b]

	2.1.1.1	2.1.1.2	2.1.1.3	2.1.1.4	2.1.1.5	2.1.1.6	2.1.1.7
Chi-square	1.032	6.516	3.480	3.841	4.827	3.296	1.537
df	6	6	6	6	6	6	6
Asymp sig	.984	.368	.747	.698	.566	.771	.957

a. Kruskal-Wallis test

b. Grouping variable: employment group

Test statistics[a,b]

	2.2.1.13	2.2.1.14	2.2.1.15	2.2.1.16	2.2.1.17	2.2.1.18	2.2.1.19
Chi-square	4.768	3.745	5.411	3.787	3.461	5.900	4.494
df	6	6	6	6	5	5	6
Asymp sig	.574	.711	.492	.705	.629	.316	.610

a. Kruskal-Wallis test

b. Grouping variable: employment group

Test statistics[a,b]

	2.2.1.20	2.2.1.21	2.2.2.1	2.2.2.2	2.2.2.3	2.2.2.4	2.2.2.5
Chi-square	5.995	6.312	5.199	6.844	1.903	4.020	3.506
df	6	6	6	5	5	6	6
Asymp sig	.424	.389	.519	.232	.862	.674	.743

a. Kruskal-Wallis test

b. Grouping variable: employment group

Test statistics[a,b]

	2.2.2.6	2.2.2.7	2.3.1.1	2.3.1.2	2.3.1.3	2.3.1.4	2.3.1.5
Chi-square	5.117	3.502	7.950	9.871	7.298	8.357	3.237
df	6	5	5	6	5	6	6
Asymp sig	.529	.623	.159	.130	.199	.213	.779

a. Kruskal-Wallis test

b. Grouping variable: employment group

Test statistics[a,b]

	2.3.1.6	2.3.1.7	2.3.1.8	2.3.1.9	2.3.1.10	2.3.1.11	2.3.1.12
Chi-square	5.701	2.525	4.423	3.384	1.259	2.042	3.689
df	6	6	6	6	6	6	6
Asymp sig	.457	.866	.620	.759	.974	.916	.719

a. Kruskal-Wallis test

Test statistics[a,b]

	2.3.1.6	2.3.1.7	2.3.1.8	2.3.1.9	2.3.1.10	2.3.1.11	2.3.1.12
Chi-square	5.701	2.525	4.423	3.384	1.259	2.042	3.689
df	6	6	6	6	6	6	6
Asymp sig	.457	.866	.620	.759	.974	.916	.719

a. Kruskal-Wallis test

b. Grouping variable: employment group

Test statistics[a,b]

	2.3.1.13	2.3.1.14	2.3.1.15	2.3.2.1	2.3.2.2	2.3.2.3	2.3.2.4
Chi-square	3.291	6.793	5.051	4.559	6.125	4.886	1.972
df	6	6	6	5	5	5	4
Asymp sig	.772	.340	.537	.472	.294	.430	.741

a. Kruskal-Wallis test

b. Grouping variable: employment group

Test statistics[a,b]

	2.3.2.5	2.3.2.6	2.3.2.7	2.3.2.8	2.3.2.9
Chi-square	3.447	3.416	3.766	1.540	1.667
df	5	5	6	6	5
Asymp sig	.631	.636	.708	.957	.893

a. Kruskal-Wallis test

b. Grouping variable: employment group