INVESTIGATING THE IMPACT OF SUPPLY CHAIN TECHNOLOGIES WITHIN AUTOMOTIVE SUPPLIER CLUSTERS

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DECLARATION

I, Lance Craig Schultz, hereby declare that:

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- This dissertation is being submitted in partial fulfilment of the requirements for the degree of Masters in Business Administration.

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This dissertation is dedicated to:

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ABSTRACT

Organisations are constantly expected to be more competitive while working in an environment in which time and cost are limited, thereby preventing such organisations from taking the time required to be responsive. The supply chain provides a critical linkage between various organisations which should seek collective opportunities to improve performance. It is, therefore, important that organisations understand that conventional knowledge and methods will not serve unless there is a concerted focus on improvement of organisational performance toward fulfilling increased expectations, not just maintaining that which is comfortable. A more sustainable approach may be the introduction of supply chain best practice. An optimal supply chain is one that continuously strives to reduce unnecessary cost and eliminate waste, thereby increasing the percentage of time that may be devoted to value-adding activities.

Supply chain technology principles were assessed and the application thereof, sought to understand its efficiency and effectiveness. This study was intended to identify supply chain cost dimensions with a focus on the optimal use of supply chain technology. Within the current supply chain context, the use of Information and Communication Technology (ICT) was explored to identify opportunities. A supply chain audit tool (SCAT) was developed which had proven to be an effective tool to analyse it's logistics functions. Implementation of remedial tools through the SCAT could result in a leaner, cost optimal and more value-adding process. The result of conducting individual organisational improvements is expected to result in an overall improvement in the total supply chain. These supply chain cost drivers were rooted in cost, quality, safety and product performance. Recommendations on further improvements were also offered.

TABLE OF CONTENTS **PAGE**

LIST OF FIGURES **PAGE**

CHAPTER TWO

CHAPTER FOUR

LIST OF TABLES **PAGE**

CHAPTER THREE

CHAPTER FOUR

LIST OF APPENDICES **PAGE**

CHAPTER ONE: INTRODUCTION, BACKGROUND AND RATIONALE FOR THE STUDY

1.1 INTRODUCTION

According to the National Association of Automotive Manufacturers in South Africa (NAAMSA), the automotive sector is a significant contributor to the South African economy, providing 28179 jobs as at March 2011 (NAAMSA Quarterly Bulletin First Quarter, 2011). In 2010, the contribution of the automotive sector to the South African Gross Domestic Product was 6, 2% (NAAMSA Quarterly Bulletin First Quarter, 2011). The automotive sector in the Nelson Mandela Bay Municipality (NMBM) region also contributes significantly to the local economy (Port Elizabeth Regional Chamber of Commerce and Industry, 2010). However, the automotive industry faces many challenges, in particular, globalisation, cost pressures and increasing competition. These challenges also impact on automotive component manufacturers (ACMs) as they are required to shorten the delivery time needed to reach the market, increase customer service levels, provide higher levels of conformity and quality, as well as reduce supply chain inefficiencies (Engineering News, 2010).

Component manufacturers, therefore, not only need to enhance their resilience to remain domestically competitive, they also need to identify new potential for exploiting cost-reduction initiatives in an attempt to enter other export markets. In addition, South African ACMs are competing with countries that can provide lower production costs (Ravendran, 2002:423). To achieve these aims and address their challenges, Byrd and Davidson (2003:243) and Power (2006:64) identify the adoption of supply chain technology (SCT) as a necessity. Levary (2000:24) states that SCT may be defined as a technology or a system that is used in coordinating and integrating the information flow electronically throughout the supply chain network of trading partners and customers, so as to generate effective and efficient business transactions. SCT also aims at providing better customer service as well as better communication channels. As SCT developments are occurring at a faster pace, SCT is also driving ACMs to re-evaluate their competitive positions (Li & Lin, 2006: 16).

Automotive industry bodies, such as the National Automotive Association of Component Manufacturers (NAACAM) and NAAMSA, view production costs as

important in creating a competitive industry. SCT, therefore, is critical for reducing costs and enhancing the competitiveness of automotive suppliers. SCT is thus a tool which is not only utilised to improve the efficiency of manufacturing operations, but one which also acts as a competitive weapon in organisational strategy.

Organisational strategy may thus use SCT to improve competitive positioning since it stems from the overall management of the supply chain. The improved positioning is achieved through optimal supply chain management. Supply chain management (SCM) is the management of activities which are involved in purchasing materials, transforming them into intermediate products and then into final products, and is completed by delivery to a customer (Stevenson, 2005:685). The sequence of SCM begins with the basic suppliers of raw materials, and extends all the way across a supply chain with the end-customer receiving the final product. The facilities involved in an assembly-type supply chain, such as that of automotive component manufacturers, include warehouses, factories, processing centres, distribution centres, retail outlets and offices.

The various supply chain activities include forecasting, planning, purchasing, inventory management, information management, quality assurance, production scheduling, distribution, delivery, disposal and customer service (Heizer & Render, 2008:434; Stevenson, 2005:692). Therefore, the management of a supply chain includes all those activities which are involved in the flow of materials and information through the supply chain–from setting a forecast to disposal and includes the ultimate of meeting customer requirements through effective service delivery. Although these supply chain activities are generically applied in manufacturing, SCM in the manufacturing of automobiles includes the integration of activities among a network of facilities. The inputs needed at each level or tier of the supply chain includes information from customers, raw materials, inventory, equipment, machinery, labour and finances to be ultimately transformed into the finished automotive components (Stevenson, 2005:692). Automotive components must then be delivered to customers through a distribution centre (DC).

In accordance with the strategic thinking of SCM, the automotive sector in South Africa (SA) has supply chain nodes which have specialised labour to improve SCM. Because

of close inter-firm relations, the functional linkage of a network chain is formed, and these companies realise a coordinated operation and collaboration under an overall management at the same time. These node enterprises can also be the integral entity of industry clusters. An industry cluster is composed of support institutions and similar firms with a specialised division of labour or related enterprises in the value chain (Han, 2009:127). On the other hand, industry clusters have vertical specialisation and horizontal scales in the value chain. Therefore, an industry cluster is a selected set of a group of chains, and, accordingly, the node enterprises in the supply chain are integral entities of SCM.

In the process of ACMs cooperating within a supply chain cluster, a unique network of relationships, knowledge and regional information exchange platforms are formed. ACMs can also take advantage of cluster unity and shared interest which boosts collaboration if cooperation is evident. Such cooperation will bring together suppliers, customers and even competitors in the supply chain to share skills and resources, thereby enhancing the inter-enterprise sharing effects of SCM.

In the short term, flexibility affects the competitive position of the firm and may impact its overall profitability. Flexibility becomes particularly relevant when the entire supply chain is considered consisting of a network of supply, production and delivery firms. Although flexibility requires the management of many sources of uncertainty, it allows for switching production among different plants and suppliers, so that management can cope with internal and external variability (Chen, Egbelu & Wu, 1994:1431).

1.2 PROBLEM STATEMENT AND RESEARCH OBJECTIVES

As competition in the 2000s has intensified and markets have become increasingly global, dynamic and customer-driven, more pressure has been placed on the automotive industry to be competitive. Motor car manufactures, also referred to as Original Equipment Manufacturers (OEMs), are required to deliver more variety, better quality, higher reliability and faster delivery to meet customer expectations. As ACMs are required to manage the supply chains in increasingly competitive markets, the

problem is to investigate causality between the extent to which SCT is effectively used in ACMs and its ability to leverage economies of scale through clustering.

To compete internationally, the focus is no longer on the management, survival, growth and competitiveness of individual organisations, but rather on efficient and well-oiled supply chains (Lee & Whang, 1998:3). As suppliers can be a crucial source of competitive advantage for an organisation in the 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 total supply chain. These SCT interactions are not just complicated by their volume and variation in processes, but also by the complexity inherent in the dependencies that exist between parties (Kamaruddin & Udin, 2009:385). These firms are forced to adopt SCT practices across common member interests, and member pressure may have an influence on SCT costs as well as determining how integrated such practices become within the supply network.

Using the SCT to manage most of the elements involved in the procurement and communication processes, makes the data exchange and the management of the supply chain faster and easier. The levels of innovation and the extent of adoption thus have a direct bearing on SCT costs.

One common theme that emerges across all these SCT cost problems is related to the quality of communication as the flow of information offer a great potential for dampening or increasing the perception of variation-in-demand which triggers hidden cost (Lee & Whang, 1998:3). In this context, as SCT has become more sophisticated and accessible, advances made in technology as a means of improving information flows has increased considerably. As information flow has its origins in the way that SCT interacts within supply chains, the development of SCM requires that all the members of a supply chain coordinate their production and logistics activities. This type of coordination can be facilitated by SCT, particularly when these technologies are used to span the traditional boundaries of supply chain firms (Sanchez & Perez, 2003:642).

1.2.1 Research objectives

Based on the background and introductory notes of the previous pages, the main objective of this study can be defined as follows: To investigate the impact of supply chain technology within automotive supplier clusters. The questions arising from this objective include:

- What are the supply chain technology and associated cost problems that ACMs in the Nelson Mandela Bay Municipality face?
- What are the barriers to solve these Information and Communication Technology (ICT) supply chain cost-related problems?
- To what extent is clustering of the automotive supply chain used for cost optimisation?

In support of the primary objective, the secondary research objectives are as follows:

- To determine how the use of SCT impact on SCM within automotive organisation structures, as firms seek to maximise their supply chain hierarchies, facilitate growth and reduce supply chain costs.
- To investigate whether the level of integration of supply chain ICT practises, within a supply chain system or a firm, has an influence on SCT costs.
- To determine which supply chain issues prevent SCT adoption of best practise.
- To develop a supply chain audit tool that can determine the level of supply chain maturity and whether SCT is used effectively.

1.3 REVIEW OF RELATED RESEARCH

Only a few studies related to SCT in South Africa have been done, but with limited clarity. As the factors that facilitate the adoption of SCT by South African ACMs are still not clear (Naude, 2009:24), the researcher of this study needed to identify and analyse the factors that affect the adoption of SCT to encourage the growth and widespread adoption of SCT amongst suppliers of automotive manufacturers in South Africa. As Naude's (2005:8) study analysed the automotive component export market in the country, his objectives were selected to provide an understanding of SCM practices in the automotive component industry in the country. The research focused

on supply chain challenges facing the South African automotive component industry in the export market and identified the issues involved and challenges faced by SCM (Naude, 2005:8). The main limitation of his study was that *only four sub-sectors* (catalytic converters, stitched leather components, tyres, wheels and parts) in the automotive component manufacturers' sector in South Africa were included, and the quota sample subsequently consisted of 27 component manufacturers. The supply chain challenges identified in Naude's literature review focused mainly on the export market and globalisation. He did not draw a link between the use of SCT and SCM as interrelated in support of clustering.

A study by Bardi, Raghunathan and Bagchi (1994:71-85) show that the SCT and systems utilised by most emerging economies were separate and meant to be used by such functions as procurement, production and sales. This makes it difficult, if not impossible, to connect each functional system. It also lowers the effectiveness and efficiency of these systems as the systems are fragmented. Therefore, from the perspective of integrated SCM, it is necessary to establish a total supply chain network with an integrated database capable of supporting each function. They also noted the extent of how supply chain clusters supported integration through sharing technology. The study, however, was not focussed on the South African automotive industry, but rather on general manufacturing in comparing other emerging economies.

Barnes (2002:4) concluded a thesis in which he investigated lean production processes that have been adopted in supply chains and what improvements would be achieved throughout the firm with supply chain optimality. The researcher analysed the various supply chain dimensions including inventory, returns, warehousing, packaging and order fulfilment as competitive SCM practises. The study revealed that no holistic tool existed to measure the state of readiness to deliver. The study did not address how SCT and SCM supported the South African automotive sector as a combined research area. Furthermore, the study did not ascertain the extent of SCT in a cluster with respect to its formation and the use of ICT as a technology lever.

1.3.1 Research gap analysis

As found by Barnes (2002:4), both SCT and SCM have been researched as two separate research areas. It appears that to date, no researcher has combined these two factors in the South African context. This current study may reveal that SCT and supply chain integration are complementary in nature, and need, therefore, to be studied together. Furthermore, it is evident that previous researchers have not addressed the critical area of the relation between SCT and how clusters improve SCM as a whole. As noted by Barnes (2002:4), it is also imperative to administer a supply chain audit tool for component manufacturers to measure the state of readiness to supply at competitive levels to OEMs.

The research gap emanating from previous research to identify the supply chain problems facing all role players within the South African automotive supply chain, is that the research has not been undertaken across the entire value chain as yet. Therefore, the main objective of this study is to investigate the impact of supply chain technology within automotive supplier clusters. This research study will also determine the factors that positively affect the adoption of a supply chain audit tool and how the formation of clusters is beneficial to optimise performance with particular emphasis on ICT usage.

1.4 PROPOSED RESEARCH DESIGN AND METHODOLOGY

Generally speaking, it is possible to distinguish between two main research approaches, namely the quantitative and qualitative approach (Leedy & Ormrod, 2005:94). According to Burns and Bush (2006:202), quantitative research refers to the use of structured, standard questions and pre-determined response options given in the form of a questionnaire to a large number of respondents. Quantitative research methods are directly related to descriptive research, which uses a set of scientific methods for collecting raw data and creating data frameworks (McDaniel & Gates, 2006:79). Quantitative research is based on positivistic methodologies for developing knowledge. These include: cause-and-effect relationships; the reduction of specific variables in the analysis; and the use of statistical measurement and observation (De Vos, Strydom, Fouché & Delport, 2005:79). Therefore, a quantitative approach

involves collecting and analysing data that can be mathematically and/or statistically interpreted and analysed (Collis & Hussey, 2003:13).

Qualitative research, on the other hand, is “any research in which qualitative data is used (Struwig & Stead, 2001:13). It includes words, pictures, drawings, photographs, films and music, therefore any information that is not expressed in numbers”. Lancaster (2005:67) argues that the qualitative research approach is mainly used when the researcher needs to gather and analyse detailed data that cannot be mathematically or statistically interpreted and analysed, such as ideas, attitudes or feelings.

The nature of the topic researched in this study dictated the use of the quantitative research methodology. Data for this study was collected from both primary and secondary sources. The questionnaire was constructed after secondary sources in the form of books, journals, electronic databases, the Internet, supply chain experts within the AIDC, as well as industry associations such as NAAMSA and NAACAM through a focus group, were consulted.

As was indicated above, this study resides in the quantitative domain, as the research fits into an existing supply chain framework which will use measurement and sampling. The methods of primary and secondary data collection, sampling frames, structure of the research instrument (questionnaire), as well as the strategies followed in administering the research instrument, are discussed and explained in more detail in Chapter 3.

1.5 DELIMITATION (SCOPE) OF THE STUDY

The purpose of the study is to test the theory of SCT costs as they relate to competitiveness and the advancement of best practices within South African ACMs. This is done by comparing the supply chain as it relates to costs for all ACMs in the NMBM with their adoption of SCT practices in reducing costs. Therefore, only component manufacturers who are members of NACAAM in the NMBM, are included.

The intention in this study was to use a sample which comprised of all ACMs within the NMBM which total 85. The target population, when stratified, were male and female managing directors and supply chain directors in the targeted supplier companies. The total number of targeted respondents would be 170. The specific interest parameter was determined by the supply chain functionary directly responsible for SCT which may be a supply chain manager.

1.6 DEFINITION OF KEY CONCEPTS

The main concepts that are dealt with in the study are defined below.

- Agility: Supply chain agility is an operational strategy focused on inducing velocity and flexibility in the supply chain. It is critical to the long-term survival of any organisation (Rockfordconsulting, 2011).

- Original equipment manufacturers (OEMs) or automotive assemblers: This category comprises both passenger and commercial vehicle assemblers, for example, General Motors, Mercedes Benz and Ford.

- Automotive Component Manufacturers (ACMs): ACMs supply components to OEMs and the independent aftermarket. The ACMs can be seen as the tiered suppliers in the automotive supply chain. This study focuses on these role players. ACMs, in the Eastern Cape industry, for example, include Shatterprufe, Faurecia and Feltex.

- Original equipment suppliers (OESs): This category comprises automotive parts and accessory sales with networks linked to OEMs.

- Automotive retail and aftermarket: This category consists of automotive parts and accessory sales, through independent retailers and repair shops.

- Supply chain (SC) and supply chain management (SCM): SCM is the management of all activities involved in purchasing materials, transforming

them into intermediate goods and final products and delivering a product or service to a customer. 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).

- Just in Time (JIT): This 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 & Render, 2008:642).

- Supply chain cluster: Clustering of the supply chain is the coupling of organisations between the industry and the supply chain. These organisations form supply chain networks in local regions by the transactional relationship between themselves as links. It creates links by way of formal convent or informal incompact based on trust and undertaking. There are many specialised relational small and medium enterprises which lay outside of these single supply chains that cooperate and reinforce the production of these single supply chains. This agile network system builds up into a cluster supply chain. Cluster supply chains have longitudinal enterprise cooperation based on highly developed technology integration.

- Characteristics of a supply chain cluster: A supply chain cluster is a supply chain network which takes an industry view and is thus different from individual supply chains. Its main features are displayed in the following aspects:

    - Dynamic rivalry based on similar industrial localisation
    - Integrity based on local cluster integration
    - Mass customisation based on time competition
    - Trust
    - Universal compatibility based on small- and medium-sized enterprise localisation

As a major part of supply chain management, procurement, which is one of the processes in supply chains, 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. There were further developments of EDI which make systems integration/connectivity in supply chains possible. These are e-commerce and e-procurement, and are explained as follows:

- e-commerce

  According to Goodman, Fandt, Michlitsch and Lewis (2007:435), 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. According to Goodman, et al. (2007:84), Electronic commerce (e-commerce) is defined as the process of buying and selling goods and services electronically with computerised business transactions.

According to Simchi-Levi and Kaminsky (2008:198), the influence of the Internet and e-commerce on business practices has been significant. Business to Business (B2B) e-commerce has made possible more efficient supply chain management strategies for virtually all businesses, including improved Business to Consumer (B2C) practises. E-commerce has radically changed the retail industry, for example, from books to music to clothing (Goodman et al, 2007:84).

- e-procurement

  Hugo, Badenhorst-Weiss and Van Biljon (2004:269) state that e-procurement is the execution of purchases against a pre-negotiated contract and includes technology such as electronic catalogues.

1.7 SIGNIFICANCE OF THE STUDY

This study is significant as South Africa is responsible for approximately 80.0% of Africa's vehicle output and produces 0.7% of the world's vehicles. 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 and the Eastern Cape region. The field of SCM is extremely dynamic as it is continually evolving with new practices and concepts.

Owing to local conditions in the Eastern Cape, the automotive component industry faces certain supply chain problems within the various supply chain dimensions. This study will focus on identifying possible problem areas in which improvements could stimulate competitiveness among Eastern Cape ACMs. The study aims to identify these supply chain problems and the extent of SCM practises which South African ACMs have to deal with. Several causes exists that impact on SCT and these will be identified. Proposed remedies will also be suggested through the study to overcome the identified supply chain problems. The study of literature, trends and new developments will also contribute to the body of knowledge and provide new insight into this field.

1.8 CHAPTER OUTLINE

This study consists of five chapters. Chapter one is the introductory chapter where the background, rationale, problem statement, objectives and significance of the study are outlined. Chapter two provides a review of the related literature, while the research design and methodology are described in chapter three. Chapter four gives a summary of the empirical results, with chapter five concluding the study.

1.9. CONCLUDING REMARKS

Having outlined the background, rationale, study objectives and study significance in this first chapter, a review of the related literature is given in the next chapter.

CHAPTER TWO: LITERATURE REVIEW

2.1 INTRODUCTION

Chapter one provided an overview for the study's context and rationale. Chapter two investigates and reviews various studies relating to the current research being undertaken. The researcher explores supply chain technology (SCT) within supply chain collaboration, challenges, clustering, transactional relationships, integration, cluster initaitives in South Africa, as well as tools to support SCT clustering.

Traditional strategies and practices have proved to be unsuitable for solving the challenges of the new business paradigm. Hugo, Badenhorst-Weiss and Van Biljon (2004:10) argue that competitive forces and an increase in environmental turbulence have forced automotive businesses to reconsider their forms, structures, linkages, strategies and models. This new paradigm calls for collaboration, business focus and wide access to information as the lack of supply chain-wide information has led to the creation of waste, information- and material-flow barriers and, consequently, poor customer service. Therefore, supply chain management (SCM) is critical to improve a business enterprise through the improved use of technology and the creation of supply chain visibility.

As was indicated in the first chapter, SCM is the management of activities which include information management, forecasting, purchasing, planning, inventory management, quality assurance, scheduling production, distribution, delivery, disposal and customer service (Heizer & Render, 2008:434; Stevenson, 2005:692). SCM includes all those activities involved in the flow of materials and information throughout the supply chain and, additionally, it requires forms of collaboration to achieve collective aims from source to end-user.

2.2 SUPPLY CHAIN COLLABORATION

Supply chain collaboration appears in recent times to have become one of the most important paradigms to create sustainability and long-term competitiveness (Simchi-levi & Kaminsky, 2008:417). Integrating previously independent ACMs accounts largely for enhanced supply chain collaboration, information and communication technology (ICT). This has significantly improved coordination and information sharing, and ultimately, provides for greater visibility of information, reduced costs, collective planning and cost transparency (Bowersox, Closs & Stank, 2000:16). Hartono and Holsapple (2004:30) describe collaboration as:

> "*An interactive, constructive and knowledge-based process, involving multiple stakeholders through the use of complementary skills and assets, with the shared objective of achieving an outcome beyond what the participants'*

capacity and willingness would normally allow the participants, to singularly achieve".

Collaboration acts as an enabler by streamlining operations across the supply chain by using information to replace any surfeit capacity or inventory. Information sharing is essential, since it enhances operational efficiency and revenue by increasing visibility across the supply chain. This is achieved because information technology (IT) acts as a driver of supply chain integration. The web, social networking and information technology have changed the business environment by shifting the negotiating power to buyers (Cokins, 2003:22). Supply chains thus need to position themselves with the end-user in mind that utilises technology platforms to derive value and optimality. As the modern focus has shifted to become more consumer-centric in improvement initiatives, it has become an imperative for companies to strengthen relationships across their supply chains (Happek, 2005:3).

2.2.1 A typology of collaboration

Three types of collaboration exist within the manufacturing environment around supply and this also holds true for ACMs in South Africa (Maccoby, 2006:60). The first is within an organisational department, in which experts collaborate in performing tasks, as found within a traditional team-based approach. The second is across departments, where products are developed or problems are solved. This allows cross-departmental knowledge or information-sharing in meeting organisational supply chain directives. The third is where collaboration occurs between companies through inter-company networks or the exchange of data (Maccoby, 2006:61). This allows for entire supply chains to partner and achieve significant economies of scale and learning curve effects. A further example of this is found by grouping these suppliers in a common or shared environment, thereby enhancing the visibility of information and resources. This is typified by the provision of supply chain enabling infrastructure to support collaboration.

2.2.2 Supply chain infrastructure

The advent of supplier parks in South Africa has also become part of the process of supply chain collaboration. Two supplier parks are evident in the South African automotive industry. One exists in Rosslyn, Pretoria, while the other one is in Uitenhage which forms part of the NMBM. These have been developed for the automotive sector by the Automotive Industry Development Centre (AIDC). By grouping suppliers, economies of scale are achieved by means of shared services, clustering similar products, consolidation and shared transport.

Logistics infrastructure is one of the biggest costs to an ACM, given the country's geographical location. Transportation is one of the major costs which do not add value to a product; and this cost needs to be reduced, to become more competitive

2.3 SUPPLY CHAIN CLUSTERING

According to Stank, Keller and Dougherty (2001:41), the philosophy in supply chain clusters requires maximising services to customers at the lowest possible total cost. This requires a strong value system, commitment and close relationship between the various trading networks.

Stank, Keller and Dougherty (2001:42) further observe that as supply chain clustering requires shared decision-making amongst trading partners, many ACMs use sophisticated ICT technology to help them gain a competitive advantage. Furthermore, advances in web-based applications, tools and electronic data interchange (EDI) have also now occurred. A number of research papers exist which have examined the impact of SC information- sharing and collaboration to improve overall business performance.

A review of studies carried out by Yu, Yan and Cheng (2007:99) shows that the globalisation of OEMs and ACMs in business has significantly increased over the past decade owing to advances in ICT, cost pressures and demand management. SCM best practice provides overall and long-term benefits for all ACMs, which occurs through cooperation and information-sharing. By coordinating activity along the SC or

establishing SC-related business partnerships, SCM creates a win-win situation for ACMs. Advances are achieved through supply and demand, cross-docking, consolidation, vendor-managed inventories and rapid response technologies.

As indicated earlier, SCM relates to the coordination of products and ICT flow amongst OEMs, ACMs and customers. Thus, for the different partners in the supply chain to coordinate their individual activities, information-sharing must occur at the appropriate levels. SCM efforts are cross-functional activities serving logistics, purchasing, the management of operations (OM), engineering, accounting and marketing, which all have relevance to the decision-making processes of SCM.

2.3.1 The bull-whip effect

Supply chains need to be managed by controlling demand and supply conditions. In this way, they can have cost, quality and lead-time controls. It is often found that the demand information is distorted, resulting in upstream amplification of order schedules. A phenomenon that creates information distortion within the supply chain is called the bull-whip effect. This occurs when orders to the ACMs tend to have larger variance than those to the buyer (called demand distortion); and the distortion exponentially increases upstream (called variance amplification). Warner (2002:62) illustrates the effect in several case studies and suggests the bull-whip effect is the consequence of industrial dynamics or of the time-varying behaviours of industrial companies. Simply put, it involves the basic form and policies used by a company creating undesirable traits or behaviour within the supply chain. It creates variations in the quantities of materials, work in process or finished goods. The financial impact of inefficiencies owing to the bull-whip effect has not been sufficiently explored in South African ACMs.

The financial impact is observed in the bull-whip through inventory holding and back-orders. In recent years, OEMs and ACMs 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 & Kaminsky, 2003:101). The bull-whip effect thus implies that inconsistency in demand increases as one move up in the

supply chain. This increase in variability causes significant operational inefficiencies as it forces every link in the chain to increase its inventory significantly (Hugo, Badenhorst-Weiss & Van Biljon, 2004:66)

A mechanism to manage the bull-whip effect is to centralise demand information and integrate business processes across the supply chain. It specifically requires each stage of the supply chain to have complete information on the actual customer demand and in this way, the bull-whip effect can be counterbalanced (Hugo, Badenhorst-Weiss & Van Biljon, 2004:66; Simchi-levi & Kaminsky, 2003:101).

According to Das (1997:244-259), this also allows the balance of resource needs against uncertainty to be better controlled. One means to control uncertainty is by forming co-operative activities, for example, strategic alliances. These strategies can then be deployed to access other manufacturers' complementary resources. This is achieved by retaining and developing owned resources, and by combining them with resources from other companies to gain competitive advantage and maximise value to the manufacturer.

2.4 SOUTH AFRICAN ACM SUPPLY CHAIN CHALLENGES

OEMs and ACMs face numerous challenges which relate to efficiency (cost minimisation) and effectiveness (maximising customer satisfaction). These are discussed in the following paragraphs.

2.4.1 OEM pressure onto ACMs

South African ACMs involve multiple players in a complex, lengthy and global supply chain. This can best be described as a multi-echelon supply chain which is producer-driven and segregated into various tiers. The potential exists to create an environment

in which ACM relationships can be more direct, more cost efficient and more interactive. In this way, unintended supply and demand variations can be ameliorated, thereby eliminating uncompetitive practices. Competitive pressures amongst OEMs have increased in recent years, forcing additional competitive demands on to their component suppliers. According to Barnes and Morris (2008:31), the implications of increased costs with reduced product-selling prices are substantial, forcing first-tier component firms to squeeze their own suppliers, or to re-source to cheaper locations, resulting in intensive competitiveness pressure throughout the supply chain through the following resource views:

- Fixed term cost-down contracts: OEMs demand that first-tier suppliers set percentage cost-down contracts over the product lifecycle produced for them. ACMs have to achieve these reductions through value adding to lower costs.

- Once-off price reductions on new products: With each new model released, OEMs demand that component suppliers manufacture their new products at reduced prices of up to 20.0%. Integrity and product quality must also improve, despite these cost reductions.

- Enhanced just-in-time (JIT) supply: OEMs increasingly demand more frequent JIT deliveries to reduce their overhead cost structures, to improve internal controls, and to better control their working capital. They also require 100% delivery reliability and any stoppages at the OEM caused by supplier non-deliveries, incur substantial financial penalties.

- Improved quality performance: ACMs are now also expected to supply perfect quality products, progressively reducing their failure rates to customers, with targets of 20 - 30 parts per million (ppm) returns being set.

- Adherence to environmental standards: OEMs are also demanding that their component suppliers secure ISO 14001 accreditation.

2.4.2 Collaborative relationships in support of information technology

Bowersox, Closs and Cooper (2007:362) identify two beliefs to facilitate a drive for supply-chain efficiency improvement and increased competitiveness. Firstly, there is an opportunity to eliminate waste and non-value added processes. For example, as a result of collaboration, substantial inventories held in a traditional channel can be eliminated. In addition, supply chain collaboration can also eliminate or reduce the risk associated with inventory speculation. Secondly, collaborative relationships will decrease risks and improve the efficiency of the entire supply chain process. To achieve this collaborative relationship, it is essential for supply chain players to share strategic information.

However, information-sharing must not only be restricted to transaction data, but must also extend to information relating to future plans so that businesses can jointly develop the best way to satisfy customers' requirements. Collaborative information is vital for businesses jointly to do the right things more rapidly and efficiently. It is evident that mutually cooperative activities in the SC may have a positive influence on the adoption and effective use of ICT, such as electronic data interchange (EDI). Collaboration through clustering, benefits all those in information technology and some of these benefits may have spill-over effects on EDI adoption (Puschmann & Alt, 2005:120).

As a major part of SCM, procurement (as a process 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 have been further developments of EDI which make systems integration, collaboration and connectivity in supply chains possible. In so doing, the learning curve effects and economies of scale provide for improved supply chain cluster initiatives. A collaborative relationship is viewed as a critical success factor as both collaborative and alliance relationships are inclined to result in lower total costs compared with the costs in 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 can be dealt with openly (Burt, Petcavage & Pinkerton, 2010:70; Lysons & Gillingham, 2003:372; Webster, 2008:94). These studies suggest that the underpinning factor within ACMs is trust, together with the adoption of a shared success approach. This is mutually beneficial at a transactional level across supply chain partners.

2.4.3 Supply chain transactional relationships

For Burt, Petcavage and Pinkerton (2010:66), transactional relationships have several negative characteristics. Firstly, there is often a lack of interest by both parties regarding the other party's well-being as o*ne party's gain is another one's loss*. Secondly, there appears to be contracts which are structured independently, thus allowing no pricing efficiencies through economies of scale. This results in low levels of collaboration. Burt and Sukoup (1989:90) also found that costs, data and forecasts are not shared with price as the main focus of transactional relationships and, lastly, a minimum set of purchasing time and energy is required to determine prices.

Monczka (2005:103) suggests that most buyers and sellers recognise a need for co-operation with suppliers to achieve cost, quality, delivery and efficiency improvements. Although during the 1990s progressive buyers eliminated poor suppliers from their supplier database, today, the goal of many of these buyers is to build collaborative relationships or alliances with current suppliers. Monczka (2005:104) defines collaboration as the "process by which two or more parties adopt a high level of co-operation to maintain a trading relationship over time".

Collaborative relationships look out for their *partners*, and not for their opportunistic customers. Both customers and suppliers, who see one another in terms of long-term relationships of mutual respect, would probably support one another in difficult times. However, 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 (Burt, Petcavage & Pinkerton, 2010:15).

Collaborative SCM focuses on shared planning and the implementation of supply chain activities (Ayers, 2006 cited in Ajmera & Cook, 2009:37). It is evident that these supply chain activities include logistics, product development and strategic planning. Although the traditional approach has been for companies to focus on improving internal operational efficiencies (Ellinger, 2002:85), this has led to a silo mentality, where the other supply chain links or interdependencies have been neglected.

The effectiveness and efficiency derived from information sharing depends on the extent of integration and collaboration. This can be internal if analysed from a department, or external if viewed from a supply chain point of view. Although the degree of collaboration results in the extent of information-sharing, it is true that up until recently, collaborative efforts have lacked any integrating plan and design activities. Therefore, the returns have been limited as the focus has been on the integration of operational processes only (Barratt, 2004:30).

Quesada, Syamil and Doll (2004:30) maintain that in a competitive environment, the trend is for companies to focus on their core competencies. This results in an ongoing increase in the level of outsourcing. They also acknowledge that in industries such as ACMs, where value is added by suppliers' significant contributions to the final product, the competitiveness of OEMs depends on supplier performance in terms of cost, quality and on-time delivery (Quesada, et al, 2004:30). 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 globally, "believe strongly that more and stronger supplier partnerships are critical to achieving competitive corporate performance" (Morgan, 2001:62). In the light of this, companies are realising the importance of developing *win-win* long-term relationships with their suppliers.

2.5 SUPPLY CHAIN INTEGRATION: A STRATEGIC VIEW

Supply chain integration as a strategic tool is aimed at reducing costs and therefore, increasing customer and shareholder value. Effective supply chain planning is based on shared information and trust among partners and is critical to the successful supply chain role within manufacturing (Kwon & Suh, 2005:98). In the context of their research study, Monczka, Trent and Handfield (2005:98) define integration as:

> "*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*".

Integration should occur at all levels within supply chains. A number of factors make it advantageous for businesses to actively manage their supply chains at all levels or tiers (Stevenson, 2005:492). Some of the major factors that have necessitated this, include:

- Competitive pressures have resulted in increased numbers 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 has resulted in longer supply chains.

- The increasing importance of e-commerce 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.

- Improved operations such as lean production and Total Quality Management (TQM) have resulted in many businesses 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 need to be carefully managed. This also lies within the domain of supply chain management.

- Inventory management plays a major part in the success or failure of any business. Shortages can disrupt the timely flow of work and have far-reaching effects, while excess inventories add unnecessary holding costs. Supply chain management includes the management of inventory throughout the entire supply chain.

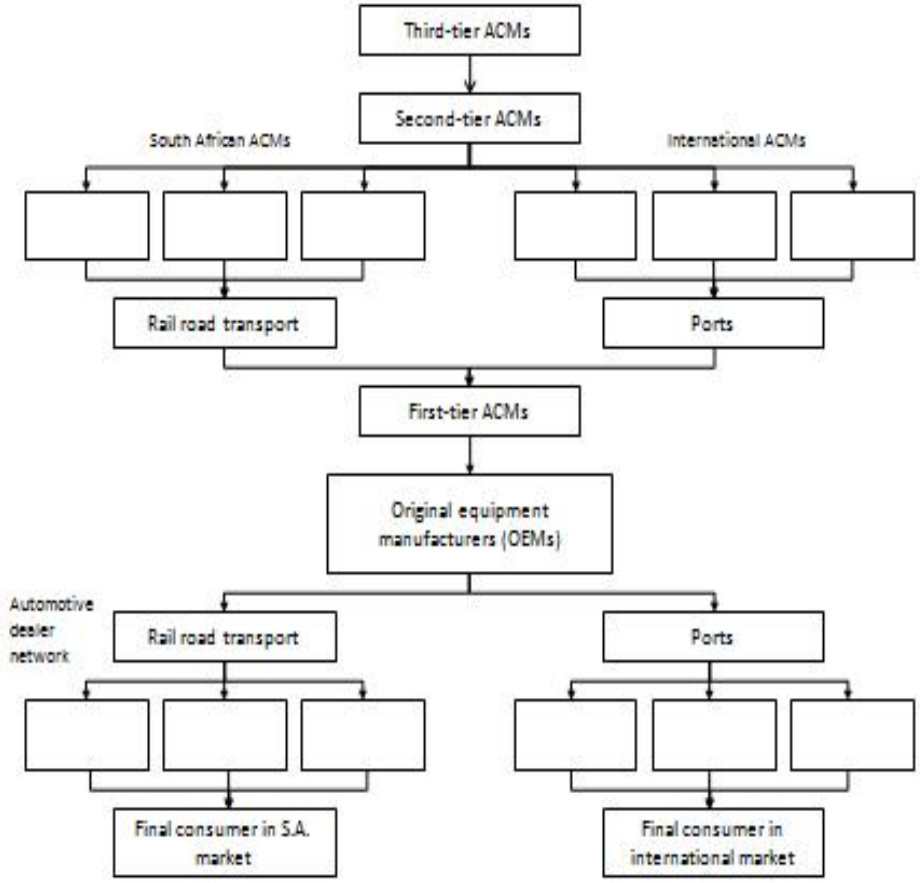
- Complex and dynamic supply chains have many basic uncertainties that can impact negatively on a supply chain, for example, inaccurate forecasts, late deliveries, sub-standard quality, equipment breakdowns and cancelled or changed orders.

- Increasing levels of outsourcing as 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 off-loading.

As indicated in Figure 2.1, it is clear that the supply chain in the automotive industry involves multiple parties, nodes, links and logistical processes to deliver the final product to the final customer. Any difficulties experienced by one party, node or link, will influence the performance and competitiveness of the entire supply chain.

There is, furthermore, a dependence on the logistics infrastructure, such as ports and railways to transport components or finished goods. This implies that several cost layers exist which result in additional pressures for value being derived. It is also well known that the automotive industry is highly competitive, and as a result, world-class management practices, such as JIT and TQM are already in use in these supply chains. In spite of these management practices, it is a known fact that the South African automotive industry still faces certain difficulties in its supply chains.

Figure 2.1: Material flow in a typical automotive supply chain in South Africa



Source: Researcher's own construction

From Figure 2.1, it is evident that a network of activities exists which aims to create an orderly flow of materials and personnel across organisational supply chains. An organisation that does not adopt this integrated approach appears fragmented and uncoordinated, with each function having its own budget, priorities and measurement systems. By integrating activities such as transportation, warehousing, inventory management, order-processing, information systems and purchasing, total logistics costs can be reduced (Stock & Lambert, 2001:27).

2.6 THE TRUST FACTOR IN RELATION TO ACM SUPPLY CHAINS

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 static (Dyer, 2000:42). Burt, et al. (2010:68-72) acknowledge that the main distinction between these two relationships is the existence of institutional trust. Given the complex set of partners in the ACM supply chain, it is important to have strong levels of trust in achieving collective goals.

Burt, et al. (2010:83) observes that trust in alliance relationships is 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 created this unit (Wisner, Keong & Tan, and 2005:62). Wisner, et al. (2005:62) also reports that alliance relationships’ failure rates have been reported to be as high as 60.0%. Speckman, Isabella and MacAvoy (2000:62) as cited in Wisner, et al. 2005:62), concluded that the eight main reasons for the failure of strategic alliances include:

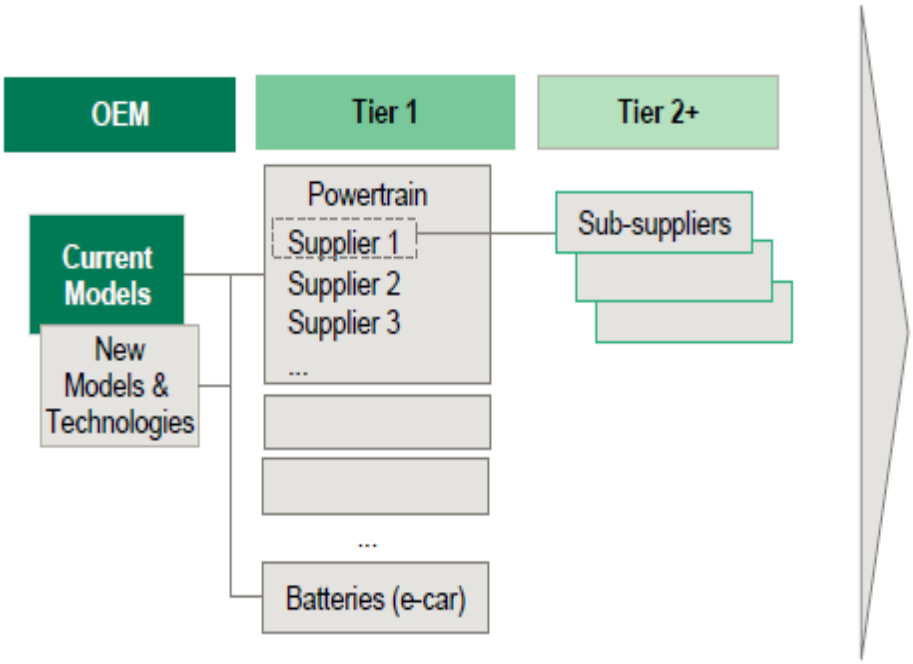
- Relationships are characterised by poor communications
- Relationships are overly optimistic
- Operating principles are misinterpreted
- Payback results are tardy
- Cultural differences exist
- Lack of alliance experience
- Lack of financial commitment
- Lack of shared benefits

From these reasons, it becomes evident that building strong alliance relationships requires hard work and commitment by both purchasers and suppliers. Within the automotive context, this resides in the realm between ACMs, OEMs and the consumer; therefore, relationships in SCM are vital. In the current competitive environment, the trend is for companies to mainly focus on their core competencies

as a competitive strategy. In addition, the consistent development of the South African automotive supply chain can enhance supplier competitiveness.

Figure 2.2 provides a depiction of a simplified automotive supply chain assessment. It describes how OEMs develop current models, new technology and how it is cascaded into the tiered supply chain. These are awarded as part of development contracts and shows how the smaller tiers do less complex technology development in model or technology development. Individual supplier development and the willingness of OEMs to collaborate on the development of a local supply base, is an important factor.

Figure 2.2: Assessment of South Africa's automotive supply chain



Source: Adapted from the Boston Consulting Group (2011)

Quesada, et al. (2006:30) acknowledge that in industries such as the automotive industry, where value added by ACMs contributes significantly to the final product, the competitiveness of OEMs depends on supplier performance in terms of cost, quality and on-time delivery. Consequently, for Morgan (2001:62), "supply, sourcing and purchasing professionals in companies nationally believe strongly that more and stronger supplier partnerships are critical to achieving competitive corporate performance".

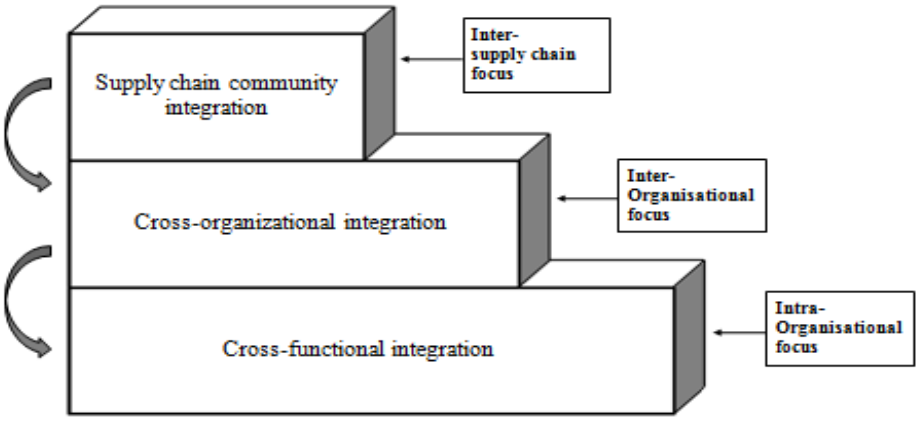
According to the KPMG Global Automotive Survey, Silberg (2011:16) states that the automotive industry could evolve a completely new business model, where existing interrelationships between OEMs, suppliers and dealers could change radically. The potential new value chain could involve any combination of modular manufacturers, assemblers, vehicle manufacturers / car designers and finally, mobility service-providers / vehicle providers / city builders. In this “New World Order”, the traditional players would have to carve out their own respective roles. Silberg (2011:16-19) also found that the ability for an OEM to be responsive to consumer trends relies on greater responsiveness and flexibility in the supply chain. However, OEMs cannot have perfect responsiveness or be flexible to customer demand if their vehicles have to travel halfway around the globe before reaching their target markets. This is due to the complexity of schedule uncertainty and the risk of delayed supply.

2.7 SUPPLY CHAIN INTEGRATION: AN OPERATIONAL VIEW

Section 2.6 above dealt with the significance of trust in the supply chain among the various partners. The ability to work together leads to optimised manufacturing and thus 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 has quickened the process of integrating business activities across both organisational and geographical borders. Stock and Lambert (2001:103) acknowledge that for SCM to be successful, business processes with key members of the supply chain need to be integrated. This integration is vital for any business to be an effective competitor in the future.

Figure 2.3 illustrates that supply chain integration generally focuses on three levels, namely, cross-functional, cross-organisational and supply chain community integration.

Figure 2.3: Levels of Integration



Source: Adapted from Hugo, et al. (2004)

In 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 ACMs to move towards cross-functional integration. The aim of cross-functional integration is to break down all functional silos, eliminate any constraints, eradicate wasteful activities inside the business; and further, to ensure that an optimal material flow pipeline is developed (Hugo, et al., 2004:356). It may thus be concluded that a prerequisite for successful SCM is to coordinate all activities in a business.

In some instances, integration can take place across entire supply chains and/or an industry, forming supply chain communities. The common vision of the members of a supply chain community is to strengthen the globally competitive position of the members and the community as a whole. A supply chain community can also be defined as a "value-added network of businesses that share processes, services and goals and have mastered supply chain operations" (Stock & Lambert, 2001:13). These chains typically share logistics expertise, transportation capacity, warehouse space, strategic global market information and other logistical infrastructure (Hugo, et al., 2004:10).

Hugo, et al. (2004:72) have further cited an example of supply chain communities 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. ACMs have also played a key role in addressing the supply chain challenges and achieve synergistic development effects. This has, however, had a mixed response, since it requires enhanced levels of shared strategies and goals.

2.7.1 The Automotive Industry Development Centre (AIDC)

The South African automotive industry requires qualified personnel to sustain and create new jobs. Furthermore, ACMs, especially lower tier levels, are not yet globally competitive with reference to cost, quality and delivery standards. Supply chains within these ACMs thus need to work complimentary to become more competitive. A major barrier to competitiveness is high logistical costs. One example of an organisation that strives to achieve competitive clustering is the Automotive Industry Development Centre (AIDC). The AIDC provides services in the areas of:

- Skills development and training
- Supply chain development
- Supplier development

The AIDC had been established to assist in increasing the skills, lean principles and reducing supply chain cost (AIDC, 2009). According to the AIDC Annual Report 2009-2010, they have identified five critical success factors as the necessary factors for successful supply chains. These factors include:

- A clear strategy for the entire supply chain that is tuned to market opportunities and focused on customer-service needs.
- An integrated organisational structure that enables the supply chain to operate as a single synchronised entity.
- An environment for excellent processes for implementing the strategy, which would embrace all plan-source-make-deliver operations.
- Reliable information using integrated technology to support effective supply chain planning, execution and decision-making.

- An effective performance management of all supply chain operations to achieve revenue growth, best asset use and bottom-line profitability.

2.7.2 The Durban Automotive Cluster

Another example of an organisation supporting the automotive industry is the Durban Automotive Cluster (DAC). The DAC is a public-private partnership (PPP) between the eThekwini Municipality and 43 KwaZulu-Natal-based automotive manufacturing entities (DAC, 2011). The members of the DAC are committed to co-operating with one another to develop a shared competitive advantage to overcome common challenges and take advantage of mutual opportunities in the following key areas:

- Localisation
- Skills development
- Infrastructure
- Transformation
- Growth
- World-class manufacturing

Both the DAC and the AIDC thus provide strategic collaboration initiatives to make the ACM supply chain behave as a single system. According to Simchi-levi and Kaminsky (2003:15), it needs to be co-ordinated with each element of the chain and aligned. A project termed the Motor Industry Supply Chain Competitiveness Improvement Project (MISCCIP) is an example of supply chain collaboration. It was initiated by the AIDC in 2002 and its goal was to unite the local automotive industry in a collaborative effort to improve international competitiveness by drawing together all key players in the automotive industry (AIDC, 2009). This resulted in an industry-wide collaborative partnership unprecedented on a global scale, since it created a unified communication platform that integrated disparate systems, delivering immediate cost savings and ongoing efficiencies. The end result was that it provided complete supply chain visibility, together with a platform based on a centralised online hub acting as the conduit for all ACM messaging. As was noted earlier, communication through

information exchange represents the first step in collaboration (Ajmera & Cook, 2009:19).

To realise a demand-driven supply chain, the process should be supported by two types of software applications (Lapide & Winter, 2005:332). These include:

- Demand management: This needs to support the development of a demand plan and an *unconstrained* baseline forecast that can be used as demand inputs to the Sales and Operation process (S & OP).

- Supply planning: These system components support the development of supply plans that are used as the supply-side inputs to the S & OP process.

2.8 CLUSTERING INITIATIVES

A means to develop demand-driven supply chains is through the clustering of activities. Supply chain clusters are understood to be spatial agglomerations of sector-related firms and other organisations (such as universities, support agencies) that derive economic benefits from co-location or collaboration (Martin & Sunley, 2003:35). As argued by Porter (2000:253), cluster initiatives (CIs) engage in deliberately supporting such advantages for stimulating competitiveness and collective innovativeness. In this type of cluster development, it is found that supply chains have professional coordinators who foster collaboration and provide other services to registered members (Raines, 2003:191).

Sölveel, Lindqvist and Ketels (2003:11) state that in order to foster collaboration, supply chains need to be measured in respect of economic and supply chain benefits to the various industry players. According to Sölveel, et al. (2003:11), the evaluation of the ACM cluster strategy draws on an ambitious approach that aims to identify tangible and intangible effects, and economic impact at the macro (region), mesa (cluster) and micro (firm) levels through multi-sectoral modelling techniques. Yet, only the top-down analysis of macro-indicators has been published, leaving open the

issues of associated cluster and corporate dynamics. The behaviour of supply chain costs may thus be better understood.

Cluster initiatives (CI) behave similarly in terms of their organisation, objectives and measures. This suggests that it is possible to evaluate common elements within the supply chain dimensions across organisations. Interdependent sets of quality and processes must be adapted to the specificities of target sectors and local contexts (Webster, 2008:35). This shows that the intricacies involved in any attempt to evaluate effectiveness will inevitably fall short of some methodical demands (Martin & Sunley, 2003:5). Nonetheless, more objective, scientifically sound empirical evaluations of CIs are urgently required.

According to Enright (2003:99) and Porter (2000:253), any CI intends to positively affect the competitiveness and business performance of the organisations included. This emerges from collective dynamics and relationships that help to source complementary assets and tend to create new innovations to help grow the supply chain. These include links in line with *soft* atmospheric qualities, intangible assets, which foster socially-embedded learning and trust among members, and encouraging future joint activities (Wolfe & Gertler, 2004:1071).

The supply chain clusters thus need to create linkages which are beneficial to members to create positive impact. Raines (2003:191) found that supply chain evaluation must explicitly regard the interdependencies of all three scales as cluster dynamics occur as a result of links between individual business behaviour, collective actions and wider economic impacts. Changes in company performance are only attributable to cluster promotion when they are actually caused by the firm's CI membership; thus simply looking at corporate figures or linkage patterns does not clearly reveal any impact.

Similarly, the improvement of regional economic indicators only counts for evaluation when evidently driven by impulses of the CI on company and collective performance. This is why neither top-down statistical calculations nor can general networking, or

input and output analyses alone, offer convincing methodological solutions in measuring supply chain impacts on business.

According to Diez (2001:907), the best way may be to combine methods in a longitudinal perspective starting from the baseline, which allows for blending the results of:

- Statistical analyses of changes of regional key indicators possibly affected by a CI (using, for instance, calculation models) as discussed by Martin and Tyler (2006:201); and

- Empirical surveys that explore all the relevant CIs have implications at the members' level as levels of cooperation is needed to be successful

As stated by Van der Meer and Edelenbos (2006:201), the evaluation of CIs is best done by collecting bottom-up data as this is considered most purposeful and unambiguous. The CI membership is evaluated by addressing three levels. Besides extracting *surface* data on basic features of the initiative from published sources (media, Internet, newsletters) and interviews, the essential task is to disclose induced *core* dynamics by directly asking member firms what the perceived benefit of working together appears to yield. This then forms the basis of assessing the maturity and supply chain dimensions which impact on cost.

2.8.1 A Supply chain Optimisation Reference Tool (SCOR)

Many supply chains act across countries and have an impact on costs in different clusters which are established. To this end it is important to have organisations that promote standards and member interests. A global non-profit organisation that assists in improving supply chain systems is the International Supply Chain Council (SCC), which strongly advocates clustering supply chain concepts. The SCC pioneered a model, termed the Supply Chain Optimisation Reference Model (SCOR). It aims to describe business activities along the value chain to satisfy customer demand. Five primary management processes are evaluated, including plan, source, make, deliver and return. The diagnostic model is useful in simple to complex industries and spans

all customer interactions. It is thus possible to diagnose the *as is* situation, to provide business re-engineering and to ensure companies become *best-in-class* against benchmarked standards. Of interest is that the return process includes elements of post-delivery customer support. The SCOR model uses metrics in conjunction with performance attributes. The performance attributes are characteristics of the supply chain that allows it to be analysed and evaluated against other competing supply chains. Each attribute also has a specific and quantifiable strategic metric in order to measure reliability and supply chain performance. The various performance attributes are measured against achieving strategic measures as follows:

- Supply chain reliability – perfect order fulfilment
- Supply chain responsiveness – order fulfilment cycle times
- Supply chain agility – upside supply chain flexibility
- Supply chain costs – supply chain management cost and the cost of goods sold
- Supply chain asset management – cash-to-cash cycle, return on supply chain fixed assets and returns on working capital

These performance attributes provide for common measurements and show how disparate supply chains can be clustered along competitive dimensions. A shortcoming, however, is that it does not address human resources, training or quality assurance (SCOR Model Reference, 2008:3.6).

2.8.2 Supply chain audit tool

The South African automotive sector has common supply chain areas where interaction, cost and SCT are evident. The AIDC has researched and thereafter created a Supply Chain Audit Tool (SCAT) to identify any gaps logically within a ACMs supply chain, and opportunities for improvement within a supply chain. The SCAT evaluates the key elements of the supplier's operation. These include an inventory, warehousing, materials handling, procurement, transport, production, order processing, packaging and materials return. Included, is the assessment of the organisation in terms of best practice. An important feature of the SCAT is that it also allows for collaboration across supply chains, since commonalities exist which represent areas of potential.

The main purpose for developing this tool was to provide ACMs with a methodology to understand and highlight the overall importance of a supply chain. The SCAT assists companies to map supply chains, and to identify the gaps in the logistical processes within the company. This also extends beyond an organisation to its suppliers and customers. The fundamental purpose of the SCAT is to assess the organisation in terms of the effectiveness of its supply chain. Once the audit has been done, an assessment is provided to assist the ACMs to implement any recommended improvements.

2.9 CONCLUDING REMARKS

It is evident from the discussion in this chapter that the extent of supply chain clustering in ACMs needs to be explored, as it presents a number of paradigms. The basis of the supply chain has varying levels of synergy that promotes collaboration in the different dimensions. Within the current realm, it is evident that the opportunity for collaboration had not been sufficiently explored as it extends not only into SCM, but also the manner in which ICT creates synergy.

The following chapter discusses the research methodology and the research design that were used to obtain the empirical data for this study.

CHAPTER THREE: THE RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

Chapters one and two provided an introduction to the research study and an overview of the impact of supply chain technology within automotive supplier clusters in the Eastern Cape automotive industry. The literature review on supply chain management clustering identified varying levels of information and communication technology (ICT) integration within automotive component manufacturers (ACMs).

Chapter three outlines the research methodology of the empirical study and formulates an appropriate research strategy to investigate the impact of supply chain technology within automotive supplier clusters. As the research methodology should be relevant to and appropriate for the nature of the topic and the research questions, the chapter provides a rationale for the selection of the particular research design.

3.2 METHODOLOGICAL APPROACHES AVAILABLE

There are two main contemporary methodological research approaches, namely, qualitative and the quantitative research. Researchers usually adopt one or a combination of these approaches and then formulate a strategy that is consistent with the approach selected.

It is, however, plausible to indicate whether research projects have a more qualitative or more quantitative nature. This, in turn, plays an important role in decisions on research processes to follow and which measuring instruments to select (Van Biljon, 1999:37). A summary of the main differences between quantitative and qualitative research approaches are illustrated in Table 3.1 below.

Table 3.1: Quantitative versus Qualitative approaches

Quantitative Paradigm	**Qualitative Paradigm**

Tends to produce quantitative data	Tends to produce qualitative data
Uses large samples	Uses small samples
Ensures data is highly specific and precise	Ensures data is rich and subjective
Uses an artificial location	Uses a natural location
Generalises from sample to population	Generalises from one set to another
Is deductive in nature	Is inductive in nature

Source: Collis and Hussey (2009)

3.2.1 The quantitative approach

As was indicated in Section 1.4, quantitative research refers to the use of structured, standard questions and pre-determined response options given in the form of a questionnaire to a large number of respondents (Burns & Bush, 2006:202). The quantitative approach is often used in the Physical Sciences and believes society is organised according to scientific observations and experiments (Jackson, 1995:5; Dooley, 1995:5). With this paradigm, it is always possible to establish a cause-and-effect relationship between variables systematically and statistically. Although quantitative research relies on objectivity and is likely to be empirical in nature and use experiments, surveys and statistics (Gummesson, 1991:152), scientists supporting positivism would argue that the general laws of science would be just as applicable to the social sciences as to the physical sciences.

Quantitative research also makes the assumption that the patterns observed in a sample will also be present in the wider population from which the sample was drawn. Therefore, the quantitative paradigm, with its emphasis on measurement through experiment or survey, uses design and sampling processes that are applied to ensure wider applicability than the initial research study.

3.2.2 The qualitative approach

The qualitative approach, as also indicated in Section 1.4, is mainly used when the researcher needs to gather and analyse detailed data that cannot be mathematically or statistically interpreted and analysed, such as ideas, attitudes or feelings (Lancaster, 2005:67). According to the qualitative approach, doubt is expressed over the question of whether it is always possible to establish cause-and-effect relationships between variables in the social sciences. For example, can the effect of bad project management decision-making on a project always be linked to a specific objective? The interpretative approach represents a reaction against the unqualified application of qualitative research in the Social Sciences. Instead of trying to explain causal relationships by means of objective truths and statistical analysis, hermeneutics use an interpretation process to understand or reconstruct reality. Language, pictures, sound, text and symbols play a central role in qualitative projects and replace quantitative data such as facts and figures as the primary sources of information (Neuman, 1994: 61; Jackson, 1995: 9).

For Glesne and Peshkin (1992:6) and Leedy (1997:106), the purpose of a qualitative study is to understand and interpret how the various participants in a social setting construct the world around them. Therefore, qualitative researchers conduct their research with an attitude of discovery or exploration that leads to discovering, building or enhancing theory as opposed to testing.

Qualitative researchers assume that the environment is ever-changing and that the realities they wish to study are not easily divided into discrete, measurable variables. The data is collected with the personal involvement and experience of the researcher in the field of the research.

3.2.3 The approach used in this study

As was noted in Section 1.4, the nature of the topic researched in this study dictated the use of the quantitative research methodology. A first reason for this selection is that this research supports deductive reasoning and analysis. A deductive design begins with an explicit conceptual framework developed from existing theory and models. Secondly, it adheres to defined themes to solve stated research problems

through a well-defined methodical process of investigation, analysis and reconstruction.

Two other reasons for selecting the quantitative research approach for the study include:

- Important aspects of the study are based on existing research and the literature data on ACMs in the automotive industry and supply chain management approaches.
- Primary sources also have to be explored to determine the supply chain problems facing Eastern Cape ACMs.

3.2.4 The research instrument: a questionnaire

The literature review provided various supply chain dimensions that impact on automotive supplier clustering and how ICT costs are related to the supply chain. The research instrument used in this study was a questionnaire. The questionnaire was developed by the researcher based in the review of the related literature. A focus group of nine people was then interviewed to contribute to developing a refined version of the questionnaire. Thereafter, the questionnaire was piloted at ten ACMs and the final design was concluded after inputs were received by the ACMs. The questionnaire identifies the problem dimensions as:

- Supply chain integration
- Supply chain innovation
- Supply chain degree of value chain best practice
- Shipment communication
- Inventory
- Warehousing
- Material handling equipment
- Packaging
- Order processing
- Production

- Returns
- General supply chain principles

The research sample consisted of 170 respondents from 85 ACMs selected to ensure that an appropriate number of ACMs within the Eastern Cape region were included in the study sample. The sample included only ACMs in the NMBM.

3.3 RESEARCH DESIGN

This section explores various issues regarding research design.

3.3.1 Research concept

Saunders, Lewis and Thornhill (2003:3) describe research as something that researchers start "to find out things" in a methodical manner, and, in so doing, augment their knowledge. Research includes reports, descriptive, explanatory or predictive studies "as long as they are methodical and provide information to solve problems" (Collis & Hussey, 2009:3). Therefore, significant attributes of research include the need to have a clear objective "to find out, validate or discover things" and systematically collect and interpret that data (Collis & Hussey, 2009).

An investigation and analysis of research definitions and descriptions from various research sources indicate a commonality of research themes (Van Biljon, 1998:28). Consequently, according to Leedy (1989:5), research is seen as a systematic investigation into and study of materials and sources to establish facts and reach new conclusions in so far as research:

- is systematic
- is humanistic
- answers a question or solves a problem
- promotes critical thinking

Other selected research definitions and descriptions include:

- A systematic and methodical approach, increasing knowledge and investigating the facts to answer questions (Collis & Hussey, 2009:15).
- 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 on the problem or issue (Cavana, Delahaye & Sekaran, 2000:5).

This research study adheres to the identified research themes framework (see Section 3.4) because it intends to solve the research question through a well-defined and careful research process, namely:

- reviewing and synthesising relevant, current knowledge
- providing solutions to identified problems
- explaining the phenomenon of the paradigm presented
- generating new knowledge with regard to the field being researched
- investigating and analysing the empirical data obtained
- controlling and managing the research process

3.3.2 Research design concept

Cooper and Schindler (2006:716) define research design as the outline for accomplishing research objectives and answering research questions. For Jankowicz (2000:178), the design is “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 relating design to research methods”. In this research study, the design encompassed seeking supply chain areas that could be formulated into categories and analysed through a research process.

3.4 PHASES FOR THE RESEARCH

To conduct empirical research, various data-processing steps are required, namely, preparing for data collection, collecting the actual data and analysing the collected data. For May (2006:135), the choice of a data collection tool is vital to ensure that the response rate is positive as response rates vary considerably when collecting data. Although the process of estimating the likely response rate from the sample to which the questionnaire is sent is difficult, one way of accomplishing this is to consider the response rates of similar questionnaire surveys.

The empirical research process for this study comprised of four distinct phases.

Phase 1: The researcher developed a draft questionnaire based on the literature review.

Phase 2: Developing a refined version of the questionnaire through a focus group of nine people. Issues discussed included what the typical problems were that related to the ACMs supply chain ability to develop in clusters or best practices.

Phase 3: Piloting the questionnaire at ten ACMs randomly selected through the AIDC database.

Phase 4: Designing a final questionnaire to encompass the problems that had been identified in the literature review and focus group interviews.

3.4.1 Phase 1: Drafting the questionnaire

The literature review presented a number of supply chain dimensions that were used as the basis for the questionnaire. Questions that were included were based on supply chain problems that related to what the literature review presented within the study context. A Likert scale was used as a measuring instrument for the questions. A Likert scale is a generic format for the identification and ranking of issues and challenges as perceived by the sample study. Likert items typically ask respondents to indicate how much they agree, disagree, approve or disapprove of a particular issue. Likert-style questionnaires work best when each question includes at least five response

categories. The questions were thus formulated by grouping the dimensions according to questions relevant to the extent of impact within the supply chain. The researcher thus used this as a draft questionnaire for further refinement within a focus group thereafter.

Collis and Hussey (2010:199) suggest that when designing quantitative questionnaires, the focus should be on:

- keeping the questions to the frame of the research
- constructing singular questions
- including questions that cross-check previous ones
- avoiding jargon or negative questions
- eliminating ambiguous questions
- avoiding negatively-phrased questions
- ensuring that target respondents understand the questions

The aforementioned bullets were used as a basis in designing the questionnaire for the current research study.

For the questionnaire design, it is also important that there is sufficient knowledge on the subject which is underpinned by a theoretical or conceptual framework. The design of the questionnaire also enables the variables to be categorised, scaled and coded after receipt of the responses. To ensure the data collection is successful, it is necessary that the researcher:

- indicates under whose auspices the research is conducted
- explains the aim of the research and who will benefit from the research
- keeps the presentation of the questionnaire professional
- keeps the questions and instructions as concise as possible
- ensures anonymity and confidentiality
- expresses sincere gratitude and appreciation to the respondents
- contacts the respondents prior to any data-collection action

- numbers the questionnaires before entering the data as this facilitates finding a specific questionnaire whenever an error is detected

The aforementioned bullets were used as a guideline for the data collection in the current research study to ensure success with the data gathering. As it takes considerable and valuable time, effort and money to conduct research, the researcher needs to address the issue of obtaining as much of the information required and keep the questionnaire simple and clear in design. Next, the researcher needs to elicit the willingness of the respondents to complete the questionnaires honestly and to return them to the researcher.

To ensure the respondents understood the questions unambiguously without being directed, the wording was kept simple and basic and the questions were designed not to lead the respondents to a set answer (Thomas, 1996:121). In addition, Thomas (1996:121) also recommends that the questionnaire should not be too long, be user-friendly and evenly-spaced so as to avoid misunderstanding the various sections.

Hence, questionnaire design requires skills and an understanding of the key issues and objectives of the research study. In this study the questionnaire was categorised for ease of completing the various sections and questions were presented to illicit the correct responses. The researcher also presented sufficient questions to ensure all the areas identified were addressed. Additional space was also provided for more response for information if so desired by the respondents. Hair, Wolfingbarger, Ortinau and Bush (2008:116) also identify that researchers have developed various ways to increase response rates, including prior notification, offering an incentive, delivering the questionnaire personally and using social influence.

In this current study, each respondent was pre-notified of the study telephonically. A second telephone call and e-mail follow-up were made to increase the response rate.

3.4.2 Phase 2: Focus group interviews

Yin (2003:58) argues that conducting focus group interviews is far more demanding than quantitative research on the researcher's intellect, ego and emotions as a researcher should:

- have the ability to ask the right questions and to interpret the answers to these questions correctly
- be a good listener and should not be restricted by his or her own biases and ideas
- 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
- have a sound understanding of the study and the issues involved
- not prejudiced or biased by any predetermined views, including those obtained from theory

Focus groups also combine interviewing and observations (Collis & Hussey, 2003:26) and have more advantages as opposed to interviewing. Collis and Hussey (2009) identify the following focus group advantages:

- relatively quick information
- stimulating new ideas
- relatively inexpensive
- flexible
- spontaneous
- synergy
- snowballing of ideas

The purpose of having a focus group interview was to validate the correct categorisation of the supply chain areas and identification of potential problem areas within the ACM supply chain. Since the group of participants selected for the focus group interview were involved in supply chain management, this ensured that problem supply chain areas were better identified and discussed. However, to ensure that all the relevant supply chain topics would be addressed during the interview, a guide

containing details of supply chain topics to be discussed with the interviewees was designed as a checklist (see Appendix A**)**.

The researcher made initial telephonic contact with management at executive level at participating organisations who agreed to participate in completing the questionnaire to elicit assistance to conduct the study and to set up a time to interview the potential focus group participants. The participants comprised of a cross-section of managing directors and supply chain managers at the targeted sample of ACMs. The researcher was granted permission prior to submitting a copy of the interview guide, and was required to conduct the focus group interviews at the randomly selected companies as outlined in Table 3.2.

Table 3.2: Interview schedule of focus group

Organisation	Position	Date
NAACAM	NAACAM Executive	21 April 2011
NAACAM	Regional NAACAM Leader	21 April 2011
AIDC	Project Manager	21 April 2011
AIDC	Project Manager	21 April 2011
AIDC	Project Manager	21 April 2011
AIDC	Department Manager	21 April 2011
AIDC	Project Manager	21 April 2011
AIDC	Chief Executive Officer	21 April 2011
AIDC	Department Manager	21 April 2011

Source: Compiled by researcher

3.4.3 Phase 3: Questionnaire pilot

The ten ACMs which were selected to participate in the questionnaire pilot were categorised as third or second-tier ACMs. The pilot of the questionnaire allowed the inclusion of all factors and problems that should be analysed in conducting supply chain audits. This allowed the researcher to use the questionnaire as a basis for developing a supply chain audit tool in order to assess ACMs in respect of the level of

their supply chain maturity. Whilst the questionnaire assessed the overall supply chain, it had a distinct set of questions that looked at levels of clustering practise in relation to ICT usage. The literature review suggested that this is an area that needs to be analysed within the study.

Table 3.3 lists the ten ACMs where the questionnaire pilot was conducted. The researcher also used literature to ensure that reliability and validity conditions were met during the construction of the questionnaire (see sections 3.4.1.3.1 and 3.4.1.3.2 below).

Table 3.3: List of respondents in the pilot questionnaire

Organisation	Position
LS Tooling	Managing Director
Acoustex Trim	Supply Chain Manager
Acoustex	Manufacturing Manager
Steeltek	Manufacturing Manager
Hansens Engineering	Managing Director
MFA	Managing Director
Bestall Springs	Managing Director
CP Engineering	Managing Director
ID Control	Managing Director
TK Manufacturing	Managing Director

Source: Compiled by researcher

3.4.3.1 Reliability

For Collis and Hussey (2010:64), reliability is important in a research study as it is concerned with the research findings. Reliability is important, since it examines the extent to which the findings accurately depict the actual research situation, and whether the data collected represents a true reflection of the study. In addition, research findings and procedures followed are creditable if they can be repeated with

reliability. This understanding is supported by Leedy (1997: 35) who describes reliability as the consistency with which the measuring instrument performs. This means that apart from delivering accurate results, the measuring instrument must deliver similar results consistently.

Cooper and Schindler (2006:716) define reliability as a characteristic of measurement concerned with accuracy, precision and consistency which is a vital but inadequate condition for validity (if the measure is not reliable, it cannot be valid). Remenyi (2005:289) confirms this understanding of reliability by defining reliability as the degree to which observations or measures are consistent or stable. The reliability of a measure indicates the stability and consistency with which the instrument measures the concept that helps to assess the so-called *goodness* of a measure or its *fit*.

For the study, 170 questionnaires were disseminated to a sample of 85 ACMs in the NMBM (see Section 3.6). The questionnaire respondents included a mixture of both managing directors and supply chain managers at the selected ACMs. A minimum of 40 respondents were planned to ensure that the minimum sample complied with the accepted sample norm for reliability and validity.

3.4.3.2 Validity

For Leedy (1997: 32), validity is concerned with the soundness and effectiveness of the measuring instrument, namely, whether it measures what it intended to measure or not, and how accurate that measurement is.

Validity, therefore, seeks to ask whether what the research findings suggest is a true representation. This should be done on the basis of having no faults, errors, poor samples or misleading measurements.

Leedy (1997: 33) also identifies several types of validity, including:

- *Construct validity*: Indicates the degree to which the content of the study is measured by the research questionnaire.
- *Content validity*: Relates to face validity to gauge the accuracy of the instrument in measuring the factors of concern to the study.
- *Criterion validity*: Occurs where validity is determined by relating a performance measure to another measure that may be set as a standard against which to measure results.
- *External validity*: Indicates the degree to which the conclusions reached in the study may be generalised.
- *Face validity*: Refers to a subjective validity where the questions are scrutinised to establish their relation to the subject under discussion, and whether the questions seem appropriate.
- *Internal validity*: Indicates the freedom from bias in formulating conclusions based on the data received.

In this research, construct and face validity were used to ensure adherence set out by the literature review. The research questionnaire was constructed through the use of a focus group, thereby enhancing the soundness of the instrument. Furthermore, the face validity was done by conducting a pilot study to determine if the questions were appropriate.

3.4.4 Phase 4: Final questionnaire design

The study's final questionnaire design included the various changes suggested by the focus group and pilot, including:

- adding a dimension that evaluated the extent of *greening* in the supply chain which entails the extent to which practices are adopted that seek environmental efficiency and eliminate wasteful practices causing greenhouse gas emission
- reducing the content through consolidation of specific questions (without compromising the overall value of the questionnaire)

Each question had a direct relationship with the theory discussed in chapters one and two. All the questions were also based on the supply chain concept and structured

according to the input from the focus group. For example, the questions were formulated with the objective of determining the most relevant points, and addressed the issue of lean manufacturing and uncovering the factors which influence lean supply. The questions selected were also mainly of a multiple choice type.

The finally completed and used questionnaire (see Appendix A) included the company profile as section A and the 14 supply chain dimensions as section B. Section B consisted of questions recommended from the literature review, focus group interviews and pilot of the questionnaire. The respondents were afforded the opportunity to state if they wished this information to be published. This was to ensure confidentiality regarding the participants in completing the questionnaire. The data obtained in this section was also used to categorise companies for analytical purposes.

To determine why companies were experiencing supply chain problems, the following statement was included before each supply chain section in the questionnaire:

> ***Please provide more information in the comment blocks when you want to clarify something or when you feel particularly strongly about one of the issues.***

Section 1 of the questionnaire rated the level of supply chain integration. The key challenge an organisation must meet to achieve true supply chain efficiency, lies in optimal supply chain integration. Integration is developed by personnel, culture and an organisation that supports the supply chain vision. Integration is also built on having trust between customers and different markets segments.

Section 2 focuses on the extent of supply chain innovation. Through these questions, the researcher attempts to understand the supply chain acceptance of new innovation and changes that have taken place in supply chains recently, principally as a result of opportunities afforded by technological advances.

Section 3 rates the extent of using a supply chain as a basis within the value chain as best practice. Best practices mean understanding operations and costs thoroughly, getting the best return on investment and satisfying customers.

Section 4 focuses on transportation as this is required in the entire production procedure, from manufacturing to delivery to the final consumers and product returns. Therefore, transportation occupies a large proportion of logistics costs as transportation systems influence the performance of logistic systems significantly. Only effective coordination between each component would ensure a maximisation of transportation benefits.
Section 5 relates to the extent of inventory optimisation. It tries to ascertain the quantity of inventory as it is spread throughout the supply chain from raw materials to work in process to finished goods which those suppliers, manufacturers, distributors and retailers hold. Inventory is a major source of cost in a supply chain and has a huge impact on responsiveness. Inventory also has a significant impact on the material flow time in a supply chain.

Section 6 focuses on warehousing optimisation. The requirement for high levels of customer service together with increasingly high labour costs has dramatically increased the complexity of warehouse operations. Each stock keeping unit (SKU) must identify its own cheapest, fastest path through the warehouse to the customer, and then competes with all the other SKUs for the necessary resources. This results in warehouse operations that are finely-tuned to patterns of customer orders, and so highly efficient.

Section 7 relates to the basis of material handling optimisation. The effective handling of materials cannot be avoided in logistics, but can certainly be reduced to minimum levels. The productivity potential of logistics can be exploited by selecting the right type of handling equipment.

Section 8 concerns packaging optimisation. Packaging is a coordinated system of preparing goods for safe, efficient and cost-effective transport, distribution, storage,

retailing, consumption and recovery, reuse or disposal combined with maximising consumer value, sales and hence profit.

Section 9 relates to the basis of order processing optimisation and building strong customer relationships. Optimised invoicing and distribution capabilities speed up inquiries and order deliveries reduce errors and minimise costs. Optimisation allows full automation of invoicing, expanded distribution capabilities and flexibility in reporting, order management and inventory control with seamless integration.

Section 10 rates the extent of production scheduling within SCM. Master Production Scheduling (MPS) is a manufacturing planning tool, and describes which parts the organisation will manufacture and at what frequency with ICT. As most customer demand signals will contain peaks and troughs of demand, a significant benefit of MPS is that it decouples customer demand from what it manufactured. Therefore, batch sizes can be tuned to optimise the production process.

Section 11 relates to the basis of returns optimisation. A return policy is a fundamental competition strategy in SCM.

Section 12 concerns the extent of supply chain greening practises as improved agility help mitigate risks and speeds up innovations. The increased adaptability often leads to innovative processes and continuous improvements, promotes alignment, involves negotiating policies with suppliers and customers, which result in better alignment of business processes and principles.

Section 13 relates to the general supply chain strategy. It seeks to determine the extent of how supply chain processes are mapped and identifies value-adding as well as non-value adding activities. It also rates the overall control within the entire supply chain.

Section 14 is open-ended. It seeks to clarify if practices are evident in support of clustering and if supply chain technology is used for competitive advantage.

3.4.5 The questionnaire issued to respondents

Covering letters and questionnaires were e-mailed or faxed to the respondents, because of the cheaper cost when compared to that of personal and telephonic interviews. The letter gave the respondents some background information regarding the research study and requested their assistance in completing the survey by a predetermined date, and then returning the completed questionnaire via facsimile or e-mail.

3.5 CONCLUDING REMARKS

A formal systematic approach to research design is crucial to ensure that a research project conforms to the principles of validity and reliability. The research design guided the researcher to identify a number of research problems as experienced by ACMs. These include using a quantitative approach incorporating questionnaires and focus-group interviews.

Chapter four provides the empirical results and an analysis of the data through statistical analysis.

CHAPTER FOUR: THE DATA ANALYSIS

4.1 INTRODUCTION

In chapter three, the research methodology and design process was discussed. A theoretical overview of the research process and methodology selection was also

provided. This chapter presents the empirical findings of the study with the aid of tables and figures. The tables and figures are based on the summaries of the questionnaire responses and presented in terms of the respective study objectives and the lay-out of the questionnaire used in the study. This approach should allow the reader to conclude objectively on the findings and success of the research study.

As explained in chapter three, a questionnaire was designed to determine the extent of the supply chain issues relating to the study. Having evaluated the research methodology options, it was decided to make use of the Likert scale approach. Likert items ranging from ‘not a problem’ to ‘problem to a greater extent’ were used to collect ordinal data. Ordinal data is categorical data in which there is a logical ordering to the categories. The Statistical Package for Social Scientists (SPSS) was used for the data analysis. The SPSS is a programme for statistical analysis in social sciences and business research. It was used to generate tabulation and frequency tables for ordinal-scaled data that was collected using the questionnaire in this study. SPSS was used since it focuses mainly on the descriptive statistical analysis of data, and also provides a coefficient value for the reliability of the results which is referred to as a Cronbach Alpha.

4.2 RESEARCH RESULTS

The empirical results of the research are discussed in this section.

4.2.1 Reliability and validity

For this research study, the sample size was 47 automotive component manufacturers (ACMs). Reliability is determined by the extent to which the findings accurately depict the actual situation, and whether the data collected represented an accurate reflection of the study. The questionnaire was designed in a manner that would ensure that a high internal consistency is achieved. The researcher made a deliberate attempt to enhance the internal validity by increasing the control of extraneous and external factors that could have affected the study’s findings. In particular, the researcher reduced to a minimum any faults, errors, poor samples or misleading measurements by standardising the data-collection tool.

The Cronbach Alpha coefficient is a good indication of the reliability of the results in a study such as this one. The closer Cronbach's Alpha coefficient is to 1.0, the greater the internal consistency of the items within the scale. A Cronbach Alpha coefficient of reliability score of 0.8125, based on the standardised items, was attained in this study. A Cronbach Alpha score of between 0.8 and 0.9 is considered "good" (Cronbach's Alpha, 2012).

4.2.2 Findings of the study

The findings of the study are discussed in the following sections with the aid of graphs and tables. It needs to be noted that not all the empirical findings are shown in the graphs and tables indicated in the chapter.

Figure 4.1: Number of years the ACM sample has been in operation (See Appendix A, Questionnaire 1.7)

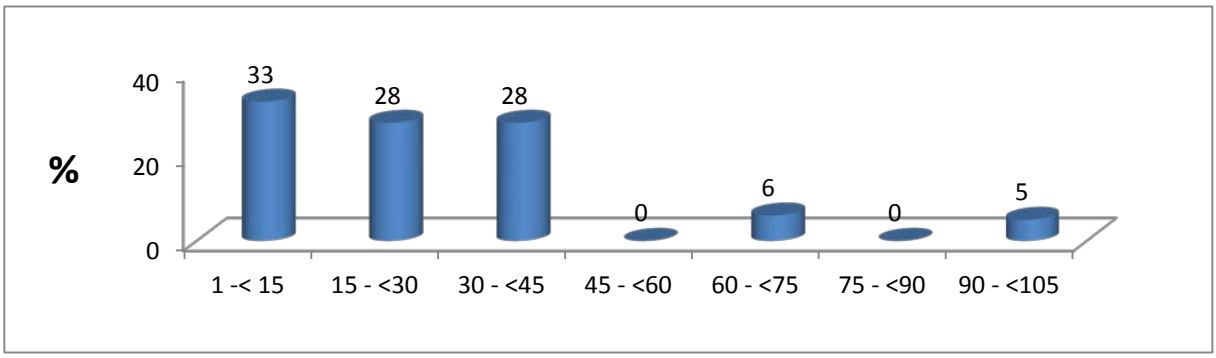


Figure 4.1 indicates the total number of years that respondents serviced the OEM, ACM, retail and other markets. As indicated in Figure 4.1, 67.0% (28+28+6+5) of the ACMs have been in operation for more than 15 years.

The majority of respondent ACMs to this survey operated mainly in the Eastern Cape Province (65.0%), while a significant number (35.0%) also have branches in other provinces. In addition, the majority of the ACMs (43.0%) that participated in the study were the head offices of their organisations. Some 23.0% were holding companies, 23.0% were branches, and only 11.0% were either subsidiaries or independents.

4.2.3 Results in terms of the research objectives

This section discusses the research results obtained in terms of the main and sub-objectives. The results are grouped and discussed in terms of each sub-objective.

Sub-objective 1: To illustrate how the use of Supply Chain Technology (SCT) impacts on Supply Chain Management (SCM) within organisational structures, as firms seek to maximise their supply chain hierarchies, facilitate growth and reduce supply chain costs.

Figure 4.2: Impact of new technology on competitive advantage (See Appendix A, Questionnaire 2.1)

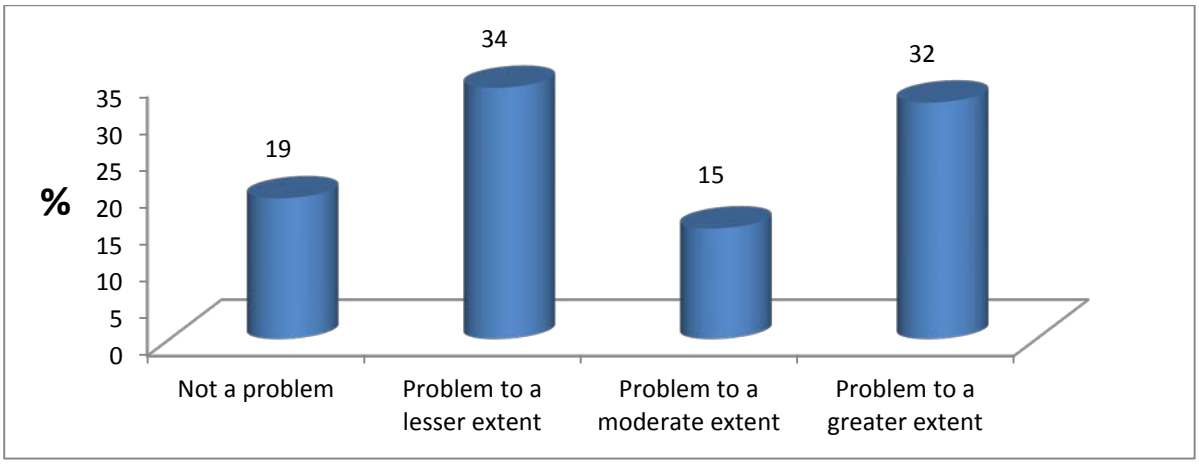


Figure 4.2 illustrates the extent to which new technology practices are adopted in an effort to obtain competitive advantage in integrated supply chains. A total of 47.0% (15+32) of the ACMs indicated that the lack of new technology was an inhibitor to achieving competitive advantage, while only 19.0% indicated that this was of no concern. This shows that most ACMs identified new technology as a constraining factor to achieve competitive advantage in the market.

The supply chain performance was also evaluated in terms of the extent to which the ACMs had formalised into clusters (See Appendix A, Questionnaire 2.1). According to the results, more than 80.0% of respondents agree that economies of scale were not being realised. It must be understood that as economies of scale increase, so too do the capacity and resource requirements, which also influence cash flow. Only 17.0% of the respondents indicated that they were realising the benefits associated with cost competitiveness.

The extent to which ACM clustering has a positive impact on improving supply chain performance was also assessed (See Appendix A, Questionnaire 2.1).

Figure 4.3: Perceived advantages of sharing shipments which are used by ACMs to reduce costs (See Appendix A, Questionnaire 2.4)

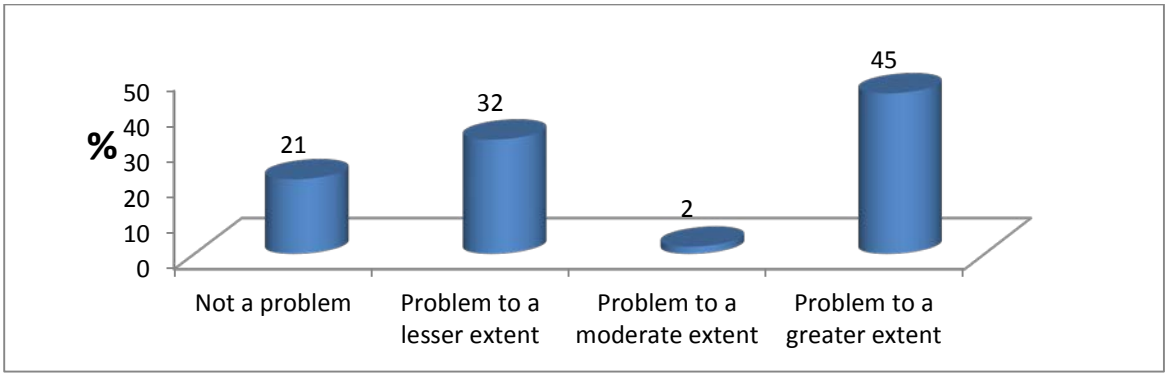


Figure 4.3 indicates the extent to which a problem was perceived in the use of shared shipments as a cost saving measure. The results indicate that 79.0% (32+2+45) of the ACMs do not fully take advantage of deriving value through shared shipments.

Although shared shipments are typically associated with cost reduction, only 21.0% realise any value through shared shipments and have indicated that this is not a problem for their business. This suggests that the possibility of shared shipments was not explored sufficiently although there was a potential to realise cost savings through economies of scale.

Table 4.1: Supply chain shipment communication between the supply networks

	Problem area to a greater extent (%)

1. Use of any formal methods to plan the distribution network.	40
2. Making use of a process to provide a status on shipments and material movement.	47
3. Rating the communication between transporters and the rest of the internal operations in the organisation.	42
4. Feasibility of shared shipments in the business organisations.	45

From Table 4.1, it is evident that the majority of ACMs (47.0%) do not make use of any formal process to communicate the status of shipments and material movements. A total of 45.0% did not realise the feasibility of shared shipments and was thus not benefitting at all out of such shared shipments. This suggests that not only were most ACMs not monitoring the movement of goods or material, but that they were also not deriving benefit out of shared shipments.

The ACMs also identified the following concerning supply chain shipment communication:

- Effective internal communication must be facilitated as failure to do so may adversely impact on lead times for the delivery of the finished goods
- Daily/weekly scheduled shipments were needed in favour of bigger consignments
- Customer dissatisfaction with inaccurate shipments continued to exist
- Correct shipments and using shared load could be opportunities for the ACMs to reduce costs. This was because they could negotiate cheaper rates and have the benefit of volume to dictate discounted pricing

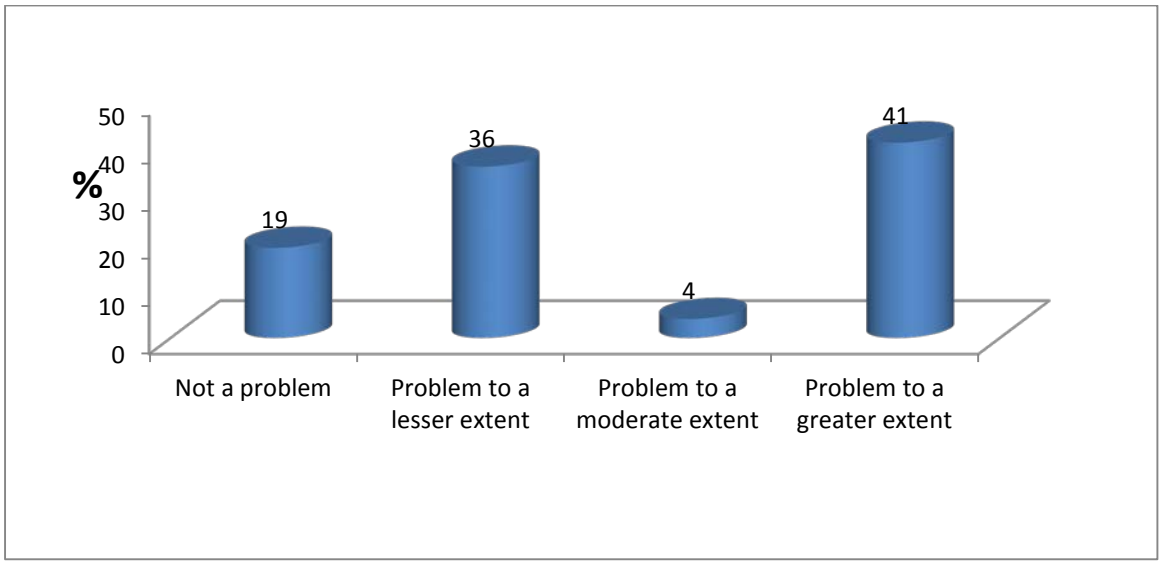
According to the Annual State of Logistics survey (2010), the high logistics costs in South Africa are as a result of the long distances to export and import products for the markets and a sub-optimal logistics infrastructure. Furthermore, the survey also showed that supply chain shipment communication was a significant problem for

ACMs in South Africa. It is evident that any improvement in supply chain shipment communication would help make ACMs more competitive by reducing costs.

4.2.3.1 The monitoring of inventory using supply chain technology

The use of supply chain technology in order to monitor the optimal use of inventory is discussed in this section.

Figure 4.4: Use of dynamic inventory systems (See Appendix A, Questionnaire 2.5)



As depicted in Figure 4.4, 41.0% of the respondents indicated that no formal inventory-management system was in use, with 59.0% (19+36+4) utilising a limited approach to dynamic inventory management, such as a first-in-first-out (FIFO) approach. Only 19.0% used a formal system. This means that the majority of ACMs had formal or informal policies that controlled how inventory is deployed within the manufacturing and supply chain. There were, however, a large number of ACMs who are yet to adopt a formal policy to measure and control inventory as a competitive strategy. Inventory control also has to be considered with the best levels of safety stock within the formal policy.

The extent of the use of an action plan as a tool to reduce safety stock was also assessed (See Appendix A, Questionnaire 2.5). Most of the respondents (79.0%) indicated that they were not actively using an approach to manage the reduction of safety stock. Some 21.0% was using a formal action plan in order to reduce safety

stock. One assumption that might be made here is that the automotive industry already operates on a lean supply basis. Hence, the responses to the challenges of reducing stock to optimal levels reside in the lean systems which are referred to as Kanban. Kanban systems limit the holding of extra inventory, as components were only ordered when required. This suggests that suppliers were actively seeking ways to reduce their safety stock levels as this might impact on the cost of finished goods owing to reduced space requirements.

Table 4.2: Summary of use of supply chain technology to manage inventory

	Problem area to a greater extent (%)
1. Using a dynamic inventory performance monitoring system	41
2. Manufacturing and inventory deployment strategy for every product	34
3. Using action plans to reduce the levels of safety stock	28

From Table 4.2, it is evident that 41.0% of respondents were not utilising proper supply chain technology at all. Reducing safety stock levels received a more favourable response, with only 28.0% of the respondents stating no formal use thereof.

Additional comments by the ACMs also identified the following situation concerning inventory management:

- Some ACMs had started using stock replenishment systems through Kanban Production and Kanban Heijunka. These are lean manufacturing techniques that assist in levelling stock according to ideal replacement cycles
- Some ACMs indicated that their projects usually had life cycles of less than one year, with only a limited need to keep safety stock on site
- Information that was not real-time caused delays or non-delivery at times

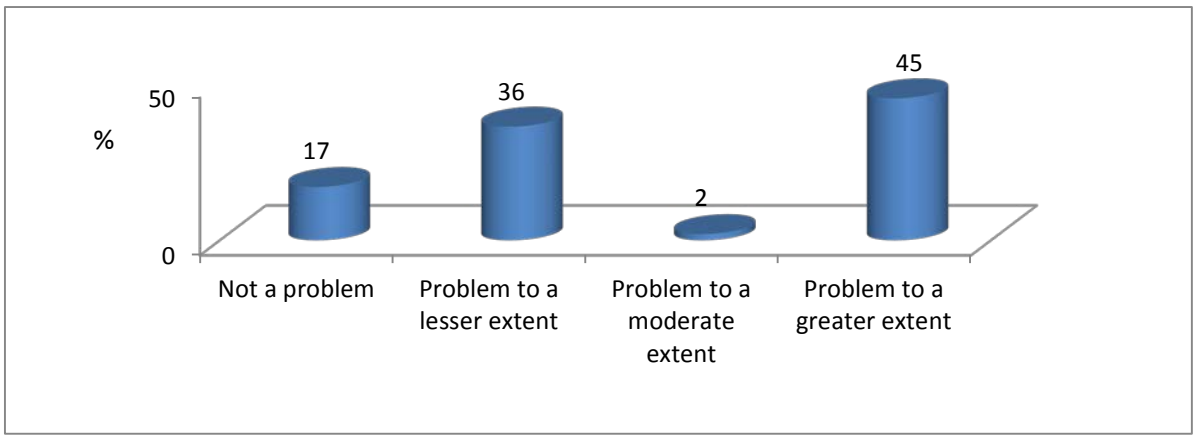
- Half of the respondents stated that ACMs had not implemented advanced SCT, owing to the associated investment cost.

The financial impact of dynamic inventory management was observed in the bull-whip effect through inventory holding and back-orders. This increase in variability causes significant operational inefficiencies, as it forces every link in the chain to increase its inventory significantly (Hugo et al, 2004:66). In recent years, OEMs and ACMs have noticed that, while customer demand for particular products did not fluctuate much, inventory and back-order levels varied significantly across the supply chain. The bull-whip effect implies that inconsistency in demand increases as one moves up in the supply chain (Simchi-Levi & Kaminsky, 2003:101). The implementation of SCT in the OEMs and ACMs can reduce the bull-whip effect, but most ACMs had not implemented it because of the associated investment costs involved.

4.2.3.2 The optimal use of warehousing and its related supply chain technologies

This section addresses the use of warehousing and warehousing technology in order to control inventory and costs by the respondents.

Figure 4.5: Software adoptions for controlling warehousing space allocation (See Appendix A, Questionnaire 2.6)



From Figure 4.5, it is evident that almost half of the respondents (45.0%) did not make use of software to control warehouse space allocation. However, a few (17.0%) of the respondents did not have a problem adopting new software in controlling warehouse space adoption. This showed that just under half (45.0%) of ACMs did not fully use software to optimise the configuration of warehouse space with part locations. This

prevented the effective use of just-in-time since only some ACMs had optimal software use to ensure space allocation was well defined.

Figure 4.6: Stock consolidation with other suppliers to lower costs (See Appendix A, Questionnaire 2.6)

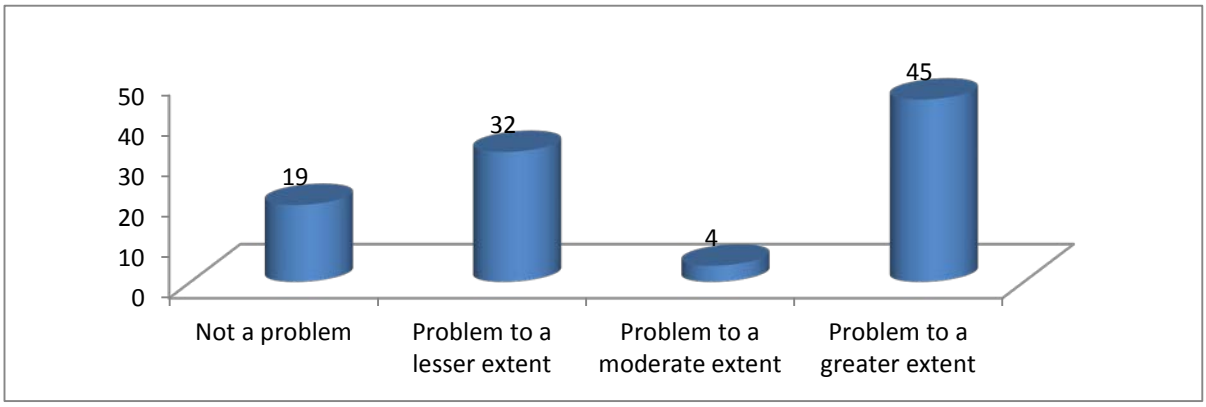
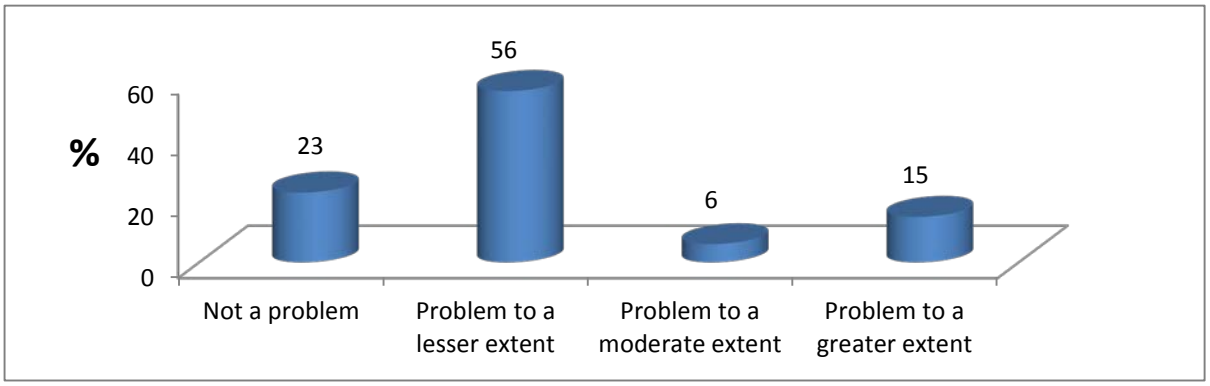


Figure 4.6 illustrates that as many as 45% of ACMs failed to consolidate stock procurement and shipping with their suppliers in order to lower costs, although 36.0% (32+4) consolidated on an informal basis. As few as 19.0% of the respondents formally consolidated stock with their suppliers. This means that the majority did not use systems that reduce costs through shared distribution of finished goods or work in progress. This is most concerning.

Figure 4.7: Manual material-handling equipment (MHE) used (See Appendix A, Questionnaire 2.7)



Question 4.18 determined the extent to which MHE was shared amongst the ACMs. Only 23.0% of ACMs made extensive use of automated MHE, with about 62.0% (56+6) having some automated systems. Some 15.0% of companies did not have any

automated MHE systems at all. This indicates another opportunity for cost reduction since by sharing resources, costs might be reduced owing to achieving economies of scale and scope through enhanced purchasing power.

Table 4.3 Summary of MHE scores (See Appendix A, Questionnaire 2.7)

	Problem area to a greater extent (%)
1. The use of automated material handling equipment for receiving and despatching.	17
2. The use of non-powered handling equipment to reduce costs.	15
3. Investment in shared procurement for MHE.	15

The low scores of 17.0%, 15.0% and 15.0% for questions 1 to 3 in Table 4.3 indicate that the respondents believe that MHE is well utilised where possible to reduce costs. This was encouraging, and the low scores further indicated that the ACMs had an opportunity to share and collaborate in order to reduce costs further.

The ACMs made the following comments about MHE:

- A limited number of ACMs did not receive and dispatch stock, and, therefore, did not require MHE systems
- There was an increasing trend towards investing in shared procurement for MHE. For example, a number of ACMs indicated that they were purchasing materials and consumables together, and were thus able to negotiate improved purchasing prices

4.2.3.3 The optimal use of packaging in the supply chain

This section addresses the way packaging is used in order to derive value.

Figure 4.8: Standardised packaging use (See Appendix A, Questionnaire 2.8)

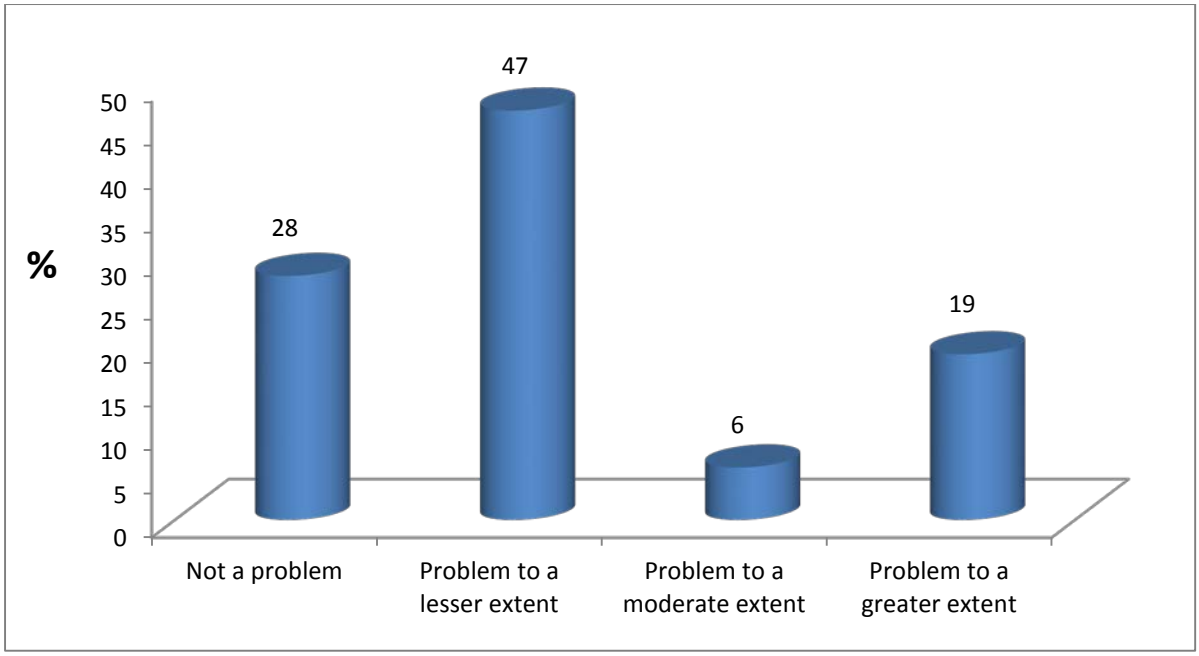


Figure 4.8 illustrates the extent to which standardised packaging is utilised to reduce re-packing or unnecessary handling. Nearly three quarters (47+6+19) of the ACMs used standardised packaging to reduce repackaging or unnecessary handling. The majority (47.0%) of ACMs did so informally or unintentionally, with only 28.0% formally using standardised packaging to reduce material handling costs.

By means of Question 4.20: Recycling of packaging (see Appendix A, Questionnaire 2.8), it was determined that some 15.0% of ACMs did not participate in any recycling of packaging whatsoever, with 59.0% doing so informally, and 26.0% having formal recycling programmes in place.

Question 2.8 ascertained the extent to which the audit process was applied to ensure that all packaging conformed to specifications. Only 23.0% of the ACMs applied a formal process to ensure that packaging conforms to specifications. This low value might be attributable to the fact that customers often supplied the packaging to their suppliers. Almost 60.0% of ACMs informally audited packaging (See Question 4.21: Audit process applied to packaging).

By means of Question 4.22: Shared purchasing of packaging (See Appendix A, Questionnaire 2.8), it was found that more than 81.0% of the ACMs did not formally share purchasing of packaged materials to reduce costs. Only 19.0% formally undertook such initiatives; while 13.0% did not embrace any shared purchasing at all.

4.2.3.4 Energy best practice

This section looks at measures taken to effectively manage energy consumption.

Figure 4.9: Adoption of energy management best practice by ACMs (See Appendix A, 2.1 in the questionnaire)

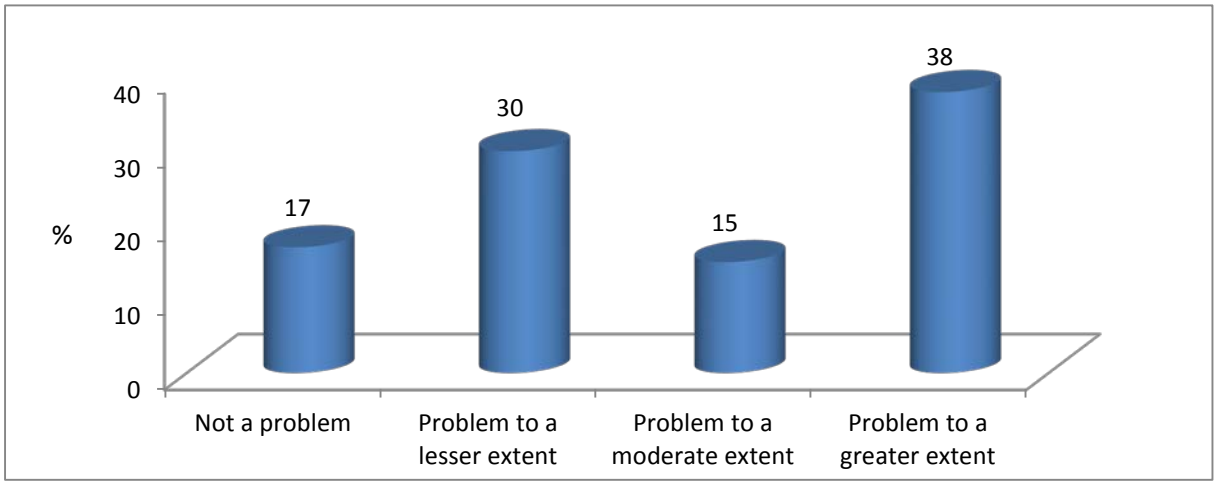


Figure 4.9 illustrates the extent to which supply chains adopted energy management best practice of energy conservation to support mutual synergy. The large majority of ACMs, 83.0% (30+15+38), did not use any shared best practises.

Table 4.4: Summary of energy usage scores (See Appendix A, Questionnaire 2.12)

	Problem area to a greater extent (%)
1. Management of peak energy demand	47
2. Use of energy management systems in use	49

The results show that almost half (47%) of the ACMs did not formally manage their energy consumption, or have any form of system in place to reduce their energy costs. Whilst there appears to be little action in favour of reducing costs, it was clear that much is currently being done to introduce ACMs to energy-reduction programmes in the future.

ACMs raised the following additional points:

- Avoidance of forklift trucks was a priority in reducing carbon footprint
- Most ACMs had implemented policies on greening and best practices
- Some ACMs had ISO 14001 certification, and a strategic mission focused on greening the supply chain

The results of the greening survey suggested that ACMs still had some work to do to make significant inroads in reducing their energy consumption. Table 4.5 illustrates the order processing scores for the ACMs surveyed.

Table 4.5: Summary of order processing scores as reflected in the questionnaire (See Appendix A, Questionnaire 2.9)

	Problem area to a greater extent (%)
1. Electronic ordering by customers	51
2. Identification of barriers that prevent the organisation from achieving increased service levels	49
3. Rating of the communication between order processing and the rest of the internal operations	49
4. Synergy and cost reduction through shared ICT in a cluster	45
5. Sharing data with suppliers in the supply chain	45

From Table 4.5, it is evident that more than half of the ACMs did not formally place orders electronically, with identification of barriers, communication between order processing, synergy and cost reduction through shared ICT, and sharing data with suppliers, being marginally lower.

The following additional points were raised by the ACMs:

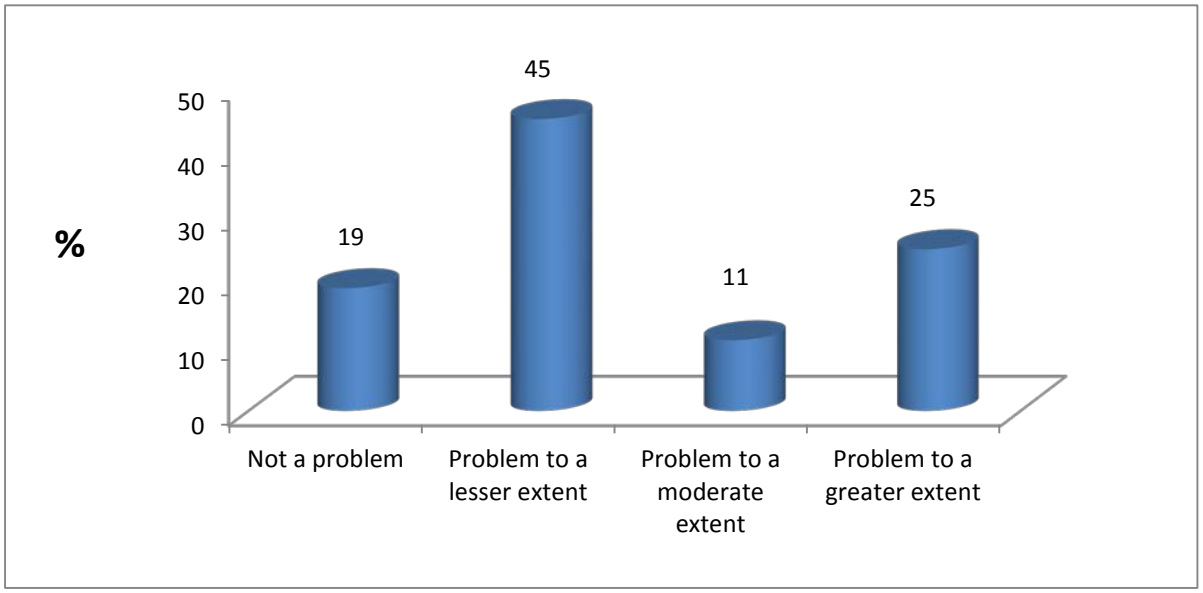
- Data-sharing happened via the existing ICT infrastructure

- Quicker internal assessment of the types of input stock required per project, and earlier identification of/and communication with suppliers would allow time for better assessment of potential mutual opportunities in the cluster and within time frames that were frequently urgent
- Joint processing in a cluster was a viable option. Resource allocation in the supply chain and cluster approach, which was a source platform, was viable
- Some ACMs did not do data sharing because they thought it was not safe
- Some ACMs used the Motor Industry Supply Chain Competiveness Improvement Programme (MISCCIP), which was established to harmonise electronic call-offs of ACMs. ACMs could thus utilise features that integrate their ERP for more real-time plans
- Some ACMs said that they could have better ordering processes, and integrate better with their suppliers, as they did not handle the bull-whip effect very well, consequently creating various types of inventory and finished goods. This could add 13.0% to the inventory costs, which would render this option not viable

4.2.3.5 The interface between production systems and the supply chain

This section considers the use of production systems such as Kanban, the sharing of services and communication, which can reduce costs, and make the sector more competitive. Figure 4.10 identifies ACM Kanban usage.

Figure 4.10: Kanban systems usage (See Appendix A, Questionnaire 2.10)



Kanban systems are utilised to maintain stock flow and keep inventory levels to a minimum in order to reduce costs and wastage. A total of 36.0% of the respondents (11+25) indicated that the optimal usage of Kanban systems was a problem ranging from great to moderate. This suggests that over a third of ACMs did not utilise this lean system aimed at reducing the cost of inventory and space requirements.

Figure 4.11: Sharing returnable stillages /packages (See Appendix A, Questionnaire 2.10)

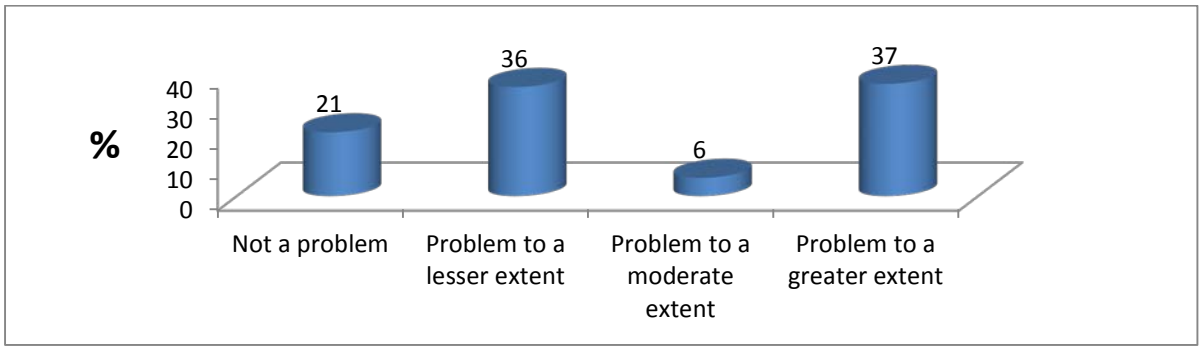


Figure 4.11 illustrates the extent to which returnable stillages were shared with other suppliers. As shown in Figure 4.11, almost 79.0% (36+6+37) of the participating ACMs said that the sharing of returnable stillages or packages with other suppliers for cost benefits was not being exploited and was thus a problem. Only 21.0% of the ACMs had embarked on a stillage sharing initiative.

Sub-objective 2: To investigate whether the level of integration of supply chain ICT practises, within a supply chain system or a firm, has an influence on SCT costs.

In this section, the researcher will discuss how the results address sub-objective 2 of the research. 4.2.3.6 General supply chain principles

The term “general supply chain principles” refers to practices of the supply chain in relation to performance, clustering, and best practice.

Figure 4.12: Supply chain processes mapped for value-adding/non-value adding identification (See Appendix A, Questionnaire 2.13)

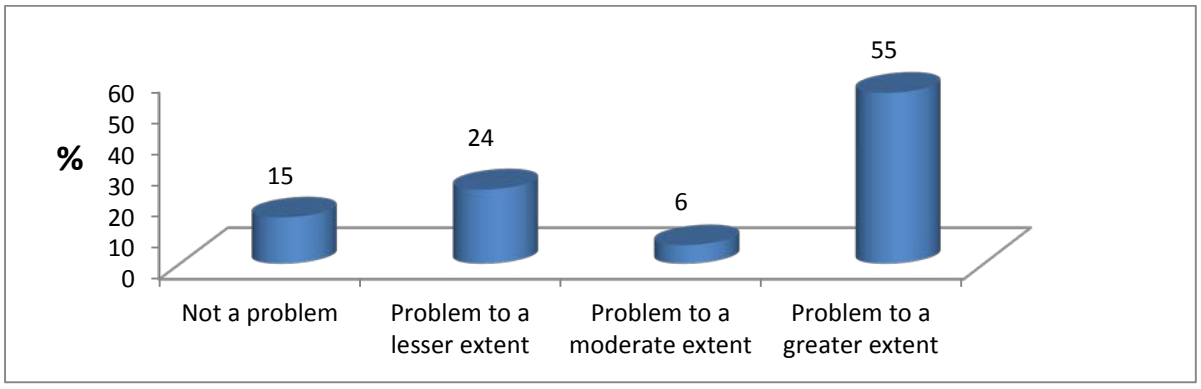


Figure 4.12 illustrates the extent to which supply chains identify value-adding and non-value-adding activities for cost reduction.

The identification of value add and the distinction from non-value add, allows for an opportunity for cost reduction to potentially be determined. A large total of 55.0% of respondents indicated that they saw the lack of mapping supply chain processes as a great problem.

Question 4.29 determined whether supply chain integration had impacted on the visibility of the supply chain performance. Some (85.0%) of the ACMs have not

realised any improved visibility of information, while 15.0% stated that they did not have a problem with visibility.

Question 4.30 interrogated the extent to which loosely-structured agreements impede the performance of ACMs since they did not formalise service levels that are expected. Only 11.0% of ACMs formally review their suppliers' service-level agreements, while almost 89.0% of the ACMs indicated that they did not review their value-chain partners' service levels. In addition, 83.0% of ACMs indicated that they were experiencing problems in the use of SC clustering to reduce costs within their value chains and only 17.0% indicated that it was not a problem.

Table 4.6: Assessing the extent of the use of value-chain best practice

	Problem area to a greater extent (%)
1. Strategic objectives are aimed at maximising value-chain practice	43
2. Organisations have adopted a benchmarked model of supply chain excellence	45
3. Organisations review their value-chain partner's service levels as a cost imperative	42
4. Value chain uses SC clustering for cost benefit	40

From Table 4.6, it is evident that formal benchmarking has not been recognised as a tool to positively influence value chain practices and cost reduction. Strategic objectives and the reviewing of partner service level agreements were tabulated in the order of their impact. The result highlighted in point 4 of table 4.6 showed that 40.0% of ACMs do not employ the use of clustering for cost benefits within their value chains.

Additional ACM comments in the questionnaire identified the following concerns relating to value chain best practices:

- Suppliers tended to operate in isolation owing to their serving of different markets, customers and operating models
- A quarter of ACMs sampled were participating in SC clustering to benefit in areas where there was some scope
- Cluster partners were needed to improve ACM competitiveness
- ACMs need to work more within clusters in order to reduce the high logistics costs, especially in inventory, warehousing and transport services

A review of studies carried out by Yu, Yan and Cheng (2007:99) show that the globalisation of OEMs and ACMs in business has significantly increased over the past decade, owing to advances in ICT, cost pressures and demand. SCM best practice provided overall and long-term benefits for all ACMs, which took place through co-operation and information-sharing. Their study also expressed that through co-ordinating activities along the SCM or establishing SC-related business partnerships, SCM creates a win-win situation for ACMs. Advances in SCM were mainly achieved through supply-and-demand, cross-docking, consolidation, vendor-managed inventories, and rapid-response technologies.

The data collected and analysed in this research confirmed that in South Africa, and in particular, the NMBM, the ACMs had not yet fully implemented the value-chain best practices to their advantage.

4.2.3.7 Supply chain shipment communication

Figure 4.13: The extent to which formal methods are utilised for planning distribution networks (See Appendix A, Questionnaire 2.4)

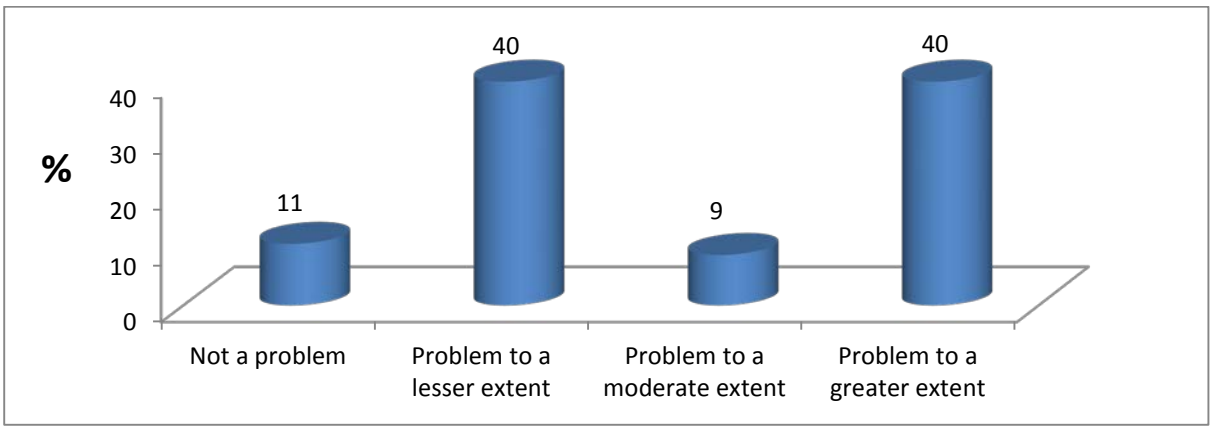


Figure 4.13 illustrates that as many as 49.0% (40+9) of the ACMs did not formally utilise planning systems for distribution network and only 40.0% utilised some measures to control its distribution through software. A total of 11.0% made formal use of software for planning its distribution network.

Just over half 51.0% (40+11) were thus using software to control their distribution networks, indicating that a challenge existed with this. A controlled supply chain of dependant partners need to have visibility in the movement of goods to track costs.

Table 4.7: Summary of warehousing scores of problems

	Problem area to a greater extent (%)
1. Use of software that controls warehousing space allocation	45
2. Use of off-site warehousing	45
3. Overall condition of equipment used within warehousing	36
4. Consolidation of stock with other suppliers to lower costs	45
5. Use of a shared ICT platform	38

From Table 4.7, it is evident that almost half of the ACMs (45.0%) did not use any software, off-site warehousing or consolidation of stock in order to reduce costs.

The ACMs raised the following points on warehousing:

- Shared warehousing was an option for saving costs. However the need to address challenges such as security, intellectual property and stable supply were the keys to this issue
- There was only limited use of software
- ICT sharing through MISCCIP yielded cost savings, but this could be improved
- Some ACMs used scanning, but in isolated locations with incorrect layout allocation

- Some organisations had unused space owing to the bull-whip effect and should perhaps integrate up/down the supply stream
- Consolidation of warehouse resource use was needed because it was sub-optimally used and more data-sharing was required within the ICT of suppliers

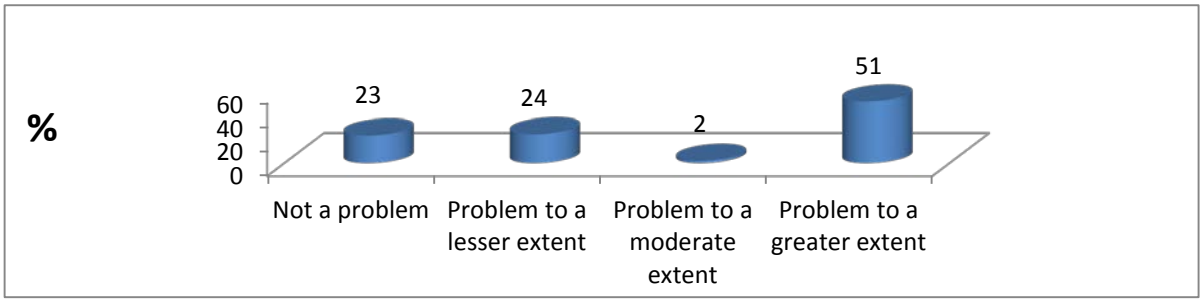
The findings confirmed the fact that an organisation that does not adopt an integrated approach appears to be fragmented and uncoordinated, with each function having its own budget, priorities and measurement systems. By integrating activities such as transportation, warehousing, inventory management, order-processing, information systems and purchasing, total logistics costs could be reduced (Stock & Lambert, 2001:27). The findings also showed that there has only been a limited use of warehousing software amongst the South African ACMs.

Table 4.8: Summary of packaging as reflected in the questionnaire (See Appendix A, Questionnaire 2.8)

	Problem area to a greater extent (%)
1. Using standardised packaging to reduce repacking or unnecessary handling	47
2. Recycling of any packaging	53
3. Using an audit process in place to make sure all packaging conforms to specifications	58
4. Establishing of a process to do shared purchases to lower costs	64

Table 4.8 illustrates that most ACMs (64.0%) do not formally embrace shared purchasing as a cost-reduction alternative. More than 81.0% of the ACMs did not formally share purchasing of packaged materials to reduce costs. Only 19.0% formally undertook such an initiative, while 13.0% did not embrace any shared purchasing at all (See Table 3 in Appendices).

Figure 4.14: Customer electronic ordering (See Appendix A, Questionnaire 2.9)



4.2.3.8 Packaging and Order processing

This section looks at the use of order processing within supply chains.

Order processing refers to the manner in which customers place orders, either through a formal or informal channel. The significance of the order placement is that it impacts on lead times, perfect order fulfilment, and the provision of goods at the right time. This satisfies two main criteria in the supply chain, namely time and place utility.

Figure 4.14 illustrates the extent to which customer orders were placed electronically since electronic ordering improves reliability. The study showed that 77.0% (24+2+51) of the ACMs indicated that the placement of electronic customer orders was not done through a formal electronic system, with only 23.0% doing this on a formal basis. It is interesting to note that 51.0% did not place electronic orders at all, but this was probably due to electronic blanket-order release call-off to tier 1 and tier 2 suppliers.

The identification of barriers hindering increased service levels was also posed to respondents (see Appendix A, Questionnaire 2.9). It was found that the majority of ACMs (49.0%) do not formally communicate at all with other internal operations, probably due to the lack of integrated ERP systems. Only 13.0% of the ACMs formally communicated their order processing to other internal operations. Almost 90.0% of ACMs were not realising the full potential of a shared ICT platform or cluster. Only 13.0% of these companies formally experienced maximum gain allied to synergy and cost reduction. Informal and partial communication took place between production and other internal operations with only 17.0% of ACMs formally communicating between production and the rest of the internal operations.

Table 4.9: Summary of production systems as reflected in the questionnaire (See Appendix A, Questionnaire 2.10)

	Problem area to a greater extent (%)
1. The use of Kanban systems.	25
2. Sharing returnable stillages/packages with other suppliers for cost benefit.	37
3. Rating the ICT communication between production and the rest of the internal operations.	30

From Table 4.9, it is evident that 25.0% of the ACMs did not utilise Kanban systems, with less than one-third (30.0%) not communicating between production and other internal operations. The ACMs had indicated that ICT introduced was not always accurate or reliable. Some respondents indicated 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, and at the right price. Kanban systems are designed to achieve this. The results show that for the South African ACMs, the production problems are not very high, except for the sharing of returnable stillages/packages with other suppliers for cost benefits, with about 37.0% of the respondents stating that it was a problem.

4.2.3.9 Returns management in the supply chain

Returns management is discussed in this section. It is important part of the supply chain since stillages, packaging, pallets, and containers are recycled and reused within the supply chain.

The extent of using a formal system to monitor returns was also ascertained (see Table 4.10). The low scores of 36.0% for returns monitoring and 30.0% for returns communication, suggest that there was scope for improvement. Product returns might add to cost of rework or scrap and was thus a potential for cost savings with ACMs.

Table 4.10: Summary of supply chain inventory returns of goods or parts to source suppliers as reflected in the questionnaire

	Problem area to a greater extent (%)
1. Monitoring system for returns (products).	36
2. Rating the communication between returns and the rest of the internal operations.	30

The following additional points were raised by the ACMs:

- There was definite room for improvement in communication, and a more refined system was required
- Process and procedures could be more effective
- ICT for returns was needed

The effectiveness and efficiency derived from information sharing depended on the extent of integration and collaboration. Although the degree of collaboration results in the extent of information-sharing, it was evident that up until 2003, collaborative efforts have lacked any focused attention and integration plan. Therefore, returns have been limited, as the focus has been on the integration of operational processes only (Barratt, 2004:30).

4.2.3.10 Determining the use of clustering as a mechanism to improve supply chain competitiveness.

The effective use of clustering best practise for supply chains is discussed in this section.

Figure 4.15: Clustering supply chain technology in organisations (See Appendix A, Questionnaire 2.13)

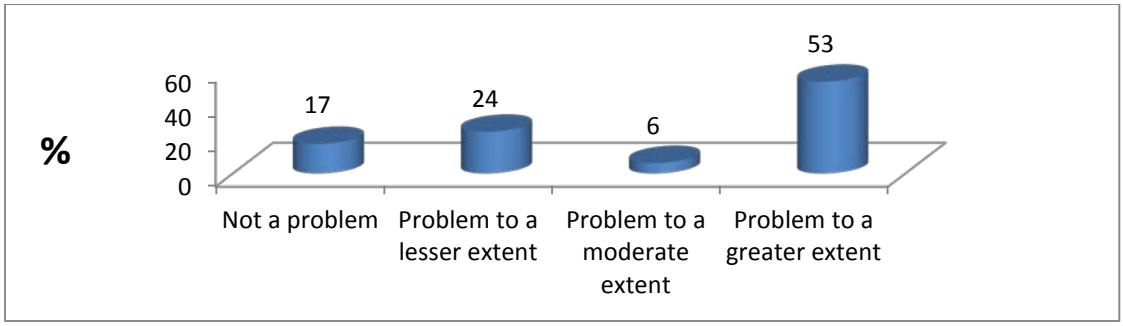


Figure 4.15 illustrates that 47.0% (17+24+6) of ACMs have no formal control over their supply chains, with 53.0% adopting formal clustering of supply chain technology to gain competitive advantage.

Table 4.11: General supply chain principles

	Problem area to a greater extent (%)
1. All supply chain processes mapped and clear identification of value and non-value adding activities.	55
2. Overall rating of organisational control within the entire supply chain.	49
3. Clustering supply chain technology benefits to organisations.	53
4. ICT creates cost saving within organisation supply chains.	55

Table 4.11 illustrates that, in three out of the four elements measured, more than half the respondents indicated that very little had been done in respect of adopting a formal supply chain approach to facilitate cost reduction.

ACMs raised the following points:

- Potential for savings was apparent, but this had yet to be improved
- Some ACMs should seek to work with SC partners through clustering of potential resources to reduce the Asian threat
- Working with SC partners should lead to the reduction of costs, including logistics
- ICT, if applied correctly, might be effective with clusters, but costs should also be considered as being the main imperative

These findings indicate that, overall, the general supply chain was not achieving the results it should. The detailed mapping of all supply chain processes and the clear identification of value-adding and non-value-adding activities must be expanded. The potential cost saving created by ICT within organisational supply chains was also not being fully exploited.

Sub-objective 3: To illustrate which supply chain issues prevent SCT adoption of best practice.

In this section, the researcher will discuss how the results obtained address sub-objective 3 of the research.

The impact of supply chain information-sharing and collaboration to improve the overall business performance has been examined by a number of research studies (Stank, Keller & Dougherty, 2001:36). Stank et al. (2001:41) observed that as supply chain clustering requires shared decision-making amongst trading partners, many ACMs use sophisticated ICT technology to help them gain a competitive advantage. Furthermore, advances in web-based applications, tools, and electronic data interchange (EDI) have also occurred.

Table 4.12: Summary of supply chain integration scores (maximum), as reflected in the questionnaire

	Problem area to a greater extent (%)
1. Best practice integration norms of supply chain allow for positive synergy	38
2. Supply chain integration improves the visibility of the information	40
3. Supplier integration is loosely structured without mutual agreement	43
4. Supplier integration provides competitive advantage in new technological practice	32
5. Supplier integration provides competitive cost advantage due to economies of scale	47
6. Supplier integration through use of SCT can lower costs	47
7. Supplier integration can be optimised through the clustering of supply chains	49

Table 4.12 illustrates a range between 32.0% - 49.0% indicating that these items were generally scored as a *problem*. The study showed that 32.0% viewed integration as providing a competitive advantage with technology. This may suggest limited levels of trust with sharing technological supply chain integration practises. The study also showed that 47.0% of the respondents viewed supplier integration through the use of SCT as a cost driver. A possible reason for this is that these companies have de-facto wholly integrated systems that probably require very little change. Less than half (49.0%), indicated that supplier integration can be optimised through the clustering of supply chains. Therefore, it appeared that supply chain integration was not being adequately implemented to influence the overall supply chain performance.

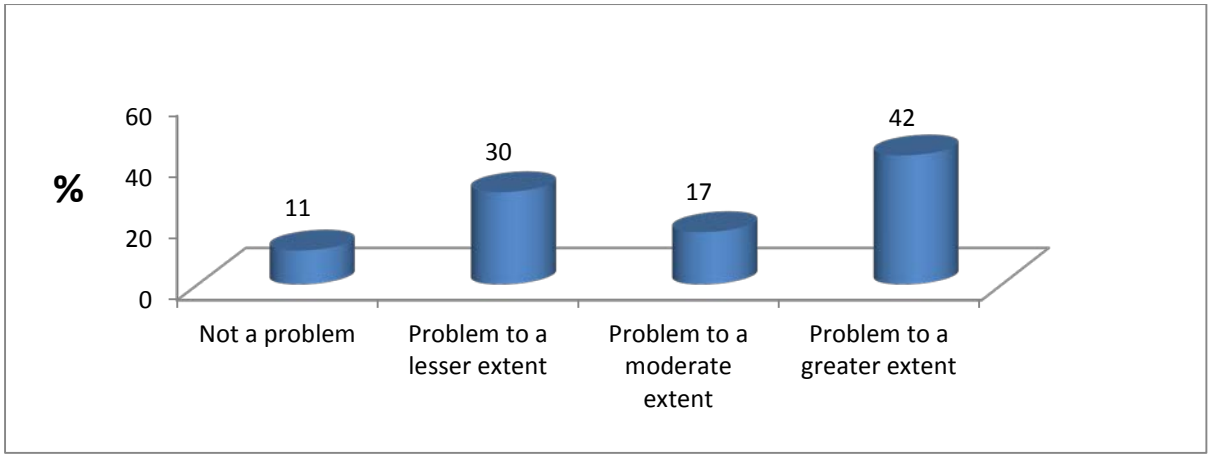
Additional comments in the questionnaire by the ACMs have identified the following issues regarding supply chain integration:

- Integration between ICT infrastructures offered potential for shared services to reduce costs
- Reduced lead times and pipeline visibility increased supplier flexibility in their markets
- Integration reduces costs for manufacturers; that is, logistics costs in materials, warehouse and transport, but currently there were very low levels of integration
- New technology, such as Radio Frequency Identification (RFID), was still very expensive
- Low levels of integration were the result of cost sensitivity by organisations

4.2.3.11 Supply chain innovation

Various supply chain innovations have occurred in automotive supplier clusters. Supply chain innovations include systems that provide data as close as possible to real time through the use of ICT in order to provide efficient and cost-effective supply chain systems.

Figure 4.16: The formal adoption of an innovation monitoring system (See Appendix A, Questionnaire 2.2)



From Figure 4.16, it is evident that 89.0% (30+17+42) of ACMs has adopted an informal approach to measuring and monitoring innovation in the supply chains, with only 11.0% formally monitoring innovation adoption. Question 4.45 in the questionnaire sought to identify the extent of supply chain strategy inclusion of innovative practice (See Appendix A, Questionnaire 2.2). A total of 64.0% indicated that supply chain innovation practices were not being readily adopted. A quarter (25.0%) stated that it had an influence, although to a lesser extent in their business.

The extent to which a supply chain innovation strategy existed in each ACM was also investigated. Almost 50.0% of the respondents indicated that they did not have any formal, focused and detailed supply chain innovation strategy in place, with more than 90.0% showing only an informal approach to some type of innovation strategy. Only 8.0% of ACMs indicated a formal approach to having a supply chain strategy. The significance is that most ACMs did not have a long-term strategic view, in particular with regards to innovation (see Table 4.13). In question 4.46 of the questionnaire, the respondents were probed to what extent a detailed supply chain innovation strategy existed in each ACM. Innovation was seen as having a large impact as 51.0% stated that it impacted on costs, but more specifically on the bottom-line performance of ACMs.

Table 4.13: Summary of supply chain innovation scores

	Problem area to a greater extent (%)
1. Organisation has a monitoring system to measure its innovation adoption	42
2. Supply chain strategy takes account of innovative practices, as observed in developed economies	47
3. Organisation has a detailed strategy for supply chain innovation	45
4. Supply chain innovation is measured to understand its impact on the bottom-line of supply chain costs	36

Table 4.13 illustrates that almost half of the respondents did not view supply chain innovation as being the key to improving performance. Only 42.0% of organisations believed that a monitoring system was of importance for the supply chain. The strategic significance of the supply chain strategy and impact on innovation recorded low scores of 47.0% and 45.0% and suggests there is room for improvement. Respondents were not realising the benefits associated with the impact of supply chain innovation on bottom-line performance.

Additional comments made in the questionnaire by the ACMs also identified the following concerning supply chain innovation:

- A third of supply practices were tailored for global markets
- With some multi-national entities, best practices were shared throughout the group and cascaded into different ACMs
- SCI was very limited when compared to international operations
- DQS South Africa (Pty) Ltd. were auditors of management systems, such as ISO or TS16949 within the supply chain industry. Organisations should use their logistics cost drivers and plan strategies to counter high costs

The use of supply chain technologies (SCT) to manage most of the elements involved in the procurement and communication processes made the data exchange and the

management of the supply chain faster and easier. The levels of innovation and the extent of adoption thus have a direct bearing on SCT costs.

It is evident that the best practices in supply chain integration were not well developed in automotive supply chains (ASCs) in South Africa, although most ACMs agreed that if well-developed and implemented, they could give ACMs a competitive advantage.

4.2.3.12 Supply chain degree of value chain best practice

All supply chains reside within an extensive value chain, which comprises both primary and secondary factors. The extent of the best practice use determines the maturity of the supply chain, since the value chain stretches from customer through to the end user.

Figure 4.17: Strategic objectives aligned to maximise value chain practice (See Appendix A, Questionnaire 2.3)

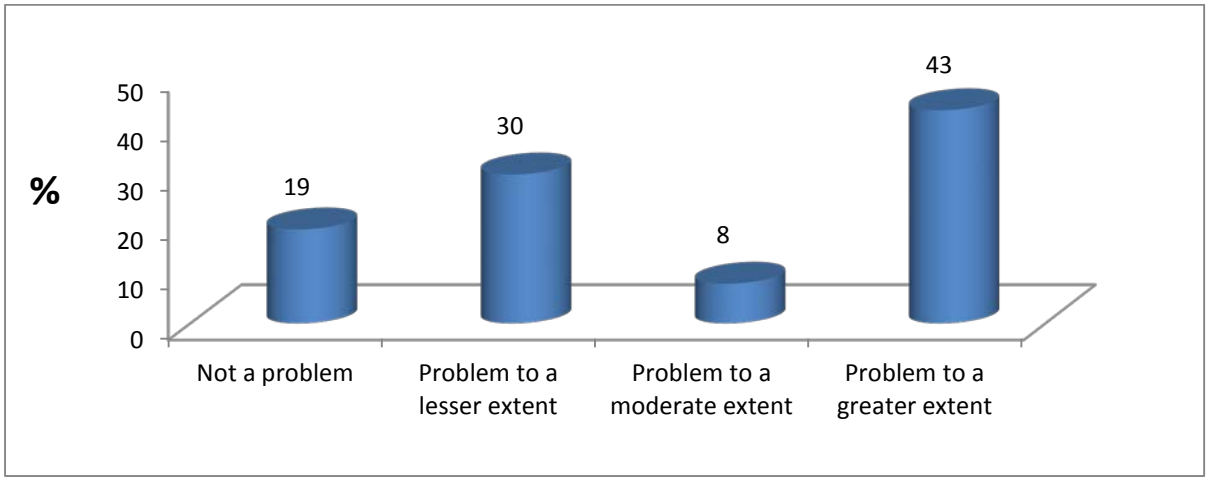


Figure 4.17 illustrates that 43.0% of the respondents do not have any strategic objectives related to maximising their value chain practice, with 8.0% having a moderate alignment. Only 19.0% of ACMs had any formal approach to aligning their strategic objectives in order to enhance their value-chain performance.

4.2.3.13 Response by ACMs to open-ended supply chain questions

The purpose of this section was to determine from the respondents what they perceived to be the barriers to supply chain technology with respect to cost, and the levels of integration.

More than half of the ACMs indicated that best practices through integration of supply chains allowed for synergy to a great extent. Additional comments raised in the questionnaire concerning these practices include:

- Some ACMs had software that links to their clients and auditors (audit logic)
- Service level agreements needed to be reviewed every year
- Within South Africa, suppliers used varying levels of integration of ICT in their firms. This problem, coupled with various ERP/MRP systems, created integration barriers
- Improved availability of data would enhance the transparency of areas allowing for better synergy
- More attention should be given to international best practices

Additional comments in the questionnaire were also raised concerning information sharing with ICT and systems throughout the supply chain:

- Lack of information at all levels of management was evident
- With the correct software, clients were able to draw all the audit reports they may need
- Information regarding scheduling was not displayed, and information was disseminated to logistics employees only, while other employees did not have time to seek this information
- Owing to current bills of material/process complexity, the ICT system was limited as to how it displayed actual movement of parts owing to the time-delayed manner of capturing its path. Once the Kanban system was in place, economic order quantities (EOQs) refined and employees trained, the visibility of information would improve
- For ACMs with comparatively simple supply chains (few out-of-town customers and suppliers), their current integration was sufficient to provide all information required by the respective parties
- Some level of the insight presented could be improved

- More agility and ability to respond to clients in time were also needed
- All SC players knew what was happening, however, this practice was not extended to the suppliers
- Sharing with OEMs was a good idea, but this would need to be explored to determine whether the logistics and transport costs could thereby be reduced

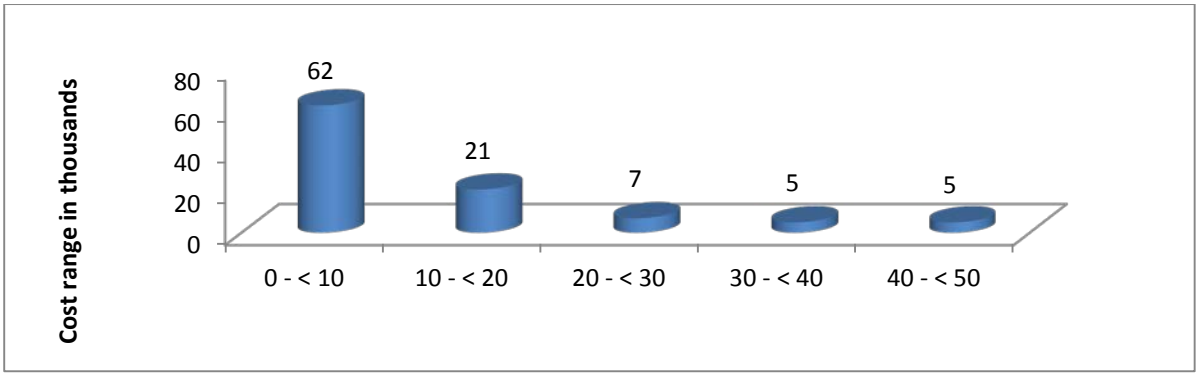
Most ACMs felt that supplier integration provided competitive advantages in the new technological ICT practice, making it easy to plan audit reports. However, this was dependent on employee skills when utilising it correctly. If formalised, it provided suppliers with a secure foundation on which relevant information could be shared and opportunities unlocked, thereby allowing each member and cluster as a whole, with potential, to be competitive.

The clustering of supply chains yielded cost benefits by reducing the costs of shipment or transportation; but not all clustering automatically resulted in cost benefits. It also yielded resource-sharing (equipment and labour), system-integration (quicker response time) and improved communication. In cases where there was a variety of businesses within the cluster, the diversity could allow the potential for cost optimisation in purchasing by promoting the sharing of ideas and collaborative purchasing.

4.2.3.14 Supply chain technology cost factors

Supply chain technology is constantly changing owing to technological advancements and this is discussed in this section. The cost factors were typically apportioned as a percentage of the total cost of ownership in relation to adopting new technologies.

Figure 4.18: Technology cost spent as a percentage of total operating costs (See Appendix A, Questionnaire 2.14b)



It is evident from Figure 4.18 that 62.0% of ACMs spent less than 10.0% of their operating costs on technology, with only 5.0% of companies spending between 40.0% and 50.0%. This was in alignment with the poor ICT integration of supply chain systems as discussed earlier.

4.2.3.15 Supplier Integration

Integration into the supplier value chain was an essential prerequisite to reducing costs and improving productivity.

Figure 4.19: Supplier integration through mutual agreements

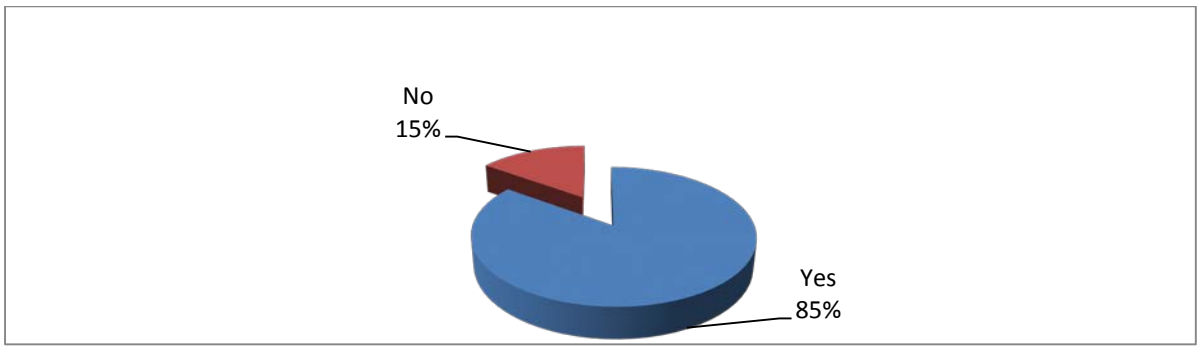


Figure 4.19 illustrates that 85.0% of the respondents believed that supplier integration through well-structured agreements were necessary for cost and productivity improvements.

Sub-objective 4: To develop a supply chain audit tool (SCAT) that can determine an individual organisation's level of SCT maturity, as this will have a positive influence on the supply chain in which it operates.

In this section, the researcher will discuss how the results address sub-objective 4 of the research.A section of the questionnaire was designed specifically to develop a supply chain audit tool (SCAT). The SCAT evaluates the key elements of an organisation's operations, which includes inventory, warehousing, materials handling, procurement, transport, production, order processing, packaging and materials return. The various elements were then used to derive at the questions which relate the specific processes deemed necessary to perform.

This audit tool is to be used as a measuring instrument to assess the level of SCT maturity of individual organisations in the supply chains they operate within. The results and discussions with respondents culminated in a SCAT consisting of 14 tables as they appear in tables 14.14 - 14.27. The tables consist of open and close ended questions. An auditor visits earmarked organisations and has all 14 tables completed in order to evaluate its performance. The assessment will identify gaps that still exist in a responding organisation's SCT maturity. By addressing these gaps and improving their SCT maturity, the supply chains in which these organisations operate should become more effective and efficient. All organisations are provided with a non-disclosure agreement that ensures that confidentiality is upheld. Organisations are requested to agree that results be shared, without the name of the organisation being made available, to measure overall supply chain efficiencies.

At the assessment, the auditor could request evidence or cite a difference of opinion. It would be the responsibility of organisation being audited to substantiate fully, prior to the final rating for each question being awarded. Once each supply chain dimension is evaluated, a rating is achieved which is reflected as a percentage score. The aggregate percentage of the audit shows how the organisation's overall supply chain technology is performing.

The response to the questions thus reflects the extent to which the organisation complies with SCT systems and processes. The overall score is categorised into three areas of maturity from a supply chain perspective. A rating of between 0.0% - 50.0% indicates that immediate intervention is needed to improve the supply chain. A rating between 51.0% -75.0% shows that certain areas need intervention in order to have an improved state of the its internal supply chain. A rating greater than 75.0% shows that

the organisation meets the minimum standards across the dimension and is thus able to supply at the desired levels of performance, quality and delivery.

An organisation may have a "good" or "bad" internal logistics performance, but that does not mean its management of logistics is helping or hurting it from a competitive perspective. A competitive advantage exists in a supply chain when customers choose one over another competitor. This is based on an aspect of the supply chain where one organisation performs better relative to your competitors. It provides a baseline assessment and will allow the company to decide on measures to do more detailed benchmarking against other class leaders. Any improvement in an individual organisation would ultimately be expected to lead to an improving within the total supply chain in which it operates.

4.2.3.16 The audit process

The audit verification process is comprised of two areas:

1) Firstly, a requirement of the auditor is to physically visit the applicable logistics areas in a walkabout as well as visiting the related production interface. At that juncture, physical logistics attributes and methods in the organisation is investigated.

2) Secondly, the audit requires the company being audited to provide evidence to substantiate the responses to all the questions being provided. The questionnaire is therefore submitted 14 days prior to ensure familiarisation and evidence is prepared for the supply chain auditor.

The next section describes the SCAT in detail.

This section serves to provide the details of the supply chain audit tool.

Table 4.14: Overview, description and aim of the supply chain audit tool

Sheet 1	**Overview**	
	Primary Aim of the Supply Chain Audit Tool	
	This tool is primarily focused at 3rd and 4th tier suppliers. Its main purpose is to identify areas within the supply chain that needs attention the most. From the tool users will be able to identify areas of opportunities and make informed decisions on which areas to focus on. The top five suppliers will also be evaluated against their current BEE status. In summary the Supply Chain Audit Tool aims at improving the overall effectiveness of the supply chain and to help SMME's to become more competitive within the manufacturing environment.	
	Nomenclature and Definitions	
	Supply Chain	A sequence of organisations, their facilities, functions, and activities, that are involved in producing and delivering a product or service
	SCAT	Supply Chain Audit Tool
	Logistics	Movements of material and information in the supply chain
	DRP	Distribution Requirements planning
	3-PL	Third Party Logistics
	Bullwhip Effect	Inventories become progressively larger looking backward through the supply chain
	AGV	Automatic Guided Vehicles
	WIP	Work in Progress
	EDI	Electronic Data Interface
	ERP	Enterprise Resource Planning
	B-BBEE	Broad Based Black Economic Empowerment
	SMME	Small Medium Macro Enterprises
	Methodology	
	1	Divide supply chain into different focus areas
	2	Gather the relevant information needed
	3	Convert information into a readiness value
	4	Use readiness value to guide efforts to areas with the most opportunity for improvements
	How to use the tool	
	1	Only use the numerical key number “1” for all answers, except in the BEE section
	2	Never select multiple answers to the same question
	3	Only one answer per row, except for the BEE section
	4	Answer all questions
	5	Enter all required information on the BEE section of the tool

The general information below provides a summary of the organisations details. All relevant organisation information serves to be captured at this point. This information can be filled in prior to the audit.

Table 4.15: Description of an organisation where the supply chain audit tool is being administered

Sheet 2	Organisation Information			
	Company Name			
	Address			
		Code		
	Postal Address			
		Code		
	Telephone Number			
	Fax Number			
	E-mail Address			
	Contact Person			
	Number of Employees			
	Main Products Produced			
	Top 5 suppliers			
	Top 5 customers			

The next section (See Table 4.16) deals with transport. It is designed to measure the extent to which organisations are using modern logistics tools and approaches to reduce costs.

Table 4.16: Possible areas which may provide for the optimal use of transport within the logistics in the organisation

Sheet 3	Transport						
	Questions					Yes	No
1	Do you organise or combine shipments in conjunction with others?						
2	Does the company make use of any route planning software?						
3	Do you make use of any formal methods to plan your distribution network?						
4	Do you make use of cross-docking?						
5	Do you make use of software integrated systems to communicate with transport companies?						
6	Do you prepare transportation documentation electronically?						
7	Do you make use of an automated process to assist in locating your product in-transit?						
8	Do you measure late delivery data?						
9	Do you make use of a process to provide a status on shipments and material movement?						
10	Do you make use of a distribution scheduling process?						
11	Do you make use of "quick response" systems like barcode scanning to convey real time information during loading and off loading?						
12	Do the company make use of third party logistics(3-PL)?						
13	Do you have adequate manoeuvring space for incoming and outbound vehicles?						
	Questions		Poor	Need Attention	Satisfactory	Good	Excellent
14	Rate your ability to transport and distribute your own products?						
15	How accurate is your late delivery recording (inbound)?						
16	How accurate is your late delivery recording (outbound)?						
17	How effectively do you schedule your distribution plan?						
18	Rate the communication between your transporters and the rest of the internal operations.						
	TOTALS						
	Rating						
0%-50%		Need Immediate Intervention					
51%-75%		Could be improved upon					
76%-100%		Good					

Table 4.16 describes the open and close ended questions which are tabled by the auditor for organisation representatives to respond to in the audit process. Close ended questions are included as questions 1 to 13 and as stated previously, were framed to attempt to limit the responses to only one outcome. Questions 14 to 18 were framed to get a range of responses. The aggregate sum of the positive scores yields a result which is based on the tally of both types of question sets. The result of the completed score sheet will result in a percentage range categorised within the three categories presented as either good, could be improved upon or requiring immediate intervention. Organisations could thus embark on remedial action if required. The same approach is used in evaluating the other internal supply chain areas described

in table 4.17 to table 4.24 herein and thus provides an assessment of the different areas.

Transport efficiency also needs to work with the inventory. Effective inventory management (See Table 4.17) is also an important contributor to efficiencies and improved productivity. This section of the tool ascertains the extent of efficient inventory management systems and practices that are in place.

Table 4.17: An assessment of how inventory is managed in the organisation in its internal logistics

Sheet 4	Inventory						
	Questions					Yes	No
1	Do you have electronic tracking capability for inventory?						
2	Do you have a process or system in place to prevent bullwhip?						
3	Do you have clearly defined organisational accountability for the performance of each inventory segment?						
4	Do you have a process in place to minimise inventory obsolescence as a result of engineering changes?						
5	Do you have a dynamic inventory performance monitoring system (FIFO, shelve life,etc)?						
6	Have you managed to progressively decrease your WIP inventories over the past three years?						
7	Does your company carry safety stock?						
8	Do you know your precise lead time to replenish inventories?						
9	Does every product have a well defined manufacturing and inventory deployment strategy?						
10	Do you have an active, on going program for vendor-delivered, point-of-use inventories?						
11	Do you have action plans in place to help reduce the levels of safety stock?						
	Questions			Poor	Need Attention	Satisfactory	Good	Excellent
12	How well does the company maintain ideal inventory levels?							
13	Rate the accuracy of your real time inventory information?							
14	Rate the accuracy of your inventory management system?							
15	Rate your communication between inventory management and the rest of the internal operations?							
	TOTALS							
	Rating							

0%-50%		Need Immediate Intervention
51%-75%		Could be improved upon
76%-100%		Good

Warehousing (See Table 4.18) is part of the inventory management system. This element of the tool ascertains the extent to which respondents are using automated systems. It also attempts to determine the ability of the organisation to optimally utilise warehouse space both efficiently and effectively as it contributes to logistics costs.

Table 4.18: The optimal use of warehouse systems and space allocation

Sheet 5	Warehousing						
	Questions					Yes	No
1	Do you electronically identify material and products?						
2	Do you have software that controls warehousing space allocation?						
3	Does the company make use of third party logistics(3-PL)?						
4	Do you make use of off-site warehousing?						
5	Do you have adequate staff for warehousing functions?						
6	Do you have appropriate material handling equipment available for warehousing?						
	Questions			Poor	Need Attention	Satisfactory	Good	Excellent
7	Rate your warehouse security?							
8	Rate how appropriate your warehousing is to the current products line-up?							
9	Rate your in-house training programs for warehousing personnel?							
10	Rate the overall condition of equipment used within warehousing?							
11	How capable is the system to handle the current volumes							
12	Rate the capability of the current warehousing systems to handle larger volumes?							
13	Rate the stability of software and electronic systems in place?							
14	Rate the communication between warehousing and the rest of the internal operations?							
	TOTALS							
	Rating							

0%-50%		Need immediate intervention
51%-75%		Could be improved upon
76%-100%		Good

Materials handling (See Table 4.19) continues with the analysis of the optimal use of material handling systems. Material handling provides the systems to transport goods and services and is described in this section.

Table 4.19: The optimal use of material handling systems

Sheet 6	Material Handling						
	Questions					Yes	No
1	Do you make use of automated MH equipment for receiving and dispatching (conveyors, robots, lifts,etc)?						
2	Do you make use of internal automated MHE (AGV's, conveyors etc.)?						
3	Do you make use of non-powered handling equipment to reduce costs (pallet trolley, etc.)?						
4	Do you have sufficient docking facilities available?						
5	Do you only use equipment for the tasks which it was designed?						
6	Do you try to standardise when choosing material handling equipment?						
	Questions			Poor	Need Attention	Satisfactory	Good	Excellent
7	How would you rate your ability to handle equipment breakdowns?							
8	Rate the overall condition of your equipment?							
9	Rate the overall effectiveness of your handling equipment?							
10	Rate the availability of appropriate equipment at crucial times?							
11	Rate how suitable your material handling is to the current product mix?							
12	Rate the overall level of training of the material handling operators?							
13	Rate the versatility of your material handling equipment?							
14	Rate the level of interaction between your material handling processes and internal operations?							
	TOTALS							
	Rating							

0%-50%		Need Immediate Intervention
51%-75%		Could be improved upon
76%-100%		Good

Although packaging (See Table 4.20) is often a neglected or hidden cost, significant savings are achievable through using standardised packaging and recycling. This element of the tool identifies those opportunities.

Table 4.20: The organisation's packaging systems and how effective they are

Sheet 7	Packaging						
	Questions					Yes	No
1	Do you make use of standard packaging to reduce repacking or unnecessary handling?						
2	Do you re-use any packaging?						
3	Do you receive any used packaging back from your customers?						
4	Do have any incentives in place for customers to return used packaging?						
5	Do you choose specific packaging sizes to accommodate material handling equipment?						
6	Do you source your packaging locally?						
7	Do you use recycled packaging products?						
8	Do your customers provide their own packaging?						
9	Do you have an audit process in place to make sure all packaging conforms to specification?						
10	Do you make continuous efforts to reduce packaging material?						
11	Do you make use of automated packaging equipment?						
	Questions			Poor	Need Attention	Satisfactory	Good	Excellent
12	Rate your flexibility to change between different forms of packaging?							
13	Rate your overall efforts to reduce packaging cost over the last three years?							
14	Rate the communication between packaging and the rest of the internal operations?							
	TOTALS							
	Rating							

0%-50%		Need immediate Intervention
51%-75%		Could be improved upon
76%-100%		Good

Correct and efficient order processing (See Table 4.21) is the entry point for control of inventory, output, stock and manufacturing. This element establishes to what extent the order processing cycle is automated and integrated into manufacturing.

Table 4.21: Ordering processes and the efficiency of the control measures utilised

Sheet 8	Order Processing							
	Questions						Yes	No
1	Can your customers electronically place orders?							
2	Can you electronically place and dispatch orders?							
3	Do you make use of the Internet for order placing?							
4	Do you have systems in place to handle order cancellations or changes in orders?							
5	Have you got a well developed e-commerce strategy in place?							
6	Do you have an EDI system implemented?							
7	Do you rely on quick response systems to guide production (auto consumption points)?							
8	Do you use the Internet to achieve cost reductions for procurement (cost comparisons)?							
9	Do you have perfect order fulfilment (no over and under deliveries in/out)?							
10	Have you identified the barriers that prevent you from achieving increased service levels (self awareness)?							
11	Have you taken action and developed appropriate steps to remove these barriers?							
12	Do you have agreements with key vendors for short cycle deliveries (JIT)?							
13	Do you know your precise lead time for customer deliveries?							
14	Have you decreased your manufacturing lead times over the last three years?							
15	Have you decreased your vendor lead times over the last three years?							
16	Do you have a comprehensive and effective sales and operations planning process for the sales, production, lead time and inventory plans?							
	Questions			Poor	Need Attention	Satisfactory	Good	Excellent
17	How do you rate the stability of your ordering procedures?							
18	How capable are you in translating customer demands into corresponding activities?							
19	How well does your forecasting results reflect actual trends (planned forecast vs. actual)?							
20	How well is planning and execution co-ordinated among suppliers?							
21	How effective is your electronic data interchange(EDI) system?							
22	How would you rate your ability to react to fluctuations in demand?							
23	Rate your on time delivery?							
24	Rate the communication between order processing and the rest of the internal operations?							
	TOTALS							
	Rating							

0%-50%		Need immediate intervention
51%-75%		Could be improved upon
76%-100%		Good

The production element (See Table 4.22) determines the systems and processes being used in the production process.

Table 4.22: Assessment of the organisation's production process

Sheet 9	Production						
	Questions					Yes	No
1	Do you make use of an internal traffic management system?						
2	Have you decreased your lot sizes over the last three years?						
3	Do you spend a lot of time expediting material or fire fighting due to part or material shortages?						
4	Do you make use of “quick response” systems like barcode scanning to convey real time information?						
5	Have you decreased your manufacturing lead times over the last three years (throughput time)?						
6	Does every product has a well defined manufacturing strategy?						
	Questions			Poor	Need Attention	Satisfactory	Good	Excellent
7	Rate the accuracy of your bills-of-material?							
8	How well does your internal logistics traffic system function?							
9	Rate your capability to increase production within the current supply chain environment?							
10	Rate the flexibility within production to accommodate changes in the supply chain?							
11	Rate the communication between production and the rest of the internal operations.							
12	Rate production's ability to adapt to change resulting from other areas within the supply chain?							
	TOTALS							
	Rating							

0%-50%		Need immediate intervention
51%-75%		Could be improved upon
76%-100%		Good

The returns element (See Table 4.23) determines how much attention the respondent is paying to returns which are both a cost and an important indicator of problems in the production process.

Table 4.23: The organisation's product return system and how the organisation deals with it

Sheet 10	Returns						
	Questions					Yes	No
1	Do you have a system in place to monitor returns (products)?						
2	Does the system provide real time feedback?						
3	Does the system distinguish between different types of returns received?						
4	Do you have action plans and strategies in place to deal with unexpected returns?						
5	Do you use a specific type of storage for returned products and materials (how)?						
6	Do you make use of a quarantine area for suspect products and materials?						
7	Do you have a system in place to monitor returns(MHE/stillages etc.)?						
	Questions			Poor	Need Attention	Satisfactory	Good	Excellent
8	Rate your electronic capability to handle returns without loss of information?							
9	Rate the procedures in place to capture data related to returns?							
10	Rate your ability to cope with difficult customer situations with regard to returns?							
11	Rate the communication between returns and the rest of the internal operations?							
	TOTAL							
	Rating							

0%-50%		Need immediate intervention
51%-75%		Could be improved upon
76%-100%		Good

The general supply chain principles section (See Table 4.24) focuses on a number of contributory management issues which controls the internal supply chain and which do not fall within the other main categories. They are, however, important indicators of how well manufacturing adopts the necessary supply chain principles.

Table 4.24: General supply chain principles

Sheet 11	General Supply Chain Principles						
	Questions					Yes	No
1	Do you have any penalty system in place for non-conformance within the supply chain?						
2	Do you have quick response strategies in place to reduce lead times?						
3	Does your geographic location influence the effectiveness of your supply chain?						
4	Are there standardised ways and integrated technology used to communicate amongst partners?						
5	Can you connect to any part of the supply chain to access data in real time on inventory levels, shipment status, etc?						
6	Do you have an event management system to support your supply chain?						
7	Do you have performance metrics in place to confirm that the supply chain is functioning as expected?						
8	Do you have a standardised method of measuring supply chain performance?						
9	Have you evaluated your supply chain management costs (mngt reporting, high overheads)?						
10	Have you evaluated the impact of your warranty costs?						
11	Do you make use of a collaborative planning, forecasting and replenishment system within the supply chain?						
12	Do you engage in strategic partnering?						
13	Have you mapped all supply chain processes and clearly identified value adding and non-value adding activities?						
14	Does your primary measurements and reward system heavily weigh towards short cycle times and quick response with minimal inventories?						
15	Do you have agreements with key vendors for mutually agreed upon goals for continuous improvements?						
	Questions			Poor	Need Attention	Satisfactory	Good	Excellent
16	How would you rate the value added per employee?							
17	How well is responsibility assigned within the supply chain?							
18	How would you rate your overall control within entire supply chain?							
19	How would you rate the success rate of your e-commerce system?							
20	How would you rate the trust amongst participants to make decisions that are mutually beneficial?							
21	How would you rate supply chain communication?							
22	Rate the effectiveness of data sharing amongst trading partners?							
23	How would you rate the level of integration between all levels of the supply chain?							
24	Rate supply chain response time?							
25	Rate your product flexibility?							
26	Rate your cash to cash cycle times?							
27	Rate how well all partners within the supply chain work towards a common goal?							
28	How would you rate your ability to dispense information throughout the supply chain?							
29	Rate the company's information velocity, the speed at which information is transferred within the supply chain?							
	TOTALS							
	Rating							
0%-50%		Need immediate intervention						
51%-75%		Could be improved upon						
76%-100%		Good						

The Broad Based Black Economic Empowerment (BBBEE) rating is captured in this section. The top five suppliers of the organisation being surveyed (See Table 4.25) is requested. This helps determine the extent of BBBEE as a business imperative within a South African context. In order to improve and sustain their own BBBEE rating,

OEMs and tier 1 and tier 2 suppliers require their suppliers to be as highly rated as possible.

Table 4.25: Top five suppliers' BBBEE ranking

Sheet 12	Top 5 Supplier B-BBEE Information											
	Name of Company	Industry Sector	Telephone Number	Fax Number	E-Mail	Contact Person	Position	Exempted Micro Enterprise			BEE Compliance Level	Recognition Level (%)
								Yes	No	More than 50% black owned		
1												
2												
3												
4												
5												

	BEE Compliance Level	Recognition Level
Exempted micro enterprise supplier without 50% black ownership	Level 4	100.00%
Exempted micro enterprise supplier with 50% black ownership	Level 3	110.00%

The summary of the results is discussed below (See Table 4.26). It is generated automatically by the tool. It provides a snapshot of the strengths and weaknesses of the company being evaluated.

Table 4.26: A summary of all the internal logistics areas assessed

Sheet 13	Summary	
	Elements	%
1	Transport	
2	Inventory	
3	Warehousing	
4	Material Handling	
5	Packaging	
6	Order Placement	
7	Production	
8	Returns	
9	General	
	OVERALL READINESS	

0%-50%		Need immediate intervention
51%-75%		Could be improved upon
76%-100%		Good

Table 4.26 provides a summary of the scores for the various internal logistics dimensions and the use of SCT.

Table 4.27 below describes the table which is generated from the audit, and which lists all the actions required to redress the shortcomings identified in the review. The model, therefore, also provides a worksheet for a remedial action plan. The auditor could then provide recommendations and plans to resolve perceived problems through the audit.

Table 4.27: Internal Logistics Action List

Supply chain audit action list							Date:
No.		Description Activities / Tasks		Responsible	Closed out	Status	Comment
	Element	CONCERN	ACTION REQUIRED				Rev. 1
6.0							
7.0							
8.0							
9.0							

4.3 CONCLUDING REMARKS

Chapter four provided an in-depth discussion of the analysis and validation of the data collected from the questionnaire. The data was analysed mainly by means of descriptive statistics, and the results of each question were presented separately, and a summary of each group of questions was provided. The main findings of the research were that:

- ACMs were still having problems making use of supply chain clustering to obtain a competitive advantage in the market
- Lack of ICT integration was not providing ACMs with anticipated cost benefits
- Owing to the lack of best practice analysis, ACMs did not understand their supply chains; and hence, did not exploit the costs beneficiation
- Best practice in supply chain integration were not well developed in ASCs in South Africa, although most ACMs agreed that if well developed and implemented, this could give them a competitive advantage
- Data collected and analysed in this research confirmed that in South Africa and, in particular, the NMBM, the ACMs had not yet implemented the value-chain best practice fully to their advantage
- Supply chain shipment communication was still a great problem for ACMs in South Africa, but it could be improved to give these ACMs an added advantage in terms of reducing their costs

Chapter five will draw conclusions based on the data analysis conducted in the study. The researcher will also make recommendations based on the findings presented. Thereafter, conclusions will also be made pertaining to the main and sub- objectives.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

In this chapter, the researcher will conclude the research study by briefly discussing the extent to which the main objective and sub-objectives were addressed. The aim of Chapter 5 is then to identify and suggest possible solutions to automotive component manufacturers (ACMs) and the automotive industry in its entirety to resolve the problems identified (see sections 5.2 to 5.6). The main findings of the research study are summarised in section 5.7 and include recommendations to ACMs. The limitations of the study are then discussed and the way forward for future research based on the findings is suggested.

Based on the background and introductory notes of the previous pages, the main objective of this study can be defined as follows: To investigate the impact of supply chain technology within automotive supplier clusters. The questions arising from this objective include:

- What are the supply chain technology and associated cost problems that ACMs in the Nelson Mandela Bay Municipality face?
- What are the barriers to solve these Information and Communication Technology (ICT) supply chain cost-related problems?
- To what extent is clustering of the automotive supply chain used for cost optimisation?

Through resolving the sub-objectives the main objective would also have been addressed.

5.2 RESOLUTION OF THE FIRST SUB-OBJECTIVE

Sub-objective 1: To determine how the use of Supply Chain Technology (SCT) impact on Supply Chain Management (SCM) within automotive organisational structures, as organisations seek to maximise their supply chain hierarchies, facilitate growth and reduce supply chain costs.

A comprehensive literature survey was conducted to explore this sub-objective. In addition, a focus group was interviewed to investigate all models, definitions and guidelines applicable to SCT impact on SCM. The main areas related to SCT having an impact on SCM were noted as supply chain communication, levels of innovation,

inventory using SCT and general supply chain principles. To solve this problem a questionnaire was used to determine the solutions for this sub-objective. The SCT impact on SCM in automotive organisational structures was addressed in Chapter 2 (see section 2.4.2).

5.2.1 Supply chain shipment communication

As noted in Table 4.1, it was evident that the ACMs were experiencing problems with supply chain shipment communication. Effective internal communication should be facilitated in the ACMs, because failure to do so may adversely impact on lead times for the delivery of finished goods.

Obtaining correct shipments and using shared loads could also be an opportunity for the ACMs to gain a competitive advantage. This is usually achieved through the accurate and timely communication of shipment and billing information. In effect, the optimal use of communication could provide for improved opportunities to seek cost reductions since sub-optimal loads as well as the empty returns of transportation resources could be filled.

5.2.2 Supply chain innovation

It was noted in Table 4.13 that best practices in supply chain innovation were not well developed in the automotive supply chains (ASCs) in South Africa. Most ACMs agreed that if supply chain strategy was well developed and implemented, it could give ACMs a competitive advantage. This could be a result of using a detailed strategy for supply chain innovation or the implementation of monitoring systems to measure innovation adoption in organisations.

5.2.3 The optimal use of inventory using supply chain technology

Most of the ACMs were experiencing challenges using SCT in handling their inventory due to the low scores (see section 4.2.3.2). Therefore, information that was not real time was potentially causing delays or non-delivery at times. This indicated that ACMs should strive to use real time information in their operations to optimise ideal delivery sequencing and timely delivery.

Since SCT has proved that it can reduce costs, ACMs should endeavour to implement advanced SCT because in the long run, it will reduce their costs and provide them with a competitive advantage. One such advanced SCT is the enterprise resource planning (ERP) system, which is used to maintain inventory data and process transactions to initiate and monitor performance and improve information sharing. This could be linked as measures within the inventory deployment strategy.

5.2.4 General supply chain principles

The response to general supply chain principles enabled the researcher to conclude that most of the ACMs were experiencing challenges using supply chain technology (see section 4.2.3.6). The mapping of supply chain processes into value and non-value adding activities also received a moderate score. This could influence the ability of ACM's to seek ways to reduce unnecessary costs within their supply chains. Working more efficiently and effectively with supply chain partners could lead to the reduction of logistics costs through clustering due to the effect of economies of scale and scope being derived.

5.3 RESOLUTION OF THE SECOND SUB-OBJECTIVE

Sub-objective 2: To investigate whether the level of integration of supply chain ICT practices, within a supply chain system or an organisation, has an influence on SCT costs.

A comprehensive literature survey was conducted to resolve this sub-objective. A focus group was interviewed to determine all practices in ACMs influencing SCT costs. These were then described as enterprise resource planning systems and the challenges of master production scheduling (MPS) as a cost driver facing ACMs. Production and returns management was seen as key to this since it used ICT and had direct cost implications. A questionnaire was used for data collection to determine the findings for this sub-objective.

5.3.1 Returns

Most of the ACMs were experiencing challenges with returns or reverse logistics (see section 4.2.2.10). As ACMs were finding it problematic to implement the effective

management of returns, definite room for improvement in communication and a more refined system was required. This handling should be made an integral part of the supply chain process.

Processes and procedures could be more effective, hence there was a need for ICT for effective returns management in all ACMs. This suggests that most ACMs were not actively seeking ways to optimise cost through returns consolidation. It is also evident that communication between production and internal operations are poor due to the sub-optimal use of ICT.

As ACMs were finding it problematic to implement supply chain integration, it was evident that ACMs could benefit significantly from supply chain clustering and integration, thereby reducing costs (see table 4.12). This cost saving could be used to acquire enabling technology such as radio frequency identification technology (RFID), which helps organisations increase supplier integration. Supply chain integration is also necessary in organisations because many businesses buy goods or services instead of producing them.

Supply chain integration could also be increased through the implementation of world-class management practices such as just-in-time (JIT) and total quality management (TQM).

5.4 RESOLUTION OF THE THIRD SUB-OBJECTIVE

Sub-objective 3: To determine which supply chain issues prevent SCT adoption of best practise.

A comprehensive literature survey was conducted to resolve this sub-objective. The literature review identified effective and efficient value chain practices as central to achieving best practice. These best practices were achieved through optimised warehousing, material handling systems, packaging and order management. The greening of the supply chain was also included since international ACMs were introducing SCT within greening practices.

5.4.1 Supply chain extent in adopting value chain best practice

As discussed in Table 4.6, respondents felt that clustering for cost benefit and valuing service levels with partners was low. This suggests that a minimal strategy was used to support cost optimisation or improved service levels. It was evident since only 43.0% of ACMs had a strategic objective to improve value chain practices to become world class. In addition, most ACMs still needed to implement these value chain best practices such as JIT, lean production and TQM.

As ACMs were finding it problematic to implement value chain best practice within their supply chains, ACMs should fully realise and utilise the clustering initiatives to benefit where there is scope. For example, through web-based applications, tools and electronic data interchange (EDI). ACMs also needed to work more within clusters to reduce the high logistics costs, especially in inventory, warehousing and transportation, by sharing real-time data within the cluster between buyers and sellers.

5.4.2 Warehousing

An analysis of responses on warehousing (see table 4.7) illustrated that most of the ACMs were having problems with warehousing their products. Therefore, as ACMs were finding it problematic to implement warehousing, organisations that had unused space owing to the bullwhip effect should integrate up or downstream in their supply chains to optimise stockholding capacity.

There was a need to consolidate the use of warehouse resources because it was sub-optimally used and more data sharing is required within the ICT of suppliers, through the mix of materials, types of security and maintenance, setting operations standards and personnel training.

5.4.3 Materials Handling Equipment (MHE)

It is evident that most of the ACMs had little challenges with MHE as the average extent of the problem was less than 20.0% (see table 4.3). There was, however, opportunity to implement plans that sought to reduce the cost of MHE to derive at the efficient and effective use of MHE. They should thus seek to increase their investment in shared procurement for MHE. This would ensure them having a competitive advantage in the long run, because with advancement in technology, better and more efficient equipment are continuously being invented.

5.4.4 Packaging

Most of the ACMs were having fewer challenges with packaging, mainly because they did not require packaging (see section 4.2.2.3). Most of their goods received were raw materials, and the ACMs mostly manufactured forms of stackable and collapsible packaging. As a result, no logistics packaging recommendations are made regarding packaging.

In terms of marketing packaging, ACMs could provide users with more and precise information on the contents of the package through proper loading and marking systems that utilise bar-coding and scanning technology.

5.4.5 Order processing

Most of the ACMs were experiencing problems with order processing (see table 4.4). The identification of barriers for improved service levels in addition to order process communication was noted as requiring improvement. ACMs should have quicker internal assessment of the types of input stock required per project, and identify communication with suppliers early to allow time for better assessment of potential mutual opportunities. These practices would help to reduce problems of order processing.

In addition, joint processing in a cluster would be a viable option. Resource intensive and clustering approaches may be viable and should be used by ACMs to seek cost reduction opportunities.

5.4.6 Greening

ACMs were experiencing moderate challenges with greening practices. A low 47.0% recognised the need to manage peak energy demand in addition to only 49.0% utilising an energy management system. As ACMs were finding it problematic to implement greening, they should avoid the use of forklift trucks as a priority to reduce carbon footprint. Also, greater transparency of any resource in the cluster approach that might be sourced environmentally would benefit and strengthen the ACMs.

5.5 RESOLUTION OF THE FOURTH SUB-OBJECTIVE

Sub-objective 4: To develop a supply chain audit tool that can determine the level of supply chain maturity and whether SCT is used effectively.

A comprehensive literature survey was conducted to resolve this sub-objective. A focus group was interviewed to identify what elements needed to be addressed through developing a supply chain audit tool (SCAT). The focus group and literature review suggested that a questionnaire provided the best basis to administer the tool. The composition of the tool was discussed in chapter 4. The tool became a template that could be used to do future audits within ACMs. The audits could in effect allow an organisation to determine gaps and areas that may require intervention. This then presented the findings in this sub-objective. The complete model is included in Annexure B as the Supply Chain Audit Tool.

5.6 OVERALL FINDINGS AND RECOMMENDATIONS

This section discusses the main findings of the research study and provides recommendations based on the study findings.

The main findings obtained from the analysis of data collected from the participating ACMs in the NMBM were noted. It was evident that ACMs were still experiencing problems making use of supply chain cost optimisation to have a competitive advantage in the market. This was largely due to concerns about confidentiality of pricing and competitive strategies. It prevented ACMs from seeking opportunities to seek mutual synergy and cost reduction by working together. It was also evident that best practices in supply chain integration were not well developed in the ASCs in South Africa. Most ACMs agreed that if well developed and implemented, they could ensure a competitive advantage. The willingness to seek out opportunities for integration within the SC had a large potential. It was also noted that the data collected and analysed in this research, provided confirmation that in the NMBM, the ACMs have not come to fully implement value chain best practices to seek competitive advantage. This diminished the ability to strengthen the value chain within the sector and become more resilient against competitive threats. It was also evident that supply chain shipment communication was still a major problem for ACMs in South Africa. This could be improved and if communication in ACMs and amongst the supply chain partners is enhanced, this could give ACMs an added advantage in terms of reducing

unnecessary logistics costs. Logistics costs are borne by the entire supply chain and costs have a knock-on effect throughout the system.

The ideal situation is where ACMs and OEMs mutually cooperate to forge strategic and tactical alliances. This would create opportunities to reduce cost and develop economies of scale. This would also lead to greater efficiencies and improve the global competiveness. The end state could be fostered through the sharing of information whilst still remaining careful that strategic supply chain decisions are protected. In this way, the supply chain areas that impact on ACMs, such as material handling, operations, forecasting and planning can be optimally managed. These areas appear to work in tandem throughout the supply chain due to dependencies.

It is recommended that OEMs form clusters with ACMs that aim to achieve mutually agreed goals. This should lead to a complete review of how information is shared and that typical supply chain processes are mapped within the system. In this way a JIT strategy can also remove wasteful and costly logistics practises. ACMs can also deploy supply chain diagnostics through the SCAT to understand its levels of supply chain maturity. The deployment of a supply chain audit tool could also serve to benchmark other ACMs against industry norms. This should be done in conjunction with establishing world class manufacturing (WCM) principles such as Kanban, Six sigma and ERP systems. The main objective with deploying lean techniques is to reduce cost, improve quality and meet customer requirements. All improvements depend in assessing investment that relates to skills and other available resources such as ICT.

ACMs should also endeavour to evaluate the direct and indirect costs of its supply chain. This will allow ACMs to assess whether there is an opportunity to reduce wasteful or incorrect practices. This would support the pressure from OEMs to continuously reduce costs for manufactured products. Hence the opportunity to reduce labour costs is limited due to stringent labour legislation. Alternatively, labour could be reduced and advanced ICT levels and automation introduced to achieve greater efficiencies. Therefore, ACMs should focus on achieving efficiencies by increasing manufacturing or throughput rates. Inefficiencies would come to light in the proposed programmes such as ICT integration, lean manufacturing and cleaner production.

ACMs should also work with their suppliers, both upstream and downstream, to improve efficiencies and reduce lead times. Three factors need to be considered when improving efficiencies and lead time reduction: (1) information availability with real time to act on opportunities; (2) the total time it takes to produce the component; and (3) the time it takes to transport the item from supplier to ACM, ACM to customer or ACM to OEM.

ACMs could also improve the adverse bullwhip effect. This could be done by improving ERP systems and improved forecast from clients. By using well-defined ICT, they could improve the order management by accurately matching demand to the components produced. In this way, they would have less work in progress and remove the desire to keep excessive finished goods. ACMs could also improve order management systems by having accurate tracking and tracing according to the well-defined requirements of the customer. In this manner, production can be levelled without unnecessary fluctuation in manufacturing patterns. This invariably leads to quality problems, added inventory costs and overtime.

It is also recommended that ACMs introduce better ICT systems that can manage not only supply, but also accurate demand forecasting. Demand management can be used to estimate, control, smooth and coordinate and balance the demand and supply of 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 that customers will require at a future time, and this involves the sourcing, procurement, receiving, material handling, manufacturing, purchasing and supply chain functions. 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.

ACMs should also focus on reducing the energy and utility costs since this presents opportunity to improve the overall balance sheet. This could be achieved by ACMs utilising the services of professionals who can conduct energy audits and seek systems that will reduce costs. Organisations such as the AIDC and the National Cleaner Production Centre (NCPC) have successfully saved many ACMs with energy consumption through its Cleaner Production programme. This indirectly helps Eskom

by reducing demand whilst saving the ACM on usage and cost. It is also suggested that more funding be provided for alternate energy through subsidies since this will increase appetite and reduce coal dependencies. Eskom has also introduced incentives to all manufacturers who reduce usage which furthermore acts as an incentive to join cleaner production programmes.

In many instances, if ACMs cannot improve their overhead cost structure owing to input and external costs, then the only option is to seek ways through its supply chain to reduce costs. This way the required cost reductions from OEMs could be offset. This in turn will allow improved cash flow and the ability to remain competitive.

In concluding the findings, ACMs and OEMs have a clear common purpose which is to grow volumes whilst reducing costs. The retention of skills in the supply chain is also fundamental as it grows the knowledge base. The supply chain presents the challenge since the market proximity adds input costs. The supply chains appear fragmented which could be overcome by improved information visibility, seeking opportunity to diversify and investing in new supply chain best practice. This should cut across the entire supply chain where ICT is used to provide real-time data to ensure quick decisions. The entire automotive industry needs to communicate more clearly to understand what supply chain opportunities exist.

5.7 LIMITATIONS OF THE STUDY AND THE WAY FORWARD FOR FUTURE RESEARCH

5.7.1 Research methodology limitations

The research study data collection consisted of three major phases. These included developing a questionnaire through a focus group interview, designing and administering the questionnaire and, finally, collecting the data that was then e-mailed to all ACMs in the NMBM. The aim of the interviews with OEMs was to determine whether the ACMs experienced supply chain problems from their perspectives. Not all ACMs in South Africa were included in the final sample because they were geographically dispersed and the focus of the study was regionally based.

A typical research problem was experienced when the questionnaire was e-mailed to the ACMs as the researcher could not be sure that the respondents understood all the

questions because of the terminology. However, the questionnaires were e-mailed to all the respondents who were dispersed across the NMBM. Although personal interviews would have been a more effective method to gather data, they are time-consuming and expensive to conduct, particularly since the respondents were geographically dispersed throughout the Eastern Cape.

Although a large number of supply chain problems were investigated, it was not possible to identify all supply chain difficulties as experienced by ACMs. This was due to the varied and complex manner in which the different supply chains operate. In addition, it should be noted that not all problems in the automotive industry can be linked solely to supply chain management.

The response rate of the questionnaires was another challenge. It was found that when contacting various respondents prior to e-mailing the questionnaire, many of them were already completing questionnaires for other students. They cited that the flood of questionnaires hampered their work and posed a challenge in prioritising which would be of more benefit to them. A number of respondents declined to participate in the study and others indicated that they would try, but could not make any commitment. Further comments were that the questionnaire was too wordy, and that some questions were too difficult to respond to. Despite this, an acceptable response rate of 85.0% was achieved.

In addition, the qualitative facet of the ACMs' responses was limited within the questionnaire as not all respondents provided information in the comment blocks. It is evident that had personal interviews taken place, this would have provided more opportunity to probe the respondents and obtain more qualitative information.

5.7.2 Way forward for future research

As a way forward, it is suggested that further research be undertaken to include all ACMs as well as OEMs to identify supply chain problems facing them in the supply chain. Alternatively, a similar study could be conducted in a more complex sector, for example, the industrial development zones, to determine whether industries in South Africa were facing similar supply chain problems.

5.8 SIGNIFICANCE OF THE RESEARCH STUDY

The research study contributes to the application of supply chain clustering through ICT in the automotive sector. Particular emphasis was placed on supply chain problems experienced by ACMs in the NMBM. The supply chain problems of ACMs identified in the study have a significant impact on the supply and demand side operations and the overall competitiveness of the ACMs as ACMs play a key role in contributing to job creation in the South African automotive industry, as well as the overall economy.

Recommendations were made to ACMs on how the problems that were identified within clustering could be overcome. These recommendations could either be adopted within the current context or further developed in future research studies to ensure sufficient complexity. In addition, the supply chain audit tool, 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 science of SCM is extremely dynamic and tends to be changing at a rapid rate to maintain relevance and cost competitiveness. However, the study of supply chain literature, trends, new developments and the empirical research contribute to new perspectives within the body of knowledge. For example, this study explored the question of whether or not collaboration through partnership and shared service is an *idealistic dream* of supply chain theory or an *inevitable reality*. What is evident is that whilst the automotive sector is one of the most mature in supply chain management, it still lacks development with best practices and heightened collaboration. Whilst it purports to be at the forefront of advanced supply chain management practices, it is still lacking in this domain. In addition, the issue of procurement contracts are determined by parent plants or OEMs and this tends to play positions of market dominance and supply chain strategies that ensure survival within the global supply chain.

5.9 CONCLUDING REMARKS

The effective use of ICT and understanding of practices within supply chains is critical to remain in business. Many ACMs need to transact on a global basis and these costs as well as standards need to be monitored. ACMs need to become more in tune with

the global environment within which they operate and compete. As the South African market is no longer isolated from global sourcing and procurement from OEMs, the strategies and plans for investment must be considered since this drives competitiveness. It is also imperative that ACMs modernise their ICT and supply chain strategies to meet global technology improvement. The amount of automotive business is directly linked to the volumes of vehicles produced and hence the extent of the supply chain. Due to the complexity of the supply chains, it becomes important to also assess the logistics functions. The completion of supply chain audits can thus play a part in assessing the performance of internal logistics functions in ACMs. The use of the SCAT could also assist to assess the supply chain performance if changes in production volumes or the supply chain itself occurs.

The South African Government has also played its part in providing support through the Motor Industry Development Plan (MIDP). Its objective is to increase production to 1.2 million units by 2020, whilst at the same time significantly increasing local content. The goal is also supported by increasing locally produced components by up to 70.0% of the entire vehicle assembly. In 2005, the Department of Trade and Industry (the DTI) initiated a review of the MIDP in order to assess its impact and recommend options to deal with identified gaps. The gaps were used to review opportunities for a MIDP update, conducted in 2012, which is termed the Automotive Production Development Programme (APDP). The architecture of Government strategy for the future development of the automotive industry will be underpinned by achieving high volumes and economies of scale. The Eastern Cape OEMs have already embraced the APDP and have obtained large export contracts, thereby deriving employment and capital benefits.

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APPENDIX A: THE QUESTIONNAIRE USED IN THE STUDY

QUESTIONNAIRE RETURN COVER PAGE

SUPPLY CHAIN ICT INTEGRATION THROUGH CLUSTERING AS EXPERIENCED BY AUTOMOTIVE COMPONENTS MANUFACTURERS

TO:

ATTENTION: LANCE SCHULTZ

FAX NUMBER: 086 219 9846 / 041 363 0762

EMAIL**:** lschultz@aidcec.co.za

PHONE NUMBER: 041 393 2104

CELL NUMBER: 083 651 4046

REFERENCE: CLUSTER AND INTEGRATION OF SUPPLIERS

FROM:

NAME (OPTIONAL): _____

COMPANY: _____

FAX NUMBER: _____

PHONE NUMBER: _____

GENERAL INFORMATION

MANY THANKS FOR THE TIME AND EFFORT INTO COMPLETING THIS QUESTIONNAIRE. THANK YOU.

Dear Respondent

I am a final year student the Nelson Mandela Metropolitan Business School. I am currently conducting research for my MBA under the supervision of Prof G. Horn from the Logistics faculty at NMMU. The focus of my study is the exploration of supply chain management clustering problems experienced by South African automotive component manufacturers (ACMs) in relation to cost and ICT. The aim of the study is to identify these supply chain levels of integration through creating clusters and the impact on cost within South African ACMs.

Instructions on the completion of this questionnaire will follow before the main 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, Mr L. Schultz, at 041 393 2104 or 083 651 4046. Once you have completed your questionnaire, please return it to me via fax to number 086 219 9846 or email it to: lschultz@aidcec.co.za. It would be appreciated if you could return the completed questionnaire to me by no later than 5 September 2011.
I look forward to your response

Yours Sincerely
Lance Schultz

THANK YOU FOR YOUR COOPERATION

SECTION 1: COMPANY PROFILE

1.1 Name of company: _____

1.2 Title of person completing 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 circles as appropriate)

PROVINCE	**CIRCLE (0)CHOICES**
Eastern Cape	01
Western 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 of the best describes the status of the company you work for?

STATUS	**CIRCLE (0) ONE**
Head office	01
Holding company	02
Branch	03
Subsidiary / Independent Unit	04

1.7 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 CUSTOMERS MARKET	**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 2012/13), indicate the percentage you supply to your different target customer (s)/ market (s)**

SECTION 2:	THE IMPACT OF SUPPLY CHAIN TECHNOLOGIES WITHIN AUTOMOTIVE SUPPLIERS

2.1 SUPPLY CHAIN INTEGRATION

Indicate to what extent your company experiences the following supply chain issues. Please provide more information in the comments block if you wish to express a view.

		TICK IF NOT A PROBLEM	IF A PROBLEM AREA, PLEASE CIRCLE (0) TO WHAT EXTENT						
	Problem areas with suppliers		**Lesser extent**						**Greater extent**
1.	Best practice integration norms of supply chain allows for positive synergy		**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.	Our supply chain integration improves visibility of information		**1**	**2**	**3**	**4**	**5**	**6**	**7**
3	Supplier integration is loosely structured without mutual agreement		**1**	**2**	**3**	**4**	**5**	**6**	**7**
4.	Supplier integration provides competitive advantage in new technological practice		**1**	**2**	**3**	**4**	**5**	**6**	**7**
5.	Supplier integration provides cost advantage due to economies of scale		**1**	**2**	**3**	**4**	**5**	**6**	**7**
6.	Supplier integration through use of SCT can lower costs		**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.	Supplier integration can be optimised through clustering of supply chains		**1**	**2**	**3**	**4**	**5**	**6**	**7**
Comment:									

2.2 SUPPLY CHAIN INNOVATION

		TICK IF NOT A PROBLEM	IF A PROBLEM AREA, PLEASE CIRCLE (0) TO WHAT EXTENT						
1.	Our organisation has a monitoring system to measure our innovation adoption		Lesser extent Greater extent						
			1	2	3	4	5	6	7
2.	Our Supply Chain strategy takes account of innovative practice as observed in developed economies		1	2	3	4	5	6	7
3.	Our organisation has a detailed strategy for supply chain innovation		1	2	3	4	5	6	7
4.	We measure our supply chain innovation to understand impact on bottom-line of supply chain costs		1	2	3	4	5	6	7
Comment:									

2.3 SUPPLY CHAIN DEGREE OF VALUE CHAIN BEST PRACTICE

		TICK IF NOT A PROBLEM	IF A PROBLEM AREA, PLEASE CIRCLE (0) TO WHAT EXTENT						
	Problem areas with suppliers		**Lesser extent**						**Greater extent**
1.	Our strategic objectives are aimed at maximising our value chain practice		**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.	Our organisation has adopted a benchmarked model of supply chain excellence.		**1**	**2**	**3**	**4**	**5**	**6**	**7**
3.	Our organisation reviews our value chain partners service levels as a cost imperative		**1**	**2**	**3**	**4**	**5**	**6**	**7**
4.	Our value chain uses SC clustering for cost benefit		**1**	**2**	**3**	**4**	**5**	**6**	**7**
Comments:									

2.2 SUPPLY CHAIN SHIPMENT COMMUNICATION

		TICK IF NOT A PROBLEM	IF A PROBLEM AREA, PLEASE CIRCLE (0) TO WHAT EXTENT						
	Problem areas with suppliers		**Lesser extent**						**Greater extent**
1.	Do you make use of any formal methods to plan your distribution network?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.	Do you make use of a process to provide a status on shipments and material movement?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
3.	Rate the communication between your transporters and the rest of the internal operations?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
4.	Do you feel that shared shipments are feasible for your business?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
Comments									

2.3 INVENTORY USING SUPPLY CHAIN TECHNOLOGY

		TICK IF NOT A PROBLEM	IF A PROBLEM AREA, PLEASE CIRCLE (0) TO WHAT EXTENT						
	Problem areas with suppliers		**Lesser extent**						**Greater extent**
1.	Do you have a dynamic inventory performance monitoring system (FIFO, shelve life etc).		**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.	Does every product have a well-defined manufacturing and inventory deployment strategy.		**1**	**2**	**3**	**4**	**5**	**6**	**7**
3.	Do you have action plans in place to help reduce the levels of safety stock?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
Comments									

2.4 WAREHOUSING

		TICK IF NOT A PROBLEM	IF A PROBLEM AREA, PLEASE CIRCLE (0) TO WHAT EXTENT						
	Problem areas with suppliers		**Lesser extent**						**Greater extent**
1.	Do you have software that controls warehousing space allocation?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.	Do you make use of off-site warehousing?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
3.	Rate the overall condition of equipment used within warehousing?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
4.	Do you consolidate stock with other suppliers to lower cost		**1**	**2**	**3**	**4**	**5**	**6**	**7**
5.	Do you use a shared ICT platform		**1**	**2**	**3**	**4**	**5**	**6**	**7**
Comments									

2.5 MATERIALS HANDLING Equipment (MHE)

		TICK IF NOT A PROBLEM	IF A PROBLEM AREA, PLEASE CIRCLE (0) TO WHAT EXTENT						
	Problem areas with suppliers		**Lesser extent**						**Greater extent**
1.	Do you make use of automated MH equipment for receiving and dispatching (conveyors, robots, lifts etc)?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.	Do you make use of non-powered handling equipment to reduce costs (pallet trolley, etc)?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
3.	Do you invest in shared procurement for MHE		**1**	**2**	**3**	**4**	**5**	**6**	**7**
Comments									

2.6 PACKAGING

		TICK IF NOT A PROBLEM	IF A PROBLEM AREA, PLEASE CIRCLE (0) TO WHAT EXTENT						
	Problem areas with suppliers		**Lesser extent**						**Greater extent**
1.	Do you make use of standardised packaging to reduce repacking or unnecessary handling?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.	Do you re-use any packaging?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
3.	Do you have an audit process in place to make sure all packaging conforms to specification?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
3.	Do you have a process in place to do shared purchases to lower cost?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
Comments									

2.7 ORDER PROCESSING

		TICK IF NOT A PROBLEM or NA	IF A PROBLEM AREA, PLEASE CIRCLE (0) TO WHAT EXTENT						
	Problem areas with suppliers		**Lesser extent**						**Greater extent**
1.	Can your customers electronically place orders?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.	Have you identified the barriers that prevent you from achieving increased service levels (self-awareness)?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
3.	Rate the communication between order processing and the rest of the internal operations?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
4.	Shared ICT in a cluster may allow for synergy and cost reduction		**1**	**2**	**3**	**4**	**5**	**6**	**7**
4.	How do you share data (demand and work flow data) with suppliers in the supply chain?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
Comments									

2.10 PRODUCTION

		TICK IF NOT A PROBLEM/NA	IF A PROBLEM AREA, PLEASE CIRCLE (0) TO WHAT EXTENT						
	Problem areas with suppliers		**Lesser extent**						**Greater extent**
1.	Do you make use of kanban systems?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.	Do you make use of "quick response" systems like barcode scanning to convey real time information?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
3.	Rate the (ICT) communication between production and the rest of the internal operations?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
Comments									

2.11 RETURNS

		TICK IF NOT A PROBLEM	IF A PROBLEM AREA, PLEASE CIRCLE (0) TO WHAT EXTENT						
	Problem areas with suppliers		**Lesser extent**						**Greater extent**
1.	Do you have a system in place to monitor returns (products)?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.	Do you have a system in place to monitor returns?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
3.	Rate the communication between returns and the rest of the internal operations?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
Comments									

2.12 GREENING

		TICK IF NOT A PROBLEM	IF A PROBLEM AREA, PLEASE CIRCLE (0) TO WHAT EXTENT						
	Problem areas with suppliers		**Lesser extent**						**Greater extent**
1.	Is peak energy demand being managed?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.	Are energy management systems in use?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
3.	Are lessons in a SC cluster a cost imperative in greening		**1**	**2**	**3**	**4**	**5**	**6**	**7**

Comments

2.13 GENERAL SUPPLY CHAIN

		TICK IF NOT A PROBLEM	**IF A PROBLEM AREA, PLEASE CIRCLE (0) TO WHAT EXTENT**						
	Problem areas with suppliers		**Lesser extent**						**Greater extent**
1.	Have you mapped all supply chain processes and clearly identified value adding and non-value adding activities?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.	How would you rate your overall control within the entire supply chain?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
3.	Do you believe that clustering of supply chain technology is beneficial for you?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
4.	Do you believe that ICT creates cost saving within your supply chain?		**1**	**2**	**3**	**4**	**5**	**6**	**7**
Comments									

2.14 GENERAL QUESTIONS

The aim of this section is to determine from the respondents what he/she perceives to be the barriers to supply chain technology with respect to cost and levels of integration.

2.14 a) Degree of integration with suppliers

1. To what extent does best practise integration norms of supply chain allow for synergy?

_____

_____

_____

_____

2. Explain how the level of your current supply chain integration affects visibility of information?

_____

_____

_____

_____

_____

3. Do you feel that supplier integration provides competitive advantage in new technological ICT practise?

_____
_____
_____
_____
_____

4. To what extent do you believe that clustering of supply chains yield cost benefit?

_____
_____
_____
_____
_____

2.14 b) Supply Chain Technology Cost Factors

On a 5-point scale select the number that best describes on people, production and process i.e. your cost on technology in relation to these factors. Specifically, what is your technology cost as a percentage of total cost?

Option are 1. 0 – 10

2. 10 – 19

3. 20 – 29

4. 30 – 39

5. 40 – 49

1. We have a decentralised structure because it enhances decision making

2. Supplier integration is well structured with mutual agreements

3. My firm is successful as a result of supply chain technology cost saving

2.14 c) Supply Chain Clusters

To what extent do you believe that clusters will improve cost optimisation by leveraging ICT?

_____
_____
_____
_____
_____
_____
_____
_____

Once again, thank you for your time and assistance in completing this questionnaire. It is greatly appreciated!