

**THE IMPACT OF DELIVERY PERFORMANCE FOR A SELECTED PART OF
GENERAL MOTORS SOUTH AFRICA (GMSA)**

By

Andrew Christopher Blouw

Submitted in partial fulfilment of the requirements for the degree of

Magister in Business Administration

at the Nelson Mandela Metropolitan University Business School

Promoter: Prof. Koot Pieterse

November 2011

DECLARATION BY STUDENT

NAME: Andrew Christopher Blouw

STUDENT NUMBER: 9516778

QUALIFICATION: Magister in Business Administration

TITLE: The impact of delivery performance for a selected part of General Motors South Africa (GMSA)

DECLARATION:

- “This work has not been accepted previously in substance for any degree and is not currently being submitted in candidature for any degree;
- This dissertation is being submitted in partial fulfillment of the requirements for the degree of Masters in Business Administration;
- This dissertation is the result of my own independent work/investigation, except otherwise stated. Other sources are acknowledged by complete referencing. A list of references is attached; and
- I hereby give consent for my dissertation, if accepted, to be available for photocopying and for interlibrary loan, and for the title and summary to be made available to outside organisations.”

Signed:.....

Date:.....

ACKNOWLEDGEMENTS

“Sometimes success is about determination. In times of challenge and uncertainty, often it is those with the strongest will to keep moving forward who ultimately win.” (Socia, 2011: 23). I wish to express my sincere gratitude to the following persons and organisations for their contribution to the timely completion of my dissertation:

- My Lord and Savior, Jesus Christ, for giving me my abilities and the opportunities to fulfill my destiny in life;
- My wife Celestine, three children Caitlyn, Andrew and Curtleigh, for their support through affording me most of our precious family time. I thank them for their understanding and assistance during the study;
- My sisters Veronica, Brenda and Beverley, for their endless words of encouragement and support;
- My promoter, Prof. Koot Pieterse, for his guidance, advice and assistance;
- Prof. Annelie Pretorius for her endless encouragement and support;
- All other family, friends and colleagues for their words of encouragement and support; and
- All the respondents who completed the questionnaire.

A special dedication is offered to my late mom, Susan Blouw, who always encouraged me to further my education, for her love and endless support.

SUMMARY

Today's customers expect zero defects with just-in-time (JIT) delivery from their suppliers, for the specified quantities, as a matter of standard practice. More importantly, customers expect companies to help them know what they need in terms of quantities and quality now, and for the future. No other change process adds long-term value as quickly as zero defects. Companies failing to embrace this quality culture face difficult challenges. To achieve this level of performance requires tremendous focus in an organisation and throughout its supply base. Business models around the world are changing dramatically from the "Source Local" to the "Source Anywhere and Build Anywhere" model (Cummins, 2008: 19).

Companies have shifted away from a hierarchical, one-dimensional, supply chain entity to a fragmented network in favor of strategic partnerships with external entities. Many businesses facing such models are experiencing challenges and, if not managed correctly, can find themselves struggling to compete in this new landscape. Thus, when price concessions are so stringent, quality has to suffer. To reduce costs, suppliers are forced to seek less expensive ways to produce parts and components. Does this mean the use of different, less expensive materials? Does this mean less skilled labor? Does this mean production shortcuts? Or does this mean that suppliers just bite the bullet and pay the price? Once all the costs have been extracted from the supply chain, the only thing left to suffer is quality.

The underlying objective of this research is to investigate the impact of delivery performance for a selected part at General Motors South Africa. In order to develop a research strategy to deal with, and solve, the main problem, the following research questions have been identified:

- a) **What can be learned from literature about the impact of quality costs?**

- b) Why is this specific part a suitable candidate for a cost investigation?**
- c) What are the processes involved if a defect occurs?**
- d) How can the cost be estimated?**
- e) What effect does poor supplier quality have on productivity?**

This dissertation aims to investigate the problems and challenges General Motors South Africa are facing pertaining to the delivery performance of a selected part. The dissertation will also strive to highlight the impact of poor supplier quality on productivity and the related cost implications. Conclusions and recommendations will furthermore be outlined.

TABLE OF CONTENTS

	Page
DECLARATION	i
ACKNOWLEDGEMENT	ii
SUMMARY	iii
TABLE OF CONTENTS	v
LIST OF FIGURES	vi
LIST OF TABLES	vii
LIST OF ANNEXURES	vii
GLOSSARY	viii

LIST OF FIGURES

FIGURE 3.1	Cost of Quality	54
FIGURE 5.1	Site demographics of the respondents	89
FIGURE 5.2	Service years demographics of the respondents	90
FIGURE 5.3	Positional demographics of the respondents	91
FIGURE 5.4	Functional demographics of the respondents	92
FIGURE 5.5	Competency demographics of the respondents	93
FIGURE 5.6	Results for 'very good' questions	94
FIGURE 5.7	Results for 'good' questions	95
FIGURE 5.8	Results for 'fair' questions	96
FIGURE 5.9	Results for the 'most problematic part supplied' question	97
FIGURE 5.10	Results for the top five 'neutral' questions	98
FIGURE 5.11	Results for the top five 'tend to agree' questions	99
FIGURE 5.12	Results for the top five 'strongly agree' questions	100
FIGURE 5.13	Results for the 'attitudes towards the supplier's quality performance' questions	102
FIGURE 6.1	Causes of non-material related costs due to poor supplier Quality	111

LIST OF FIGURES (CONTINUED)

FIGURE 6.2	Best practices supplier audit	112
FIGURE 6.3	Closed loop vs. loosely coupled quality management Systems	114

LIST OF TABLES

TABLE 3.1	Examples of quality costs	53
TABLE 3.2	Product identified which causes poor quality	56
TABLE 3.3	Lean manufacturing tool list	57
TABLE 4.1	Differences between research design and research Methodology	65
TABLE 4.2	Features of the main two approaches	77
TABLE 4.3	The main decisions when using questionnaires	80
TABLE 4.4	Questions of reliability and validity	85

LIST OF ANNEXURES

ANNEXURE 1.1	Survey Covering Letter	132
ANNEXURE 1.2	Questionnaire used for the survey study	134

GLOSSARY

CAPA:	Corrective Action / Preventive Action
CKD:	Complete Knock Down
CM:	Commodity Manager
COPQ:	Cost of Poor Quality
CPO:	Chief Procurement Officer
FIFO:	First In First Out
FTQ:	First Time Quality
GM:	General Motors
IPO:	Initial Public Offerings
JIT:	Just In Time
MA:	Magnetto Automotive
MRB:	Material Review Board
OEM:	Original Equipment Manufacturer
PDCA:	Plan Do Check Act
PQC:	Poor Quality Cost
QMS:	Quality Management System
SQM:	Supplier Quality Manager
SQP:	Supplier Quality Process
TPM:	Total Productive Maintenance
TPS:	Toyota Production System

CHAPTER 1

THE RESEARCH PROBLEM AND OUTLINE OF THE STUDY

1.1	INTRODUCTION	1
1.2	MAIN PROBLEM	2
1.3	SUB-PROBLEMS	3
1.4	DELIMITATION OF RESEARCH	4
1.4.1	General Motors South Africa	4
1.4.2	Supply chain	5
1.4.3	Theoretical delimitation	5
1.4.4	Geographical delimitation	5
1.4.5	Subject of evaluation	6
1.5	DEFINITION OF CONCEPTS	6
1.5.1	'Kaizen'	6
1.5.2	Continuous improvement	6
1.5.3	Total quality management (TQM)	6
1.5.4	Operational disruptions	7
1.5.5	Supplier quality assurance	7
1.5.6	First tier suppliers	7
1.5.7	Lean manufacturing	7
1.5.8	Supply chain management (SCM)	7
1.5.9	Quality of conformance	8
1.5.10	Efficiency	8
1.5.11	Effectiveness	8

1.5.12 Productivity	8
1.5.13 Cost of quality (COQ)	9
1.6 RESEARCH DESIGN	9
1.7 OUTLINE OF THESIS	10
1.8 CONCLUSIONS	12

CHAPTER 2

COMPANY OVERVIEW OF GENERAL MOTORS

2.1	INTRODUCTION	13
2.2	GENERAL MOTORS GLOBAL HISTORY	14
2.3	GENERAL MOTORS SOUTH AFRICA HISTORY	15
2.4	NEW GENERAL MOTORS BUSINESS STRATEGY	16
2.4.1	Background	16
2.4.2	Vision / Going Forward	17
2.4.3	Strategy for Brand Re-structuring	18
2.4.4	General Motors Strategic Plan	18
2.4.5	General Motors SWOT Analysis	20
2.5	GENERAL MOTORS STRENGTHENING OPERATIONS	23
2.6	CURRENT SITUATION AT GENERAL MOTORS SOUTH AFRICA	25
2.7	CONCLUSIONS	26

CHAPTER 3

LITERATURE REVIEW ON SUPPLIER QUALITY, LEAN MANUFACTURING, AND COST OF QUALITY

3.1	INTRODUCTION	27
3.2	OVERVIEW OF THE RELATED LITERATURE	28
3.2.1	GMSA as part of GMC	29
3.2.2	What is supplier quality management?	30
3.2.3	Quality products now inevitable	30
3.2.4	The benefits of quality management systems	32
3.2.5	Characteristics of lean production practice	34
3.2.6	The building blocks of 'lean'	35
3.2.7	Quality Improvement System	35
3.2.8	Productivity Improvement System	37
3.2.9	Company and supplier performance	38
3.2.10	Lean manufacturing	39
3.2.11	'Leaning' the South African way	40
3.2.12	The Toyota production system (TPS)	41
3.2.13	The Toyota way according to Liker	46
3.2.14	Supplier Quality Management Measures: Preventing Supply Chain Disruptions	47
3.3	THE COST OF QUALITY	49
3.4	PREVIOUS RESEARCH	57
3.5	CONCLUSIONS	58

CHAPTER 4

RESEARCH DESIGN AND METHODOLOGY

4.1	INTRODUCTION	59
4.2	DEFINITION OF RESEARCH DESIGN	60
4.2.1	Definition of research	60
4.2.2	Definition of design	61
4.2.3	Research design and research methodology	61
4.3	RESEARCH DESIGN	65
4.4	PLANNING THE EMPIRICAL STUDY	69
4.4.1	Research Methodology Utilised	77
4.5	CONCLUSIONS	86

CHAPTER 5

THE EMPIRICAL STUDY ANALYSIS AND INTERPRETATION OF RESULTS

5.1	INTRODUCTION	87
5.2	HOW INFORMATION FOR THE QUANTITATIVE STUDY WAS OBTAINED	87
5.3	RESULTS OF THE QUANTITATIVE STUDY	88
5.4	CONCLUSIONS	103

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1	INTRODUCTION	104
6.2	RESOLUTIONS TO THE FIRST SUB-PROBLEM	104
6.3	RESOLUTIONS TO THE SECOND SUB-PROBLEM	104
6.4	RESOLUTIONS TO THE THIRD SUB-PROBLEM	105
6.5	RESOLUTIONS TO THE FOURTH SUB-PROBLEM	106
6.6	RESOLUTIONS TO THE FIFTH SUB-PROBLEM	107
6.7	RESOLUTIONS TO THE RESEARCH OBJECTIVE	108
6.8	METHODOLOGY, EMPIRICAL STUDY AND RESULTS	115
6.9	CONCLUSIONS	116
6.10	RECOMMENDATIONS	116
6.11	FURTHER RESEARCH PROJECTS SUGGESTED	117
	LIST OF REFERENCES	118

CHAPTER 1

THE RESEARCH PROBLEM AND OUTLINE OF THE STUDY

1.1 INTRODUCTION

Manufacturing organisations consider the adoption of lean principles as basic mandatory requirements for achieving world-class operational excellence or best practice. Lean philosophies have been employed by manufacturing organisations for many years. Many organisations have reached the conclusion that lean philosophies will help them survive global competition and stay in business (Atkinson, 2004: 125). Supplier quality issues like non-conformance management, product recalls and product failures are proving fatal for global organisations. More than ever, companies need to proactively address their supplier quality issues before it can damage business operations or cause serious supply chain risks and financial losses; especially when current business conditions are unfavorable. Most companies are already feeling the heat of the current financial conditions, putting chief procurement officers (CPOs) and their teams under intense pressure to reduce costs and improve cash flow, while simultaneously managing an increasingly vulnerable supply base.

As recession continues to bite, there is no place left for supply chain disruptions; any discrepancy in supplier quality can significantly reduce a company's revenue, impact on market share, increase production cost, threaten the brand image and reputation, and lead to high cost of poor quality (COPQ) (Cole, 2010: 16). Organisations can attain systematic reductions in the cost of poor quality by implementing a quality management system (QMS) that provides an integrated and closed loop corrective action process. General Motors South Africa, for example, experiences daily cost of quality due to non-conforming parts supplied by first tier suppliers. The objective of this research is to investigate the impact of delivery performance for a selected part at General Motors South Africa. In order to develop a research strategy to deal with and

solve the main problem, sub-problems have been identified to draw conclusions and make recommendations.

1.2 MAIN PROBLEM

Among the general public, the term 'quality management' has many meanings. For most it is related to the final product / service quality, but for others it may mean certifications such as ISO 9000. Some others may link quality management with Six Sigma, 'Kaizen' and similar examples. Quality management has evolved over a number of years with the contribution of many stalwarts. Today it has acquired a very strategic position in the organization's operations. Organisations of all types and sizes (Big or Small, Manufacturing or Service providers, Non Governmental Organisations and Government bodies) have adopted structured quality management to achieve effectiveness in their operations in order to realise customer satisfaction and sustained growth. It is the policy of General Motors South Africa to achieve a clear competitive advantage through continuous improvement in quality, manufacturing, service, delivery and cost from their suppliers in the total supply chain.

It is the mission of original equipment manufacturers (OEM's) in South Africa that suppliers shall:

Do it Right the First Time by planning, preparing, and being trained to supply quality products and services;

Do it Right Every Time by assuring consistent quality products and services through addressing all concerns; and

Continually Improve by proactively improving the quality and value of products and services (Swarts, 2003: 78).

As companies seek ways to reduce costs, speed up time-to-market and improve product quality, supplier performance plays a critical role in maintaining the

competitiveness of value chains (Fitzgerald, 2005: 31). In the auto industry, over seventy percent of a product's total value is created by suppliers (Leenders, Fearon, Flynn & Johnson, 2010: 49). Supplier on-time performance determines the ability of the original equipment manufacturer (OEM) to implement engineering changes while also quickly ramping up the production of resulting new products (Hartley, Zirger & Kamath, 2008: 68). The quality of an original equipment manufacturer's final product can only be as good as the quality of the inputs they receive from suppliers (Forker, 2007: 19). Original equipment manufacturers rely on suppliers to achieve major reductions in product cost and to sustain first-time quality (Afuah, 2003: 32). One of the major contributors to this problem is the inability of suppliers to meet the required (OEM) needs.

The underlying objective of the research is to investigate delivery performance for a selected part at General Motors South Africa (GMSA).

1.3 SUB - PROBLEMS

It is the objective of General Motors South Africa to achieve a clear competitive advantage through continuous improvement in quality, manufacturing, service, delivery and cost from their suppliers in the total supply chain. In order to develop a research strategy to deal with and solve the main problem, the following sub-problems have been identified:

- a) What can be learned from literature about the impact of quality costs?**
- b) Why is this part a suitable candidate for a cost investigation?**
- c) What are the processes involved if a defect occurs?**
- d) How can the cost be estimated?**
- e) What effect does poor supplier quality have on productivity?**

1.4 DELIMITATION OF RESEARCH

To ensure that the research project remains at a manageable size it was adjudicated to only consider two plants of General Motors South Africa, viz. Kempston Road Plant and Struandale Plant in Port Elizabeth. The following ten first tier suppliers, known for or required to apply lean manufacturing principles, were selected. However, no questionnaires were issued to them as all the relevant data for this study, resides within General Motors South Africa:

- Magnetto Automotive Uitenhage Plant;
- Magnetto Automotive Berlin Plant;
- Stateline Pressed Metal Port Elizabeth Plant;
- Stateline Pressed Metal Queenstown Plant;
- Bel Essex Corporation Uitenhage Plant;
- Formex Engineering Plant;
- Perfect Tooling;
- OPM (Other Peoples Money) Tooling;
- Onvlee Engineering; and
- Yenza Manufacturing, in no particular order.

1.4.1 General Motors South Africa

The study will be conducted at General Motors South Africa, Kempston Road Plant (Port Elizabeth), manufacturer of the Isuzu bakkies, and Struandale Plant (Port Elizabeth), manufacturer of the Corsa bakkies. The research focuses specifically on a first tier original equipment manufacturer (OEM) supplier, supplying General Motors South Africa.

1.4.2 Supply chain

This study is delimited to a production supplier responsible for the supply of lean material. The research focuses specifically on a first tier original equipment supplier (OEM), supplying General Motors South Africa. The remainder of the supply is just as important, however, for the purposes of this study, it will be excluded to maintain the manageability of the research.

1.4.3 Theoretical delimitation

This research aims to evaluate the delivery performance of a selected part at General Motors South Africa and how possible deficiencies can be overcome. The following sub-problems were investigated:

- a) What can be learned from literature about the impact of quality costs?**
- b) Why is this part a suitable candidate for a cost investigation?**
- c) What are the processes involved if a defect occurs?**
- d) How can the cost be estimated?**
- e) What effect does poor supplier quality have on productivity?**

1.4.4 Geographical delimitation

To ensure that the research project remains at a manageable size of 50 respondents, only General Motors South Africa, Kempston Road Plant and Struandale Plant (both located in Port Elizabeth), were considered. The sample size is representative of the required population.

1.4.5 Subject of evaluation

The underlying objective of the research is to investigate the delivery performance of a selected part at General Motors South Africa (GMSA) and the impact it has on productivity. An analysis and recommended solutions are provided.

1.5 DEFINITION OF KEY CONCEPTS

For the purposes of this study, the following meanings are associated with the concepts in the title and the problem statement of this research.

1.5.1 'Kaizen'

'Kaizen' refers to improving quality through many small, incremental steps, usually by teams (Pieterse, Lourens, Louw, Murray & Van Der Merwe 2000: 214).

1.5.2 Continuous improvement

The belief that an organisation must constantly measure the effectiveness of its processes and strive to meet more difficult objectives to satisfy customers (Bicheno, 2009: 37).

1.5.3 Total quality management (TQM)

The management of quality throughout the organisation at all management levels and across all areas (Davis & Goetsch, 2000: 179).

1.5.4 Operational disruptions

An act of delaying or interrupting the continuity of operations causing disorder due to non-conforming material supplied by a supplier (Besterfield, 2001: 15).

1.5.5 Supplier quality assurance

Confidence in a supplier's ability to deliver a good or service that will satisfy the customer's needs. Achievable through an interactive relationship between the customer and the supplier, it aims at ensuring the product's 'fit' to the customer's requirements with little or no adjustment or inspection (Berry, 1990: 139).

1.5.6 First tier supplier

A company that sells and directly delivers materials or goods to a customer's factory or shop (Besterfield, 2001: 107).

1.5.7 Lean manufacturing

Womack and Jones (1996: 46) define lean manufacturing as providing a way to do more and more with less and less (less human effort, less equipment, less inventories, less time and less space), whilst coming closer and closer to providing customers with exactly what they want when they want it.

1.5.8 Supply chain management (SCM)

Management of material and information flow in a supply chain to provide the highest degree of customer satisfaction at the lowest possible cost. Supply chain management

requires the commitment of supply chain partners to work closely to coordinate order generation, order taking, and order fulfillment (Fawcett and Ellram, 2007: 29).

1.5.9 Quality of conformance

The degree to which the product or service meets the specifications required by design during the production process (Caplen, 1997: 21).

1.5.10 Efficiency

Efficiency in general describes the extent to which time or effort is well used for the intended task or purpose. It is often used with the specific purpose of relaying the capability of a specific application of effort to produce a specific outcome effectively, with a minimum amount or quantity of waste, expense, or unnecessary effort (Caplen, 1997: 29).

1.5.11 Effectiveness

Effectiveness means the capability of producing an effect, and is most frequently used in connection with the degree to which something is capable of producing a specific, desired effect (Caplen, 1997: 41).

1.5.12 Productivity

Productivity is a measure of output from a production process, per unit of input. For example, labor productivity is typically measured as a ratio of output per labor-hour, an input. Productivity may be perceived as a metric of the technical or engineering efficiency of production (Davis & Goetsch, 2000: 182).

1.5.13 Cost of quality

The costs of a good quality management programme are prevention costs and appraisal costs (Davis & Goetsch, 2000: 636).

1.6 RESEARCH DESIGN

In this section, the methodology followed in the research project is described. In conducting the research, the following procedure was adopted to solve the main problem and the sub-problems:

- The researcher has initially conducted a study of the literature. This has assisted the researcher in understanding the concepts of supplier quality management systems, supplier quality, cost of quality and discrepancies in the lean manufacturing operations;
- This was followed by an analysis of the supplier quality and cost of quality on lean manufacturing operations in General Motors South Africa;
- The current state of the identified cost of quality in the lean manufacturing operations was compared to what the literature reveals on cost of quality. This comparison highlighted the fact that there is an impact of cost of quality on lean manufacturing operations;

- The empirical study consists of the following: The measuring instrument used in the mail survey is a comprehensive questionnaire and interviews were conducted at all levels within General Motors South Africa's operational areas. The data was collected, analysed and interpreted. The interview structure was scheduled, as well as on an ad hoc basis. Both the questionnaire and interviews were not extended to suppliers as the required information for this study lies within General Motors South Africa. The empirical study assisted in resolving the main problem and sub-problems;
- The results of the literature study, combined with the results of the empirical study, were used to develop a strategy to resolve the main problem and sub-problems; and
- Recommendations were made to the management of General Motors South Africa for improvement.

1.7 OUTLINE OF THESIS

The research consists of the following chapters:

Chapter 1: Introduction to the research problem and outline of the study

An explanation and background of the research topic is provided. This is followed by the problem statement, significance of the research and delimitations of the research. The definition of terms is provided in addition to the explanation of the research approach.

Chapter 2: Company overview

This chapter provides a comprehensive company overview. It enables the reader to understand the rich and colorful history of General Motors globally and in South Africa. The strategic vision is also highlighted.

Chapter 3: Literature review on cost of quality, supplier quality, and lean manufacturing.

In this chapter, the consulted literature is demarcated and discussed.

Chapter 4: Research design and methodology

An empirical study and a theoretical explanation on the methodology used to conduct the research are furnished.

Chapter 5: The empirical study and interpretation

In this chapter, the results of the empirical study are presented and interpreted in order to draw conclusions. The main findings are highlighted.

Chapter 6: Conclusions and recommendations

This chapter indicates whether the gaps identified in the literature have been filled, as well as whether the research objectives have been achieved. Recommendations on areas for further research are identified. An overall summary of the study conducted, is provided.

1.8 CONCLUSIONS

In this chapter, the main problem and sub-problems are identified. The key concepts are defined, a related literature review is presented and the study outline is highlighted. In Chapter 2 the historical overview of General Motors is described. Chapter 3 focuses on the literature review on cost of quality, supplier quality, and lean manufacturing. In this chapter, the studied literature is demarcated and discussed. In chapter 4, an empirical study and a theoretical explanation on the methodology used to conduct the research, are offered. Chapter 5 presents and interprets the results of the empirical study, in order to draw conclusions. The main findings are furthermore highlighted. Chapter 6 indicates whether the gaps identified in literature have been filled as well as whether the research objectives have been achieved. Recommendations for areas of further research are identified. This chapter also provides an overall summary of the study conducted.

CHAPTER 2

COMPANY OVERVIEW OF GENERAL MOTORS

2.1 INTRODUCTION

This chapter provides an overview of General Motors, also referred to as GM. General Motors Company (commonly known as General Motors or GM), is an American multinational automotive corporation headquartered in Detroit, Michigan and the world's largest automaker (before Toyota). The old General Motors Corporation was founded in 1908 and was re-established on July 10, 2009. With its global headquarters in Detroit, General Motors employs 209,000 people in every major region of the world and conducts business in some 157 countries. General Motors produces cars and trucks in 31 countries, and sells and services these vehicles through the following divisions and brands: Buick, Cadillac, Chevrolet, GMC, Opel, Vauxhall, Holden, and two joint ventures in China. On June 8, 2009, General Motors filed for re-organisation under the provisions of Chapter 11, Title 11, of the United States Code. On July 10, 2009, with financing partially provided by the United States Government, the company emerged from re-organisation and was listed on major stock exchanges on November 18, 2010 with the world's largest IPO (Initial Public Offerings) (Simon, 2010: 121).

It is evident from the General Motors quality strategy that the company demands world-class performance of itself. In turn, General Motors expects its suppliers to meet, or exceed, world-class standards of performance in quality and the reliability, cost, and delivery of the products and services provided to them. The General Motors quality goal and overall objective is to achieve 'Total Customer Satisfaction'. This is accomplished by utilising appropriate process improvement techniques (e.g. Zero Defects, Supplier Certification, Lean, Six Sigma, etc.) in a manner that delivers improved productivity and the optimal deployment of resources. General Motors aggressively manage their supply base to maintain a strategic and competitive advantage in the marketplace. The method used by General Motors to achieve this

objective is through the supplier quality process, or SQP. Supplier quality process utilises a number of different elements to improve, measure, monitor, and recognise General Motors suppliers. The flexible design of the supplier quality process allows it to be applied to the specifics of each General Motors / Supplier relationship.

The supplier quality process (SQP) Improvement Team (consisting of the Supplier Quality Manager [SQM], Commodity Manager [CM] and Client within General Motors) works with the supplier to resolve performance issues required to meet General Motors expectations. The improvements gained should benefit all suppliers' customers and eliminate unnecessary costs. Each supplier is expected to measure its performance in a way that is consistent with General Motors business needs, and it is responsible for driving continuous improvement within their operations (Bernard, 2010: 12).

2.2 GENERAL MOTORS GLOBAL HISTORY

The company was founded on September 16, 1908, in Flint, Michigan, as a holding company for Buick, at the time controlled by William C Durant. At the turn of the 20th century, there were fewer than 8,000 automobiles in America and Durant had become a leading manufacturer of horse-drawn vehicles in Flint before making his foray into the automotive industry. General Motors' co-founder was Charles Stewart Mott, whose carriage company was merged into Buick prior to General Motors' creation. Over the years Mott became the largest single stockholder in General Motors and dedicated his life to his Mott Foundation, which benefited the city of Flint, his adopted home. In 1909, Durant brought in Cadillac, Elmore, Oakland and several others. Also in 1909, General Motors acquired the Reliance Motor Truck Company of Owosso, Michigan, and the Rapid Motor Vehicle Company of Pontiac, Michigan, the predecessors of GMC Truck.

Durant lost control of General Motors in 1910 to a bankers' trust, primarily due to the large amount of debt taken on in its acquisitions coupled with a collapse in new vehicle sales. The longest-lived continuous automobile nameplate still in production is the Chevrolet Suburban. The next year, Durant started the Chevrolet Motor Car Company and through this he secretly purchased a controlling interest in General Motors. Durant took back control of the company after one of the most dramatic proxy wars in American business history. He proceeded to reorganise General Motors Company into General Motors Corporation in 1916. Shortly after, he again lost control, this time for good, after the new vehicle market collapsed.

Alfred P Sloan was elected to take charge of the corporation and led it to its post-war global dominance. This unprecedented growth of General Motors would last into the early 1980s when it employed 349,000 workers and operated 150 assembly plants. General Motors led global sales for 77 consecutive years, from 1931 through 2007, longer than any other automaker. In 2008 and 2009, General Motors has ranked as the second largest global automaker by sales (Reynolds, 2010: 18).

2.3 GENERAL MOTORS SOUTH AFRICA HISTORY

In South Africa, Chevrolet was General Motors' main brand name until 1982, with a number of Vauxhall Motors and Holden derivatives being built under the Chevy name from 1964. Originally, Chevrolets were CKD (Complete Knock Down) kits of United States models assembled in the Port Elizabeth plant. However, since South Africa was right-hand drive and the United States left-hand drive, along with encouragement by the South African government to use local content, Chevrolets such as the Biscayne were eventually manufactured entirely in South Africa, along with General Motors' own car for South Africa': the Ranger (Clare, 2008: 27).

By the 1970s, larger South African Chevrolets were based on Australian General Motors- Holden's models. The Chevrolet Nomad sold in South Africa was entirely different from the Nomad sold in America; whereas the American Nomad was originally conceived as a station wagon version of the Corvette, and eventually became the station wagon version of the Bel Air, the South African Nomad was a Sports Utility Vehicle (SUV) of truck proportions before SUVs became popular. These were replaced by Opel models like the Rekord, Commodore and Senator, and in 1982 the Chevrolet brand name was dropped in favor of Opel (Nel, 2007: 59).

Because of the political climate at the time, General Motors decided to divest from South Africa in 1986, and a local group eventually bought out General Motors' South African operations (including the Port Elizabeth plant). The company was renamed as the Delta Motor Corporation, which concentrated on Opels, Isuzus and Suzukis, built under licence. Thanks to an improved political climate in the 1990s, General Motors decided to re-enter South Africa, eventually buying out the whole of Delta. In 2001, the Chevrolet name made a comeback, used on the Lumina, a re-badged Holden Commodore, and later on, on the Daewoo range of cars. Current Chevrolets include the Spark (a re-badged Daewoo Matiz), Aveo, Optra, Cruze, the Lumina (including the Ute model) and the Vivant, a MPV that is a re-badged version of the Daewoo Tacuma (Peters, 2005: 9).

2.4 NEW GENERAL MOTORS BUSINESS STRATEGY

2.4.1 Background

General Motors Corporation has been in business for 100 years, has produced nearly 450 million vehicles globally and operates in virtually every country in the world. While General Motors has recently enjoyed rapidly growing sales and revenues outside the United States, this country remains the company's largest single market. The auto

industry today remains one of South Africa's top employers with 1 in 10 South Africans working in the industry.

General Motors is also one of the largest purchasers of steel, aluminum, iron, copper, plastics, rubber and electronic and computer chips. Global auto sales across all manufacturers, including South Africa, for foreign and domestic markets, declined by more than 30%, which is the steepest decline in 50 years. These major economic shifts demand a fundamental change in the way business is conducted at General Motors (Mouton, 2009: 17).

2.4.2 Vision / Going Forward

Recent economic conditions have reminded General Motors that the *status quo* is no longer enough to remain a global top automobile brand. This recent crisis forced the company to investigate the future of the auto industry and to assess the place General Motors will have in this rapidly evolving automobile market (Tucker, 2010: 19).

The vision of General Motors is a streamlined brand that represents quality and fuel efficiency through innovative design, with respect for quality and customers. General Motors must appeal to the modern-day environmentally friendly and economical global citizen in order to regain the trust and confidence they once enjoyed. Through the rebuilding and strengthening of their core business they can successfully expand, not only domestically, but, multi-nationally (McLagan, 2009: 21).

2.4.3 Strategic Brand Re-structuring

Over the next five years General Motors will be focusing on the re-structuring of their brand while concentrating on their core business. Chevrolet, Cadillac and Buick will remain at the core of their business. This decision was based on sales statistics. The introduction of new models and re-branding of vehicles will have a positive impact on market share (Regan, 2010: 21).

The youth demographic is increasing rapidly, and it is estimated that over 3 billion people will be between the ages of 15 and 44 in 2020. This statistic emphasises the need to recognise the needs of today's youth and cater for that need by producing vehicles with options and features that appeal to this market. With this brand re-structuring will also come a significant number of General Motors re-structuring initiatives to further reflect cost-cutting initiatives (Lee, 2009: 31).

2.4.4 General Motors Strategic Plan

- **Fuel Efficiency**

Scientific research on the effects of global warming and green technology has pushed industries across the board to become more sustainable and environmentally friendly in their practices (Van Heerden, 2009: 7). This new environmental initiative is not only forcing industry to evolve, but the consumer as well. This is reflected throughout the automobile industry with new product lines that offer fuel efficient choices to consumers, including electric, hybrid and flex-fueled automobiles. With the average price of oil spiking over recent years, fuel efficiency and environmentally conscious vehicles have been top priority for consumers.

Many foreign brands have been industry leaders in fuel efficiency and General Motors has been forced to play 'catch up'. However, over the past five years the company has more than doubled its fuel efficient vehicles. In the next five years it plans to increase its fuel efficiency capabilities through its flex-fueled vehicles (Jack, 2009: 19).

- **Cost Cutting**

Through the reduction of General Motors brands and models, the company has gained significant cost savings. But this is not enough to offset the lack of liquidity and self-sufficiency that General Motors has faced. A reduction in salary expenses is also required. Just as many consumers have had to tighten their wallets due to lay-offs, pay cuts and bankruptcies, General Motors executives were required to do the same. High bonuses and pay-outs were also terminated. A more modest compensation strategy was adopted (Wood, 2009: 34).

- **Emerging Markets**

Emerging markets such as China, India and Eastern Europe, are increasing their buying power for the demand of vehicles. The Indian government supported a comprehensive system that will rapidly increase growth in the industry. The Chinese government is loosening financing restrictions in the automotive industry and allowing automotive dealers to create their own financing structures. For General Motors South the Sub-Saharan regions in Africa have plenty of opportunities for export. These rapidly expanding countries present an opportunity for General Motors to expand their global brand and become the center of these new markets. In order to capitalise on this global effort, General Motors must establish manufacturing facilities which will not only create jobs in these countries, but also establish favorable relationships with their governments (Prince, 2010: 45).

- **Marketing and Promotion**

General Motors must re-establish itself as a global brand. Commercials and advertisements globally must promote and emphasise the developments in sustainability and fuel efficiency. Through such a marketing campaign, General Motors should clearly communicate their specific strategies in re-structuring and expanding its business. In the current economic conditions the taxpayers are feeling much of the financial burden (Hill, 2009: 34).

2.4.5 General Motors SWOT Analysis:

Brown (2009: 52) states that General Motors, one of the world's largest automobile manufacturers, and its roots go back to 1908. General Motors, along with its strategic partners, manufactures trucks and cars in 31 countries. The vehicles are sold through the following well-known brands: Buick, Cadillac, Chevrolet, FAW, GMC, Daewoo, Holden, Jiefang, Opel, Vauxhall and Wuling. China is known to be the largest national market, followed by the United States, Brazil, Germany, the United Kingdom, Canada and Italy.

Strengths:

According to Brown (2009: 79), the following strengths can be identified pertaining to General Motors:

- Renowned brand name, translating into the recognition level amongst clients being high;
- It owns a global presence, both in terms of its brand image and manufacturing plants;
- It has assembly lines and distribution networks in more than 50 countries;

- The company has a very strong brand portfolio;
- General Motors employs more than 200,000 people globally;
- Its business is operated in approximately 157 countries;
- The quality of the product serves as the focal point for the company's achievement of success;
- It has strong technological potential; and
- General Motors also invests in market securities and bond portfolios in order to minimise the overall risk the company faces.

Weaknesses:

Brown (2009: 81) noted several possible weaknesses of the General Motors company:

- It lacks concentration on processes that will stabilise its market share, if not increase it;
- The product line-up is quite dull, which makes it difficult for the company to complete the lead sales;
- Lack of understanding the use of technology to make higher profits with low debt;
- Vertical integration regarding the products is quite high;
- Lack of implementing the strategy which aims to provide a positive influence in the company regarding the structure;
- Bureaucratic culture is noted as a shortcoming of General Motors;
- Constantly losing market share;
- Product design is not according to the preference of the customers, thus decreasing consumer acceptance;
- Profitability is decreasing (regarding the operational profits);
- Downsizing has a negative influence on the company due to the lack of containment of the core competencies;

- A lack of leadership brought about experiences that decreased the workers' morale to the bottom line; and
- The intense promotion of automobiles that have no market attractiveness (low mileage Sports Utility Vehicles).

Opportunities:

Opportunities identified by Brown (2009: 83) include the following:

- The company can use the knowledge that it gained from Toyota – Nummi joint venture and Saturn experience;
- It could build its image and gain increased market shares with its newly built confidence regarding the customers;
- New car models and designs could be introduced, taking cognisance of customer preferences, because in the automobile industry, the needs of the customer are the valid puncture points that will provide profitability if handled with delicacy; and
- Expansion of its business processes, keeping in mind the preferential influence of the customers.

Threats:

Brown (2009: 84) furthermore described several possible threats for general Motors:

- Although the industry has matured considerably, there is still room for improvement. New entrants are still entering the market, even though the competition is already tough. (New entrants do not likely pose much of a threat, although domestic and foreign competition both act as active threats for the company that has already experienced a loss in market share);
- Regulations and legislative authorities engaging the industry more actively;
- Consumer lawsuits to be accounted for; and
- Japan, being a high manufacturing ground for automobiles, is being affected by the decline in its currency, the Yen.

2.5 GENERAL MOTORS STRENGTHENING OPERATIONS

Lee (2010: 2) provides a discourse of the strengthening of operations in General Motors. Management is focused on hiring new and promoting current, talented employees who can bring new perspectives to its business in order to “execute on our strategy as follows: Deliver quality products”. The intention is to maintain a broad portfolio of vehicles so that the company is positioned to meet global consumer preferences. The plan is to do this in several ways. Concentrating on design, engineering and marketing resources on fewer brands and architectures. The plan is to increase the volume of vehicles produced from common global architectures to more than 50 percent of the company’s total volumes in 2015 from less than seventeen percent today (Lee, 2010: 3).

Lee (2010: 6) further states that “The expectation is that this initiative will result in greater investment per architecture and brand and will increase our product

development and manufacturing flexibility, allowing us to maintain a steady schedule of important new product launches in the future. The four-brand strategy globally will continue to enable General Motors to allocate higher marketing expenditures per brand. Develop products across vehicle segments in our global markets. The plan is to develop vehicles in each of the key segments of the global markets in which General Motors competes. General Motors will continue to compete in the largest and fastest growing markets globally.

Broaden the South African product portfolio. General Motors South Africa plans to launch 13 new vehicles in South Africa across the four brands in 2011 and 2012. This will be in the growing vehicle and crossover segments, where in some cases, General Motors is under-represented. The strategy is also to introduce an additional 18 new vehicles between 2013 and 2014. General Motors also plans to improve the product quality and product perception in South Africa. By the start of 2012, General Motors plans to have eighty percent of the Opel/Chevrolet carlines volume refreshed such that the model stylings are less than three years old.

General Motors plans to continue to execute growth strategies in countries where it already holds strong positions, such as China, and to improve market share in other important markets, including South Africa. General Motors plans to strengthen the General Motors South Africa product portfolio through three strategies: (1) leveraging our global architectures; (2) pursuing local and regional solutions to meet specific market requirements; and 3) expanding our joint venture partner collaboration opportunities.”

2.6 CURRENT SITUATION AT GENERAL MOTORS SOUTH AFRICA

Socia (2011: 1) discusses the current situation at General Motors South Africa in detail as follows: “Success in today’s fiercely competitive worldwide marketplace begins with product. For General Motors South Africa to continue to present opportunities for the company, the customers, and the suppliers, the company must focus on building vehicles that consumers want to buy and at competitive prices.

At General Motors South Africa the primary responsibilities are to procure the parts and services that go into developing vehicles and the secondary responsibility is to drive waste and cost out of the company. Improving overall value to employees, consumers, and shareholders. General Motors needs to make sourcing decisions based on the performance of its four priorities: Supply Chain and Logistics, Quality/Launch, Programme Management and Current/Future Business. General Motor’s requirements of its supply base include developing and executing supply chain capabilities, providing world-class quality parts.

Launching new programs at the right quality, the right time, and the right cost, service that goes beyond expectations, technologies that differentiate the products, and competitive prices, are vital. It is the combination of these elements that will help General Motors succeed. Suppliers have consistently made outstanding contributions to General Motors South Africa and played a major role in General Motor’s success. The entire General Motors team is focused on making sure the best performing suppliers grow with General Motors. General Motors teams will work closely with them to develop new opportunities.”

2.7 CONCLUSIONS

Socia (2011: 7) says “Sometimes success is about determination. In times of challenge and uncertainty, often it is those with the strongest will to keep moving forward who ultimately win.” General Motors has been moving forward aggressively to answer the call for leadership to continue the momentum it started to establish as a company.

While General Motors is aware of the fact that it has a long way to go, the company is encouraged by the positive attitude visible in General Motors people and stakeholders. It is a desire to win and a commitment to continuous improvement and achieving General Motors goals. It is a sense that the company will continue to push for excellence, no matter what, especially during the challenging times. This is the true foundation of General Motor’s future success, and the company could not be more proud and determined. However, with forecast business strategies like delivering quality products, any discrepancy in supplier quality can significantly reduce a company’s revenue, impact market share, increase production cost, threaten brand image and reputation and lead to high cost of poor quality. The quality of the product serves as the focal point for the company for achieving success.

CHAPTER 3

LITERATURE REVIEW ON SUPPLIER QUALITY, LEAN MANUFACTURING, AND COST OF QUALITY

3.1 INTRODUCTION

As companies seek ways to reduce costs, speed up time-to-market and improve product quality, supplier performance plays a critical role in maintaining the competitiveness of value chains (Fitzgerald, 2007: 79). In the auto industry, over seventy percent of a product's total value is created by suppliers (Leenders, 2002: 49). Supplier on-time performance determines the ability of the original equipment manufacturer (OEM) to implement engineering changes, whilst also quickly ramping up the production of resulting new products (Hartley, 2001: 57). The quality of an original equipment manufacturer's final product can only be as good as the quality of the inputs they receive from suppliers (Forker, 1997: 19). Original equipment manufacturers rely on suppliers to achieve major reductions in product cost (Afuah, 2003: 46). As companies expand their business reliance on outsourcing, they note an increase in the size of their supply chain. With a more decentralised supply chain, companies are reaping the reward of savings in the products they purchase.

They are also being exposed to a higher level of risk. Companies' supply chains are at risk due to specific disruptions, including economic uncertainties, customer demands and quality related problems. As a result, these potential risks within the supply chain increased the exposure of companies which are conducting business operations abroad and raised concerns on continuity of manufacturing or service delivery operations. Visibility in real-time quality performance levels at suppliers can lead to reductions in total supply network costs for both parties. Suppliers will also be measured on masking scrap and re-work rates cycle times. Supplier scorecards can include true quality measures, and total product supply costs can be reduced.

The price of non-conformance (Crosby, 1979: 128) or the cost of poor quality (Juran, 1951: 79), are inclusive in the term 'Cost of Quality', referring to the costs associated with providing poor quality product or service. Quality processes cannot be justified simply because "everyone else is doing them", but return-on-quality (ROQ) has dramatic impacts as companies mature. Research shows that the costs of poor quality can range from fifteen percent to forty percent of business costs (e.g. re work, returns or complaints, reduced service levels and lost revenue). Most businesses do not know what their quality costs are because they do not keep reliable statistics (Rusnak, 2006: 39).

Finding and correcting mistakes consumes an inordinately large portion of resources. Typically, the cost to eliminate a failure in the customer phase is five times higher than it is at the development or manufacturing phase. Effective quality management decreases production costs because the sooner an error is found and corrected, the less costly it will be. Cost of quality comprises of four elements: External Failure Cost, Internal Failure Cost, Inspection (appraisal) Cost, and Prevention Cost. This section provides an overview of the literature on supplier quality management requirements, lean manufacturing principles, cost of quality and previous research as it relate to this study. It provides abstract sections from different authors on the subject.

3.2 OVERVIEW OF THE RELATED LITERATURE

This section offers an overview of literature on supplier quality management, lean manufacturing principles, cost of quality and previous research as it relate to this study.

3.2.1 GMSA as part of a GMC

Global manufacturers today face economically challenging times with complex and crowded agendas. Today's market pressures require manufacturers to balance multiple priorities, including productivity, globalisation, innovation and sustainability (Moller, 2009: 59). At General Motors South Africa, the lean manufacturing products are designed to ensure customer satisfaction.

End users and commercial businesses alike rely on the comprehensive portfolio of General Motors South Africa pertaining to products and services that deliver value and assist in meeting business objectives. A continuous improvement mindset is central to everything General Motors South Africa does, including its relationships with suppliers. The supply chain strategy of General Motors South Africa has evolved from managing transactions, to forming stronger business relationships with an emphasis on shared goals. Working together with suppliers is critical in the changing economic environment where companies, large and small, strive to reduce expenses and improve profit margins without sacrificing quality. Around the world, General Motor's employees are committed to putting its customers' needs first (Lee, 2009: 19).

Simply put, General Motors South Africa is there with the right solution, when and where the customers need it. The company is committed to building a more valuable business by achieving growth and performance simultaneously, including a comprehensive set of productivity initiatives utilising Lean, Six Sigma and other tools. A company-wide focus on productivity initiatives allows it to maintain best-in-class operating margins and re-investing for future growth. This more streamlined approach to doing business will result in a more efficient, effective company. General Motors South Africa's objective is to develop a diverse supplier base of quality, delivery and price performance leaders (Smith, 2008: 7).

3.2.2 What is supplier quality management?

Today, more than ever, final product quality is highly dependent on a company's supplier product quality. Inconsistent or low quality incoming lots can lead to long-term problems for any manufacturer; poor supplier quality costs companies billions annually. Managing risk within this supply network is a growing strategic imperative. Supplier quality management and performance monitoring are key components of any risk management strategy. Having insight into supplier operations and quality programmes (such as Six Sigma) will assist in ensuring that the products meet requirements, thus reducing the risk of a defective lot (Pickering, 2004: 29). A study by the Aberdeen Group reported that eighty five percent of those surveyed have suffered financial losses as a result of supply chain disruptions (Jones, 2008: 57). These companies plan to improve supply chain risk management by implementing a data-driven, collaborative approach to working with suppliers.

3.2.3 Quality products now inevitable

How can chief procurement officers (CPOs) mitigate the loss of Japanese suppliers, well-known for their high-quality approach (Hogg, 2011: 19). Supplier disruptions can happen anytime, anywhere. The Japan disaster is a reminder to procurement executives of just how unpredictable and devastating supply disruptions can be. The effects of the Japanese earthquake and tsunami will be felt for years (Maxwell, 2011: 37).

Capacity has disappeared, transport costs are escalating and companies are going under. Businesses worldwide are left scrambling to find new suppliers to replace the ones they lost in Japan. Japan is a major player in the manufacturing industry, and any slowdown in production, not to mention a complete stoppage, leaves companies in all

parts of the world vulnerable (Jackson, 2011: 29). Even more so, the world relies on Japanese manufacturers for their high-precision capabilities. Japanese suppliers have long been known for the high quality and durability of their work (Smith, 2010: 41).

While replacing a supplier is never easy, it is even more challenging when the original is highly specialised (Kemp, 2011: 79). Many substitute options will not have the experience or high-precision manufacturing capabilities required for these types of products. Replacing a qualified, high-performance supplier could take between nine and twelve months. The time and financial investment will be heavy. Companies need to assure and qualify the supplier quality, or their products will suffer. Japan's manufacturing production will slowly get back to pre-disaster capacity. But even when it does, the supplier burden won't necessarily end.

Against the background of demand, building materials, specialty steel and metals will continue to be in short supply. Due to the scale of the disasters, Japan will be rebuilding for years to come. As a result, the products and raw materials that are typically exported to other countries will instead be internally consumed. One positive that came to light during the Japan disaster, was just how well-prepared the people and infrastructure were (Williams, 2011: 43). Japan certainly will not deviate from its quality strategy now, but before it begins exporting again, capacity will first be utilised to satisfy the country's internal need to rebuild. Where can companies looking to source high-performance items, turn? Four countries, viz. Germany, South Korea, the United States and South Africa, have the capabilities to help fill the gap (Bosch, 2011: 42).

Each country has high-precision manufacturing experience and facilities similar to Japan. However, while each of these countries can help, they do not have sufficient available capacity to completely replace what was lost. In addition, each country would rely increasingly on their highly skilled workforces. Another strategy for replacing the loss of Japan's capacity might be to turn to emerging manufacturing nations such as Malaysia and India. While countries such as these will certainly have the opportunity to take on demand, it remains to be seen if they will struggle to meet quality standards (Boardman, 2011: 41). Smart procurement executives develop tier two, and even tier three suppliers all year long. This means that if disaster occurs, the challenge of ramping up demand for already qualified suppliers is a much easier and productive process compared to starting the supplier selection process from scratch (Scelta, 2011: 12).

3.2.4 Benefits of quality management systems

The global adoption of ISO 9000 may be attributable to a number of factors. Many major purchasers require of their suppliers to hold ISO 9001 certification. In addition to several stakeholders' benefits, various studies identified significant financial benefits for ISO 9000 certified organisations. (Corbett, 2005: 20) established that certified organisations achieved superior return on assets compared to otherwise similar organisations without certification. (Heras, 2002: 34) discovered similarly superior performance and demonstrated that this was statistically significant and not a function of organisation size. Naveh and Marcus, (2007: 19) depicted that implementing ISO 9001 led to superior operational performance. Sharma, (2005: 81) identified similar improvements in operating performance and linked this to superior financial performance.

Chow-Chua, (2002: 29) state that better overall financial performance was achieved by companies in Denmark. Rajan and Tamimi, (2003: 11) say that ISO 9000 certification

resulted in superior stock market performance and suggested that shareholders were richly rewarded for the investment in an ISO 9001 system. While the connection between superior financial performance and ISO 9000 is clearly visible, there remains no proof of direct causation, though longitudinal studies, such as those of Corbett (2005: 19) may suggest it. Other writers such as Heras, (2002: 21) suggest that while there is some evidence of this, the improvement is partly driven by the fact that there is a tendency for better performing companies to seek ISO 9000 certification.

The mechanism for improving results has also been the subject of much research. Lo (2007: 13) identified operational improvements (cycle time reduction, inventory reductions, etc.) as following from certification. Buttle (2000: 7) and Santos (2004: 8) both indicated internal process improvements in organisations leading to externally observable improvements. The results of Hendricks and Singhal (2003: 11) indicate that organisations outperformed their control group during the post implementation period and effective implementation of total quality management principles and philosophies lead to significant wealth creation.

The benefit of increased international trade and domestic market share, in addition to internal benefits such as customer satisfaction, interdepartmental communications, work processes, and customer/supplier partnerships derived, far exceed any and all initial investment according to Alcorn (2001: 39). It is widely acknowledged that proper quality management improves business, often having a positive effect on investment, market share, sales growth, sales margins, competitive advantage, and avoidance of litigation. The quality principles in ISO 9000:2000 are also sound, according to Wade (1998: 29) and Barnes (2000: 47), who state that "ISO 9000 guidelines provide a comprehensive model for quality management systems that can make any company implementing ISO, competitive."

3.2.5 Characteristics of lean production practice

Lean production has several characteristics as identified in researches. Seven core characteristics of lean production are listed by Oliver (2001: 29).

- Organisation with team that involves flexible, multi-skilled operators taking a high degree of responsibility for work in their areas;
- Shop-floor with problem-solving structure which is central to 'kaizen' or continuous improvement activities;
- Lean manufacturing operations such as low inventories, small number of direct workers, small batch size and just-in-time production. High commitment human resource policies, which encourage a sense of shared destiny within a factory;
- Close relationship with suppliers and smaller supplier base;
- Cross-functional development teams; and
- Retailing and distribution channels which provide close links to the customer and permit a make-to-order strategy to operate.

The presence of the above characteristics in a production system makes the system lean. It suggests that a lean production system, in order to be really useful in eliminating wastes, requires a team organisation structure with cross-functional development teams, a problem-solving structure on the shop floor, a small quantity of inventories, a small batch size, just-in-time production and delivery, flexible and employee-oriented human resource policies, integration with a small base of suppliers and close links to the customers. The term 'lean', in this sense, encompasses the entire enterprise: from the shop floor to the executive suit, and from the supplier to the customer value chain.

3.2.6 The building blocks of lean

Lean is established upon several building blocks. Alukal and Manos (2002: 47) have identified the following building blocks: 5S's, visual control, streamlined layout, standardised layout, teams, quality at source, point of use storage, quick changeover, pull/'kanban', cellular/flow and total productive maintenance (TPM). These building blocks must be in place in an organisation to ensure success with the lean production system. All these building blocks are keys to lean production. In order to be truly lean, the working environment needs to be organised, clean and safe.

These are necessary ingredients for efficient and quality work. When employees have a clear view of what is happening, they easily understand the whole system, resulting in higher productivity. Operationally sequential plant layout helps in reducing cycle time. Standardised work facilitates ensure consistency in the performance of employees. Well-organised work teams perform better in achieving higher productivity with less input and efforts. Ensuring quality from the very beginning of the production process reduces the chance of having unexpected scrap/defects in the subsequent stages of production. Storing necessary materials and other items close to the place of work/use, improves production efficiency. 'Kanban' reduces the inventory level through using systematic and timely signaling for forty five materials. As a building block of lean, total productive maintenance (TPM) focuses on overall equipment effectiveness through regular, routine maintenance of equipment.

3.2.7 Quality improvement system

For companies to successfully produce goods while receiving only minimum deliveries, no room can be allowed for poor quality (Birch, 2001: 69). This requires an overhaul in the thinking of management, which traditionally sought the so-called acceptable quality

level (AQL). After receipt, delivered goods are randomly inspected to determine how many defective parts occur within a predetermined sample size. If the number of defects exceeds a certain amount (the AQL), the entire batch is rejected. No such provision is made under lean/just-in-time (JIT); all parts must be good. The Japanese use the term 'zero defects' to describe this philosophy.

Zero defects certainly cannot be obtained overnight, nor can it be expected from all of a company's current suppliers (Willard, 2007: 79). To facilitate the receipt of high quality goods, a company must offer more than the usual short-term contract or purchase order to the lowest bidder. A company may also have to eliminate or decrease the use of multiple sourcing, or purchasing the same part from several sources as a backup in case one source experiences quality or delivery problems. By issuing long-term contracts to a single source, the lean/just-in-time (JIT) company gives its supplier the confidence and incentive to spend time and money on ensuring near perfect quality and constantly improving the product. Frequently, this makes for a captive supplier who must maintain the required quality in order to survive. The lean/just-in-time (JIT) company should then work constantly and directly with the supplier to monitor quality and provide technical support.

The use of lean/just-in-time (JIT) improves the quality of suppliers, as well as the lean/just-in-time (JIT) company's internal quality. When lot sizes are drastically reduced, defect discovery is naturally enhanced (Daniels, 2002: 7). If a worker produces a lot size of one and passes it to the next station, the feedback on quality will be immediate. In this way, defects are discovered quickly and its causes can be corrected immediately. Production of large lots with high defect rates is avoided. South African manufacturers traditionally allowed lot sizes and inventory levels to remain high "just in case" a quality problem, an equipment problem or a delivery problem should arise. This "just in case" inventory, commonly called buffer stock, allowed the company

to maintain its production flow while the problem was being corrected (Theron, 2005: 72).

When a quality problem emerged and inventory was ample, the search for the source of the problem was postponed until a more suitable time. This suitable time may have never occurred. When lot sizes are minimal, one worker's problem threatens to bring subsequent processes to a halt. This means that all production workers and management must collaborate to find an immediate solution. The benefits here are two-fold. First, the company avoids the production of large quantities of defective parts. Secondly, good managers will be able to use this as motivation for unity of purpose within the workforce.

3.2.8 Productivity improvement system

Productivity can be defined as good output divided by required input. The productivity facet of lean/just-in-time (JIT) has been described as nothing sitting idle, which wastes time. If equipment is operated only for productive purposes, then energy waste is eliminated. If all inventories are converted into product, then material waste is eliminated. If errors are not allowed, then re-work is eliminated (Todd, 2006: 9).

A number of productivity improvements may result from lean/just-in-time (JIT) implementation. Among these are lower inventory levels, lower scrap rates, reductions in re-work costs, reduction of inventory carrying costs, smaller floor space requirements, reduced material handling, simpler inventory accounting and more positive inventory control (Jones, 2004: 11). All of these lower the input component or increase the good output of the productivity ratio. Reductions in idle inventories allow the company to reduce internal lead times from the purchase of raw materials to the

shipping of finished goods, allowing quicker changes in product mix and production quantities. Furthermore, the company's ability to forecast is enhanced because the forecast horizon is shortened.

3.2.9 Company and supplier performance

Burt (2008: 17) depicts company and supplier performance in detail. Recent research in manufacturing has investigated the impact of enabling operations management (OM) practices on quality and time-based performance separately. This research investigates the concurrent impact of supply management, human resources, just-in-time (JIT) and cross-functional practices on quality and time-based performance. The sample was drawn from companies from the automotive components industry. The relationships of thirteen individual operations management (OM) practices with three objective measures of quality performance and two objective measures of time-based performance, were analysed using simple and stepwise multiple regressions.

Results indicate that seven of these practices, namely incoming material quality, 'kanban' systems, set-up time reduction, performance-based pay and quality training to workers, cross-functional interactions between design and quality assurance, and between production and new product development, have significant synergistic relationships to both quality and time-based performance. The research supports the argument that there is synergy between quality and time-based performance capabilities.

3.2.10 Lean manufacturing

Pettersen (2009: 19) authored that lean manufacturing or lean production, often simply referred to as 'Lean', is a production practice that considers the expenditure of resources for any goal other than the creation of value for the end customer, to be wasteful and a target for elimination. Working from the perspective of the customer who consumes a product or service, 'value' is defined as any action or process that a customer would be willing to pay for. Essentially, lean is centered on preserving value with less work. Lean manufacturing is a management philosophy derived mostly from the Toyota Production System (TPS), hence the term 'Toyotism' is also prevalent. It was identified as 'Lean' only in the 1990s.

The Toyota Production System (TPS) is renowned for its focus on reduction of the original Toyota seven wastes to improve overall customer value, but there are varying perspectives on how this is best achieved. The steady growth of Toyota, from a small company to the world's largest automaker, has focused attention on how the company achieved this. Lean manufacturing is a variation on the theme of efficiency based on optimising flow; it is a present-day instance of the recurring theme in human history towards increasing efficiency, decreasing waste and using empirical methods to decide what matters, rather than uncritically accepting pre-existing ideas. Lean manufacturing is often regarded as a more refined version of earlier efficiency efforts, building upon the work of earlier leaders such as Taylor or Ford, and learning from their mistakes.

The Toyota Production System (TPS) is an integrated socio-technical system, developed by Toyota, and comprises its management philosophy and practices. The Toyota Production System (TPS) organises manufacturing and logistics for the automobile manufacturer, including interaction with suppliers and customers. The system is a major precursor of the more generic 'Lean manufacturing'. Taiichi Ohno,

Shigeo Shingo and Eiji Toyoda developed the system between 1948 and 1975. Originally called 'Just-in-Time Production', it builds on the approach created by the founder of Toyota, Sakichi Toyoda, his son Kiichiro Toyoda, and the engineer Taiichi Ohno. The founders of Toyota drew heavily on the work of W Edwards Deming and the writings of Henry Ford. When these men came to the United States to observe the assembly line and mass production that made Ford rich, they were unimpressed. However, while shopping in a supermarket they observed the simple idea of an automatic drink re-supplier; when the customer wants a drink, he takes one, and another replaces it. The principles underlying the Toyota Production System (TPS) are embodied in 'The Toyota Way'.

3.2.11 Leaning the South African way

'Leaning' the South African way is discussed by Pieterse, Lourens, Louw, Murray, and Van Der Merwe (2005: 59). There are five basic principles associated with lean manufacturing principles. Within these five basic principles lies the path a company must take to be successful in implementing lean manufacturing principles.

It commences with the value of the product that is ultimately determined by the customer, and not the company. This product value is determined specifically around the customer's need for the product at a specific price and at a specific time. When the true value of the product as required by customer, or user, has been established within the product, the next step is to identify the value stream that produces that product. Only now is it appropriate to bring the value of the product into the company. The value stream takes the product through the concept phase, into design and engineering to production launch, then the transformation phase from raw materials to the finished product, including the information phase from taking the order, scheduling production to delivering to the customer.

The next step's challenge is to let the production process flow in one steady stream. To achieve this, it is necessary to focus on the product from the start to the finish. Move beyond traditional boundaries within the company that will form barriers to the flow product. All back-flow of the product as stoppages, re-works or as scrap must be eliminated. With a reduced time through production, the company can now produce the product only on demand, allowing the company to move away from producing in advance to sales forecasts. All this needs to be followed up by a constant need to improve towards perfection in both the product as well as in the processes establishing that product.

3.2.12 The Toyota Production System (TPS)

According to Baily (2007: 47), the main objectives of the Toyota Production System (TPS) are to design out overburden ('muri') and inconsistency ('mura'), and to eliminate waste ('muda'). The most significant effects on process value delivery are achieved by designing a process capable of delivering the required results smoothly; thus, by designing out 'mura' (inconsistency). It is also crucial to ensure that the process is as flexible as necessary without stress or 'muri' (overburden), since this generates 'muda' (waste). Finally the tactical improvements of waste reduction or the elimination of 'muda' are very valuable. Seven kinds of 'muda' are addressed in the Toyota Production System (TPS):

- over-production;
- motion (of operator or machine);
- waiting (of operator or machine);
- conveyance;
- processing itself;
- inventory (raw material); and

- correction (re-work and scrap).

The elimination of waste has come to dominate the thinking of many when they look at the effects of the Toyota production System (TPS), because it is the most familiar of the three to implement. In the Toyota Production System (TPS) many initiatives are triggered by inconsistency or overburden reduction which drives out waste without specific focus on its reduction.

❖ **The Origins**

This system, according to Ohno (1998: 79), more than any other aspect of the company, is responsible for making Toyota the company it is today. Toyota has long been recognised as a leader in the automotive manufacturing and production industry. Toyota received its inspiration for the system not from the American automotive industry (at the time the world's largest by far), but from visiting a supermarket. This occurred when a delegation from Toyota (led by Ohno) visited the United States in the 1950s.

The delegation first visited several Ford Motor Company automotive plants in Michigan but, despite Ford being the industry leader at that time, found many of the methods in use to be not very effective. They were primarily appalled by the large amounts of inventory on site, by how the amount of work being performed in various departments within the factory was uneven on most days, and the large amount of re-work at the end of the process. However, on a subsequent visit to a Piggly Wiggly, the delegation was inspired by how the supermarket only re-ordered and re-stocked goods once they had been bought by customers.

Toyota applied the lesson from Piggly Wiggly by reducing the amount of inventory they would hold to only a level that its employees would need for a small period of time, and then subsequently re-order. This would become the precursor of the now-famous Just-in-Time (JIT) inventory system. While low inventory levels are a key outcome of the Toyota Production System, an important element of the philosophy behind its system is to work intelligently and eliminate waste so that inventory is no longer needed. Many American businesses, having observed Toyota's factories, set out to attack high inventory levels directly without understanding what made these reductions possible. The act of imitating without understanding the underlying concept or motivation may have led to the failure of those projects.

❖ Principles

The underlying principles, called the 'Toyota Way', have been outlined by Toyota as follows (Ohno, 1998: 27):

➤ Continuous Improvement

- **Challenge** (We form a long-term vision, meeting challenges with courage and creativity to realise our dreams);
- **'Kaizen'** (We improve our business operations continuously, always driving for innovation and evolution); and
- **'Genchi Genbutsu'** (Go to the source to find the facts to make correct decisions).

➤ Respect for People

- **Respect** (We respect others, make every effort to understand each other, take responsibility and do our best to build mutual trust); and

- **Teamwork** (We stimulate personal and professional growth, share the opportunities of development and maximise individual and team performance).

External observers have summarised the principles of the Toyota Way as:

➤ **Long-term philosophy**

1. Base your management decisions on a long-term philosophy, even at the expense of short-term financial goals.

➤ **The right process will produce the right results**

1. Create continuous process flow to bring problems to the surface;
2. Use the "pull" system to avoid over-production;
3. Level out the workload ('heijunka' - Work like the tortoise, not the hare);
4. Build a culture of stopping to fix problems, to get quality right from the start;
5. Standardised tasks are the foundation for continuous improvement and employee empowerment;
6. Use visual control so no problems are hidden; and
7. Use only reliable, thoroughly tested technology that serves your people and processes.

➤ **Add value to the organisation by developing your people and partners**

1. Grow leaders who thoroughly understand the work, live the philosophy, and teach it to others;
2. Develop exceptional people and teams who follow your company's philosophy; and
3. Respect your extended network of partners and suppliers by challenging them and helping them improve.

➤ **Continuously solving root problems drives organisational learning**

1. Go and see for yourself to thoroughly understand the situation ('Genchi Genbutsu');
2. Make decisions slowly by consensus, thoroughly considering all options ('Nemawashi' - implement decisions rapidly); and
3. Become a learning organisation through relentless reflection and continuous improvement ('Kaizen').

The Toyota Production System has been compared to squeezing water from a dry towel. What this means is that it is a system for thorough waste elimination. Here, waste refers to anything which does not advance the process or everything that does not increase added value. Many people settle for eliminating the waste that everyone recognises as waste. But much remains that simply has not yet been recognised as waste or that people are willing to tolerate. People resigned themselves to certain problems, became hostage to routine and abandoned the practice of problem-solving. This going back to basics, exposing the real significance of problems and then making fundamental improvements, can be witnessed throughout the Toyota Production System (Hobbs, 2004: 98).

❖ **Results**

Toyota was able to greatly reduce lead time and cost using the Toyota Production System (TPS), while improving quality. This enabled it to become one of the ten largest companies in the world. It is currently as profitable as all the other car companies combined and became the largest car manufacturer (Banks, 2011: 81). It has been proposed that the Toyota Production System (TPS) is the most prominent example of the 'correlation', or middle, stage in a science, with material requirements planning and other data gathering systems representing the 'classification' or first stage. A scientist in this stage can see correlations between events and can propose

some procedures that allow some predictions for the future. Due to the success of the production philosophy's predictions, many of these methods have been copied by other manufacturing companies, although mostly unsuccessful (Brain, 2007: 38). Also, many companies in different sectors of work (other than manufacturing) have attempted to adapt some or all of the principles of the Toyota Production System to their own companies. These sectors include construction and health care.

3.2.13 The Toyota way according to Liker

Liker (2004: 29) says, within Toyota, at least some of these lean manufacturing principles were born, but as a whole, these principles have moved beyond the status of principles to a philosophy of how to do business. It has become the company's culture. This culture has its roots in the belief that success is derived from balancing the role of people in a culture of continuous improvement, with a technical system focused on high value-added flow. Within the Toyota Production System (TPS), the key principles that drive the techniques and tools are based on the following four areas, which expands into the fourteen principles contained in the Toyota Production System (TPS).

It sets out with a long-term philosophy rooted in a learning organisation that is continuously adding value to their customers and to society as a whole. One that can adapt to constant changes in its environment, but still remains competitive. As with most manufacturing companies, Toyota is a process-oriented company that has learned that the processes that work are the ones that operate with one-piece flow. This implies that a continuous flow process yields the best quality at the lowest cost, ensuring high safety and moral standards.

People and partners to the company need to be continuously developed and trained. It requires a sense of urgency from all to overcome and confront business problems, fast and effectively. Management at Toyota makes it part of their goals to build people, and not just cars. A culture of organisational learning becomes the vehicle to identify root causes to problems, and effectively solving them, preventing them to occur again. It culminates into a standardised best-known practices of all the lessons learned.

3.2.14 Supplier Quality Management Measures: Preventing Supply Chain Disruptions

Burt, Dobler and Starling (2003: 17) state that quality issues not discovered and addressed prior to shipment, can hurt the bottom line of any organisation. World-class manufacturers are realising the need to maintain a consistent and systematic quality process to gain real-time inspections data with analytics of trend analysis. By improving operational efficiencies in quality systems, automated solutions enables companies to create a transparent environment for proactively identifying, tracking and resolving quality issues. Moreover, the embedded best practices for supporting key processes and requirements for standards and regulations such as ISO 9000, lower the cost of regulatory compliance and the risk for non-compliance.

According to Hunter (2002: 37) supplier quality plays a critical role attributing to almost fifty two percent of the overall manufacturing performance. In such a scenario, the need to implement streamlined supplier quality management measures can never be over-emphasised. Some of the measures employed by leading global manufacturers include:

- **Supplier Site Inspections:** Ensuring that all supplier components and materials are sampled, examined, tested and authenticated before being shipped. It includes tracking supplier non-conformance issues in real-time by

establishing consistent procedures for components and lots that do not conform to specifications;

- **Streamlined Corrective Actions:** Implementing a proactive approach to supplier corrective action requests (SCARs) or corrective/preventive action requests (CAPAs) across the supply-base, by following a common methodology for performing root/cause analysis, assigning follow up actions while effectively tracking and routing cases from initiation to closure;
- **Supplier Charge-backs:** Charging cost of poor quality back to the supplier for the costs incurred by a manufacturer due to non-conforming components, materials and late deliveries in order to introduce business discipline and accountability into the supply chain;
- **Supplier Scorecards:** Monitoring supplier performance on scorecards to proactively identify and implement timely corrective actions to improve supplier performance. Scorecards measure key performance indicators (KPIs) in real-time and track improvements over time supporting sound decision-making based on data; and
- **Supplier Audits:** Conducting supplier audits to ensure that suppliers meet the established product and process quality requirements and the audit process drives continuous improvement.

The best way to control quality is to prevent non-conformity at the source. Most organisations today are spending a little more time upfront to identify the discrepancies, non-conformances in manufacturing and quality process at the supplier's site itself (Barness, 2003: 39).

3.3 THE COST OF QUALITY

3.3.1 Cost versus quality

Costs are very closely linked with quality. Commercially, a product is worth what our customers are prepared to pay for it. If the quality and delivery are bad, then the selling price will be correspondingly low. The days are gone when a producer could add almost any profit margin to his costs of manufacturing, etc. There are various reasons for this. Dessler, (2002: 41) states:

- Competition is continually increasing;
- The consumer is tending to become more knowledgeable about goods he buys; and
- Quality standards demanded by various official bodies, and also by many commercial undertakings increased.

More and more we find that our selling price has a ceiling and therefore, if our quality costs are higher than they ought to be, our profit is correspondingly reduced. In practice, quality costs often tend to be the same degree of magnitude as the profit margin. Thus, it follows that if these costs are excessive, the profit may be largely or even completely lost (Drake, 2000: 51).

3.3.2 Analysis of quality costs

There is no precise definition of what is meant by the term 'quality costs'. Since almost everything that we do in a company has something to do with quality, we could say that almost all costs are quality costs. However, in order to clarify quality costs, it is standard practice to consider them under the three headings of failure, appraisal, and prevention (Caplen, 2001: 212).

3.3.2.1 Failure costs

Caplen (2001: 216) says this is the cost of failing to design, make or provide the quality of product or service demanded by the customer. Failure costs tend to be easily the largest of the three quality costs, and we divide them into internal and external costs as follows:

➤ **Internal Failure Cost.** These are the costs incurred within the manufacturing organisation, up to the moment when the product is transferred to the customer. Typically they include the following:

- Scrap, i.e. work which is useless and must be thrown away;
- Re-work and Corrective Operations. This is the cost of correcting work which is wrong. In quality control we use the word 'defective' to denote all work which is not to specification, and therefore unacceptable, regardless of whether it can or cannot be corrected;
- Downgrading, Seconds, etc. This is work which is still usable, even though it contains one or more defects, but it has to be sold at a reduced price; and
- Associated Costs. In addition to the cost of the defective work itself, other associated costs are usually incurred, and sometimes these are far greater than that for the work itself. Examples are as follows:
 - a) Loss of production capacity and interference with production schedules;
 - b) Cost of setting up again to make replacement items;
 - c) Cost of investigating the cause of unsatisfactory work, and making corrections so that it will not happen again; and
 - d) Cost of correcting unsatisfactory designs and specifications. This is liable to have a knock-on effect, because to meet the revised specification, it may be necessary to modify or renew some of the production plant.

➤ **External Failure Cost.** These are costs incurred after the product has been handed over to the customer. For example:

- Cost of products or services rejected by the customer, or recalled because of some defects;
- Product liability and warranty costs;
- Rushing replacement parts, engineers, etc. over long distances to make corrections; and
- Cost of placating irate customers, loss of future orders from those customers, and also from other potential customers hearing how inefficient the product or service was. Bad reports in trade journals fall under this category. One can never really tell how much customer displeasure has cost the company, but clearly, it can be considerable.

3.3.2.2 Appraisal costs

Caplen (2001: 218) says these are the costs of inspection and test in its widest sense, including checks done by people who are not titled inspectors, e.g. setters, supervisors, etc. Appraisal costs are divided into two groups:

➤ **Cost of test and inspection to identify and eliminate defective work, e.g.** the cost of one hundred percent inspection or sorting to find and eliminate defective work that should not have been made in the first place. Along with process sorting, one should include final test and inspection before despatch, to eliminate defective work which is about to escape from the company. On-site performance checks, checking stocks for spares, etc. are also included. In principle, all of the above costs are undesirable, because if one succeeds in doing it right first time, the

company will have no defective work to eliminate. Hence, high costs here indicate that the quality control of production is unsatisfactory.

➤ **Cost of test and inspection to monitor processes, and keep them right:**

- First-off inspection to ensure that each production run starts off correctly;
- In-process checks such as patrol inspection, operator checks, monitoring by instrument, etc. to ensure that production quality remains satisfactory; and
- Goods inwards inspection to ensure that only satisfactory materials are fed into the production lines.

Provided that they are well planned and efficient, appraisal costs in this group are desirable, because they assist in keeping processes running correctly.

3.3.2.3 Prevention costs

Prevention costs, as defined by Caplen (2001: 219) entail all that a company spends to prevent defective work being produced in the first place. It includes:

- Costs of quality management, setting up and operating quality control and quality assurance systems;
- Providing satisfactory equipment, jigs, etc.;
- Provision of foolproof methods, so that work is bound to be made correctly;
- Supplier quality assurance, vendor appraisal, etc. ;
- Calibration and maintenance of measuring equipment;
- Selection and training of operators, etc.;

- Maintenance of machines, plants and other equipment, so that they continue to produce satisfactory quality; and
- Systems, etc. to ensure that designs are correct.

There is considerable room for discretions as to what should or should not be included in prevention costs. Therefore, to make any meaningful control possible, it is essential for the quality manager and the accountant to agree precisely what should and should not be included (Marx, 2005: 27).

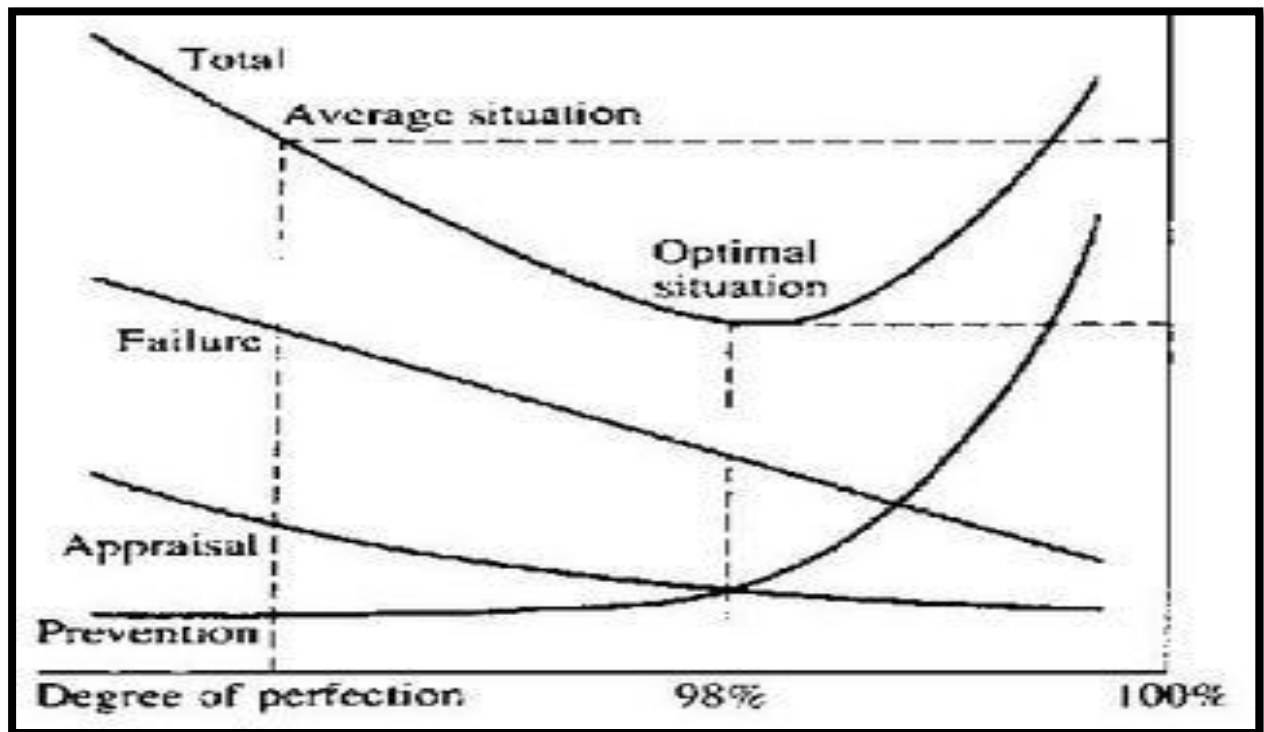
Table 3.1 Examples of Cost of Quality

Prevention	Appraisal
<ul style="list-style-type: none"> • Statistical Process Control • Capability/feasibility studies • Improvement programmes • Preventive actions • Consultancies • Training • Procedures/Work instructions • Communications • Calibration systems 	<ul style="list-style-type: none"> • Inspection • Design review • Code inspection • Audit (internal & external) • Testing • Training testers • BIW (Body & White) testing • Test equipment & automation • Usability testing
Internal Failure	External Failure
<ul style="list-style-type: none"> • Rectification • Scrap • Re-work • Concessionary work • Investigations • Corrective Actions 	<ul style="list-style-type: none"> • Rectifying returned products • Replacements • Warranty claims • Complaints • Site repairs • Lost custom/reputation • Legal ramifications

Source: Caplen (2001: 131)

The minimum total cost, for example, is shown below as being achieved at ninety eight percent perfection. This percentage is also known as best practice. That is, the cost of achieving an improvement outweighs the benefits of that improvement.

Figure 3.1: Cost of Quality



Source: Philips (2003: 23)

Similar cost curves created doubts amongst a few as the X-axis was labeled 'Defects'. In fact it is the 'degree of perfection' achieved towards the individual curves like Appraisal, Prevention, etc. In a few instances, this axis is taken with increasing quality of design (Philips, 2003: 22).

3.3.2.4 Right first time or zero defects

Earlier in this study, it was stated that General Motors South Africa's philosophy is to be right the first time, with no scrap or corrective operations. Under the title 'zero defects', the American colleagues have developed this idea into quite a best practice. Everyone is expected to aim for 'no defective' work in all instances. How does one reconcile this with Figure 3.1, showing clearly that in most cases minimum overall cost implies that some defective work will be made? The answer is that most operational shops work well above the percentage of defectives which would yield minimum overall cost. In these days, with so much emphasis on quantity and when incentive schemes tend to be quantity biased, it is all too easy for those on the shop floor to become somewhat indifferent to the amount of defective work made. With a little well-directed effort, they can reduce this defective work quite markedly, without any corresponding rise in prevention costs. Therefore, 'right first time' or 'zero defects' are good philosophies, which in practice assist the attainment of minimum overall cost (Philips, 2003: 27).

3.3.2.5 Cost and the manufacturing quality

The designer is responsible for converting customer requirements into manufacturing drawings and specifications. The higher the quality standard demands, (i. e. the tighter the tolerances), the more manufacturing will tend to cost. However, there is usually a critical limit represented by the capacity of the machine or process. Suppose, for example, that a machine is capable of producing a diameter of 20 mm to a minimum tolerance of ± 0.04 mm. As long as the drawing tolerances are wider than this, it may make only a marginal difference whether they are, say, ± 0.06 mm or ± 0.12 mm. It depends on the pattern of behaviour of the machine. If, however, the tolerances are tighter than ± 0.04 mm, out of limit work will be produced at an increasingly alarming rate (Mills, 2001: 39).

Table 3.2 Product identified which causes poor quality

CAUSE	NUMBER OF DEFECTS	PERCENTAGE
Poor design	60	48%
Defective parts	36	29%
Wrong part dimensions	12	10%
Incorrect machine calibration	7	6%
Operator errors	4	3%
Defective material	3	2%
Surface abrasions	3	2%
	125	100%

Source: Adapted from General Motors Supplypower 2011 monthly report

For each cause of poor quality, the number of defects attributed to that cause has been tallied over a period of time. Table 3.2 above identifies the major cause of poor quality to be poor design. However, for the purposes of this research project, the second highest items will be investigated, which are defective parts. Correcting the defective parts problem will result in a twenty nine percent quality cost savings with the least expenditure. However, the other problems should not be ignored. Total quality management (TQM) teaches that total and continual quality improvement is the long-term goal. Table 3.2 simply identifies that improving the top two concerns will have a positive impact on productivity.

3.4 PREVIOUS RESEARCH

Specifically to General Motors South Africa, no prior studies have been performed to understand the ‘delivery performance of a selected part’ and how effective the company has been addressing the challenges it encounter. This is partly a generic question, as some of the dynamics influencing supplier quality output are similar from company to company. Those dynamics form the basis of the research to determine the uniqueness of the ‘delivery performance of a selected part’ on lean manufacturing at General Motors South Africa.

Table 3.3 Lean manufacturing tool list

❖ Teamwork	❖ Total Quality
❖ ‘Kanban’	❖ ‘Kaizen’
❖ Value Stream Mapping	❖ Elimination of Waste
❖ Process Mapping	❖ Continuous Improvement
❖ ‘Pokayoke’	❖ Standardisation
❖ ‘Jidoka’	❖ One Piece Flow
❖ Work Balancing	❖ Visual Management
❖ Supplier Development	❖ Process Control
❖ Limited Storage	❖ Benchmarking

Source: Coldman (2000; 129)

3.5 CONCLUSIONS

This chapter presented the findings of a literature study for supplier quality, lean manufacturing, and cost of quality. The next chapter describes the design of the research and methodology.

CHAPTER 4

RESEARCH DESIGN AND METHODOLOGY

4.1 INTRODUCTION

Utilising science as an empirical method, questions can be asked and answers obtained objectively (McBurney, 1994: 103). It is this basic need to seek answers that lead to the question on what strategy to follow when obtaining these answers. Leedy and Ormrod (2005: 43) define research as the systematic process of collecting, analysing and interpreting information in order to increase our understanding of the phenomenon regarding our need to understand that which fuels our interest, or that which concerns us. Expressed differently, formal research is a structured technique to find solutions to problems that exist in any facet of society. This research is critically judged by peers in the field to determine its value to the advancement of this specific field. It implies that formal research can be trusted for its substance and validity. According to Collis and Hussey (2003: 84), before a research design is formulated, one needs to determine the research paradigm and choose a research topic because the choice of the paradigm has essential implications on the choice of methodology and methods for collecting data. According to Mouton and Babbie (2001: 74), all research starts with a research problem that is identified and clearly formulated, either in the form of a research question or a hypothesis, followed by the selection of an appropriate research design.

The aim of this chapter is to explain the process used during the empirical study and to document the results from the questionnaire, developed from the literature study. This is achieved through the following activities:

- Firstly, the research design is documented in order to explain the steps taken during the study;

- Secondly, the planning of the study is set out: this covers the population size, the development of the questionnaire, the pilot study, the administration of the questionnaire, and the responses to the questionnaire; and
- Finally, a quantitative analysis of the demographical data of the respondents is presented to identify the groups that responded to the questionnaire.

4.2 DEFINITION OF RESEARCH DESIGN

Research design is built from two distinctive elements, viz. research and design. A short definition of each are provided below.

4.2.1 Definition of research

What is research? Research is a systematic process of collecting, analysing, and interpreting information in order to increase one's understanding of the phenomenon one is concerned about or interested in (Leedy and Ormrod, 2005: 2). There is no consensus in the literature on how research should be defined because research means different things to different people. The following three things are mutually in agreement (Leedy and Ormrod, 2005: 11):

- Research is systematic and methodical;
- Research increases knowledge; and
- Research is a process of enquiry and investigation.

4.2.2 Definition of design

A detailed proposal relating to a defined piece of logical endeavor, including a definition of a problem, subject, or hypothesis for investigation, the background and context to the investigation, the proposed means and methods of the investigation, the work plan and timetable, details of the proposed investigators, management arrangements and quality control procedures (White, 2003: 3).

Design as a noun informally refers to a plan or convention for the construction of an object or a system (as in architectural blueprints, engineering drawings, business processes, circuit diagrams and sewing patterns), while “to design” (verb) refers to making this plan. No generally-accepted definition of “design” exists and the term has different connotations in different fields. More formally, design has been defined as follows: (noun) a specification of an object, manifested by an agent, intended to accomplish goals, in a particular environment, using a set of primitive components, satisfying a set of requirements, subject to constraints (Jackson, 1999: 158).

4.2.3 Research design and research methodology

Different types of research designs have different advantages and disadvantages. The design is the structure of any scientific work. It gives direction and systematises the research. The method chosen will affect the results and how findings are concluded. Most scientists are interested in obtaining reliable observations that can help the understanding of a phenomenon. It is a documented process for the management of projects that contains procedures, definitions and explanations of techniques used to collect, store, analyse and present information as part of a research process in a given discipline (Martin, 2001: 37).

Research can be defined as the search for knowledge, or as any systematic investigation, with an open mind, to establish novel facts, solve new or existing problems, prove new ideas, or develop new theories, usually using a scientific method. The primary purpose for basic research (as opposed to applied research) is discovering, interpreting and the development of methods and systems for the advancement of human knowledge on a wide variety of scientific matters of the world and the universe. Scientific research relies on the application of the scientific method, a harnessing of curiosity (Saunders, 2000: 29).

This research provides scientific information and theories for the explanation of the nature and the properties of the world around us. It makes practical applications possible. Scientific research is funded by public authorities, by charitable organisations and by private groups, including many companies. Scientific research can be subdivided into different classifications according to their academic and application disciplines. Artistic research, also seen as 'practice-based research', can take form when creative works are considered both the research and the object of research itself. It is this debatable body of thought which offers an alternative to purely scientific methods in research in its search for knowledge and truth. Historical research is embodied in the historical method (Thomas, 2004: 59).

Knowledge is a collection of facts, information, and/or skills acquired through experience or education or, more generally, the theoretical or practical understanding of a subject. It can be implicit (as with practical skill or expertise) or explicit (as with the theoretical understanding of a subject), and it can be more or less formal or systematic. In philosophy, the study of knowledge is called epistemology, and the philosopher Plato famously defined knowledge as 'justified true belief'. There is, however, no single agreed upon definition of knowledge, and there are numerous theories to explain it. Knowledge acquisition involves complex cognitive processes:

perception, learning, communication, association and reasoning, whilst knowledge is also said to be related to the capacity of acknowledgement in human beings. In the field of organisational knowledge management, the term is used to define 'the confident understanding of a subject with the ability to use it for a specific purpose if appropriate' (Schultz, 2003: 11).

Pure research, basic research or fundamental research is research carried out to increase the understanding of fundamental principles. Oftentimes the end results have no direct or immediate commercial benefits; pure research can be thought of as arising out of curiosity. However, in the long term it is the basis for many commercial products and applied research. Pure research is mainly carried out by universities. Pure research advances fundamental knowledge about the human world. It focuses on refuting or supporting theories that explain how this world operates, what makes things happen, why social relations are a certain way and why society changes. Pure research is the source of most new scientific ideas and ways of thinking about the world. It can be exploratory, descriptive, or explanatory; however, explanatory research is the most common. Pure research generates new ideas, principles and theories, which may not be immediately utilised, although they are the foundations of modern progress and development in different fields (Park, 2004: 37).

Today's computers could not exist without the pure research in mathematics conducted over a century ago, for which there was no known practical application at that time. Pure research rarely helps practitioners directly with their everyday concerns. Nevertheless, it stimulates new ways of thinking about deviance that have the potential to revolutionise and dramatically improve how practitioners deal with a problem. A new idea or fundamental knowledge is not generated only by pure research, but pure research can build new knowledge. In any case, pure research is

essential for nourishing the expansion of knowledge. Researchers at the center of the scientific community conduct most of what is pure research (Mullins, 2005: 109).

Generally speaking, methodology, unlike method (which systematically details a given procedure or process), does not describe specific methods, despite the attention given to the nature and kinds of processes to be followed in a given procedure or in attaining an objective. When proper to a study of methodology, such processes constitute a constructive generic framework; this may be broken down in sub-processes, combined, or their sequence changed. As such, methodology may entail a description of generic processes or metaphorically, may be extended to explications of philosophically coherent concepts or theories as they relate to a particular discipline or field of inquiry (Leedy and Ormrod, 2003: 67).

Table: 4.1 Differences between research design and research methodology

Research Design	Research Methodology
<ul style="list-style-type: none"> • Focuses on the end-product: What kind of study is being planned and what kind of results are aimed at • Point of departure = Research problem or question • Focuses on the logic of research: What kind of evidence is required to address the research question adequately 	<ul style="list-style-type: none"> • Focus on the research process and kind of tools and procedures to be used • Point of departure = Specific tasks (data collection or sampling) at hand • Focuses on the individual (not linear) steps in the research process and the most 'objective' (unbiased) procedure to be employed

Source: Mouton and Babbie (2001: 75)

4.3 RESEARCH DESIGN

Research involves the application of various methods and techniques to create knowledge through the use of scientific methods and procedures (Welman & Kruger, 1999: 3). Riley, Wood, Clark, Wilkie and Szivas, (2000: 9) refer to two types of research: pure research and applied research. Pure research is that which has no obvious practical implications beyond contributing to a particular area of intellectual enquiry. Applied research, on the other hand, is problem-focused and is directed towards solving some particular intellectual question that has practical implications for a client outside the academic world. According to Leedy, (1997: 147) research's role is

to provide a method for obtaining those answers by inquiring and studying the evidence within the parameters of a scientific method. These parameters are (Leedy, 1997: 147):

- Research originates from a main problem or question;
- Research has a goal;
- Research is formally planned and methodical;
- The main problem is broken down into more manageable and specific sub-problems;
- Research revolves around the main problem;
- Research uses critical assumptions, such as self evident truths;
- Data is interpreted to resolve the main problem as far as possible; and
- Research has a closed cycle, as it develops from a point and through logical explanation, returns to the problem with a plausible.

In the case of this study the main problem posed by the researcher is:

AN INVESTIGATION INTO THE IMPACT OF DELIVERY PERFORMANCE OF A SELECTED PART IN GENERAL MOTORS SOUTH AFRICA (GMSA).

According to Welman and Kruger (1999: 12) a research problem refers to some difficulty that the researcher experiences in the context of either a theoretical or practical situation and for which s/he wishes to obtain a solution.

Following from the main problem, the sub-problems below were developed to facilitate the solution of the main problem:

- **What can be learned from the literature about the impact of quality costs?**
- **Which parts are suitable candidates for a cost investigation?**
- **What are the processes involved if a defect occurs?**
- **How can the cost be estimated?**
- **What effect does poor supplier quality have on productivity?**

Research involves the application of various methods and techniques to create knowledge through the use of scientific methods of procedures (Welman & Kruger, 1999: 2). This research attempts to develop a strategy in order to solve a problem and is thus applied research.

The procedure used to resolve the main problem and the sub problems was as follows:

- A literature study was conducted to establish the paradigm of the delivery performance of a selected part in lean manufacturing operations. In carrying out this evaluation, it was necessary to evaluate the present situation within General Motors South Africa lean operations. Various theories were used;
- The literature study in Chapters 2, 3 and 4 was utilised to establish the answers to the three sub-problems. The empirical study aims to help create an understanding of practical issues experienced by General Motors South Africa during manufacturing operations, caused by non-conforming parts supplied by first tier suppliers. Ten first tier automotive suppliers were selected and General Motors South Africa operational areas were surveyed;
- In these chapters the researcher identified the main problem facing General Motors South Africa lean manufacturing operations. The key concepts pertaining to the study were highlighted and explained in these

chapters. The researcher explained the significance of the research and strived to identify previous research related to supplier quality and cost of quality strategies that was available;

- To solve the main problem, the researcher identified three sub-problems. The sub-problems dealt with in Chapter 2, identified problems and challenges faced by General Motors South Africa;
- Chapter 3: This section gives an overview of the literature on supplier quality requirements, lean manufacturing principles and cost of quality as it relate to this study. It provides abstract sections of different authors on the subject;
- The primary objective of this research is to investigate the impact of delivery performance for a selected part in General Motors South Africa's lean manufacturing operations and to integrate the data with theoretical material available, based on previous research;
- Chapter 4: This chapter describes the methodology used by the researcher and the theoretical basis for conducting this type of research. After discussing the research methodology in general, and the reasons for choosing a particular method for this study, attention is given to the questionnaire construction and administration;
- Chapter 5: This chapter represents the results of the empirical study. It is based on the results obtained in the three sections of the questionnaire, covering demographics, customer satisfaction, and general attitudes towards supplier quality performance. Each section will be discussed individually, both descriptively as well as graphically, where applicable. The response rate within the target group selected for this study was one hundred percent; and
- Chapter 6: In this chapter the researcher concludes the research project by briefly discussing the extent to which the main problem and sub-problems were solved. Through resolving the five sub-problems, the main problem will also have been solved. The main problem addressed the

question: What is the impact of the delivery performance of a selected part on General Motors South Africa? Conclusions concerning the achievement of the objectives of the study are made. Recommendations are provided to combat the root cause of inefficiencies that affect the delivery performance of a selected part in General Motors South Africa.

4.4 PLANNING THE EMPIRICAL STUDY

Research is the planning process that consists of the visualisation of data and problems associated with the employment of this data in the entire research project (Leedy, 1997: 93). A documented process for the management of projects that contains procedures, definitions and explanations of techniques used to collect, store, analyse and present information as part of a research process in a given discipline (Hutton, 1999: 37), is provided.

(Leedy, 1997: 93) describes the scientific method of research as the means whereby insight to the unknown is sought by:

- Identifying the problem that defines the goal of the quest;
- Gathering the data with the hope to solve the problem;
- Positioning a hypothesis both as a logical means of locating the data and as an aid to resolving the problem; and
- Empirically testing the hypothesis by processing and interpreting the data to determine whether the interpretation of it will solve the question that initiated the research.

In planning the empirical survey there can be distinguished between two approaches, viz. a quantitative and a qualitative study (Leedy, 1997: 105). For the purposes of this research, the researcher made use of the quantitative study. However, qualitative research is also explained.

(a) Quantitative Research

This form of research is well-suited to answer questions about relationships with the purpose of explaining, predicting, and controlling a single phenomenon or between two or more phenomena. It tests the situation as it is, and it either confirms or dismisses the hypotheses being tested (Leedy, 2005: 179).

The following research designs are aimed at providing quantitative information that can be summarised through statistical analysis:

- **Survey research.** A descriptive (or normative) survey uses a sample group of the targeted group to acquire information with relation to the research field, by asking questions and tabulating those answers. The study draws inferences of the group based on the response of the sample group. These surveys can be conducted by means of a face-to-face or telephone interview, or through the use of a questionnaire;
- **Developmental designs.** One can distinguish between two types, namely cross-sectional and longitudinal studies. Both are used primarily in the study of developmental patterns within society. Cross-sectional implies the study of a cross-section of society at the same time, while longitudinal studies refer to the same sample group over an extended period of time;

- **Correlation research.** Data is gathered around two or more characteristics or variables under research. The differences between the characteristics are compared for correlation and interdependency; and
- **Observation studies:** Frequencies within a particular aspect of behavior being researched are quantified. This study form usually involves comprehensive advance planning and concentration on detail (Leedy, 2005: 177-186).

Quantitative research is generally conducted using scientific methods, which can include (Leedy, 2005: 188):

- The generation of models, theories and hypotheses;
- The development of instruments and methods for measurement;
- Experimental control and manipulation of variables;
- Collection of empirical data;
- Modeling and analysis of data; and
- Evaluation of results.

Quantitative Methods

Quantitative methods are research techniques that are used to gather quantitative data — information dealing with numbers and anything that is measurable. Statistics, tables and graphs are often used to present the results of these methods. They are therefore to be distinguished from qualitative methods.

In most physical and biological sciences, the use of either quantitative or qualitative methods is uncontroversial, and each is used when appropriate. In the social sciences,

particularly in sociology, social anthropology and psychology, the use of one or other type of method has become a matter of controversy and even ideology, with particular schools of thought within each discipline favoring one type of method and pouring scorn onto the other (Coldwell, 2004: 29). Advocates of quantitative methods argue that only by using such methods can the social sciences become truly scientific; advocates of qualitative methods argue that quantitative methods tend to obscure the reality of the social phenomena under study, because they underestimate or neglect the non-measurable factors, which may be the most important.

The modern tendency (and in reality the majority tendency throughout the history of social science) is to utilise eclectic approaches. Quantitative methods might be used with a global qualitative frame. Qualitative methods might be used to understand the meaning of the numbers produced by quantitative methods. Using quantitative methods, it is possible to provide precise and testable expression to qualitative ideas. This combination of quantitative and qualitative data gathering is often referred to as mixed-methods research (Leedy, 2005: 189).

(b) Qualitative Research

Qualitative research is designed to reveal a target audience's range of behavior and the perceptions that drive it, with reference to specific topics or issues. It uses in-depth studies of small groups of people to guide and support the construction of hypotheses. The results of qualitative research are descriptive rather than predictive. Qualitative research methods originated in the social and behavioral sciences: sociology, anthropology and psychology. Today, qualitative methods in the field of marketing research include in-depth interviews with individuals, group discussions (from two to ten participants is typical), diary and journal exercises and in-context observations.

Sessions may be conducted in person, by telephone, via videoconferencing and via the Internet (Robertson, 2007: 37).

Qualitative research has several methods for conducting research. These are different from each other, but have two common features. They focus on issues in their natural or real setting and they study all the complexities of those issues (Leedy, 2005: 132). This method answers questions with regards to complex issues or phenomena, in such a way that it is analysed and understood from the researcher's own viewpoint. Leedy (2005: 133) refers to this method as the interpretative, post-positivist or constructivist approach.

Qualitative research is a set of research techniques, used in marketing and the social sciences, in which data is obtained from a relatively small group of respondents and not analysed with inferential statistics. This differentiates it from quantitative analysed data for statistical significance (Marks, 2000: 102). Qualitative research is a holistic view and the researcher focuses on the design, interview instruments, interpretations, developments and changes along the way. The researcher needs to interact with the participants and, with this interaction, variables will emerge from the data which will lead to patterns and theories that will shape and explain the study (Leedy, 1997: 106). 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 main types of qualitative research

According to Mark (2000: 107), the main types of qualitative research are:

- **In-Depth Interviews**

- interview is conducted one-on-one and lasts between thirty and sixty minutes;
 - best method for in-depth probing of personal opinions, beliefs and values;
 - very rich depth of information;
 - very flexible;
 - probing is very useful at uncovering hidden issues; and
 - unstructured (or loosely structured) - this differentiates them from survey interviews in which the same questions are asked to all respondents.
- **Focus Groups**
 - an interactive group discussion led by a moderator;
 - unstructured (or loosely structured) discussion where the moderator encourages the free flow of ideas;
 - usually eight to twelve members in the group who fit the profile of the target group or consumer, but may consist of two interviewees (a dyad), three interviewees (a triad) or a lesser number of participants (known as a mini-group);
 - usually last for one to two hours;
 - can use computer and internet technology for on-line focus groups; and
 - respondents feel a group pressure to conform.

- **Projective Techniques**

- these are unstructured prompts or stimuli that encourage the respondents to project their underlying motivations, beliefs, attitudes or feelings onto an ambiguous situation; and
- they are all indirect techniques that attempt to disguise the purpose of the research.

Qualitative research methods are used to serve one or more of the following purposes:

- **Evaluation.** To measure the effectiveness of particular policies, practices or innovations;
- **Verification.** Test the validity of certain assumptions, theories or generalisation in a real world context;
- **Interpretative.** To gain new insight into a particular issue or phenomenon, develop a new concept or theoretical perspective or to discover problems within the phenomenon; and
- **Descriptive.** To reveal the nature of a certain situation, process, relationship, system or people (Leedy, 2005: 133).

How to choose:

Qualitative research is used to denote approaches which are supported by a set of hypotheses concerning the way the social world functions. It deduces many of its basic principles from the perspective that there are fundamental differences between the science of human world and science of natural world, and consequently needs to use distinctive methods. The significance of qualitative research rests in placing stress on

describing and understanding complex phenomena. It investigates, for instance, the relationships and patterns among factors, or the context in which the activity happens. It is concentrated with understanding the full multi-dimensional picture of the subject of investigation.

The approaches of the qualitative research differ from the methods of the quantitative research. Quantitative methods aim at dividing into clearly defined parts or variables. One disadvantage of the quantitative as well as qualitative research is that it does not always underpin the understanding of multi-dimensional pictures. Qualitative methods are helpful, not only in giving rich explanations of complex phenomena, but in creating or evolving theories or conceptual bases and in proposing hypotheses to clarify the phenomena. Its major disadvantage is that the small group of interviewed individuals cannot be regarded as representative (Schwartz, 2011: 101). Each research design in its own right present advantages and disadvantages when employed (Leedy, 2005: 144).

Table: 4.2 Features of the main two approaches

Quantitative Approach	Qualitative Approach
<ul style="list-style-type: none"> • Tends to produce quantitative data • Uses large samples • Concerned with hypothesis testing • Data is highly specific and precise • The location is artificial • Reliability is high • Validity is low • Generalises from sample to population 	<ul style="list-style-type: none"> • Tends to produce qualitative data • Uses small samples • Concerned with generating theories • Data is rich and subjective • The location is natural • Reliability is low • Validity is high • Generalises from one setting to another

Source: Collis and Hussey (2003: 55)

4.4.1 Research Methodology Utilised

Research is a systematic examination to discover new information to expand or verify existing knowledge in an attempt to resolve a problem. Leedy (1997: 5) further describes methodology as the logic of implementing scientific methods in the study of reality within the research cycle. Four research methodologies may be utilised, depending on the type of research objective:

- The historical method;
- The descriptive survey method;
- The analytical survey method; and
- The experimental method.

The three methods of data collection are the standardised, unstructured, and structured data collection methods. Unstructured and standardised data collection methods are specialised techniques and require considerable experience to control. Structured data collection methods are not as specialised or analytical; therefore, it can be used by most researchers (Leedy, 1997: 240). The 'descriptive survey method', as an example of the structured method, was used to obtain data for this research.

4.4.1.1 Literature study

The researcher identified the role of supplier quality on lean manufacturing operations and the importance of implemented quality management systems on sustainability, reliability and continuous improvement best practices. Supplier quality information will be derived from the literature survey.

4.4.1.2 The empirical study

a) E-mail Survey

The empirical study was conducted by means of an e-mail survey with the use of a questionnaire (see Annexure 1.1 and 1.2) developed from the literature study. The results of the questionnaire were tabulated and statistically analysed. The e-mail survey was conducted among operational team leaders, coordinators, managers and other business partners, utilising a questionnaire drawn up by the researcher to analyse the information obtained from conducting the literature survey. The questionnaire identified the impact of delivery performance of a selected part of General Motors South Africa in lean manufacturing operations and the challenges faced by operational levels and other business partners.

b) Measuring instrument

The researcher developed a comprehensive questionnaire for this research project to determine the impact of delivery performance for a selected part of General Motors South Africa lean manufacturing operations and the challenges faced by operational levels.

c) Sample

The researcher identified twenty operational team leaders and coordinators and ten operational managers to enable an in-depth analysis. The researcher identified ten component suppliers in the Eastern Cape. However, questionnaires were not distributed to the suppliers.

4.4.1.3 The questionnaire

The questionnaire is a common instrument for observing data beyond the physical reach of the observer (Leedy, 1997: 191). The questionnaire used in this study was developed using information obtained from the literature study. The questions were selected to address each of the five sub-problems impacting on lean operations. The instructions to a questionnaire must ensure that all respondents are treated equally. Two principles form the foundation for good instructions, viz. clarity and courtesy. These two principles were used in the development of the questionnaire.

Table 4.3 The main decisions when using questionnaires

- Sample size;
- Type of questions;
- Wording of the question and how to ensure that they are intelligible and unambiguous;
- Design of the questionnaire, including any instructions;
- Wording of any accompanying letter;
- Method of distribution and return of the completed questionnaires;
- Test for validity and reliability and when they should be applied;
- Methods for collating and analysing the collected data; and
- Any action to be taken if questionnaires are not returned.

Source: Collis and Hussey (2003: 174)

Questionnaires, in this instance, are most suited for the acquisition of data. It is advantageous because the respondent completes the questionnaire electronically, fast and effectively, and remains anonymous, ensuring true and factual data. To ensure that respondents' data are accurate, each question is explained in detail, giving the respondent clear instructions on what is meant by the question, preventing bias. (Riley (1998: 83) states that there may be open and closed questions. A closed question is one where responses are restricted to a small set of responses that generate precise answers. Open-ended questions do not impose restrictions on the possible answer, but are difficult to aggregate and computerise. A structured questionnaire must provide questions possessing an element of steering information for the respondent without any prompting from the researcher. This was the method used in the questionnaire developed for the empirical study.

The questionnaire is divided into three parts:

It consists of closed questions. Some of these required respondents to record the degree to which they concurred with certain statements. Others required ranking in order of importance and the balance were 'yes' or 'no' type of questions. The benefits of the method of questioning are the following: The quantitative data collection methods rely on random sampling and structured data collection instruments that fit diverse experiences into predetermined response categories. They produce results that are easy to summarise, compare, and generalise (Collis & Hussey, 2003: 170).

The Likert scale is the most widely used form of scaled items where the respondent chooses a point on a scale that best represent his/her view (Allison, 1996: 83). In this study a five point Likert-type scale was used. Scoring for the scale is as follows: 1 indicates strong agreement, 2 indicates agreement, 3 indicates uncertainty, 4 indicates disagreement and 5 indicates strong disagreement. Riley (1999: 121) added that the Likert scale must have some dividing point between positive and negative. This function is performed by the midpoint in this scale, which is neutral. The scale is used to measure a batch of attitudes that are added together for the researcher to draw conclusions.

In-ordinal measurement is numbers used to rank the order of cases on some variable. In this study ordinal measurement was used to measure the intervals between variables pertaining to certain practices in the organisations surveyed (Singleton, 1993: 111). Ordinal measurements are rather crude and as such few statistical operations may be used in their analysis (Singleton, 1993: 112). According to Thomas (1996: 121) questions should not lead respondents who do not have clear views of their own on a particular issue. Simple grammar should be used and the things that the respondents have to keep in mind in order to understand the question should be limited. Specific

terms should be used in preference to abstract ones: this ensures that the respondent has a clear understanding of the question. The questions should be easy for the respondent to answer.

(Riley, 1999: 96) name the following key issues pertaining to questionnaire design:

- Test the questionnaire first;
- Give clear instructions;
- Make the layout easy to follow;
- Get the question order right. Be straightforward and guard against double meanings;
- Each question should be polite;
- Using simple concise language;
- Do not make unrealistic demands of those who fill in the questionnaire; and
- Each question should have no 'escape route', for example 'don't know' or 'no comment'.

According to Cooper and Schindler (1996: 333) open-ended questions may be used for comments and to capture any unusual circumstances not covered in the structured factor list. When drawing up the questionnaire the above principles were followed.

4.4.1.4 Testing the questionnaire

Before the completion of the questionnaire, the questions were checked by professional staff members from the Department of Statistical Studies at the Nelson Mandela Metropolitan University. (Refer to Annexure 1.2).

a) Test Validity

In science and statistics, validity has no single agreed definition, but generally refers to the extent to which a concept, conclusion or measurement is well-founded and corresponds accurately to the real world. The word 'valid' is derived from the Latin word 'validus', meaning strong. Validity of a measurement tool (i.e. test in education) is considered to be the degree to which the tool measures what it claims to measure (Kendler, 2006: 34).

Perri (2010: 47) states that there are several types of validity. These are:

- **Construct validity:** refers to the extent to which operationalising of a construct (e.g. practical tests developed from a theory) actually measure what the theory says it does;
- **Content validity:** is a non-statistical type of validity that involves "the systematic examination of the test content to determine whether it covers a representative sample of the behavior domain to be measured";
- **Criterion validity:** evidence involves the correlation between the test and a criterion variable (or variables) taken as representative of the construct. In other words, it compares the test with other measures or outcomes;
- **Convergent validity:** refers to the degree to which a measure is correlated with other measures that it is theoretically predicted to correlate with;

- **Face validity:** is an estimate of whether a test appears to measure a certain criterion; it does not guarantee that the test actually measures phenomena in that domain;
- **Concurrent validity:** refers to the degree to which the operationalising correlates with other measures of the same construct that are measured at the same time;
- **Predictive validity:** refers to the degree to which the operationalising can predict (or correlate with) other measures of the same construct that are measured at some time in the future;
- **Internal validity:** is an inductive estimate of the degree to which conclusions about causal relationships can be made (e.g. cause and effect), based on the measures used, the research setting and the whole research design; and
- **External validity:** concerns the extent to which the (internally valid) results of a study can be held to be true for other cases, for example to different people, places or times. In other words, it is about whether findings can be validly generalised.

In this study, face validity, content validity and construct validity were used.

b) Reliability

Validity is often assessed along with reliability. Reliability is the extent to which a measurement gives consistent results. In statistics, reliability is the consistency of a set of measurements or of a measuring instrument, often used to describe a test. Reliability is inversely related to random error (Houston, 2003: 24).

There are several general classes of reliability estimates, according to Roussouw (2002: 79)

- Inter-rater reliability is the variation in measurements when taken by different persons but with the same method or instruments;
- Test-retest reliability is the variation in measurements taken by a single person or instrument on the same item and under the same conditions. This includes intra-rater reliability;
- Inter-method reliability is the variation in measurements of the same target when taken by a different methods or instruments, but with the same person, or when inter-rater reliability can be ruled out. When dealing with forms, it may be termed parallel-forms reliability; and
- Internal consistency reliability assesses the consistency of results across items within a test.

Table 4.4 Questions of Reliability and Validity

Quantitative	Qualitative
<ul style="list-style-type: none"> • Validity: Does an instrument measure what it is supposed to measure? • Reliability: Will the measure yield the same results on different occasions (assuming no real change in what is to be measured)? 	<ul style="list-style-type: none"> • Has the researcher gained full access to knowledge and meanings of informants? • Will similar observations be made by different occasions?

Source: Easterby-Smith, Thorpe and Lowe (1991: 41)

4.4.1.5 The analysis of the questionnaire

The researcher's aim with the questionnaire was to provide meaning to the theoretical information gathered, by analysing a real-time scenario. The study was designed to determine what problems and challenges first tier suppliers face in lean manufacturing in section 2. The interview section relates to the organisation and activities within in the operational areas that forms the basis of lean manufacturing. Section 3 relates to the effects of supplier quality discrepancies in lean manufacturing. Section 4 relates to supplier quality strategies to overcome operational disruptions.

The answers to the questions were related to the opinions formed in the theoretical study. This comparison was then utilised to create the model presented in Chapter 5.

4.5 CONCLUSIONS

This chapter discussed the research design and methodology used obtaining the required information. The results of the research are presented in the following chapter.

CHAPTER 5

THE EMPIRICAL STUDY ANALYSIS AND INTERPRETATION OF RESULTS

5.1 INTRODUCTION

This chapter represents the results of the empirical study. It is based on the results obtained in the three sections of the questionnaire, covering demographics, customer satisfaction and general attitudes towards supplier quality performance. Each section is discussed individually, both descriptively as well as graphically where applicable. The response rate within the target group selected for this study was one hundred percent. This is considered exceptionally well for the study.

The aim of this chapter is to analyse the results of the empirical study, and interpret it within the context of the theoretical framework outlined in this study. According to Leedy and Ormrod (2005: 179), quantitative research examines a situation as it is and does not involve itself in changing or modifying the situation under investigation. A methodological analysis approach for analysing the data is utilised.

5.2 HOW INFORMATION FOR THE QUANTITATIVE STUDY WAS OBTAINED

The activities that took place at General Motors South Africa's business area during the period from 26 September 2011 until 14 October 2011, were observed. During the observation period, employees were engaged formally and questionnaires were utilised to access their mindset on the delivery performance of a selected part at General Motors South Africa (see Annexure 1.1).

5.3 RESULTS OF THE QUANTITATIVE STUDY

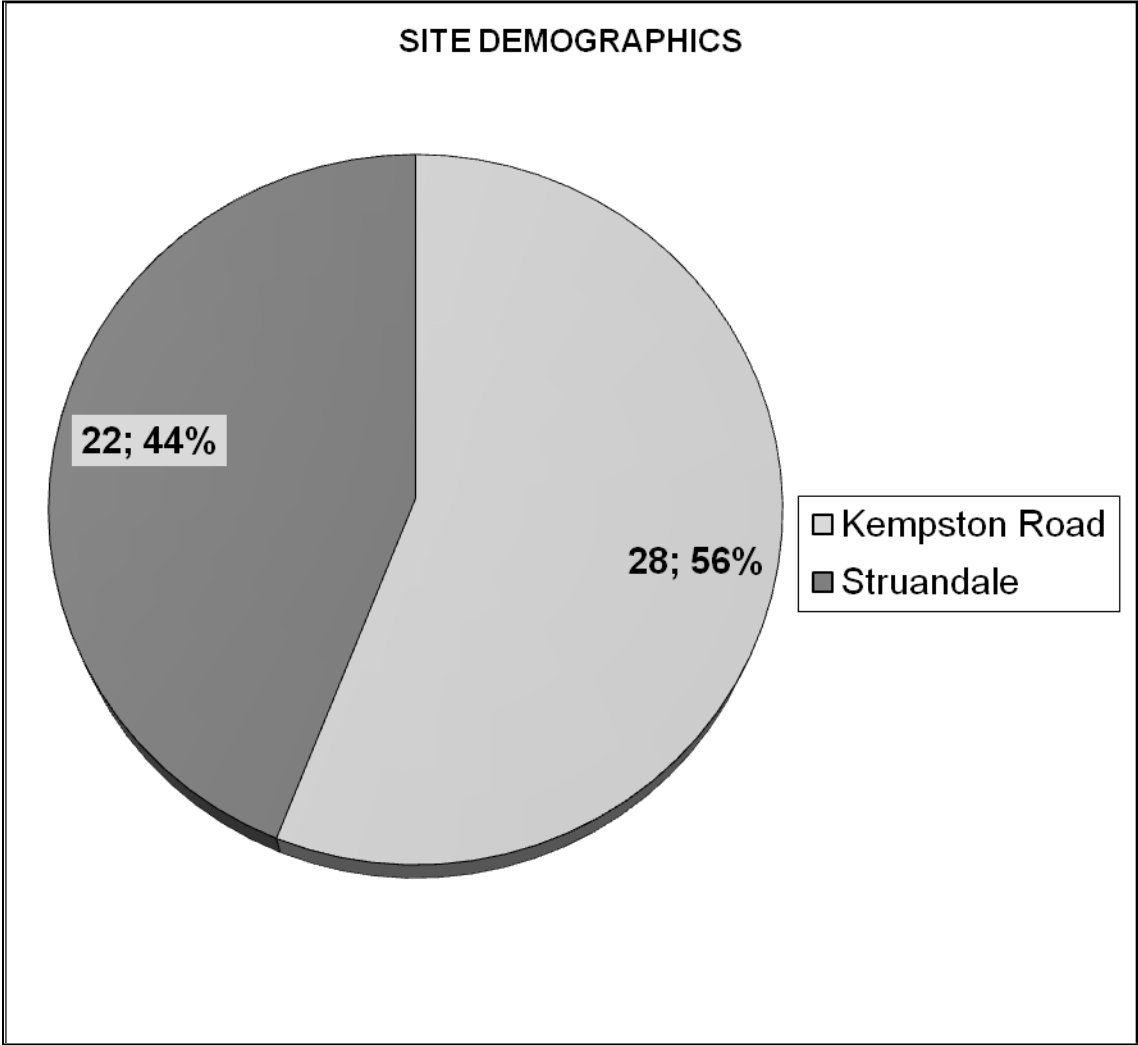
- Fifty questionnaires were sent to and returned by a select group of General Motors South Africa employees;
- An analysis and interpretation of the responses on each mentioned question was then performed;
- A total of nineteen questions were asked in the questionnaire to the General Motors South Africa employees; and
- Questions gathered information on demographical information, customer satisfaction and the general attitudes towards supplier quality performance.

The results, as gathered by the questionnaires, are listed below:

5.3.1 Section A: Demographic information, the results and an analysis

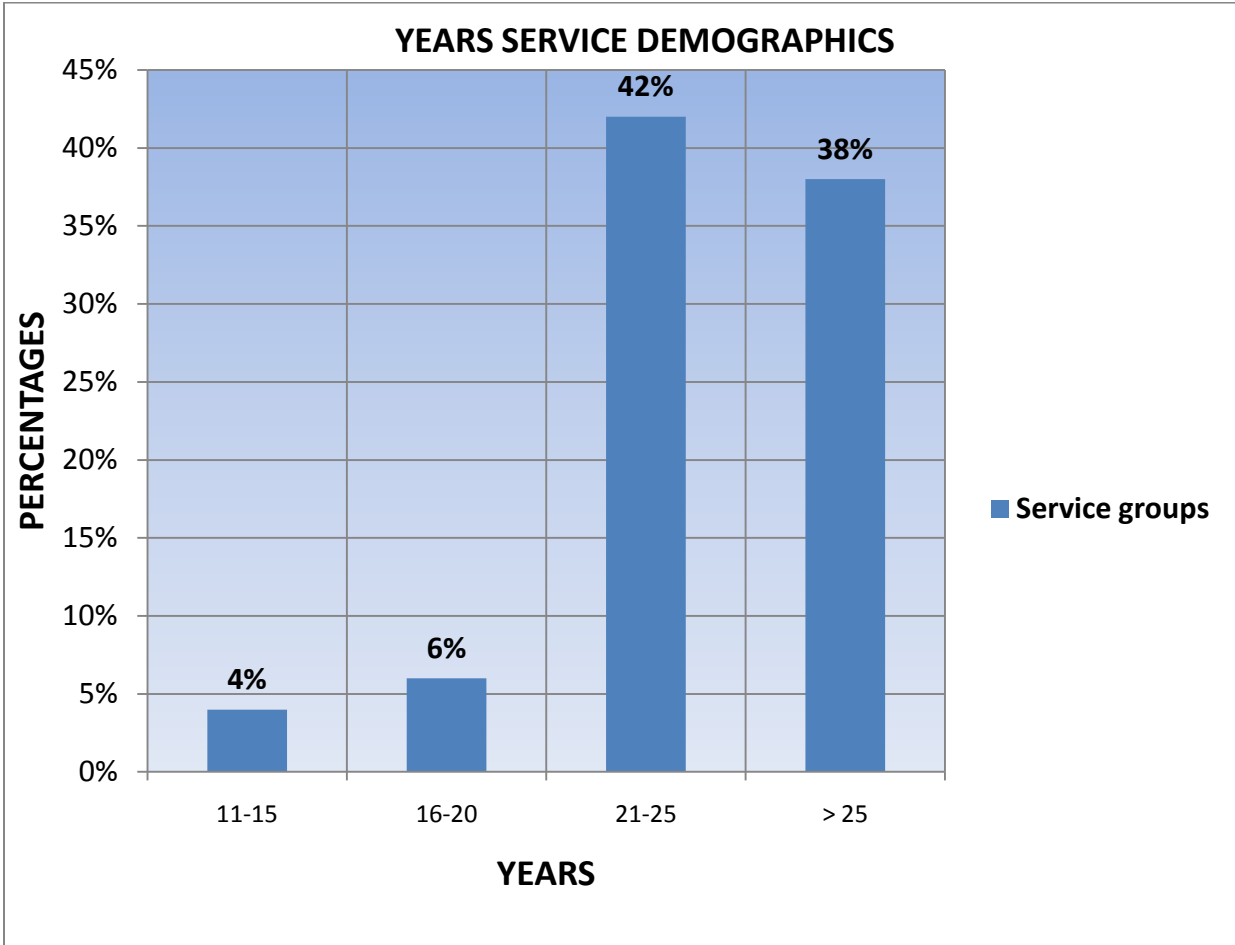
A total of five questions were asked in this section of the questionnaire, presented to General Motors South Africa staff.

Figure 5.1 Site demographics of the respondents



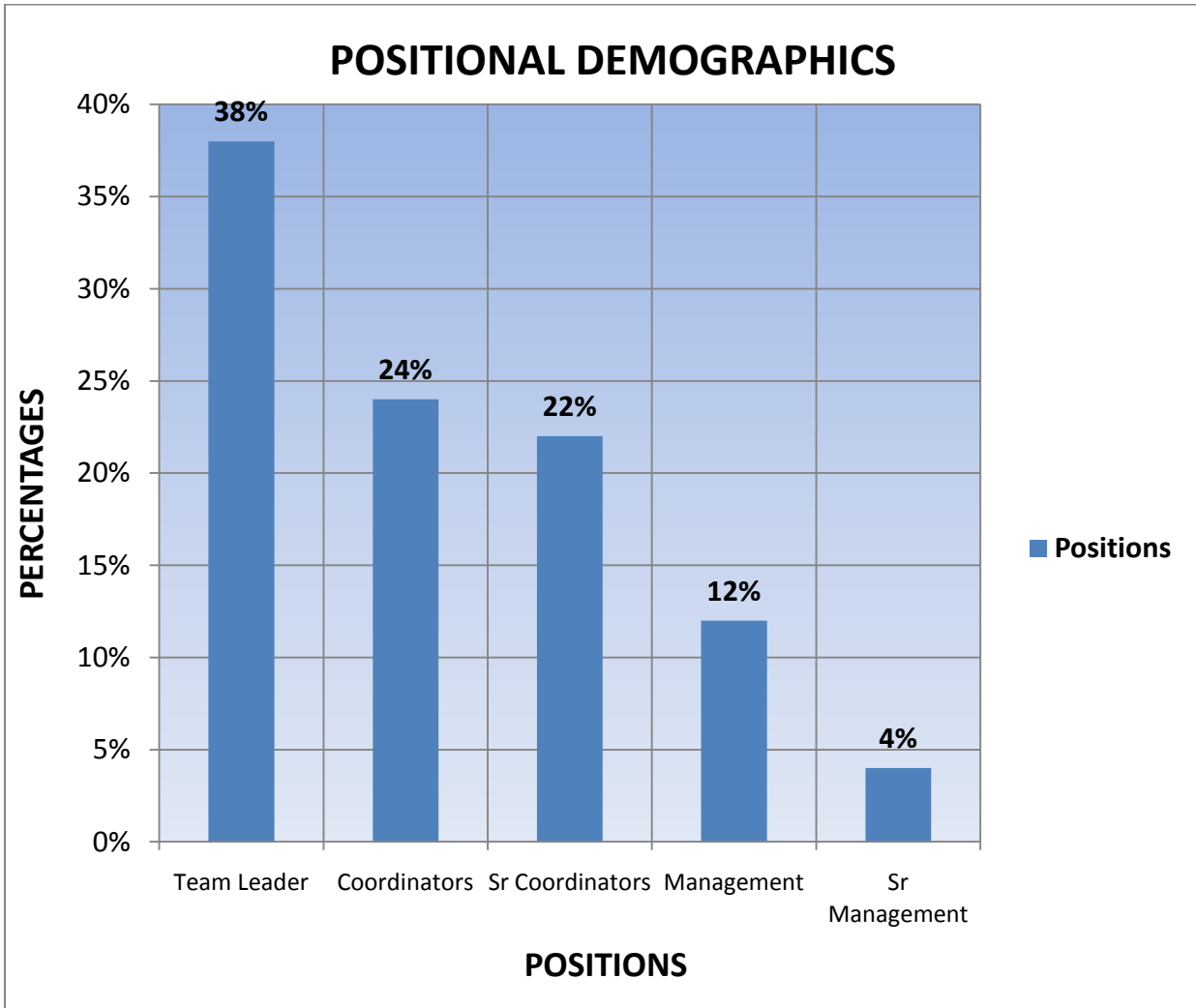
The respondents were well-spread between the two plants (Kempston Road with 56% and Struandale with 44%), with the amount of respondents representative of the overall headcount in the target group. (Refer to figure 5.1)

Figure 5.2 Service years demographics of the respondents



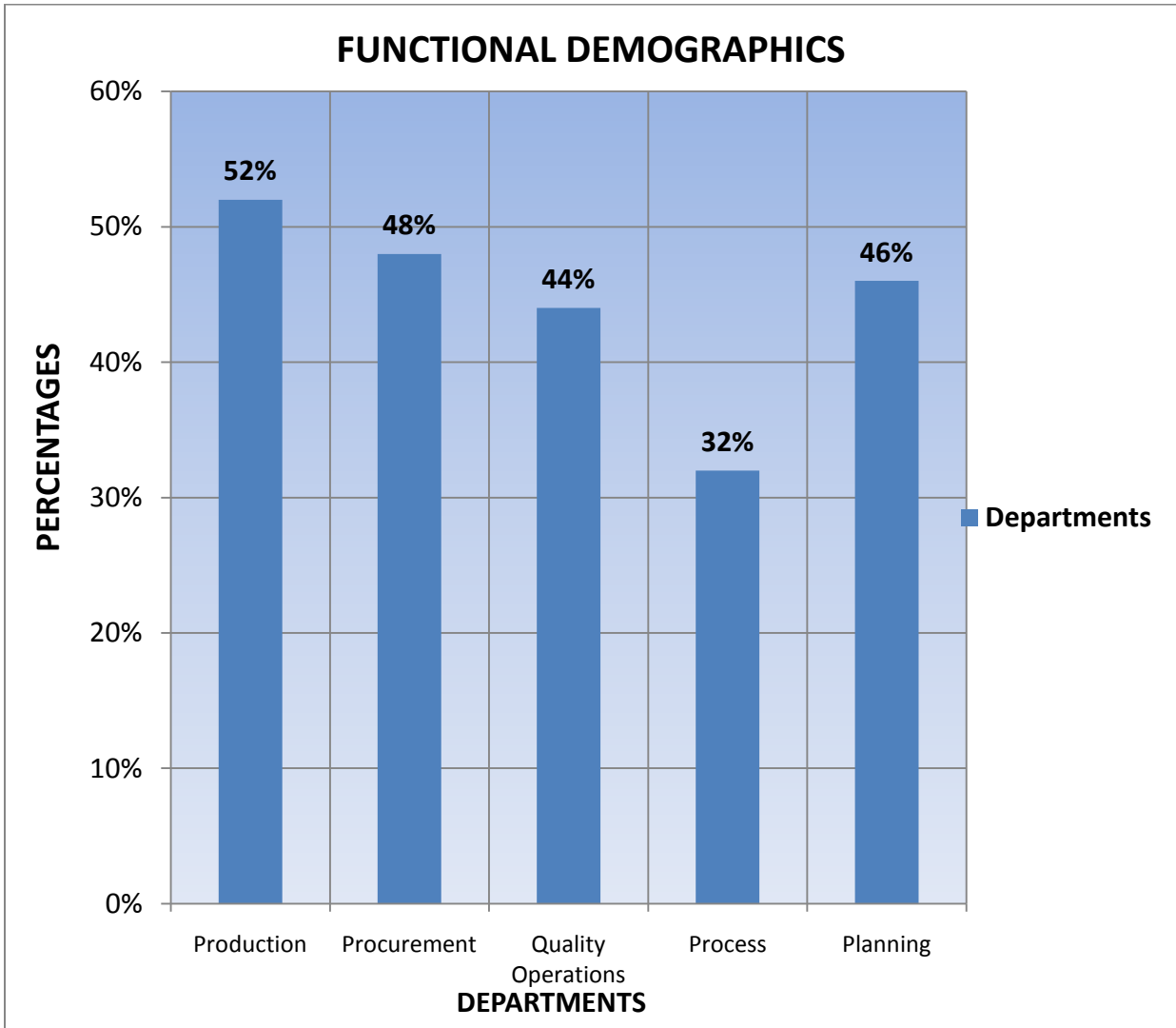
The respondents in the study group are predominantly 42% between service years 21 to 25 and 38 % of the respondents have service years above 25 years. In total 80% of the respondents have more than 20 service years. More than 10% has service years above 11 and only 10% has service years of less than 10. In total 90% of the respondents have more than 10 service years. (Refer to Figure 5.2)

Figure 5.3 Positional demographics of the respondents



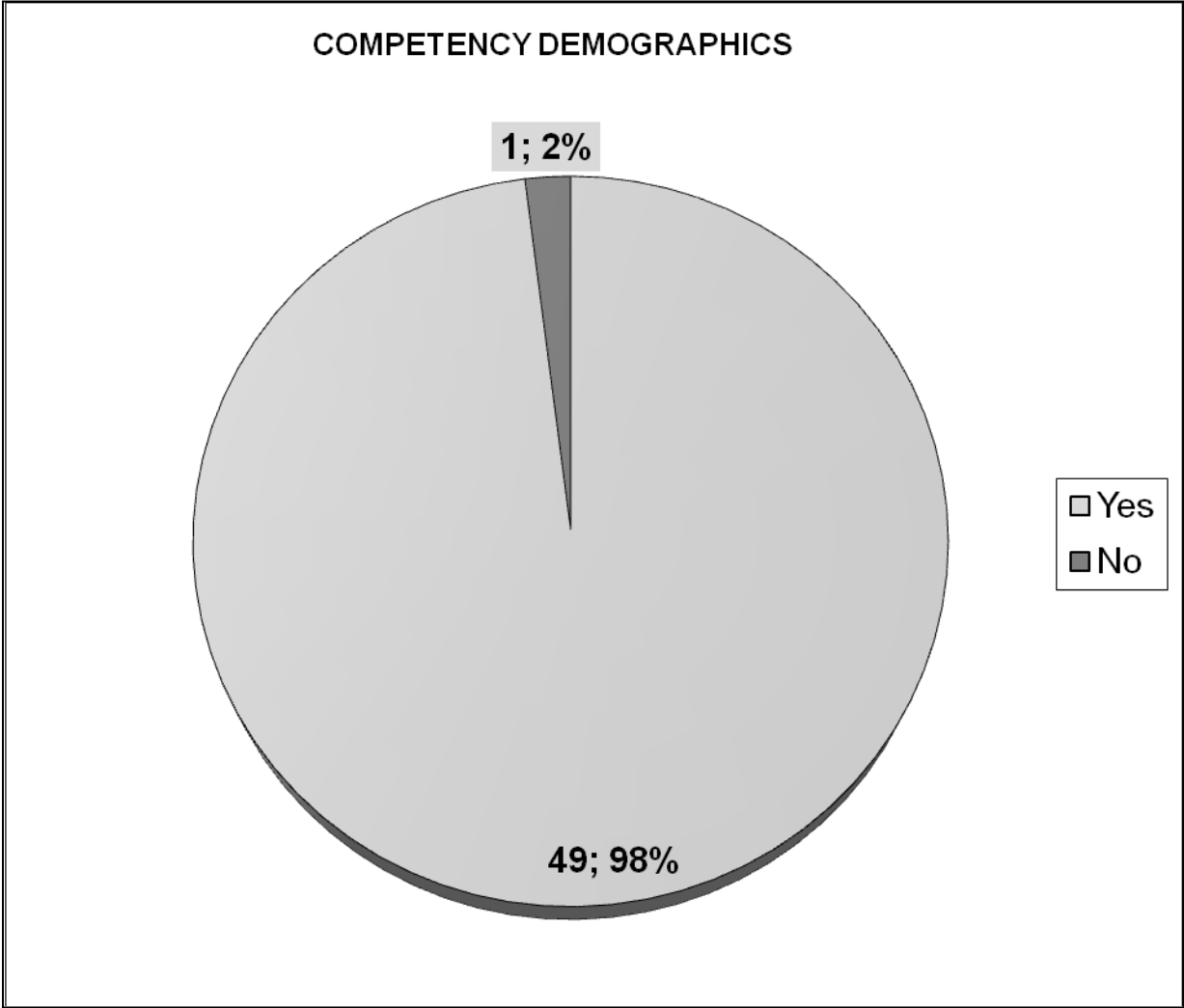
The majority of the respondents were at team leader level 38%, followed by the coordinators 24% and the senior coordinators 22%. On these three levels the response was representative, especially when considering that these are the personnel dealing daily with the selected supplier’s part performance. On management level 12% and on senior level 4% acknowledged the selected supplier’s part performance. (Refer to Figure 5.3)

Figure 5.4 Functional demographics of the respondents



The majority of the respondents were from the production departments 46%, followed by the quality operations department 28%. The process engineering department respondents represented 14%. The respondents from these three departments were representative, especially when considering that these are the personnel dealing on a daily basis with the selected supplier's part performance. The procurement department respondents represented 10% and the planning department 2% of the acknowledgement of the selected supplier's part performance. (Refer to Figure 5.4)

Figure 5.5 Competency demographics of the respondents



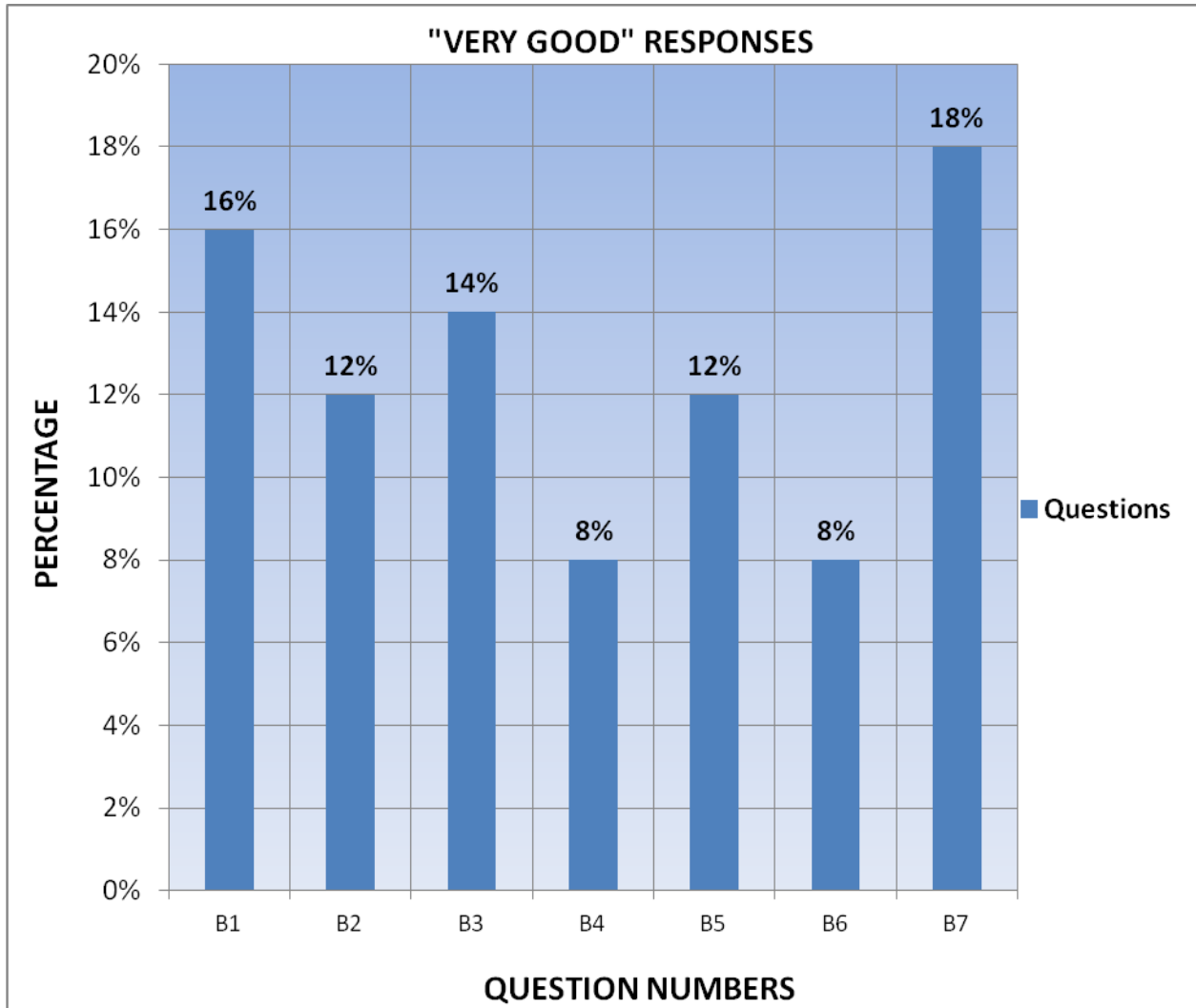
The respondents in the study group predominantly responded 'yes' 98% and only 2% responded 'no' on being competent in supplier quality standards. (Refer to figure 5.5)

5.3.2 Section B: Customer Satisfaction information, the results and an analysis

A total of eight questions were asked in this section of the questionnaire to General Motors South Africa personnel. The replies on the first seven questions range from

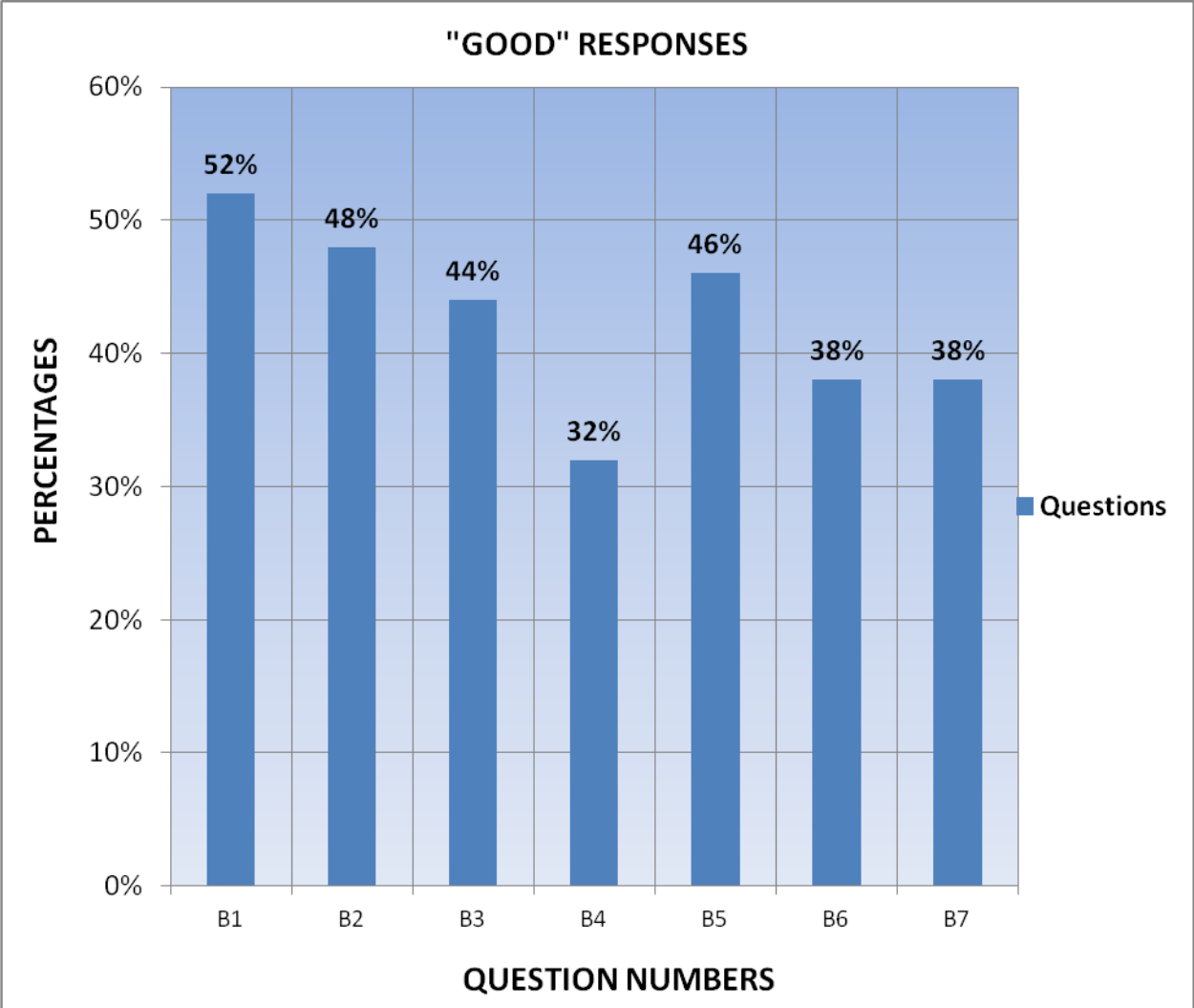
'poor' to 'excellent' rating. Question 8 required from respondents to indicate the most problematic part supplied.

Figure 5.6 Results for "very good" question



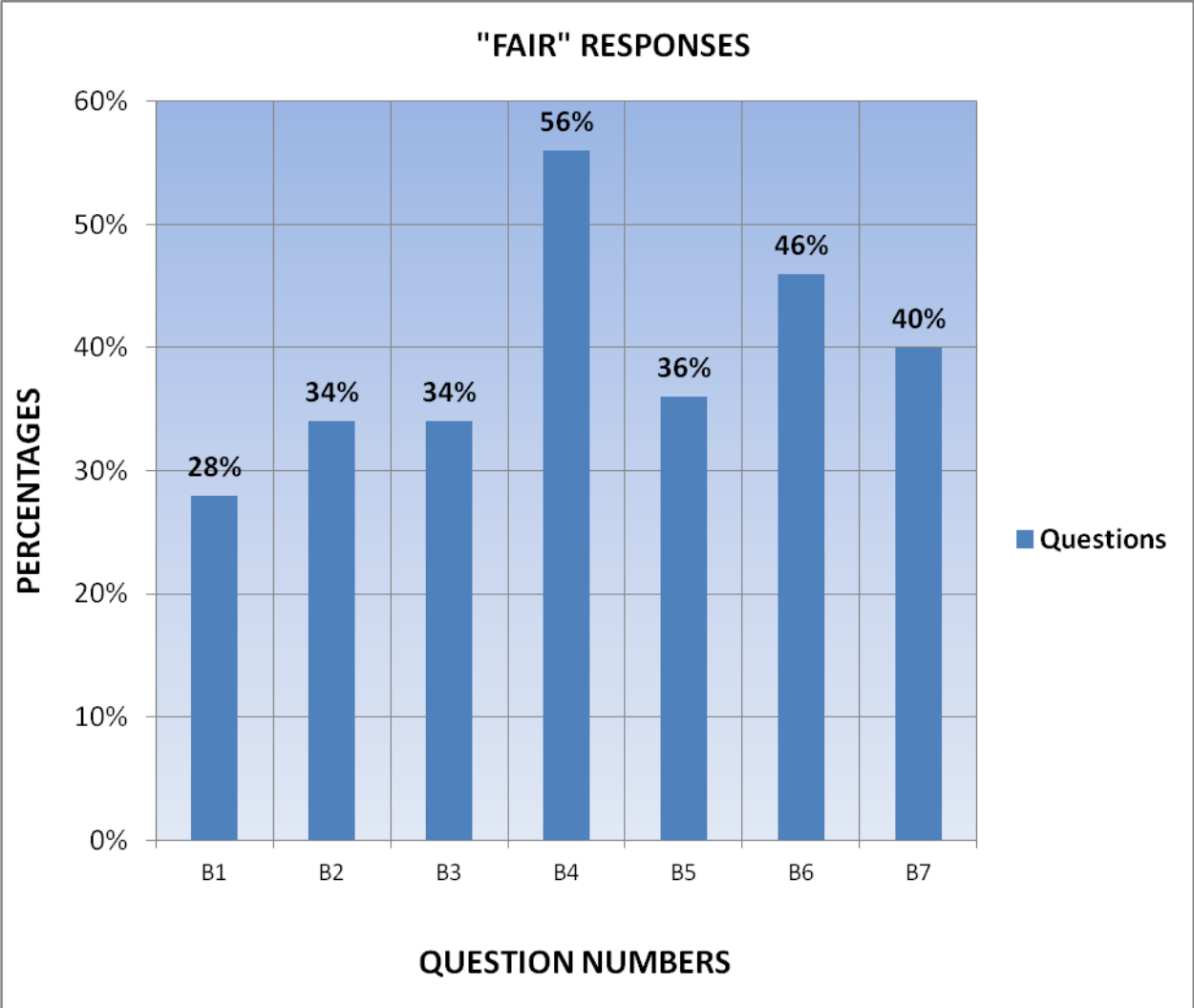
From a total of seven questions, there was a 'very good' response on all of the questions. Figure 5.6 shows the top questions that received 'very good' customer satisfaction ratings from the personnel.

Figure 5.7 Results for “good” question



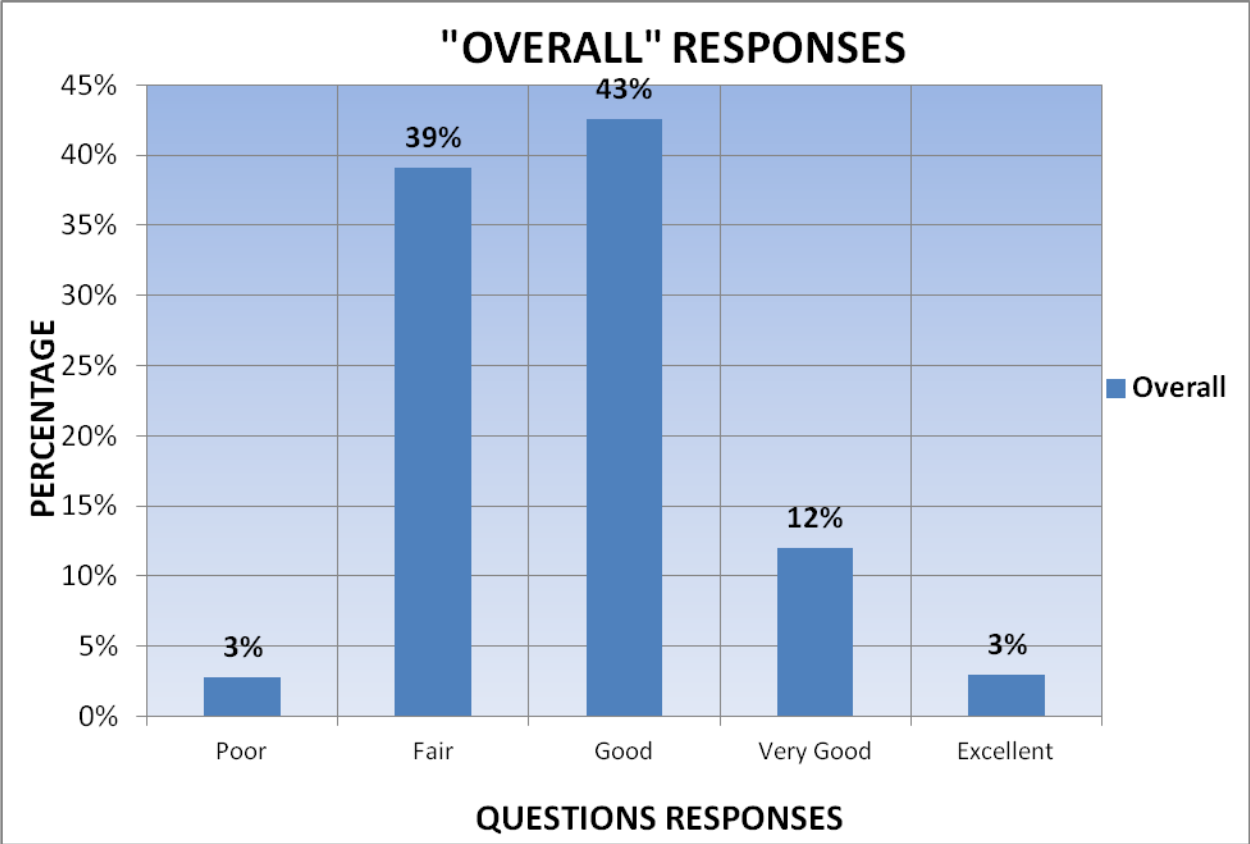
A total of seven questions produced the above ‘good’ responses on questions. Figure 5.7 shows the top questions that received ‘good’ customer satisfaction ratings from the personnel.

Figure 5.8 Results for "fair" question



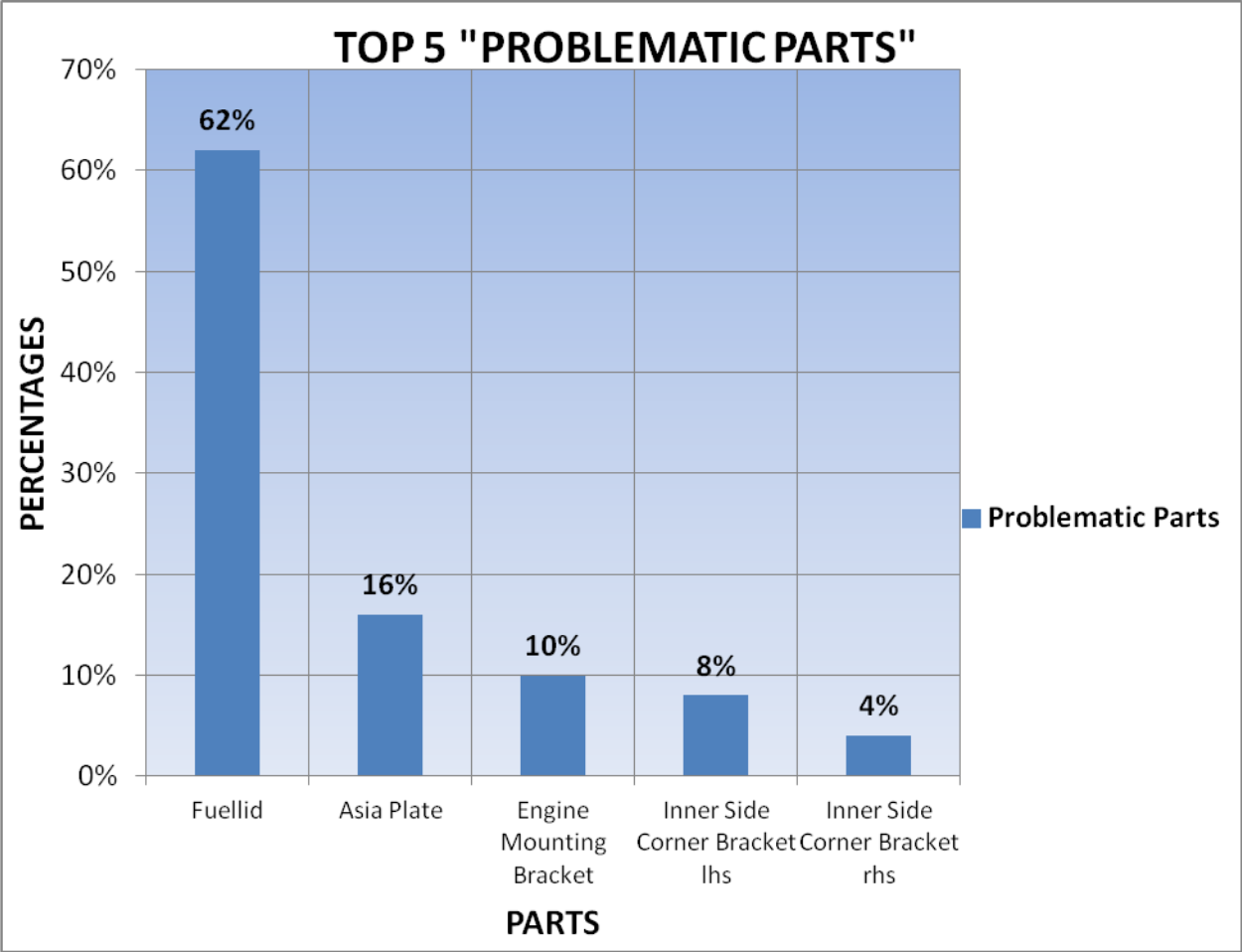
The top three of the respondents customer satisfaction was 56%, followed by 46% and 40% fair. The other respondents ratings was 36%, 34% respectively and 28% fair. The overall customer satisfaction was 39% for fair. (Refer to Figure 5.8)

Figure 5.9 Results for “overall” question



The responses indicated customer satisfaction from the respondents in the following order: 'good' 43%, 'fair' 39% and 'very good' 12%. Customer satisfaction ratings for 'poor' and 'excellent' were both at 3%. (Refer to Figure 5.9)

Figure 5.10 Results for the “most problematic part” supplied question



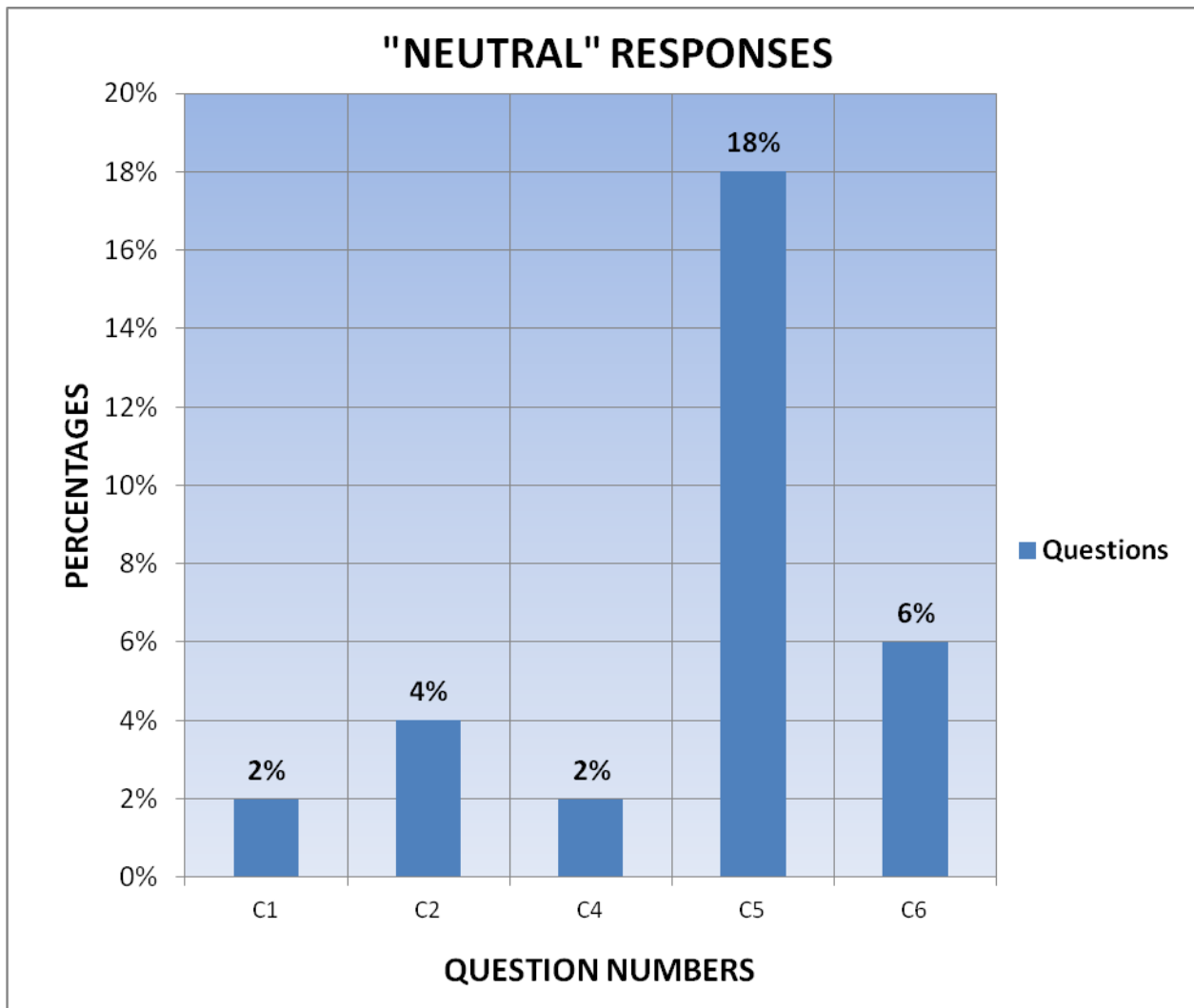
The fuellid part recorded the highest response rate 62%, followed by the asia plate 16%, the engine mounting bracket 10%, the inner side corner bracket left hand side 8% and the inner side corner bracket right hand side at the lowest 4%. (Refer to Figure 5.10)

5.3.3 Section C: Attitudes towards supplier's quality performance information, the results and an analysis

A total of six questions were asked in this section of the questionnaire, presented to General Motors South Africa personnel.

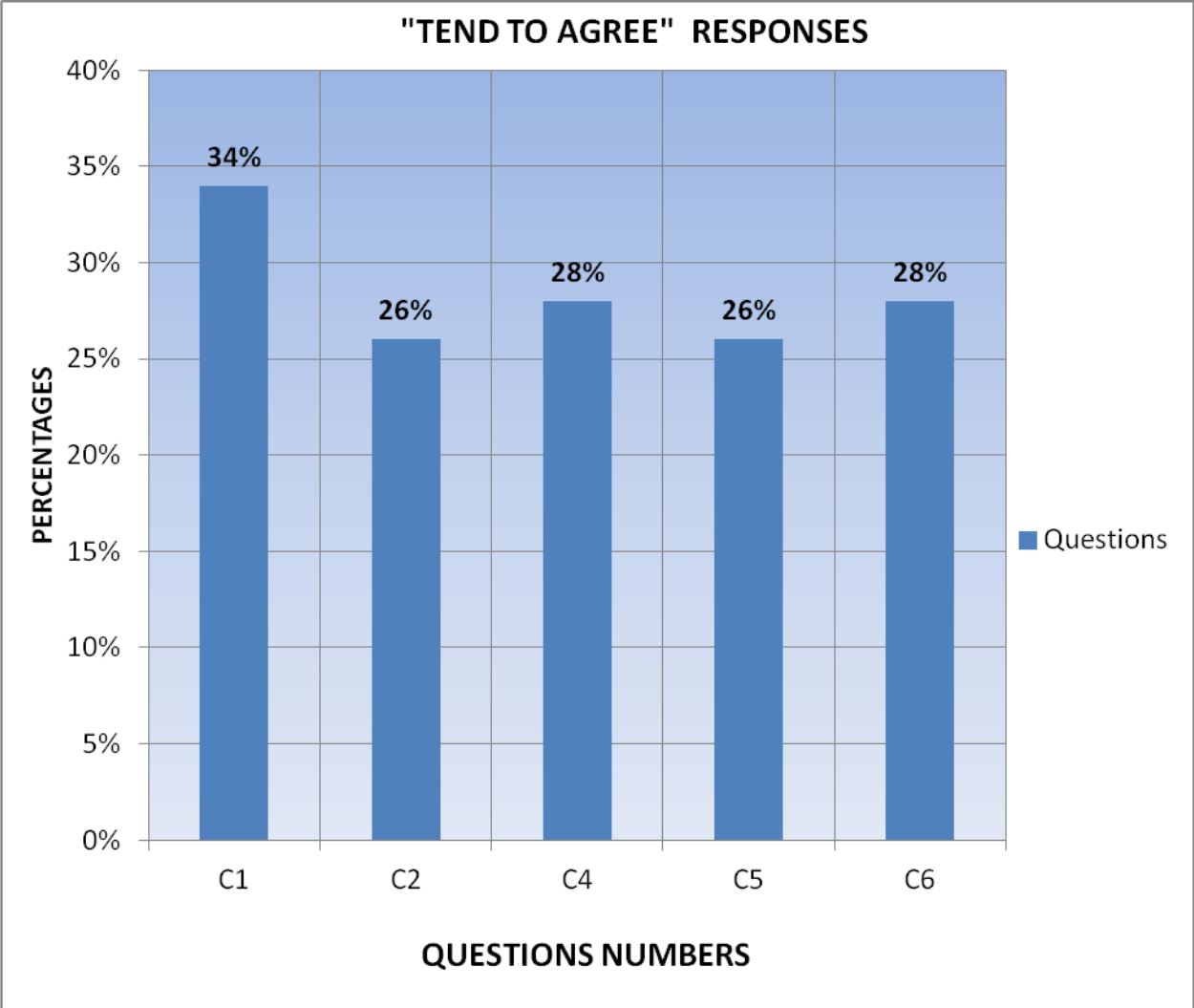
From the results, an analysis of the top five 'negative' (neutral, tend to agree, strongly agree) questions was made. The results were as follows:

Figure 5.11 Result of the top five "neutral" question



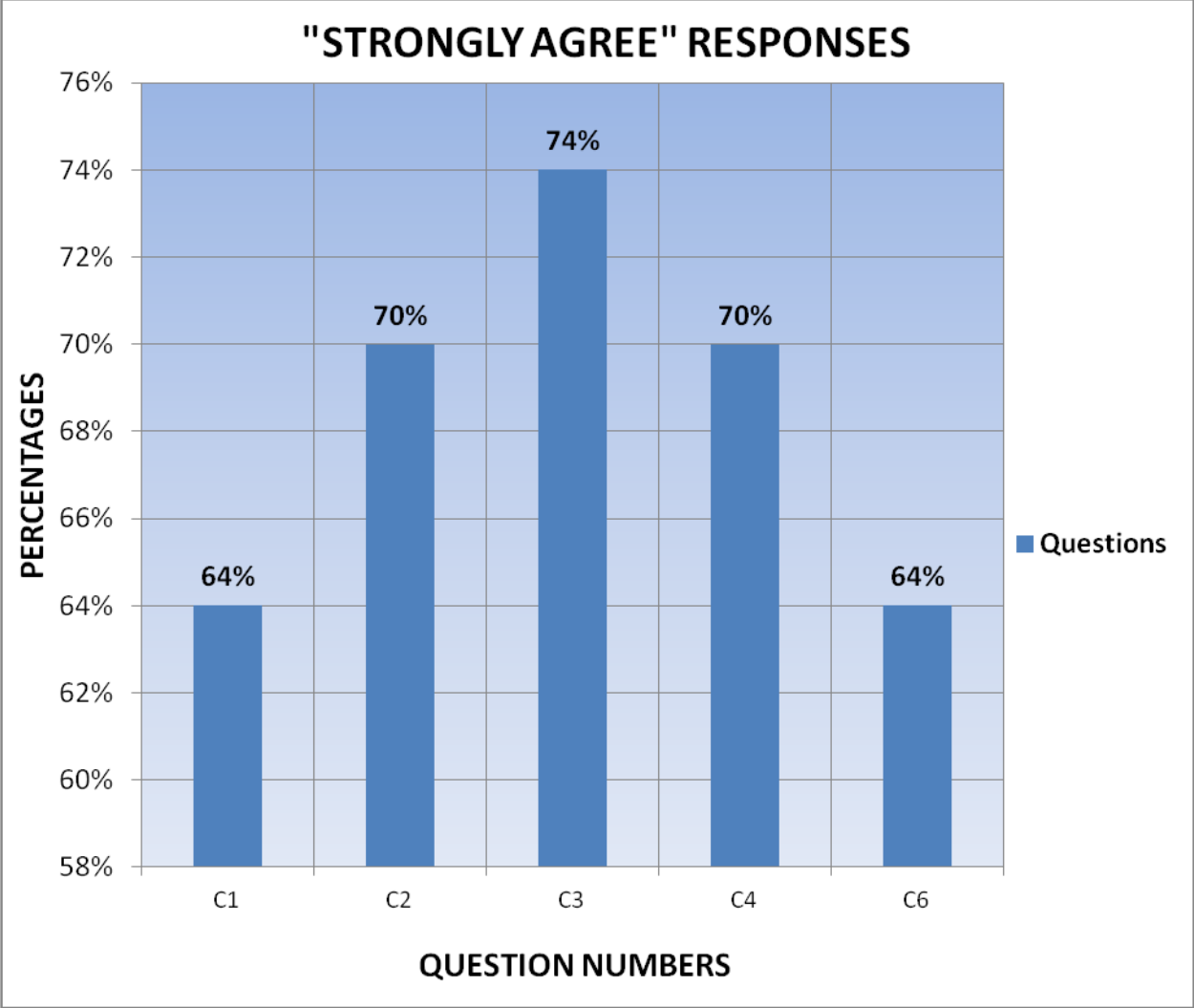
The top five questions out of the six questions administered in the questionnaire to the respondents, and on which they stand 'neutral', were as follows: Question C5 18%, Question C6 6%, Question C2 4% and Questions C1 and C4 received 2% each. (Refer to Figure 5.11)

Figure 5.12 Result of the top five "tend to agree" question



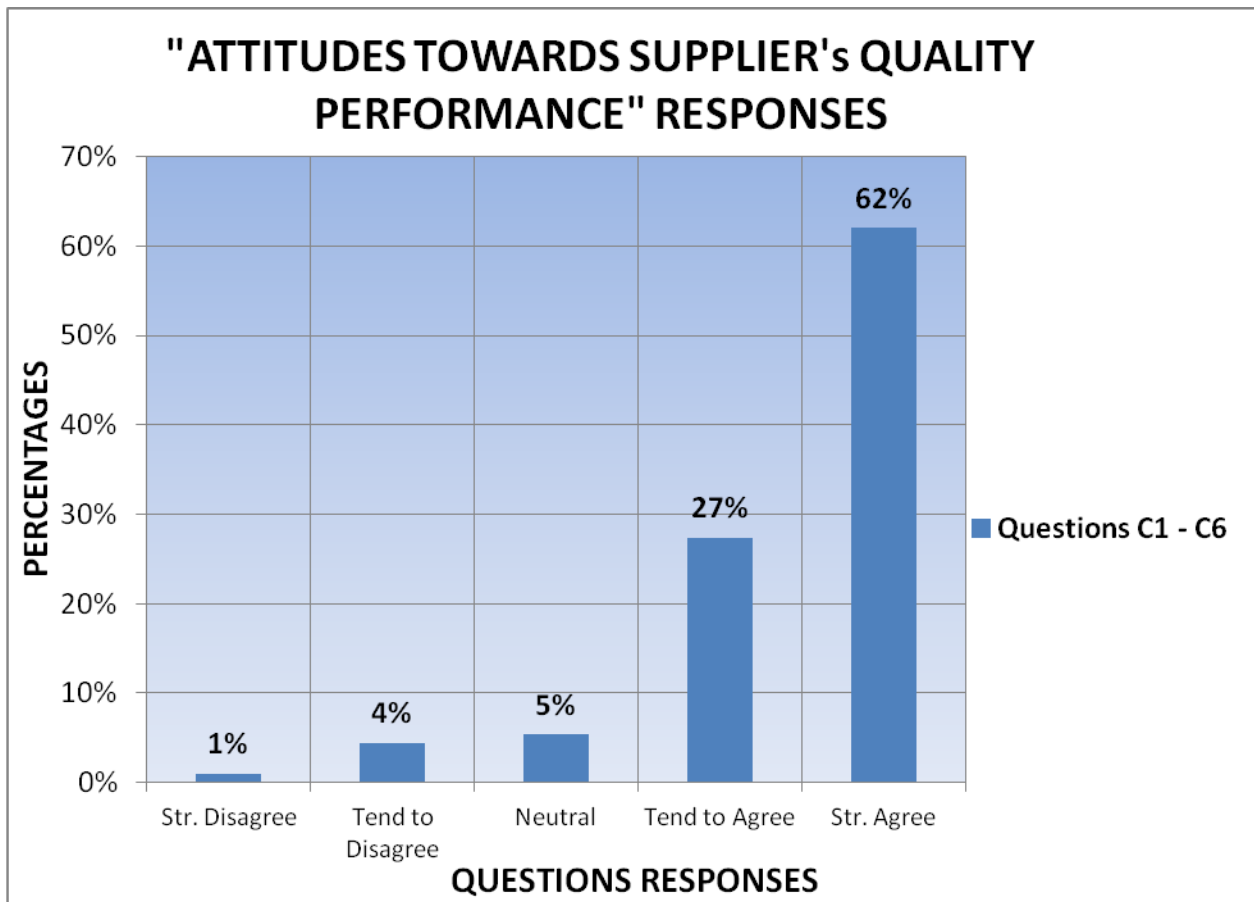
The top five questions on which the respondents 'tend to agree' were Question C1 34%, Questions C4 and C6 (both at 28%), and Questions C2 and C5 (both at 26%). (Refer to Figure 5.12)

Figure 5.13 Result of the top five “strongly agree” question



The top five questions on which the respondents 'strongly agree' were Question C3 74%, Questions C2 and C4 (both at 70%), and Questions C1 and C6 (both at 64%). (Refer to Figure 5.13)

Figure 5.14 Result of the “attitudes towards the supplier’s quality performance” question



A total of six questions were asked in the section C part of the questionnaire administered to the respondents. This section evaluated the general attitudes of the respondents towards this supplier quality performance. From the results, an analysis of the top five “negative” (‘strongly disagree’, ‘tend to disagree’, ‘neutral’, ‘tend to agree’ and ‘strongly agree’) questions was performed. The ‘strongly agree’ rating recorded the highest response rate 62%, with 27% for the ‘tend to agree’ rating, 5% for the ‘neutral’ rating, 4% for the ‘tend to disagree’ rating and 1% for the ‘strongly disagree’ rating. (Refer to Figure 5.14)

5.4 CONCLUSIONS

This chapter provided the results of the empirical study. The information provided by the respondents by means of the questionnaire yielded good results in the first two sections, however, the third section yielded negative results. The results were presented in both descriptive terms as well as graphically.

Figure 5.2 clearly illustrate that the majority of the respondents had the required competencies for the investigation. Figure 5.3 showed that 84% of the respondents deal with poor quality parts daily which is also reflected in figure 5.4. Figure 5.5 clearly illustrate that the majority of 98% of the respondents are competent. Figure 5.9 illustrate that the overall customer satisfaction responses 43% good and 39% 'fair', the majority of the respondents are not satisfied. Figure 5.10 illustrate 62% of the respondents regards the fuellid as the top 'problematic part'. Figure 5.11 showed that 32% of the respondents prefer to be 'neutral'. Figure 5.12 showed that an average of 28.4% of the respondents 'tend to agree'. Figure 5.13 illustrate normal bell shape distribution with an average of 68.4% 'strongly agree'. Figure 5.14 illustrate skew distribution to the right that 89% of the respondents are not satisfied with the supplier's quality performance.

Chapter 6 utilises and capitalises on this information by linking the information with all the concepts noted during this dissertation (treatise) and answers both the main problem and sub-problems as noted in Chapter 1. This will form the basis of the summary, the recommendations, and the final conclusion.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

In this chapter, the researcher concludes the research project by briefly discussing the extent to which the main problem and sub-problems were solved. Through resolving the five sub-problems, the main problem will also have been solved. The main problem addressed the question: What is the impact of delivery performance for a selected part at General Motors South Africa? Conclusions concerning the achievement of the objectives of the study are made. Recommendations will also be made to combat the root cause of inefficiencies that affect the delivery performance of a selected part at General Motors South Africa.

6.2 RESOLUTIONS TO THE FIRST SUB-PROBLEM

What can be learned from literature about the impact of quality costs?

A comprehensive literature research was carried out in order to address this sub-problem. Definitions, concepts and guidelines were evaluated and the core components and arguments extracted in order to illustrate the term 'quality cost'. In General Motors South Africa, the term 'quality cost' means the cost of poor quality.

6.3 RESOLUTIONS TO THE SECOND SUB-PROBLEM

Which parts are suitable candidates for a cost investigation?

A detailed literature research was performed to address this sub-problem. General Motors South Africa literature was evaluated and the top five problematic parts were

identified. In Chapter 5 the questionnaire results clearly illustrate the top five problematic parts. The majority of the problems are derived from fuellids with sixty two percent. Root cause analysis should be implemented to establish why fuellids have a high percentage. Corrective and preventative measures should then be recommended for implementation activities.

6.4 RESOLUTIONS TO THE THIRD SUB-PROBLEM

What are the processes involved if a defect occurs?

General Motors South Africa literature was evaluated to establish what processes are in place when defects occur.

Defect management is crucial to closing the loop between requirements, implementation, verification and validation. Traditional defect tracking management, implemented in a stand-alone fashion, can no longer address the complexity and pace of change in modern software development. Defect management processes must be tightly interlinked with all other software development processes. Defect management processes should contain the following elements:

- **Defect Discovery** – Identification and reporting of potential defects. The defect tracking software must be simple enough so that people will use it, whilst also ensuring that the minimum necessary information is captured. The information captured here should be enough to reproduce the defect and allow development to determine root cause and impact;
- **Defect Analysis and Prioritisation** – The development team determines if the defect report corresponds to an actual defect, if the defect has already been reported and what the impact and priority of the defect is. Prioritisation and scheduling of the defect resolution is part of the overall change management process for the software development;

- **Defect Resolution** – The development team should determine the root cause, implement the changes required to fix the defect, and document the details of the resolution in the defect management software, including suggestions on how to verify that the defect is fixed;
- **Defect Verification** – The build containing the resolution to the defect is identified, testing of the build is performed to ensure that the defect has truly been resolved and that the resolution has not introduced side effects or regressions. Once all affected areas of development have been verified as resolved, the defect can be closed; and
- **Defect Communication** – This encompasses automatic generation of defect metrics for management reporting and process improvement purposes, as well as visibility into the presence and status of defects across all disciplines.

6.5 RESOLUTIONS TO THE FOURTH SUB-PROBLEM

How can the cost be estimated?

A comprehensive literature research was carried out in order to address this sub-problem. An approximation of the probable cost of a product, programme or project is computed on the basis of available information (Wale, 2007: 103).

Best Practice: Measuring and tracking cost of poor supplier quality.

Todd (2005: 79) says most organisations do not track and measure the cost of poor supplier quality (COPQ) attributed to their suppliers. Such cost of poor supplier quality may add up to over ten percent of the organisation's revenue. Some companies only track supplier cost of poor quality by measuring scrap and increase in MRB (Material Review Board) inventory. Results have shown that materials account for less than fifty percent of the total cost of poor quality. The following should be taken into account to calculate the actual cost of poor quality:

- Scrap, re-work, sorting and processing costs due to poor quality;
- MRB (Material Review Board) inventory and processing costs due to inspection failure;
- Line shutdown attributed to poor quality;
- Using equipment that is capacity-constrained for re-work due to poor quality, reducing the overall utilisation of the production line;
- Freight costs due to expedited shipment to customers/downstream plants;
- Warranty expenses due to poor quality; and
- Recall expenses due to poor quality of products shipped to customers.

Quality management systems (QMSs) or manufacturing systems can track whenever any of the above costs are incurred due to supplier quality issues. World-class manufacturers are using all of the above factors to track actual supplier-related cost of poor quality.

6.6 RESOLUTIONS TO THE FIFTH SUB-PROBLEM

What effect does poor supplier quality have on productivity?

Literature research was performed in detail to address this sub-problem. Productivity is a measure of the efficiency of production. Productivity is the ratio of what is produced to what is required to produce it. Usually this ratio is in the form of an average, expressing the total output divided by the total input. Productivity is a measure of output from a production process, per unit of input. Cost of poor quality (COPQ), or poor quality costs (PQC), are defined as costs that would disappear if systems, processes and products were perfect (Wale, 2007: 134).

6.7 RESOLUTIONS FOR THE RESEARCH OBJECTIVE

The underlying objective of the research is to investigate the delivery performance of a selected part in General Motors South Africa (GMSA).

A comprehensive literature research was performed in order to address the main problem. Definitions, concepts and guidelines were evaluated and the core components and arguments extracted in order to illustrate the delivery performance of the selected part. It was also clearly illustrated that the selected part performance of the fuellid, with a rating of 62%, was regarded by respondents as problematic.

Best Practices in Supplier Quality Management

(Wale, 2007: 19) delineates that supplier quality management has emerged as one of the leading business practices. World-class manufacturers are making significant investments in systems and processes to improve supplier quality. This section briefly outlines some of the best practices implemented by such manufacturers in supplier quality management.

Why is Supplier Quality critical? With companies outsourcing their manufacturing to strategic partners across the globe, the supply chains have become very long. In addition, many of these manufacturers streamlined their supply chain and implemented lean inventory techniques. As a result, any issue in supplier quality can quickly result in stock-outs. Companies that sell industrial products need to preserve their preferred supplier status to continue to be considered for future business. As a result, they are under pressure to ensure that their products continue to meet or exceed acceptable PPM and Corrective Action thresholds set by their customers. Hence, managing their own supplier's quality is very high on the agenda for these companies.

The following best practices enable these companies to improve their own quality by improving their supplier's product and delivery quality:

(a) Best Practice: Measuring and tracking cost of poor supplier quality.

Most organisations do not track and measure the cost of poor supplier quality (COPQ) attributed to their suppliers. Such cost of poor supplier quality may add up to over ten percent of the organisation's revenue. Some companies only track supplier cost of poor quality by measuring scrap and increase in MRB (Material Review Board) inventory. Results have shown that materials account for less than fifty percent of the total cost of poor quality. The following should be taken into account to calculate the actual cost of poor quality:

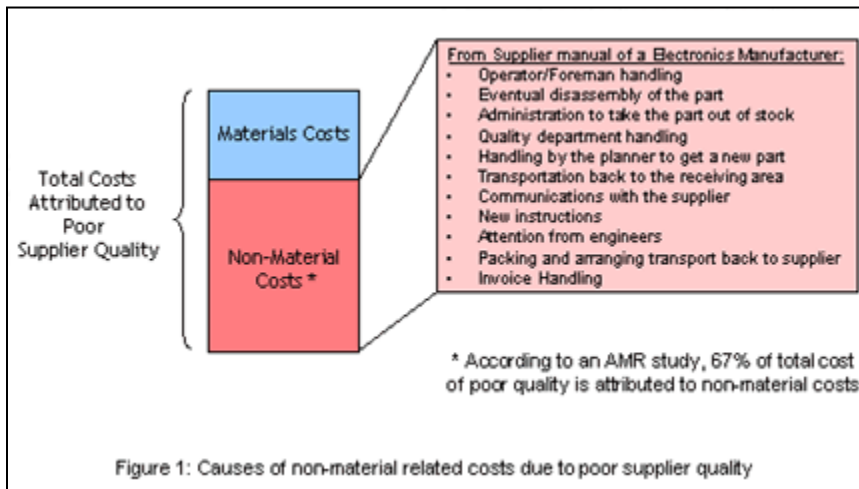
- Scrap, re-work, sorting and processing costs due to poor quality;
- MRB (Material Review Board) inventory and processing costs due to inspection failure;
- Line shutdown attributed to poor quality;
- Using equipment that is capacity-constrained for re-work due to poor quality, reducing the overall utilisation of the production line;
- Freight costs due to expedited shipment to customers/downstream plants;
- Warranty expenses due to poor quality; and
- Recall expenses due to poor quality of products shipped to customers.

Quality management systems (QMSs) or manufacturing systems can track whenever any of the above costs are incurred due to supplier quality issues. World-class manufacturers are using all of the above factors to track actual supplier-related cost of poor quality.

(b) Best Practice: Cost recovery as discussed above, is the total cost of poor quality (COPQ) being equal to the cost of poor quality (COPQ) of the original equipment manufacturer (OEM) plus inherited cost of poor quality (COPQ) of suppliers. As a result, companies need to proactively work with their suppliers to improve their quality, so that they can reduce their own cost of poor quality (COPQ). Hence, a cost-recovery system, where suppliers are charged back for providing poor quality of components, is an effective way to introduce business discipline and accountability into the supply chain.

However, based on the findings, less than 50% of companies pursue cost recovery with their suppliers. In addition, the majority of these companies only recover material costs from their suppliers. According to a recent report by AMR (Annual Monitoring Report), an industry analyst group, about 65% of the costs attributed to poor supplier quality are non-material related (see an example in figure 6.1 below). If a company institutes a quality management system to aggregate such costs and use it for charge-backs, not only would they be able to fully recover the costs of poor quality from their suppliers, they would also be able to institute a discipline that forces the suppliers to quickly improve their quality of products shipped.

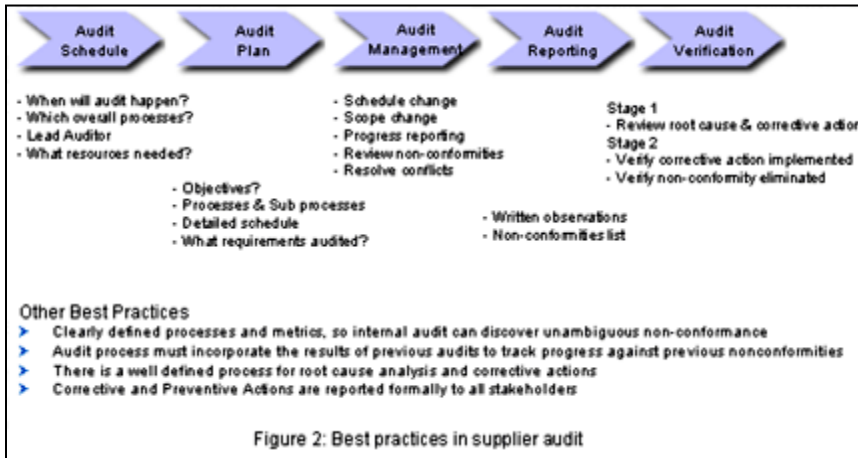
Figure 6.1: Causes of non-material related costs due to poor supplier quality



Source: Wale (2005: 132).

(c) **Best Practice: Supplier Audit:** Supplier Audits are one of the best ways to ensure that suppliers follow the processes and procedures that were agreed upon during the selection processes. The supplier audit identifies non-conformances in manufacturing processes, shipment processes, engineering change processes, invoicing processes and quality processes at the supplier. After the audit, the supplier and manufacturer jointly identify corrective actions which must be implemented by the supplier within an agreed-upon timeframe. A future audit ensures that these corrective actions have been successfully implemented. Over fifty percent of the manufacturers do not follow the best practices in audit when engaging with their suppliers. By implementing best practices, manufacturers ensure that the audit process is effective and efficient and allows them to audit their entire supplier base at least once a year while maintaining a lean staff of auditors. The following figure shows the best practices process for internal auditing:

Figure 6.2: Best practices supplier audit



Source: Wale (2005: 132).

(d) **Best Practice: Supplier Scorecard.** Supplier Scorecards is an excellent technique in using facts to rank the supplier’s relative performance within the supply base and tracking improvement in supplier’s quality over time. Scorecards also provide a data point into any future business negotiations. Following are the key operational metrics that leading manufacturers track in their supplier scorecard:

- PPM of supplier components;
- Number of corrective actions in last quarter;
- Average response and resolution time for corrective actions;
- Number of RMAs processed per month;
- MRB inventory levels;
- Number of re-work hours due to supplier components;
- Percentage of actual cost of poor quality (COPQ) recovered from suppliers;
- Number of customer complaints on product quality;

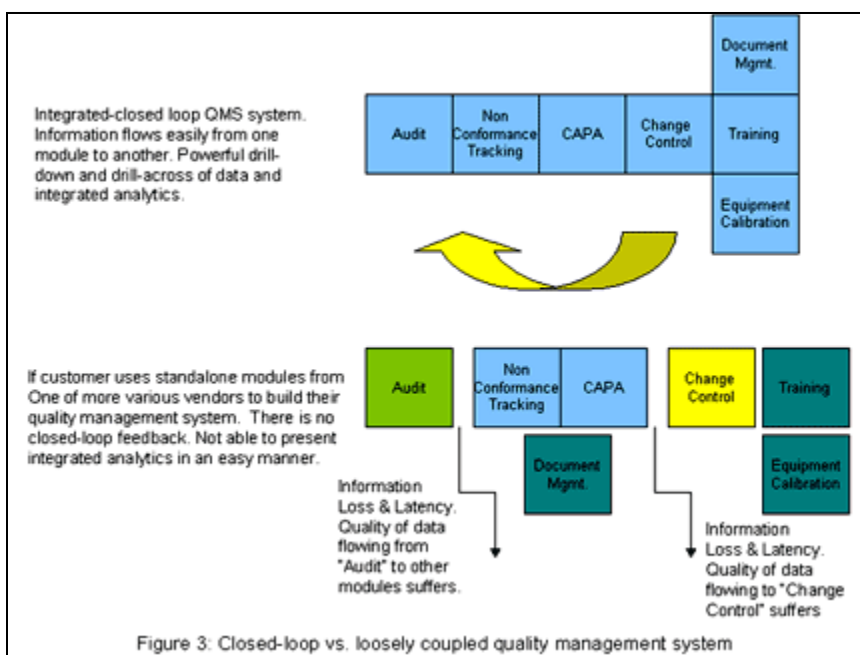
- Warranty reserves;
- Relative ranking of supplier; and
- Performance against benchmark.

(e) **Best Practice: Closed Loop Corrective Action.** Systematic reductions in the cost of poor quality can be attained by implementing a quality management system (QMS) that provides an integrated and closed-loop corrective action process. In a manufacturing organisation, when deviations, non-conformance, out of specifications, quality incidents or customer complaints occur, corrective and preventive actions need to be initiated to remedy the problems. Once a quality problem has been identified, the first step is to initiate an investigation and to properly identify the root cause of the problem. After the root cause has been identified, corrective action/preventive action (CAPA) items are created and routed for approval. When approved, appropriate changes are implemented in the environment and then the corrective action/preventive action (CAPA) is closed out. These changes may include amendments to a documented procedure, upgrading the skill set of an employee through a training and certification process, or recalibrating the manufacturing equipment. In addition, the system may capture cost of poor quality (COPQ) associated with that non-conformance and use that information to initiate and complete a cost recovery process with a supplier.

It is critical to deploy a closed-loop, integrated quality management system, rather than a set of loosely connected modules from one or more vendors. Integration ensures that the information flows out the corrective action process with a high degree of accuracy and velocity without falling through the cracks. It also ensures that the entire change control process is auditable from end-to-end, a critical requirement to support the 21 CFR (Code of Federal Regulations) Part 11 requirement in FDA (Food and Drug

Administration) regulated industries. Finally an integrated system ensures that audits become a core driver into the corrective action process and a key tool for continuous improvement. (Refer to figure 6.3)

Figure 6.3: Closed-loop vs. loosely coupled quality management system



Source: Wale (2005: 132)

(f) **Best Practice: Engaging Suppliers in quality systems.** It is critical for manufacturers to engage suppliers in all aspects of their quality management system, so that the supply base is fully integrated into the quality management system (QMS) being rolled out. Key requirements include:

- Suppliers should be able to provide quality-related data to the manufacturer without having to deploy a mandated quality management system within their

environment. This can be achieved by feeding information from the supplier's quality system into the manufacturer's quality system (for larger suppliers or ones sharing their production line with multiple customers) or getting the supplier to use a manufacturer's web-based quality management system (for smaller suppliers or ones with dedicated lines for a customer). A web-based quality management system dramatically reduces the cost of ownership for a supplier by providing the right information to a key customer without having to deploy software in-house; and

- Manufacturers should be able to get every relevant stakeholder within the supply base to use the quality system without having to train every employee. Emerging capability includes a scenario where an application form is embedded within an email delivered by the system to the employee user at a supplier. When the user opens an email, they hit reply, enter the data in the embedded form and hit send. The data in the form is processed by the system as if it came from the screen. As a result the user does not need to learn to navigate the quality application, yet can participate in the quality system.

By deploying these best practices, manufacturers can dramatically improve their supplier quality and achieve their own business objectives. Such practices have been implemented by world-class manufacturers using enterprise quality management software.

6.8 METHODOLOGY, EMPIRICAL STUDY, AND RESULTS

The empirical research consists of a quantitative study in which the activities taking place at the two plants were recorded, analysed and interpreted. The research process went smoothly. The number of respondents that participated in the research was sufficient, thus ensuring that the sample was truly representative of the whole population.

The study was conducted over a period of time. Respondents interviewed seemed frustrated about the repetitive poor quality of the selected part, and this was clearly demonstrated with the 62% rating.

Section A: demographical information between the two plants. The competency level of all respondents in their respective fields was high and they were the correct respondents selected from the population group.

Section B: Customer satisfaction information highlights that 'good' 43% scored the highest, 'fair' 39% the second highest, 'very good' 12% came in third and 'excellent' and 'poor' shared the fourth place 3% each.

Section C: General attitudes towards supplier's quality performance show that 62% 'strongly agree', 27% 'tend to agree', 5% was 'neutral', 4% 'tend to disagree', and 1% 'strongly disagree'. The results clearly illustrate that the performance of the selected part has an impact on productivity.

6.9 CONCLUSIONS

It can thus be concluded that the performance of the select part has a profound effect on operational efficiency. Poor quality material inputs equal poor productivity outputs on operational plants.

6.10 RECOMMENDATIONS

Recommendations based on the research findings include:

- Customer satisfaction: A rating of only 43% from all respondents was achieved for the 'good' option. Management should investigate the root cause of the poor

customer satisfaction rating from respondents and implement measures to improve the current condition;

- The most problematic part received a 62% rating from respondents. Management should immediately conduct an investigation into the poor performance of the selected part. It should further be ensured that all supplier quality management systems are operational. The selected supplier should be frequently audited for conformance; and
- General attitudes towards supplier's quality performance: The majority 62% of respondents 'strongly agree' that the selected part has an impact on productivity, that supplier delivery performance has an impact on daily output, that poor supplier quality has a high cost implication on the company, that re-work and associated costs have a high cost implication on the company, that line stoppage is predominantly caused by the selected part and that defective quality deliveries affect employees' morale at the plant. Management should, as a matter of urgency, conduct an investigation into to general attitudes of employees towards supplier's quality performance and implement corrective and preventative measures.

6.11 FURTHER RESEARCH PROJECTS SUGGESTED

It is proposed to investigate the actual quality cost implications of the delivery performance of a selected part at General Motors South Africa (GMSA).

LIST OF REFERENCES

- Afuah, F. (2003). Management: Meeting and Exceeding Customer Expectations. USA: South-Western College Publishing.
- Afuah, F. (2003). Using Simulation to understand and Optimize a Lean Service Process. Proceedings of the Spring Simulation Multi-Conference. [Online]. Available: <http://www.suryatech.com/> [Accessed: 3 August 2011].
- African Journal of Information Management. [Online]. Available from: <http://www.sajim.co.za/default.asp?to=editvol7nr1> [Accessed: 12 September 2011].
- Alcorn, A. (2001). Case study research. Design and methods. 3rd Edition. Applied Social Research Method Series, Volume 5. USA, California: Sage Publications.
- Alukal, L. and Manos, M. (2002). What is competitiveness? The Competitive Institute (TCI). [Online]. Available from: <http://www.competitiveness.org/article/articleview/774> [Accessed: 12 July 2011].
- Allison, C. A. (1996). Research methods. A Practical Guidance for postgraduates. 2nd Edition. England: Prentice Hall.
- Atkinson, S. (2004). Strategic management concepts and cases. 8th Edition. Upper Saddle River: Prentice Hall.
- Bailey, B. (2007). Lean Manufacturing. Kaizen Strategies for Winning Through People. 1st Edition. England: Prentice Hall.
- Banks, A. (2011). Exploring Corporate Strategy. 1st Edition. London: Prentice Hall.

Barnes, B. (2000). Warehouse Management Systems (WMS) and Lean Manufacturing. [Online]. Available from: <http://www.devicelink.com/mddi/archive/html> [Accessed: 10 August 2011].

Barnes, V. (2003). Principles of 5S. [Online]. Available from: <http://members.lycos.fr/hconline/5S/fives.htm> [Accessed: 2 August 2011].

Besterfield, A. (2001). From Continuous Improvement to Continuous Innovation [Online]. Available from: <http://granitebay.com/articles> [Accessed: 11 July 2011].

Berry, S. (1990). Lean Service: In defence of a production-line approach. International Journal of Service Industry Management, 9 (3), 207).

Bernard, A. (2010). Driving change in GM worldwide purchasing. Automotive sourcing. General Motors issue, Volume 6, Issue 6. [Online]. Available from: <http://www.automotivesourcing.com/articles> [Accesses: 21 August 2011].

Bicheno, J. (2008). The Lean Toolbox for Service Systems: South African Edition. South Africa, Port Elizabeth: TriLean Publishing.

Birch, N. (2001). Purchasing Principles and Management. 9th Edition. London: Pitman Publishing.

Boardman, B. (2011). International Competitiveness. New Delhi: Hindustan Publishing Company.

Bosch, V. (2011). Slow growth ahead despite fewer economic jitters. [Online]. Available from: <http://www.purchasing.com/article/ca310876.htm1> [Accessed: 8 July 2011].

Brain, S. W. (2007). Strategic Management: Competitiveness and Globalisation. 5th Edition. Cincinnati: South-Western College.

Brown, W. J. (2009). What are the critical steps for lean success? AMIEI of Manufacturing Solutions. [Online]. Available from: <http://www.manufacturing-solutions.org/papers/leanpaper06.doc/htm> [Accessed: 23 July 2011].

Buttle, F. (2000). Foresight Manufacturing Report. [Online]. Available from: http://www.dst.gov.za/foresight_reports/documents/foresight%20manufacturing%20report.pdf.htm [Accessed: 15 June 2011].

Burt, M. (2008). World Class Supply Management. The key to supply chain management. Business week 6th Edition. London: McGraw-Hill Irwin.

Burt, B., Dobler, G. and Starling, T. (2003). Japanese 5S House Keeping. Good Workplace Organization. [Online]. Available from: <http://www.expage.com/tij12.htm> [Accessed: 2 August 2011].

Caplen, C. (1997). A practical approach to quality control. London. New York. Continuum.

Chow-Chua, J. (2002). The Packaging Marketplace: A Global View. Packaging World Magazine. 10. 1st Edition. New York: The Free Press.

Clare, G. (2008). Harnessing value in the supply chain. United states of America: John Wiley and Sons.

Coldman, C. (2000). What is competitiveness? The Competitive Institute (CTI). [Online]. Available from: <http://www.competitiveness.org/article/articleview/711> [Accessed: 23 July 2011].

Coldwell, C. (2004). Delivering Service Quality. Balancing Customer Perceptions and Expectations. 2nd Edition. New York. London: Collier Macmillan.

Cole C. (2010). International Business Competing in the Global Marketplace. Washington: McGraw-Hill.

Collis, J. and Hussey, R. (2003). Business research: A practical guide for undergraduate and postgraduate students. 2nd Edition. London: Palgrave Macmillan.

Corbett, C. (2005). Inspiring a competitive South Africa. Enterprise Productivity and Competitiveness. [Online]. Available from: <http://www.npi.cp.za/pebble.asp?relid=66/htm> [Accessed: 9 July 2011].

Crosby, P. (1979). Quality is free. Quality Management. 1st Edition. Prentice Hall.

Cummins, D. (2008). Operations management. 3rd Edition. Essex: Pearton.

Daniels, P. (2002). Supply Chain Management: The Basics and Beyond. Baco Raton, Fla: St. Lucie.

Davis, S. B. and Goetsch, D. L. (2000). Quality Management. Introduction to Total Quality Management for Production, Processing and Services. 3rd Edition. Upper Saddle River. New Jersey: Prentice Hall.

Dessler, Z. (2002). Total Productive Maintenance. [Online]. Available from : <http://www.home.att.net/-iso9k1/tqm/tqm.html> [Accessed: 2 August 2011].

Drake, G. W. (2000). Using Simulation to Understand and Optimize a Lean Service Process. Proceedings of the Spring Simulation. [Online]. Available from: <http://www.suryatech.com/> [Accessed: 23 June 2011].

Easterby-Smith, J. W., Thorpe, A. and Lowe, A. (1991). A practical guide for research and design. 2nd Edition. New York: The Free Press.

Fawcett, D. & Ellram, G. (2007). Closing the Productivity Gap: Lean Manufacturing for Banks [Online]. Accessed from: <http://www.boozallen.com/htm>. [Accessed: 12 July 2011].

Fitzgerald, F. (2007). A Framework for Management. 4th Edition. New Jersey: Prentice Hall.

Fitzgerald, F. (2005). World class manufacturing. Great Britain: University Press. Traverser Issue 4: 2006.

Forker, H. (2007). Value Stream Management: Strategy and Excellence in the Supply Chain. Harlow: Prentice Hall.

Forker, S. (1997). Management For Productivity. 5th Edition. New York: John Wiley & Sons, Inc.

GMSupplypower (2011). GMSupplypower performance database. General Motors issue, Volume 6, Issue 6. [Online]. Available from: <http://www.automotivesourcing> [Accessed: 10 August 2011].

Hartley, H., Zirger, P. and Kamath, M. (2001). Lean Glossary: Quality Progress. [Online]. Available from: <http://www.asq.org/> [Accessed: 2 August 2011].

Hartley, H., Zirger, P. and Kamath, M. (2008). Integrated Operations Management: Adding Value for Customer. New Jersey: Prentice Hall.

Hendricks, S. and Singhal, H. (2002). World Economic Forum. The Global Competitiveness Report 2001- 2002. Oxford University Press: USA.

Heras, F. (2002). *Bulk Packaging remains strong. Trade News: Machinery.* [Online]. Available from: <http://www.ttnet.net/cgi-bin/enews.cgi?date=20020721> [Accessed: 29 June 2011].

Hill, C. W. (2009). *International Business Competing in the Global Marketplace.* Washington: McGraw-Hill.

Hobbs, K. (2004). *Strategic Management Concepts and Cases.* 9th Edition. Upper Saddle River: Prentice Hall.

Hogg, H. (2011). *Kaizen strategies for winning through people.* England: Prentice Hall.

Hunter, H. (2002). *Lean Supply Chain Management.* [Online]. Available from: <http://wwwwebpronews.com/enterprise/crmanderp/wpn-15-20020618LeanSupplyChainManagement.html> [Accessed: 2 August 2011].

Hutton, B. A. (1999). *The Challenge of Strategic Management.* 1st Edition. Homewood: Irwin.

Jack, H. (2009). *Management.* 4th Edition. Englewood Cliffs, New Jersey: Prentice Hall Inc.

Jackson, J. G. (1999). *Research Methods. Guidance for postgraduates.* 1st Edition. London. Arnold.

Jackson, A. (2011). *Unit labour costs, productivity and international competitiveness.* [Online]. Available from: www.ilo.org [Accessed: 12 August 2011].

Jones, J. (2004). *Driving change in GM worldwide purchasing.* Automotive Sourcing. General Motors issue, Volume 9, Issue 7. [Online]. Available from: <http://www.automotivesourcing> [Accessed: 13 July 2011].

Jones, A. (2008). *Impact of Supply Chain Sensitivity to Quality Certification on Quality Practices and Performances*. New York: The Free Press.

Juran, J. M. (1951). *Quality control handbook*. 1st Edition. New York. McGraw-Hill.

Kemp, V. (2011). *Marketing Management*. 11th Edition. Upper Saddle River, New Jersey: Pearson Education.

Kendler, G. (2006). *Practical Research Planning*. 2nd Edition. England: Prentice Hall.

Leenders, G., Fearon, H., Flynn, D. and Johnson, T. (2002). *Operations Management: Southern Africa Edition*. London: Pitman Publishing.

Lee, J. H. (2009). *Business Performance Improvement*. [Online]. Available from: <http://wwwaccaglobal.com/publications/studentaccount/32445?view=Printable+version>. [Accessed: 16 July 2011].

Lee, T. (2009). *From Continuous Improvement to Continuous Innovation*. [Online]. Available from: <http://www.asq.org/> [Accessed: 4 August 2011].

Lee, T. (2010). *Attributes and Best Practice of Lean Supply Chains*. [Online]. Available from: http://www.smthacker.co.uk/lean_supply_chains.htm [Accessed: 2 August 2011].

Leedy, P. D. (1993). *Practical Research-Planning and Design*. 5th Edition. New Jersey: Prentice Hall.

Leedy, P. D. (1997). *Practical Research-Planning and Design*. 6th Edition. New Jersey: Prentice Hall.

Leedy, P. D. (1999). *Practical Research-Planning and Design*. 7th Edition. New Jersey: Prentice Hall.

Leedy, P. D. and Ormrod, J. E. (2003). Practical Research-Planning and Design. 6th Edition. New Jersey: Prentice Hall.

Leedy, P. D. and Ormrod, J. E. (2005). Practical Research-Planning and Design. 8th Edition. New Jersey: Prentice Hall.

Leenders, G., Fearon, H., Flynn, D. and Johnson, T. (2010). The Management and Control of Quality. 6th Edition. Australia: Thomson, South-Western.

Liker, J. K. (2004). The Toyota Way. 14 Management Principles. 1st Edition. New York: McGraw-Hill.

Lo, L. (2007). Value Based Management (VBM). Competitive Forces Porter. [Online]. Available from: http://www.valuebasedmanagement.net/methods_porter.html [Accessed: 12 August 2011].

Marks, T. (2000). Qualitative research - A practical guide. 1st Edition. New York: Oxford.

Martin, K. (2001). Foundations of behavioral research. 5th Edition. New York: Holt.

Marx, F. (2005). Taking Control of Quality Costs. [Online]. Available from: <http://www.manufacturingcenter.com/qm/archives/1198/1198equal.asp> [Accessed: 17 July 2011].

Maxwell, A. (2011). Principles of Operations Management. 4th Edition. Prentice Hall: New Jersey.

McBurney, C. R. (1994). Business Research Methods. 4th Edition. Homewood: Irwin.

McLagan, W. (2009). Hidden Value. How Great Companies Achieve Extraordinary Results with Ordinary People. U.S.A. Harvard Business School Press.

Mills, M. A. (2001). Managing Quality. Amsterdam. Bonn. Don Mills, Ontario. Madrid. Massachusetts. Menlo Park, California. Mexico City. Milan. New York. Paris. San Juan. Seoul. Singapore. Sydney. Taipei. Tokyo. Wokingham, England: Addison-Wesley.

Moller, R. (2009). Integrated Operations Management: Adding Value for Customer. New Jersey: Prentice Hall.

Mouton, M. (2009). Economics for South African students. Pretoria: J.L Van Schaik.

Mouton, J. and Babbie, B. (2001). How to succeed in your Master's and Doctoral Studies. Van Schaik Publishers.

Mullins, M. A. (2005). A Practical guide for Research and Design. [Online]. Available from: <http://www.cimec.coza> [Accessed: 29 August 2011].

Naveh, J. and Marcus, N. (2007). Facts about US Manufacturing. [Online]. Available from: <http://www.nam.org.statedata> [Accessed: 12 August 2011].

Nel, J. (2007). Global operations and logistics: text and cases. New York: J. Wiley.

Ohno, T. (1998). Toyota Production System. Beyond Large-scale Production. Massachusetts: Productivity Press.

Oliver, J. (2001). Too Little to Late? Financial Mail. Vol. 6. No. 8, pp. 34.

Park, J. (2004). Business Research. South Africa: Juta & Co Ltd.

Perri, W. (2010). Becoming quantitative researchers: an introduction. New York. Prentice Hall.

Peters, J. (2005). Managing Change, the learning organization and management education. In the Drake Business Review. Vol. 12. No. 1, pp. 7.

Pettersen, P. W. (2009). Delivering Service Quality. Balancing Customer Perceptions and Expectations. New York. London: Collier Macmillan.

Pickering, A. M. (2004). Managing for Total Quality. 2nd Edition. New York: Prentice Hall International.

Pieterse, K., Lourens, A., Louw, A., Murray, A., and Van Der Merwe, K. (2005). Leaning the South African Way. Implementing Lean manufacturing in the Rainbow Country. 1st Edition. Port Elizabeth: Trilean.

Philips, P. H. (2003). Quality is just the beginning. Managing for total responsiveness. New York. San Francisco. Washington, D.C. Auckland. Bogota. Caracas. Lisbon.

Prince, P. (2010). Lean Manufacturing Implementation: A complete Execution Manual for any size manufacture. USA: J. Ross Publishing, Inc.

Rajan, B. and Tamimi, A. (2003). The dynamic capabilities of firms: An introduction. Technology, Organization and Competitiveness. Perspectives on Industrial and Corporate Change. Oxford: Oxford University Press.

Regan, R. (2010). Competitive Strategy: techniques for analyzing industries and competitors. New York: The Free Press.

Reynolds, A. (2010). Strategic supply chain alignment: Best practices in supply chain management. Aldershot: Gower publishing.

Riley, C. (1998). International Business Competing in the Global Marketplace. 3rd Edition. England: Prentice Hall.

Riley, C. (1999). Competing for the future. 1st Edition. London: Macmillan Press.

Riley, P., Wood, B., Clark, V., Wilkie, D. and Szivas, B.N. (2000). Business research methods. 2nd Edition. South Africa: Oxford University Press.

Robertson, R. (2007). Competing for the future. Harvard Business Review. 2nd Edition. New York: Prentice Hall.

Roussouw, J. (2002). Avoid the pitfalls in supplier development. Sloan Management Review, Vol. 41. No.4, pp. 42.

Rusnak, R. (2006). Service Industry Lean Manufacturing – Implementing Guide. [Online]. Available from: <http://www.ezinearticles.com/Service-industry-Lean-Manufacturing-Implementation-Guide/> [Accessed: 3 August 2011].

Santos, D. (2004). Foresight Manufacturing Report. [Online]. Available from: http://www.dst.gov.za/foresight_reports/documents/foresight%20manufacturing%20report.pdf.htm [Accessed: 15 June 2011].

Saunders, K. (2000). Order management via advanced planning systems. 6th Edition. Apic Magazine. New Jersey: Prentice Hall.

Schonberger, R. (2001). Overcoming the Crisis in Manufacturing: Let's fix it. New York: The Free Press.

Schultz, V. (2003). Doing quantitative research - A practical handbook. London: Sage.

Schwartz, V. B. (2011). Business research: a practical guide for undergraduate and postgraduate students. Bristol: Macmillan Press.

Scelta, C. (2011). Comparative cost advantage and trade performance in South African manufacturers: 1970 – 2011. School of Economics and Management, University of Natal. The International Trade Journal, 6(4): 213).

Sharma, S. (2005). Business competitive index. [Online]. Available from: http://www.weforum.org/pdf/global_competitiveness_reports/reports/gcr_2005/BCI.pdf [Accessed: 12 August 2011].

Simon, S. (2010). Industry clustering for economic development. In Economic Development Review, Spring 2010. Vol. 12, Issue2, pp. 26.

Smith, A. (2008). Creating and Implementing Lean Strategies. Management Services. [Online]. Available from: <http://www.philipatkinsonconsulting.com/> [Accessed: 4 August 2011].

Smith, B. (2010). ASEAN-China trade better than expected. China Daily. [Online]. Available from: www.chinadaily.com.cn/english/home/news/htm1 [Accessed: 6 July 2011].

Socia, R. (2011). Heart of Lean Manufacturing. [Online]. Available from: <http://www.strategosic.com/workcell.htm> [Accessed: 2 August 2011].

Swarts, F. R. (2003). The key to supply chain management. Leadership. 1st Edition. South Africa: Juta & Co Ltd.

Theron, M. (2005). Designing Dreams Raising Quality and Efficiency. The Challenges Ahead. Automotive Sourcing. [Online]. Available from: <http://www.automotivesourcing.com>. [Accessed: 12 July 2011].

Thomas, A. (2004). Management, Analysis, Planning, Implementation and Control. 9th Edition. Upper Saddle River: Prentice Hall.

Todd, A. W. (2005). Logistics. An integrated approach. 5th Edition. London: Collir McMillan

Todd, C. (2006). Global Operations and Logistics: Text and Cases. New York: J. Wiley.

Tucker, T. (2010). *The Change of Strategic Management*. London: Kogan Page Ltd.

Van Heerden, F. W. (2009). *The South African Motor Industry Files*. [Online]. Available from: <http://www.cartoday.com/content/conference/slides/0930rp/sld011.htm>. [Accessed: 16 July 2011].

Wade, W. (1998). *Aggregate Measures of Competitiveness. Asian Development Outlook 1998: Competitiveness in Developing Asia*. [Online]. Available from: http://www.adb.org/documents/books/ado/1998/part3_3-3.asp [Accessed: 10 August 2011].

Wale, T. (2007). *The new manufacturing challenges*. 4th Edition. Prentice Hall international.

Welman, J. C. and Kruger, S. J. (1999). *Research Methodology for the Business and Administrative Sciences*. New York: Oxford.

White, G. (2003). *Total Quality Management (TQM)*. [Online]. Available from: <http://www.home.att.net/-iso8k1tqm.html> [Accessed: 2 August 2011].

Willard, T. (2007). *Business Linkages and Supply Chain Management. The Underutilised Competitive edge for Southern Africa*. Management Today Magazine. March 2001 pp. 12.

Williams, R. (2011). *Innovation and competitiveness in South Africa: The case for competitive intelligence as an instrument to make better use of information*. South Africa: Juta & Co Ltd.

Womack, J. P. and Jones, D. T. (1996). *Lean Thinking: Banish Waste and Create Wealth in Your Corporation*. New York: Simon & Schuster.

Wood, F. W. (2009). *Creating and Implementing Lean Strategies. Management Services.* [Online]. Available from: <http://www.philipatkinsonconsulting.com/> [Accessed: 24 July 2011].

INDEX

Annexure 1.1 Survey Covering Letter

SURVEY COVERING LETTER

26 September 2011

Dear Respondent,

This research aims to investigate the impact of the delivery performance of a selected part on General Motors South Africa.

I am currently studying towards my Masters in Business Administration (MBA) degree at the Nelson Mandela Metropolitan University. This questionnaire forms part of a research paper for the post-graduate degree of Masters in Business Administration (MBA) degree at the NMMU Business School and will be treated as CONFIDENTIAL.

The questionnaire is aimed at measuring your perception of the current conditions within GMSA lean manufacturing operations with regards to the delivery performance of a selected part supplied by one supplier. The questionnaire is divided into three sections, all of equal importance, which are demographic information, customer satisfaction and the general attitudes towards this supplier's quality performance. Your view is important, thus there are no right or wrong answers.

It would be appreciated if you can assist me by completing the questionnaire and return it to me by Friday, 14 October 2011. Completion of the questionnaire should not take more than 15 minutes of your time. This will give me the information required in

my dissertation. If you would like a copy of the summary of the findings, please indicate and it would be forwarded to you in due course.

Thanking you in anticipation for your participation

Persons to contact in the event of any problems or queries:

Researcher:

Supervisor:

Andrew C. Blouw

Prof Koot Pieterse

0834185547

0415043774

Email: andrew.blouw@gm.com

Email: JJ.Pieterse@nmmu.ac.za

ANNEXURE 1.2 Questionnaire used for the survey study

SECTION A: DEMOGRAPHIC INFORMATION

Please indicate your response by placing a cross (x) in the appropriate block.

1. Site reporting to.

Kempston Road	1	Struandale	2
---------------	---	------------	---

2. Years service (for statistical purposes only)

11 - 15	1
16 - 20	2
21 - 25	3
> 25	4

3. Current position.

Team Leader	1
Coordinator	2
Senior Coordinator	3
Management	4
Senior Management	5

4. Current function.

Production	1
Procurement	2
Quality Operations	3
Process	4
Planning	5

5. Do you have experience or knowledge of supplier quality standards.

Yes	1	No	2
-----	---	----	---

SECTION B: CUSTOMER SATISFACTION

Please tick the appropriate box to indicate your degree of satisfaction.

Where: 1 = Poor, 2 = Fair, 3 = Good, 4 = Very Good, 5 = Excellent

No	Topic	1	2	3	4	5	Comments
1	RESPONSIVENES: How do you rate the responsiveness of the supplier in dealing with GMSA?						
2	PROFESSIONALISM: How do you rate the supplier's professionalism in dealing with GMSA?						
3	TECHNICAL SUPPORT: If you received any technical support, how do you rate the technical expertise of the supplier's technical competence of the engineers and their response time?						
4	PRODUCT QUALITY: How do you rate the supplier's products and services and did they meet GMSA's daily needs and expectations regarding performance?						
5	DELIVERY RELIABILITY: How do you rate the supplier's delivery on time performance and their commitment to meet GMSA's delivery expectations?						
6	QUALITY: How do you rate the supplier's approach to quality management to ensure complete customer satisfaction?						
7	OVERALL: Supplier rating on overall performance measurement						
8	SELECT: The most problematic part supplied by the supplier						
	1. Fuellid						
	2. Asia Plate						
	3. Engine Mounting Bracket						
	4. Inner Side Corner Bracket lhs						
	5. Inner Side Corner Bracket rhs						
Do you have any comments or suggestions that would help improve the supplier's quality, delivery performance or customer service?							

SECTION C: GENERAL ATTITUDES TOWARDS SUPPLIER'S QUALITY PERFORMANCE

Please tick the appropriate box to indicate your satisfaction.

Where: 1 = Strongly disagree, 2 = Tend to disagree, 3 = Neutral, 4 = Tend to agree, 5 = Strongly agree

No	Topic	Strongly disagreed	Tend to disagree	Neutral	Tend to agree	Strongly agree
1	Poor supplier quality have a impact on productivity	1	2	3	4	5
2	Supplier delivery performance have a impact on daily output	1	2	3	4	5
3	Poor supplier quality have a high cost implication on the company	1	2	3	4	5
4	Reworks / associated cost have a high cost implication on the company	1	2	3	4	5
5	Line stoppages are predominately caused by defective parts	1	2	3	4	5
6	Does defective quality deliveries affect employees morale in the plant?	1	2	3	4	5
How can GMSA be of assistance?						

THANK YOU FOR YOUR TIME AND EFFORT