AN ANALYSIS OF THE SUSTAINABILITY OF
THE LEAN MANUFACTURING IMPLEMENTATION AT
VOLKSWAGEN GROUP SOUTH AFRICA

By

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Declaration : In accordance with Rule G4.6.3, I hereby declare that the abovementioned treatise is my own work and that it has not previously been submitted for assessment to another university or for a qualification.

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ABSTRACT

This research report examines the changing nature of the organisation of work, in particular, the production methods in the South African automotive industry. The competition in the local and global markets has increased significantly in recent years. The increased complexity of products and individuality of customers pose strong challenges for the automotive manufacturers, (OEM – Original Equipment Manufacturers), with regard to product Quality, Cost and Delivery.

For these challenges, Volkswagen Group South Africa, has defined objectives that, when met, will contribute towards establishing it as a leading automotive brand. It is aligned to the Volkswagen Group AG, Strategy Mach18, increased vehicle production and the creation of long-term delighted customer base.

To achieve these objectives, the Volkswagen Production System (VPS) is an imperative component of the Volkswagen Group South Africa (VWGSA) production strategy. The core elements consist of, “Cycle”, “Flow”, “Pull” and “Perfection”. These are the four fundamentals on which Lean Manufacturing is built, as first introduced and described by the Toyota Production System. Lean manufacturing is a whole-systems approach that creates a culture in which everyone in the organisation continuously improves the process and production.

Volkswagen Group South Africa is facing increased competition in the South African and global marketplace. A search of the internet revealed that extensive research has been conducted into Lean manufacturing in South Africa. However, no research is noted with regard to the sustainability of Lean manufacturing at Volkswagen Group South Africa.

The aim of this study is to analyse the sustainability of the lean manufacturing implementation at VWGSA.
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CHAPTER 1

PROBLEM STATEMENT AND STUDY OVERVIEW

AN ANALYSIS OF THE SUSTAINABILITY OF THE LEAN MANUFACTURING IMPLEMENTATION AT VOLKSWAGEN GROUP SOUTH AFRICA

1.1 INTRODUCTION

In February 1946, the automotive manufacturing plant, the South African Motor Assemblers and Distributors (SAMAD), was officially opened in Uitenhage. In 1951, the first Beetle was produced. During 1956, the controlling interest in the company was sold to the German automobile manufacturer, Volkswagen Aktiengesellschaft (VWAG). In 1966, the company was renamed Volkswagen of South Africa. During the next few years and decades, various milestones were achieved. By 1974, Volkswagen SA became a wholly-owned subsidiary of Volkswagen AG. A remarkable achievement was attained in 2007; Volkswagen SA achieved passenger vehicle market leader position for three consecutive years. (Source: [http://vw.co.za/en/volkswagenworld/](http://vw.co.za/en/volkswagenworld/)).

In 2009, Volkswagen AG changed to Volkswagen Group, incorporating top brands like, Volkswagen, Audi, Porsche, Bentley, Bugatti, Lamborghini, Scania, SEAT, Skoda and Volkswagen Commercial Vehicles. This made the Volkswagen Group, the fourth largest automobile manufacturer in the world. The Volkswagen Group Strategy 2018, known as Mach 18, focusses on the VW Group’s position as global economic and environmental leader among automobile manufacturers.

VW Group is defined by four objectives which will enable it to be the most successful and fascinating company globally by 2018.

- Customer satisfaction and environmental leader: Achieve customer satisfaction and quality through implementing intelligent innovations and technologies using natural resources more responsibly.
- Volume Growth: Increased unit sales to more than 10 million vehicles per year and in the process capturing an above average market share in the major growing markets.

- Profitability: Increase the return on sales before tax to at least 8%, ensuring a financially viable position with the ability to act in difficult market conditions.

- Top Employer: Aiming to become the top employer through teamwork.

(Source: Annual Report 2011: https://volkswagenag.com/content/vwcorp/content/en/the_group/strategy.html)

The automotive industry is the third largest contributor to South Africa’s Gross Domestic Product (GDP) behind agriculture and mining, contributing roughly 5% (NAAMSA 2004). NAAMSA represents the National Association of Automobile Manufacturers of South Africa. The GDP has shown a steady growth during 2011 estimated 6.8% versus the figure for 2010 of 6.2%. The industry thus plays an important role in South Africa’s economy and a downturn or any instability in the industry (such as the labour strikes experienced by Volkswagen in 2000) can have negative consequences for the country in terms of lost production. The conditions and forecast for 2008, industry export sales were projected to exceed 255 000 vehicles. Within four years of this forecasted market projection, the manufacturing levels and market size has grown both for the local and export markets.

In the NAAMSA 4th Quarter report of 2011 the forecast for the local and export market envisaged that in 2012 new vehicle sales would remain a function of the performance of the domestic economy. The assumption is that the South African economy would grow by about 2.7%. The challenges facing the industry include, the prevailing historic low interest rates, improved vehicle affordability, new model introductions and easier access for consumers to vehicle financing, as well as continued strong demand by the car rental Industry.
The NAAMSA’s projection for 2012 translated into an expected improvement of about 7.5% in domestic sales volumes for the year.

Export sales would remain a function of the performance and direction of global markets. Vehicle exports into Europe were likely to decrease due to the recession and debt crisis in the Eurozone. The 2012 aggregate exports were estimated to reach about 301 000 vehicles compared to the 272 457 vehicles exported in 2011 (Naamsa-4th Quarter 2011 Report).

The global market has become an increasingly competitive environment. In most places local companies are up against the world’s best which are bidding to attract these new customers. The Western and Eastern worlds have been practicing these world class concepts for decades ensuring a competitive advantage in terms of quality, cost and speed.

Without exports and a local market demand, there is no future for any Original Equipment Manufacturer (OEM). A search of the internet revealed that extensive research has been conducted into Lean manufacturing in South Africa. However, no research is noted with regard to the sustainability of Lean manufacturing at Volkswagen Group South Africa.

1.2 RESEARCH OBJECTIVE

The aim is to gain insight into the challenges which exist and how these can be resolved to improve sustainability.

1.2.1 PRIMARY OBJECTIVE

The primary objective of this study was identified as: An analysis of the sustainability of the Lean manufacturing implementation at Volkswagen Group South Africa.

1.2.2 SECONDARY OBJECTIVE

In order to resolve the primary objective the following secondary objectives have been identified:
I. Investigate the contribution of the application of the Philosophy of long-term thinking to the sustainability of the implementation of Lean.

II. Investigate the contribution of the application of lean manufacturing processes to the sustainability of the implementation of Lean.

III. Investigate the contribution of people and partners to the sustainability of the implementation of Lean.

IV. Investigate the contribution of the application of problem solving methods to the sustainability of the implementation of Lean.

The abovementioned secondary objectives were addressed by means of a literature study. This was concluded with a survey which was conducted among the leadership in the production departments at VWGSA.

1.3 DELIMITATION OF THE RESEARCH

The aim of delimitating a study is to provide a specific focus to make the study manageable.

1.3.1 GEOGRAPHICAL DEMARCATION

The empirical part of the research was conducted at Volkswagen Group South Africa (Pty) Ltd, Uitenhage plant in the Eastern Cape.

1.3.2 ORGANISATIONAL DEMARCATION

The research was conducted within the production department among the permanent employees in leadership positions (in particular the Body shop, Paint shop and Assembly).

- Division Heads
- Production Managers
1.3.3 THEORETICAL DELIMITATION

The research focused on the sustainability of the lean manufacturing implementation in the automotive industry.

1.4 DEFINITION OF CONCEPTS

In this section, concepts of lean and sustainability are presented and discussed.

1.4.1 LEAN MANUFACTURING

Pieterse (2007:2) defines the term “world class manufacturing” as first used by Schonberger and Hayes and Wheelwright (Japanese Manufacturing Techniques: 1982) to describe organisations which achieved a global competitive advantage, by using their manufacturing capabilities as a strategic weapon.

The concept of lean manufacturing is further formalised in a book by Womack and Jones (2003) entitled, “Lean Thinking: Banish waste and create wealth in your corporation”. As implied by the title, lean is, in its basic form, the manufacture of a product with a minimum of waste. The concept of lean production represents the natural evolution of “Just-in-time” (JIT), a production concept pioneered by Toyota.

Kobayashi (1990:4) stipulates, that improving manufacturing quality means constantly seeking ways to manufacture better quality and goods faster and less expensively, as well as safely. Successful firms constantly seek methods and programs to achieve these basic, universal manufacturing goals.

According to Kobayashi (1990:10), today’s business climate demands reduced costs and also improved product quality, leveled production, and shorter cycle
times. This has become the blueprint for success in many organisations today. These focus points determine customer satisfaction and financial viability. Santos, Wysk & Torres (2006:3), states that, in order to improve (quality, cost and time) production activities, it is necessary to know the source of a factory’s problem(s). These are classified as poor quality, increase in production cost and lead times.

According to Santos et al (2006), two of the best known improvement approaches have been chosen as references: just-in-time methodologies (lean manufacturing) and the 20 keys to workplace improvement developed by Kobayashi. Both these approaches have proven to be successful due to improvement methodology simplicity, worker involvement and teamwork.

1.4.2 SUSTAINABILITY

Mann (2010:205) states that, “The purpose of lean management is to sustain a lean production system”. The task of sustaining these lean manufacturing concepts is the function and responsibility of the leader to perform. The leaders are responsible to motivate the workforce to perform daily tasks to the required standard. They sustain these lean activities in the workplace through performing daily functions of planning, implementation and results monitoring.

Liker (2004:284) supports this view that senior management ensuring that systems which were implemented remain sustainable. The author advises that management should do monthly reviews of the lean status boards. These reviews consist of evaluating metrics and assisting with resolving any obstacles which may hinder the implementation. Lastly it affords them the opportunity to give recognition to teams when achieving specific targets.

1.5 THE SIGNIFICANCE OF THE STUDY

Volkswagen Group South Africa is facing increased competition in the South African and global marketplace. VWGSA is reliant on both these markets to sell vehicles produced at its plant.
In September 2012, VWGSA achieved a market share of 22.2% and maintained a nine month year-to-date market leadership position. (Source: http://getnews.co.za/story?id=1938)

- Leaders at VWGSA faced with unsuccessful implementation of Lean manufacturing, which lead to the loss of production, producing vehicles which do not meet the quality standards and loss of jobs.

- Scholars in the field of operations management, industrial engineering or businesses that study organisational behaviour and might be faced with issues of sustainability of Lean implementation in the organisation.

Considering the Naamsa forecast for 2012, this research will be of great significance to VWGSA to sustain and improve its production operations through Lean manufacturing.

1.6 RESEARCH DESIGN

The researcher’s objective is to deduce and test the implications of performed hypotheses (quantitative research) or to induce hypotheses from his or her own observations (qualitative research). Collis and Hussey, (2003:47): There are two main research paradigms or philosophies can be labeled positivistic and phenomenological. The positivistic approach seeks the facts or causes of social phenomena, with little regard to the subjective state of the individual, (Collis and Hussey, 2003:52). The phenomenological paradigm is concerned with understanding human behaviour from the participant’s own frame of reference.

1.6.1 RESEARCH METHODOLOGY

The researcher followed a positivistic approach to determine the causal relation between sustainability and lean manufacturing. The study conducted was quantitative, which tested the hypotheses, based on the data collection and analysis thereof.
1.6.2 LITERATURE STUDY

A literature study was conducted to determine what Lean manufacturing principles and strategies management (leaders) can use to sustain implementation thereof. The literature focused on the factors that influenced long-term strategic thinking, optimising the process through continuous improvement programs, the people and business relationship, as well as problem solving and management strategies to sustain this implementation in the operations. A questionnaire was developed, from the results of the literature study, which was used as a data-collection tool in the empirical part of the study.

1.6.3 EMPIRICAL STUDY

The respondents were from the core production process at Volkswagen Group South Africa. The researcher utilised group distribution to deploy the questionnaire. This afforded the researcher the opportunity to clarify any concerns which were raised by the respondents. Convenience sampling was used to select division heads, managers, supervisors and group leaders. The sample size was 140 respondents from the leadership positions as stratified above.

1.6.4 DATA ANALYSIS

A self-constructed measuring instrument was used to measure these variables. The tool is based on a literature review of the variables from different sources. The data was collected by means of a questionnaire, captured into a Microsoft Excel software program. The following statically techniques (Mean, Frequency and Standard Deviation) were utilised to present and interpret the data analysis.

A total of 140 questionnaires were distributed to the selected sample from the larger population. Of these 124 questionnaires were returned for the purpose of analysis. This response rate equates to a 90 per cent result which is regarded as very good.
The respondents gave their opinion using the Likert scale, rated “strongly disagree” to “strongly agree”. The questionnaire results were statistically analysed and interpreted.

In principle all the participants in the research should be offered the opportunity to remain anonymous, (Collis and Hussey, 2003:35). This allowed the participants to express their opinions freely without feeling it will be held against them in what form or way. The anonymity of the survey participants was guaranteed to ensure confidentiality of the points as declared in the questionnaire.

1.7 OUTCOME OF STUDY

Chapter 1  Problem Statement and Study Overview
The challenges and demands facing the automotive manufacturing in today’s market. The research objectives and limitations are also discussed.

Chapter 2  Literature Review
The concept of Lean manufacturing is detailed with regard to background, principles and philosophy, as well as sustainable implementation.

Chapter 3  Research Design and Methodology
The different research methodologies are discussed and the research strategy chosen. Describes the questionnaire designed which measures the sustainability of Lean Manufacturing implementation.

Chapter 4  Research Results and Analysis
Presenting the results obtained from the study conducted.
The analysis of the data collected from the questionnaire.

Chapter 5  Conclusion and Recommendations
Final presentation of the results and a discussion as well as recommendations
CHAPTER 2
LITERATURE REVIEW

2.1 INTRODUCTION

In Chapter one, the researcher tried to understand the importance of Lean Manufacturing in the automotive industry of South Africa. An outline of the primary objective and secondary objectives which need to be solved were given.

In Chapter two, insights from literature on the concept of Lean Manufacturing, historical background, principles and philosophy, strategy integration, employee involvements, as well as sustainable implementation measures are discussed.

2.2 DEFINITION OF LEAN MANUFACTURING

Morgan (2005:11) defines Lean Philosophy as “The fundamental concept of the lean philosophy is the identification and elimination of waste, a concept that has been applied to manufacturing processes with great success”.

Lean manufacturing is described as “Basically, lean manufacturing is the systematic elimination of waste. As the names implies, lean is focused on cutting “fat” from production activities” (Santos, Wysk and Torres, 2006:9). The authors describe it as “According to the lean philosophy, the approximations to improve the lead time are based on the reducing waste in the activities that add value (AV) to the products”.

Davis and Heineke (2005:349) define “Lean production is an integrated set of objectives designed to achieve high-volume flexible production using minimal inventories of raw materials”.

The concept “World-Class” has been interchanged with Lean Manufacturing by various authors and researchers alike.
Todd (1995:3), “Lean Production follows a typical ‘World-Class’ approach in that it requires the involvement of the whole work force in attack waste”.

Several authors and researchers in this field of study defined and described lean from different viewpoints based on previous studies of successful implementation in their operations. Waste is the most commonly shared idea on the subject as summarising theses definitions on lean manufacturing. Reducing or the elimination of waste in the manufacturing or service operation remains the most important objective to be achieved. Waste can be defined as any non-value adding operation or activity in the manufacturing process. This has an additional cost element to the manufacturing cost which the customer is not willing to pay.

2.3 HISTORICAL BACKGROUND TO LEAN MANUFACTURING

The automotive industry is described as the world’s largest manufacturing activity. “Forty years ago Peter Drucker dubbed it the industries of industries”, (Womack, Jones and Roos, 2007:9).

It has changed fundamentally during the past century in which goods are produced. Womack et al (2007:7) states it as “And how we make things dictates not only how we work but what we buy, how we think, and the way we live”.

These authors stated that the world of manufacturing transcended from craft production to mass production until what is termed lean manufacturing. This is summarised by Womack et al (2007:7), “After World War I, Henry Ford and General Motors’ Alfred Sloan moved world manufacture from centuries of craft production- led by European firms-into the age of mass production”.

The most significant change in the automotive was brought about after the Second World War. Eiji Toyoda and Taiichi Ohno at Toyota Motor Corporation in Japan pioneered the concept of Lean Production after numerous visits to the American automotive industry.
2.3.1 CRAFT PRODUCTION

Craft production is described by Womack, Jones and Roos (2007:11) as “The craft producer uses highly skilled workers and simple flexible tools to make exactly what the consumer asks for – one item at a time”. Therefore it can be deduced that automobiles were expensive to purchase during this era.

Pieterse (2007:3) describes craft production as “It was a method that worked, but it was expensive and not suitable for the manufacture of goods on a large scale. With craft production, volumes were low”. He further points out, “It is hard to achieve consistency and reliability, since every article that was made differed in some respect from the next”.

Craft production characterised by Womack, Jones and Roos (2007:22):
- The labour force was highly skilled through intensive learnership training. Enabling them to be self-employed subcontractors to assembly plants when the opportunity arose.
- The different functions within the organisation were decentralised. The owner co-ordinated the interaction between customers, employees and suppliers which provided smaller components from their shops.
- Operations such as grinding, drilling performed on wood or metal were done by general purpose equipment.
- Inherently craft methods produced different products, resulting in lower production volumes.

2.3.2 MASS PRODUCTION

The concept of Mass production must be attributed to the actions taken by Henry Ford at the beginning of the twentieth century. As stated by Pieterse (2007:3), “Henry Ford developed the method to a fine art by in the early twentieth century”. A key factor to make this work was having the parts that were interchangeabeable and simple to assembly. For this to work Pieterse mentions, “Interchangeability was achieved when Ford started using the same
gauging system for all parts, throughout the manufacturing process and when machine tools were produced that could machine pre-hardened metals”.

Pieterse (2007:4) puts it across as, “With Mass production, a worker no longer had to be a skilled craftsman with a complex array of tools”. The skilled tasks were broken down into smaller tasks which required less skill to perform. This meant it only required fewer minutes of training to perform the job which became the duty of the first line of supervision. With this definition, it can easily be noticed that new job opportunities were been created for the less skilled population.

This concept is further illustrated by Pieterse (2007:7) stating it as “A worker on the Ford line had only one simple task to perform, such as attaching one wheel to a car”. During this era, jobs were simplified to increase productivity which increased the availability of new products to the customers.

The advent of mass production required less skill craftsmen, low costs, which lead to higher volume of goods to be produced. This method of production was adopted the world over. This achieved very successful results which lasted more than a half century in different industrialised countries.

According to Santos, Wysk and Torres (2004:40), “Mass production has two basic characteristics: low prices compared with cost of handmade products and the ability to replace component parts on the manufactured models that break or wear out”. This meant simply that manufacturing costs had to be reduced to meet the increasing demand of new products by consumers. Reducing the complexity of component parts of the product meant reduction in spare part holding and maintenance thereof simpler.

2.3.3 LEAN PRODUCTION

Womack et al (2007:11) qualifies the term Lean Production which was coined by John Krafcif as “lean, because it uses less of everything compared with
mass production”. It is defined as utilising only half the resources as compared to mass production. These resources are human effort (labour), manufacturing space (factory layout), investment in tools (set up costs), and engineering hours to develop new productions (research and development). With this new approach significant reductions are evident with results been halved in the number of defects, higher volumes produced and increased product range.

The greatest significance between these two manufacturing methodologies lies in its objectives. Womack et al (2007:11), states that “Mass production set a limited goal for them –“good enough”. In this manner, the resultant measures are the number of defects which are allowed, inventory levels are set to the maximum and product ranges are limited because of standardising it.

From the literature study, there are specific tasks identified to continually improve, strive for perfection, reduced operating costs and lower inventory stock levels. With this approach the end point is a continuous moving target. As the set objective is achieved, the next improvement is initiated. Therefore setting these stretched objectives drives the lean philosophy on a continuous basis.

2.4 EMPLOYEE INVOLVEMENT

According to Davis and Heineke (2005:361), “For lean production to be successful, the workforce needs to be engaged in continuous improvement and involved in the process” The management responsibility extends further than control and reducing operational costs, but to establishing a culture that supports these work engagement and involvement.

Davis and Heineke (2005:361) strongly belief, that, “Lean production managers listen to their workforce and encourage their suggestions for improvement. Employee involvement is a key element of lean production”.

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Clearly to realise the potential of lean production, the organisation needs to take employee ideas to the next step. The authors suggest that an effective idea management program is imperative requiring the following:

- **Top management accountability.** Their role includes understanding the program and giving support in terms of resources to manage it. Ensure participation and involvement by all levels in the organization.
- **Supervisor engagement.** This level is the communicator between the shop floor employees and management. To ensure non-resistance from this level, management needs to recognise their engagement from both supervisors and the participating shop floor employees.
- **Ideas management coordinator.** For immediate and fair assessment of ideas leads to a successful program.
- **Shop floor employee involvement and training.** Job security is important in reassuring employees that job losses will not result from productivity improvements.
- **Ideas management committee.** Responsible to review and do policy updates on a regularly basis.

### 2.5 THE LEAN PRINCIPLES

Womack and Jones (1996:10) summarise these lean principles in their book, *Lean Thinking*, “We concluded that lean thinking can be summarized in five principles”. The authors postulate this concept as, a dependable guide for managers willing to change from the chaos of mass production.

- The customer defines value with regard to its needs, timing and price.
- Identify the value stream for a specific product.
- Continuous product flow through the other value adding processes.
- Customers pull value from the next process.
- Perfection is reached when no waste is created, only perfect value.

This decodes the lean techniques which once were misunderstood by managers resulting in failure.
These principles are illustrated in a cycle of continuous improvement.

![Continuous Improvement Cycle](http://www.lean.org/Whatslean/Principles.cfm)

**FIGURE 1: CONTINUOUS IMPROVEMENT CYCLE**

Pieterse (2006:11) states it is a demanding task to transfer the different lean tools which took more than 30 years to develop at Toyota without a well thought through strategy in place. The author refers to the book written by Womack and Jones in which they summarise the principles of “lean thinking”. This guided managers through the implementation phase, “This was an attempt to create such an implementation strategy that puts first things first and to establish a philosophical basis for the change process” (Pieterse 2006:8).

Bicheno (2004:10) emphasizes the importance and benefit of these five principles as “Reading the Introduction to Lean Thinking should be compulsory for every executive”. The author states it is a journey of continuous improvement and not just a sequential procedure followed once off.

According to Liker (2004:36), “the more I understand it is a system designed to provide the tools for people to continually improve their work”. The author studied the Toyota Production Systems and the Toyota Way of conducting
business. The dependence on people is very evident because they breathe life in the culture.

A culture in which workers reduce inventory, solve problems and work together as a team. This is more than just a set of efficiency and improvement techniques. The authors agree that sustaining this culture is brought about by the behaviour and commitment of both management and the shopfloor employees.

Liker (2004:6) documents the “Toyota Way” as four principle areas, Philosophy, Process, People/Partners and Problem Solving.

![4P Model Diagram](source)

**FIGURE 2: 4P MODEL**

(Source: Adapted from “4P” Model of the Toyota Way, Liker 2004:6)

2.5.1 PHILOSOPHY - LONG-TERM THINKING

The management base their decision on future growth whilst aligning the entire organisation towards a common purpose. This is often done at the expense of the financial gain in the short term.
• Importantly to generate new customers, the future financial viability depends on it.
• Protect the environment by utilising resources more efficiently.
• Social responsibility, uplifting the community and its people.
• Ensure the organisation contributes to the economy.

2.5.2 PROCESS – ELIMINATE WASTE

The organisational focus is on having the right processes in place to deliver the desired outcomes. The principles of flow, pull, customer quality and perfection are imperatives which enables the successful elimination of waste.

• Create flow in the production environment through reducing waiting time by redesigning work processes.
• Cultivate a culture on the shopfloor of stop and fix problems before passing it onto the next process.
• Operations are standardised which form the basis for continuous improvement activities.
• Problems are visualised and resolved through utilising quality tools.

2.5.2.1 WASTE TYPES

The term “waste” is commonly referred to as non-valued activities which the customer is not prepared to pay for. Literature suggests that these “wastes” account for a high percentage of the costs incurred in a non-lean manufacturing environment. The Volkswagen Production System (VPS) describes the non-value adding cost element, as commonly known as the nine wastes:

• Overproduction: The customer (internal or external) orders are less than the current production rate. This is contrary to the Lean principle which is based on a “Pull” system; products are produced just as the customer orders are received. Any production rate above this (work-in-progress or safety stock) inventory levels result in utilising more labour and material than required.
- Waiting time: This includes time waiting for information, material, machine or man. Lean requires that all resources are available on a just-in-time (JIT) basis.
- Transportation: Raw materials are shipped from the supplier to a receiving location. Then processed, transported to the warehouse and eventually supplied to the production area. Lean requires that material after processing at the supplier is directly supplied to the location where it is used.
- Non-value-added process: The reworking of parts prior it being used (inspection or reworks) as this does not meet the required standard. Value Stream Mapping is the technique used to identify non-valued-added steps in the process.
- Excess Stock: Directly related to overproduction, stock on hand which exceeds customer orders. It has a negative impact of decreasing available floor space and creates cash flow problems.
- Insufficient communication: It serves to exchange information and know-how requiring a balance, not too much or too little in order for daily work to continue.
- Defects or Reworks: Production or service defects result in more materials used, additional labour hours, cost of rework and the potential increase of customer complaints.
- Waste by motion: Direct result of poor layout, work flow and poor housekeeping.
- Non-ergonomic work processes: This entails work procedures that cause additional physical stress, effort or loss of motivation and performance by the employee.

2.5.3 PEOPLE AND PARTNERS

The leaders in the organisation are developed to understand the work content, live the philosophy of lean manufacturing and have the ability to transfer this knowledge to others.
Leaders act as the role models of the organisation’s strategy.

Employees work together as teams to improve quality and productivity.

Create a culture that reflects the organisation’s values and beliefs.

According to the VPS, management is the key for the success of any initiative which has been introduced to the organisation. The operative management plays an active and visible role in living the lean philosophy. They are personally present in the process, learning to see it. They understand the process better and can provide more appropriate support when and where required. By observing and checking for deviations from the standard and directly addressing it as it occurs. They communicate the information that is accurate and clear enabling effective decision making is possible.

2.5.4 PROBLEM SOLVING – CONTINUOUS IMPROVEMENT AND LEARNING

The fourth principle is problem solving and continuous improvement which drive the solving of the root causes of problems. Create a culture of a learning organisation and that strives to continually improve.

- Problem solving is done where it occurs through direct observation.
- The 5 why technique is used to solve problem root causes.
- The decisions are implemented rapidly.
- Learning is standardised through best practices.

The VW Production System follows the Deming cycle of Plan-Do-Check-Act (PDCA) as a problem resolution and continuous improvement guideline for the entire process. This is found and illustrated in the Toyota Production System-Creating flow and PDCA, (Liker 2004:264).
In this problem solving and continuous improvement section, the following lean concepts, PDCA, A3 Problem Sheet, 5 Why Analysis, Brainstorming techniques and Teamwork are utilised to determine root causes and countermeasures to these problem situations.

The VPS utilises this tool by the empowering the shop floor employees in Problem solving teams (PST). Shop floor employees are trained in these problem solving techniques to solve challenges which affect them directly as employees.
2.6 LEAN TERMINOLOGY

The following concepts are implemented as part of the lean manufacturing philosophy.

- Lean manufacturing is a systematic approach to identify and eliminating waste (non-value-added activities) through continuous improvement, (Field, 2001:6).


- 5S housekeeping is the basic housekeeping discipline for lean, quality and safety. The philosophy focuses on simplifying the work environment: sort, simplify, shine, standardize and sustain, (Bicheno, 2004:52).

- Visual Controls are simple signals that provide immediate and easy to understand information (Lean Tools).

- Single piece flow is the processing of the product by one operator to minimize production and in a ratio of one piece at a time.

- Overall Equipment Effectiveness of machines is Availability x Performance x Quality expressed in percentage terms, (Bicheno, 2004:56). It is a measure of the extent to which the machines are available for production.

- Kanban production: a signal is used to inform the previous manufacturing step that it may now manufacture what is required, (Pieterse, 2007:12).

- Just-in-time, according to this principle, nothing is manufactured until there is a demand, fulfilling customer requirements, (Santos, Wysk and Torres, 2006:4)

Total Quality Management (TQM): is an organisation-wide approach to continuously improving the quality of all organisation's processes, products and services, (Kotler, 2000:56).

Muda, Japanese term for waste. In lean manufacturing any action which does not add value is deemed to be waste, (Pieterse, 2007:136)

Value stream, the steps in the manufacturing process to change the state of raw materials to finish goods, ready to be used by the customer, (Pieterse, 2007:137).

2.7 SUSTAINING LEAN MANUFACTURING

Mann (2010:205) states that, “The purpose of lean management is to sustain a lean production system”. The task of sustaining these lean manufacturing concepts is the function and responsibility of the leader to perform. Leaders motivate and support these activities in the workplace.

2.7.1 ASPECTS OF SUSTAINABLE IMPROVEMENT

According to Drew, McCallum and Roggenhofer (2004:17), there are three aspects of sustainable improvements.

- Operating Systems: Value delivery to the customer through managing the resources by effectively reducing all non-value adding activities.
- Management Infrastructure: Operating systems are supported and sustained through engaged management who implement processes and systems which are designed to for this purpose.
- Mind sets and behaviour: The organisational culture defines how standard work is performed safely, consistently and productively.
2.7.2 PREREQUISITES FOR SUSTAINABLE IMPLEMENTATION

Mann (2010:205), summaries these prerequisites for sustainable implementation of lean manufacturing as follows:

- Performing daily Leader standard work that enables sustainable lean management and production implementations.
- Visual controls are maintained and updated daily by the leader. These provide the information which drive effective root cause analysis and problem resolution.
- Conduct regular walks to the shop floor to view the operations in motion. It creates a culture of continuous learning, therefore assessing the process performances.
- Periodically assess your lean management system. These represent the standards you aiming to achieve. This assessment also identifies opportunities which require focus efforts to improve the weaker areas in the system.

In conclusion, it is noted that lean manufacturing is a whole systems approach which requires specific concepts to be implemented and managed in order to be successful.
CHAPTER 3
RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

In chapter two, the researcher described in detail the concept of Lean Manufacturing with regard to historical background, principles and philosophy, as well as sustainable implementation measures to ensure competitive advantage in the automotive industry.

In chapter three, the research objective is to determine the appropriate methodology to seek the answer to the dilemma facing the organisation. In this study, an exploratory research was made using a literature search of books and the internet.

The study aimed at following a positivistic approach to test and determine the causal relation between sustainability and lean principles by using quantitative methods. The research was conducted in an automotive OEM – in its production department, namely Volkswagen Group South Africa.

3.2 RESEARCH OBJECTIVE

The aim was to gain insight into the challenges which exist and how these can be resolved to improve sustainability.

3.2.1 PRIMARY OBJECTIVE

The primary objective of this study was identified as: An analysis of the sustainability of the Lean manufacturing implementation at Volkswagen Group South Africa.

3.2.2 SECONDARY OBJECTIVE

In order to resolve the primary objective the following secondary objectives have been identified:
I. Investigate the contribution of the application of the Philosophy of long-term thinking to the sustainability of the implementation of Lean.

II. Investigate the contribution of the application of lean manufacturing processes to the sustainability of the implementation of Lean.

III. Investigate the contribution of people and partners to the sustainability of the implementation of Lean.

IV. Investigate the contribution of the application of problem solving methods to the sustainability of the implementation of Lean.

The abovementioned secondary objectives were addressed by means of a literature study. This was concluded with a survey which was conducted among the leadership in the production departments at VWGSA.

3.3 RESEARCH METHODOLOGY

Collis and Hussey (2003:1) summarises the different definitions of research as:

- It is an enquiry and investigative process,
- Follows a systematic and methodical approach,
- Knowledge is increased.

Leedy (1997:9) characterises research as “The core concept underlying all research is its Methodology”. This means that the study is controlled by the methodology which is followed. The data which is collected and processed into logical relationships are determined by it.

The conclusions derived lead to the expansion of knowledge. Stating that research methodology has two primary functions:

- To order and command the collection of data.
- To compare the data after collection and derive a conclusion from it.
The below research cycle represents the researchers own construct based on the literature reveal on how this process is followed. It is cyclical in nature, and starts with a problem situation which required to be answered. The next step defines clearly the desired state or outcome of the study.

Then the hypotheses are formulated to solve the primary and secondary objectives of the study. The research instrument is designed which will be used to collect data. The data is analysed and interpreted to answer the problem situation.

**FIGURE 4: THE RESEARCH CYCLE**

(Source: Adapted from the Research Cycle, Leedy 1997:10)
3.3.1 EXPLORATORY RESEARCH

According to Collis and Hussey (2003:10), exploratory research is conducted when a research dilemma or situation is unknown or no evidence of previous studies is available. The objective of the study is to seek patterns, ideas or hypotheses, other than proving or confirming a hypothesis.

Dixon (1989:13) agrees that the purpose is to explore an unknown subject area. The desirability and priority rating of the research is gained through these insights. Exploratory research is aimed at gaining insights which forms the basis for further investigation.

3.3.2 DESCRIPTIVE RESEARCH

This describes the phenomena as it exists. It identifies and obtains information about the characteristics of the dilemma or situation. It may answer the following questions:

- What is the absentee rate in the different production areas?
- What the workers think about retrenchments?
- What are the qualification levels of subgroups of employees?

(Collis and Hussey 2003:11)

Dixon (1989:14) defines this kind of survey as a detailed description given to the phenomenon being investigated.

3.3.3 ANALYTICAL RESEARCH

Dixon (1989:14) explains the aim of exploratory studies is to reveal whatever causal relationship exists between variables which may explain or even predict the phenomenon under specific conditions.

The studies could confirm this viewpoint, extend the descriptive characteristics by analysing and explain how and why it happened.
Analytical research targets understanding of the phenomena by exploring and measuring causal relations between them, attempting to answer questions such as:

- How to reduce customer complaints?
- How to improve product delivery time?
- How to expand the range of services?

(Collis and Hussey 2003:11)

### 3.3.4 PREDICTIVE RESEARCH

Predictive research is a forecast of the probability that a similar phenomenon will occur elsewhere. It aims to generalise from the analysis by forecasting a particular situation based on a hypothesis.

Predictive research answers the following questions:

- Opening a new retail store in which city will be more profitable?
- Will productivity levels be increased by bonus schemes?
- What product packing will increase sales?
- How will the profit margins be affected by increased interest rates?

(Collis and Hussey 2003:11)

The researcher seeks to combine the explorative and analytical research in an attempt to answer the dilemma facing the OEM. This view is supported by the fact that this kind of research had not been done before in this particular manufacturer, therefore it will be discovering new knowledge. Secondly the causal relation will be revealed in the interpretation of the analysis gained from the collected data.

### 3.4 METHODICAL APPROACHES

Collis and Hussey (2003:47): There are two main research paradigms or philosophies can be labeled positivistic and phenomenological. There are differences between these two approaches that need to be examined to
determine which approach should be used. The positivistic approach seeks the facts or causes of social phenomena, with little regard to the subjective state of the individual (Collis and Hussey, 2003:52). The phenomenological paradigm is concerned with the understanding human behavior from the participant’s own frame of reference.

3.4.1 POSITIVISTIC PARADIGM

Collis and Hussey (2003:52), states “The positivistic approach seeks facts or causes of social phenomena, with little regard to the subjective state of the individual”. The approach used in the natural sciences (biology, botany and physics) forms the basis for social sciences. Positivism is founded on the belief that human behaviour can be studied in the manner as conducted in the natural science studies. The assumption is that social reality is independent of human subject and it exists regardless.

3.4.2 PHENOMENOLOGICAL APPROACH

Leedy (1997:161), states “Phenomenology is defined here as a research method that attempts to understand participants’ perspectives and views of social realities”. The author elaborates this term by stating that the researcher often experiences this phenomenon. The phenomenologists try to increase their own understanding of the phenomenon by studying the participants’ experience.

Collis and Hussey (2003:53), confirms this definition, “the phenomenological paradigm is concerned with understanding human behaviour from the participants own frame of reference”.

3.5 QUANTITATIVE AND QUALITATIVE APPROACHES

Leedy (1997:104) quotes (Creswell 1994) who defines a quantitative study as “an inquiry into a social or human problem based on testing a theory composed of variables, measured with numbers and analysed with statistical procedures,
in order to determine whether the predictive generalization of the theory holds true”. The author states in contrast a qualitative study is defined as “inquiry process of understanding a social or human problem, based on building a complex, holistic picture, formed with words, reporting detailed views of the informants, and conducted in a natural setting”.

Clear distinction is revealed through the definitions of each approach. The approach of the study can be quantitative or qualitative depending whether the researcher intends to deduce and test a particular hypothesis from his or her observations. In the quest to achieve these objectives, the research processes includes various methods of sampling, data capturing, analysis and various report writing styles to publish these findings.

Distinguishing Characteristics

<table>
<thead>
<tr>
<th>Character</th>
<th>Quantitative</th>
<th>Qualitative</th>
</tr>
</thead>
<tbody>
<tr>
<td>The purpose of the research</td>
<td>Explain and predict</td>
<td>Describe and explain</td>
</tr>
<tr>
<td></td>
<td>Confirm and validate</td>
<td>Explore and interpret</td>
</tr>
<tr>
<td></td>
<td>Test theory</td>
<td>Build theory</td>
</tr>
<tr>
<td></td>
<td>Outcome oriented</td>
<td>Process-oriented</td>
</tr>
<tr>
<td>The nature of the research process</td>
<td>Focused</td>
<td>Holistic</td>
</tr>
<tr>
<td></td>
<td>Known variables</td>
<td>Unknown variables</td>
</tr>
<tr>
<td></td>
<td>Established guidelines</td>
<td>Flexible guidelines</td>
</tr>
<tr>
<td></td>
<td>Detached view</td>
<td>Personal view</td>
</tr>
<tr>
<td>The methods of data collection</td>
<td>Representative sample</td>
<td>Small sample</td>
</tr>
<tr>
<td></td>
<td>Standard instruments</td>
<td>Observations, interviews</td>
</tr>
<tr>
<td>The form of reasoning used</td>
<td>Deductive analysis</td>
<td>Inductive analysis</td>
</tr>
<tr>
<td>The communicated findings</td>
<td>Statistics, aggregated data</td>
<td>Narratives, individual quotes,</td>
</tr>
<tr>
<td></td>
<td>Formal voice, scientific style</td>
<td>personal voice, literary style</td>
</tr>
</tbody>
</table>

**TABLE 1: QUANTITATIVE VS QUALITATIVE**

(Source: Adapted from Leedy 1997:106)
3.6 DATA COLLECTION

According to Collis and Hussey (2003:150), “data collection methods are used in that part of the research process which is concerned with collecting data”.

Herbst (1989:179) states, “The data collection phase is the only opportunity the researcher will have of interacting with the entities he is studying, ie the respondents”.

According to Collis and Hussey (2003:160) there are two main sources of data, namely, “Original data is known as primary data, which is collected at sources”. These include survey data which is obtained by asking questions or observations of uncontrolled situations. The other source, “Secondary data is data which already exists, such as books, documents”. This information is organised in useful form such as, annual reports, published statistics and personal records.

These authors illustrate the data collection process as follows:

- Identify variables or phenomena
- Select Sample
- Select type of data required
- Choose appropriate collection method(s)
- Conduct pilot study or exploratory research
- Modify collection method(s)
- Collect Data

**FIGURE 5: DATA COLLECTION PROCESS**

Source: Adapted from Collis and Hussey (2003:152)
3.6.1 DATA COLLECTION METHODS

According to Sekaran (200:221), “Interviewing, administering questionnaires, and observing people and phenomena are the three main data methods in survey research”:

- **Interviewing**: The researcher can adapt or change the questions as he or she proceeds whilst conducting the interview.
- **Questionnaires**: This method is an advantageous means of obtaining data in terms of efficiently utilising the researchers’ time, cost and effort.
- **Observation**: This is an unobtrusive method of data collection which has the advantage of being more accurate.

In this study the researcher used a questionnaire to obtain information from the defined population that consisted of leaders from the selected organisation. Convenience sampling was used to select Managers, Supervisors and Group Leaders. Personal interviews were conducted in the identified group to determine the status quo of lean manufacturing principles. The anonymity of the survey participants was guaranteed to ensure confidentiality of the points as declared in the interviews and focus group sessions.

3.6.2 THE QUESTIONNAIRE

Sekaran (2000:233) defines “A questionnaire is a preformulated written set of questions to which respondents record their answers”.

Collis and Hussey (2003:174) state that questionnaires are a popular method to collect data. It is cheaper, less time consuming than conducting interviews and larger samples can be taken.

3.6.2.1 A QUESTIONNAIRE IS:

- A carefully structured list of questions.
- Selected after considerable testing.
An efficient data collection mechanism.

Measuring the variables of interest with regard to a specific group of participants.

The content and purpose is clearly stated.

3.6.2.2 QUESTIONNAIRE CONSTRUCTION

Leedy (1997:193) state that, “The writer of a questionnaire should never forget that he or she is asking of the recipient a gift of time and effort and the favor of reply”.

The researcher viewed these considerations as important whilst constructing the questionnaire:

- Be courteous: The introduction ensured co-operation which increased attention given to the questionnaire.
- Simplify: Easy to read and reply, requiring the least amount of time and effort.
- Consider first impressions: It was neatly typed which impressed the respondent on receipt.
- Concentrate on the universe: It addressed general problems rather than personal issues.
- Make it brief: Questions were kept simple so that only one meaning was possible.
- Check for consistency: Include questions which cross reference answers to other questions.
- Send return postage: Ensure respondent convenience in returning the questionnaire by including a self-addressed stamped envelope.
- The result of the study was offered to the respondents.
- Think ahead: The questionnaire format was determined by how the data was processed.
3.6.2.3 QUESTIONNAIRE TYPES

According to Sekaran (2000:236) the researcher will obtain incorrect answer to questions when the same questions are either misunderstood or misinterpreted by the respondent thus being biased.

- Open-ended question is answered in the manner which the respondent chooses to reply.
- A closed question permits a respondent to make a choice from set alternatives as given by the researcher.
- Positively and negatively worded question minimize the tendency of respondents to select points from one end of the scale.
- Sequencing of questions facilitates questions from general to specific which ensure progression by the respondent through the questionnaire.

3.6.2.4 QUESTIONNAIRE DISTRIBUTION

Collis and Hussey (2003:175), “Cost is often an important element when it comes to deciding on the best method to distribute your questionnaire”. Further it is dependent the location and size of the sample. Every method poses its own advantages and disadvantages.

- By post: Popular means of distribution and relatively affordable when the sample is large. Administration is less complicated; however response rate can be low as 10 percent. This can pose a problem of bias as it may not be representative of the population.
- By telephone: It enables personal contact, yet reduces the cost associated with face to face interviews. Very high response rate of 90% can be achieved. The inherent problem with this method leans towards bias, only people who have telephones or that are willing to participate are surveyed.
- Face-to-face: The respondent is presented with the questionnaire in the street, office, home or anywhere convenient.
It is time consuming and an expensive method, especially when the interviewee choose the location. Comprehensive data is collected with a high response rate.

- Group distribution: conducting a survey at different locations makes this an appropriate method. This gives the researcher chance to assemble subgroups in one venue. Explain the questionnaire answer any queries.
- Individual distribution: The sample is located at one place making distribution, collection of individual questionnaires. This method can be precise in targeting the appropriate sample.

### 3.7 PILOT STUDY

Collis and Hussey (2003:175), clearly states that it is imperative to pilot or test before distributing it.

The researcher conducted a pilot study compromising of 5 respondents. Paint shop Manager, Supervisor and Group leader, Assembly Manager and a Body shop Supervisor. The respondents clearly understood the requirements and minor changes were made as discussed with this pilot group.

The advantage to first conducting the pilot study was that glaring problems were easily recognised and corrected. It is costly to redo after the large number of copies of the questionnaire is printed. Lastly the validity and reliability can be compromised in this manner.

### 3.8 RESPONSE RATE

The researcher utilised group distribution to deploy the questionnaire to selected sample. This meant that respondents were gathered in one venue, namely, the supervisor office. A brief explanation was given to the respondents who were present. Further, any clarification was offered when and if required. This was done between 17 October 2012 and 02 November 2012.
The researcher immediately collected the questionnaires after completion. In some instances, collection was done within two days of distribution. This method of distribution allowed effective control and ensured a higher response rate. A total of 140 questionnaires were distributed during the study and 124 were received for data analysis. This response rate equates to a 90 per cent result which is regarded as very good.

<table>
<thead>
<tr>
<th>Sample Size</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Questionnaires distributed</td>
<td>140</td>
</tr>
<tr>
<td>Number of Questionnaires returned for analysis</td>
<td>126</td>
</tr>
<tr>
<td>Number of Questionnaires not returned for analysis</td>
<td>14</td>
</tr>
</tbody>
</table>

**TABLE 2: RESPONSE RATE**

(Source: Researcher’s own construct)

According to Collis and Hussey (2003:195), statistics is a body of methods which enables the researcher to recognise and evaluate errors in quantifying the experience.

- **Mean**
  \[
  \text{Mean} = \frac{\sum x}{n}
  \]
  where,
  \[
  x = \text{each observation}
  \]
  \[
  n = \text{total number of observations}
  \]
  \[
  \sum = \text{the sum of}
  \]

- **Frequency distribution**
  \[
  \text{Percentage relative frequency} = \frac{f}{\sum f} \times 100
  \]
  where,
  \[
  f = \text{the frequency}
  \]
  \[
  \sum = \text{the sum of}
  \]

The above-mentioned statistical data analysis techniques were utilised to interpret and present data obtained from the survey.
3.9 QUESTIONNAIRE LAYOUT

The author of “The Toyota Way” correlated the 14 principles which define the management behaviour and business process to four categories. Liker (2004:6) refers to it as the “4P” model of the Toyota way. These categories are, Philosophy, Process, People/Partners and Problem solving.

The researcher utilises this model to analysis the sustainability of lean manufacturing implementation in these different categories.

In the book, “Creating a Lean culture”, David Mann (2010:212) states that to periodically assess the overall status of lean management implementation is a good idea. According to the author these lean management standards may include process, behaviour which forms part of nine manufacturing dimensions. With this in mind, the standards are defined at five different levels of system status.

Considering the “4P model” and this lean management standards assessment tool, the researcher constructed his own matrix to form the basis for the research questionnaire.

<table>
<thead>
<tr>
<th>Category Level</th>
<th>Philosophy</th>
<th>Process</th>
<th>People Partners</th>
<th>Problem Solving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification Phase</td>
<td>Organisational strategy</td>
<td>Processes followed</td>
<td>Behaviours reflect values</td>
<td>Root cause analysis</td>
</tr>
<tr>
<td>Systematic Stabilisation</td>
<td>Customer oriented process</td>
<td>Systems implemented</td>
<td>Individuals work together as a Team</td>
<td>Resolve problems</td>
</tr>
<tr>
<td>Sustainable Implementation</td>
<td>Leader standard work</td>
<td>Measure, control and review</td>
<td>Respect, developing exceptional people</td>
<td>Structured Problem resolution</td>
</tr>
</tbody>
</table>

**TABLE 3: LEAN SUSTAINABILITY MATRIX**

Source: Researcher’s own construct
The questionnaire was subdivided into: Appendix 2

SECTION A (A1 - A2) BIOGRAPHICAL INFORMATION
This section was designed to obtain biographical information regarding the respondent’s position and manufacturing plant of the organisation.

SECTION B (B1 – B6) PHILOSOPHY: LONG-TERM THINKING
The objective of this section was to determine adherence to the philosophy, long term thinking of Lean implementation. It focusses on organisational strategy, customer oriented processes and leader standard work.

SECTION C (C1 – C6) PROCESS: WASTE ELIMINATION
This section of the questionnaire deals with the process control and waste elimination. Process activities which measure monitor and review actions that are sustainable.

SECTION D (D1 – D6) PEOPLE AND PARTNERS
The objective of this section focusses on people and the customer. The organisational values are displayed in the behaviour of the leaders who develop exceptional people/teams to achieve exceptional results.

SECTION E (E1 – E6) PROBLEM SOLVING: CONTINUOUS IMPROVEMENT AND LEARNING
The focal point for this section of questionnaire is problem resolution and continuous improvement. Leaders seek root causes to problems by going to where it happens on the shopfloor.

COVERING LETTER

The objectives of the research study were explained to the potential respondents in an accompanying cover letter. The confidentiality and anonymity of the respondent was assured. Contact details were provided in the event respondents have any queries. (Appendix 1)
3.10 VALIDITY AND RELIABILITY

Leedy (1997:32), states validity and reliability is primarily encountered with the measuring tools. This will determine the research’s integrity by how well it is understood and applied in practice. It underpins the data collection, competency with which the research structure is designed, as well as making it an integral part of the measuring instrument.

3.10.1 VALIDITY

According to Collis and Hussey (2003:58), validity reflects the accuracy of the findings based upon the real situation. “An effect or test is valid if it demonstrates or measures what the researcher thinks or claims it does” (Coolican, 1992, p35). The validity can be questioned when research errors done by following incorrect procedures, insufficient data collection and using inappropriate measuring instruments.

Leedy (1997:32), states that by following a standardised test, validity will raise questions as:

- What does the test measure?
- Does it measure what it supposed to?
- How well, comprehensively and accurately does it measure it?

According to Leedy (1997:33), there are six types of validity.

- Face Validity: Basically relies on the researcher’s subjective judgement. The researcher has to answer two questions to the best of his or her ability. Does the instrument measure what was intended to be measured and sample size representative of the behaviour trait being measured.
- Criterion Validity: Cross referencing performance on a particular measure against the performance on another measure is called criterion validity. The essential component is reliable and valid criterion. It forms the standard against which the results of the instrument doing the measuring are measured. There should be a high correlation between
the data of the measuring instrument compared to the equivalent data of the criterion.

- **Content Validity:** This refers to the accuracy with which the instrument measures the content of the situation under study.

- **Construct Validity:** It is any concept which cannot be isolated or observed directly. Deals with the degree to which the construct is actually being measured. Firstly making use of convergence which focusses on the focal effect of various methods of measuring a construct. Secondly, discriminability that the measuring instrument should be able to differentiate the construct being studied for other similar constructs.

- **Internal Validity:** It seeks to confirm that a change in the dependent variable is a result of the independent variable rather than the research design.

- **External Validity:** This refers to the generalisation of the conclusions reached through observation to other cases.

The researcher utilised two statistical methods to validate the measuring instrument which was used to collect the data for this study. The criterion validity is done by cross referencing the performances of these measures. There was a high correlation between the results of both methods. Therefore the validity of the measuring instrument in question was validated.

### 3.10.2 RELIABILITY

Reliability is defined as “If a research finding can be repeated, it is reliable” (Collis and Hussey, 2003:58). This means when the researcher or another repeats this research, the findings should be same.

Leedy (1997:35) elaborates, “To be reliable, each instrument must consistently measure the factors for which it was designed. Add accuracy to consistency, and the value of the instrument is greatly enhanced”. Therefore reliability refers to the consistent performance of the measuring instrument. The integrity of the
research can be ensuring that is mandatory for the researcher to clear state the specifications of the measuring instrument. Literature has shown that researchers tend to steer clear of stating what the criteria used would ensure the reliability of the study.

The researcher determined the reliability by making a comparison between the results of the pilot study and the actual survey. The reliability test was thus proven in this manner.

3.10.3 GENERALISATION

The question arises; will the research findings be applicable to cases of situations out of the study? The term “Generalisation” is ‘the extent to which you can come to conclusions about one thing (often a population) based on information about another (often a sample)’ (Vogt, 1993, p99).

‘Thus, you will be concerned with whether the patterns, concepts and theories which have been generated in a particular environment can be applied in other environments’, (Collis and Hussey 2003:61). In order to do this, the researcher needs to understand the behaviours and the activities which are being studied.

3.11 CONCLUSION

In this chapter the researcher explained and discussed the research design and methodology chosen for this study. In the next chapter the results and findings will be further discussed.
CHAPTER 4
RESEARCH RESULTS AND ANALYSIS

4.1 INTRODUCTION

In chapter 3 the research methodology and research chosen was for the study was discussed.

In this chapter the results and findings of the empirical study will be presented and analysed.

The data was analysed and interpreted following the questionnaire structure, which was sub-divided into the following sections:

- SECTION A (A1 - A2) BIOGRAPHICAL INFORMATION
- SECTION B (B1 – B6) PHILOSOPHY: LONG-TERM THINKING
- SECTION C (C1 – C6) PROCESS: ELIMINATE WASTE
- SECTION D (D1 – D6) PEOPLE AND PARTNERS
- SECTION E (E1 – E6) PROBLEM SOLVING: CONTINUOUS IMPROVEMENT
4.2 SECTION A  BIOGRAPHICAL INFORMATION

The profile of the respondents was gathered from the biographical information in Section A of the questionnaire. In this section respondents were requested to provide information about their position and in which manufacturing plant they are working.

4.2.1 THE RESPONSE RATE

There were 140 questionnaires distributed to individuals and purpose of the study explained, as illustrated in table 4.

<table>
<thead>
<tr>
<th>SAMPLE DISTRIBUTION</th>
<th>NUMBER OF QUESTIONNAIRES</th>
<th>PERCENTAGE PARTICIPATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUP LEADER</td>
<td>61</td>
<td>43.57%</td>
</tr>
<tr>
<td>SUPERVISOR</td>
<td>49</td>
<td>35.00%</td>
</tr>
<tr>
<td>MANAGER</td>
<td>13</td>
<td>9.29%</td>
</tr>
<tr>
<td>DIVISION HEAD</td>
<td>3</td>
<td>2.14%</td>
</tr>
<tr>
<td>NON RESPONDENTS</td>
<td>14</td>
<td>10.00%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>140</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

TABLE 4: BIOGRAPHICAL DISTRIBUTION

See below pie chart representation of overall participation by the respondents. A ninety per cent response rate was achieved with 126 of the 140 questionnaires being returned for the purpose of analysis.

FIGURE 6: OVERALL PARTICIPATION

(Source: Researcher’s own construct)
4.3 SECTION B PHILOSOPHY – LONG-TERM THINKING

This section is aimed to establish the degree to which Philosophy is present in the leadership positions in the organisation.

**FIGURE 7: PHILOSOPHY LONG-TERM THINKING**

- **Group leader:** The score of 4.35 (87.10%) out of five as illustrated in figure 7 indicates they Strongly Agree with strategy of Philosophy Long-term thinking.

- **Supervisor:** The score of 4.25 (85.03%) out of five as illustrated in figure 7 indicates they Strongly Agree with strategy of Philosophy Long-term thinking.

- **Manager:** The score of 4.5 (90%) out of five as illustrated in figure 7 indicates they Strongly Agree with strategy of Philosophy Long-term thinking.

- **Division Head:** The score of 4.16 (83.33%) out of five as illustrated in figure 7 indicates they Agree with strategy of Philosophy Long-term thinking.

- **Organisation:** The score of 4.32 (86.51%) out of five as illustrated in figure 7 indicates they Strongly Agree with strategy of Philosophy Long-term thinking.
The overall results for Philosophy indicate that Managers had scored higher on all questions than the other leaders. This reflects on the importance of their role to communicate and interpret the organisation’s strategy to the lower levels for implementation and sustainability.

4.3.1 PHILOSOPHY – IDENTIFICATION PHASE

![Graph: Philosophy - Identification Phase](image)

**FIGURE 8: PHILOSOPHY- IDENTIFICATION PHASE**

B1 The organisational strategy is known and understood by all leaders.

- **Group leader:** The score of 4.41 (88.20%) out of five as illustrated in figure 8 indicates they Strongly Agree that the strategy is known and understood.

- **Supervisor:** The score of 4.49 (89.80%) out of five as illustrated in figure 8 indicates they Strongly Agree that the strategy is known and understood.

- **Manager:** The score of 4.85 (96.92%) out of five as illustrated in figure 8 indicates they Strongly Agree that the strategy is known and understood.

- **Division Head:** The score of 4.67 (93.33%) out of five as illustrated in figure 8 indicates they Strongly Agree that the strategy is known and understood.
Organisation: The score of 4.49 (89.84%) out of five as illustrated in figure 8 indicates they Strongly Agree that the strategy is known and understood.

B2 Management decisions are based on long term philosophy at the expense of short term financial gain.

Group leader: The score of 4.07 (81.31%) out of five as illustrated in figure 8 indicates they Agree decisions are taken for the long term financial viability.

Supervisor: The score of 3.84 (76.73%) out of five as illustrated in figure 8 indicates they Agree decisions are taken for the long term financial viability.

Manager: The score of 4.15 (83.08%) out of five as illustrated in figure 8 indicates they Agree decisions are taken for the long term financial viability.

Division Head: The score of 4.00 (80.00%) out of five as illustrated in figure 8 indicates they Agree decisions are taken for the long term financial viability.

Organisation: The score of 3.98 (79.68%) out of five as illustrated in figure 8 indicates they Agree decisions are taken for the long term financial viability.

The overall interpretation of the identification phase is an indication that the organisational strategy is known by the leadership. However the execution thereof is equally viewed to be contrary to what would be expected by leaders.
4.3.2 PHILOSOPHY – SYSTEMATIC STABILISATION

B3 Customer oriented processes drive long term approach to building flexible and learning organisation.

- Group leader: The score of 4.18 (83.61%) out of five as illustrated in figure 9 indicates they Agree that customer oriented process are in place.

- Supervisor: The score of 4.16 (83.27%) out of five as illustrated in figure 9 indicates they Agree that customer oriented process are in place.

- Manager: The score of 4.46 (89.23%) out of five as illustrated in figure 9 indicates they Strongly Agree that customer oriented process are in place.

- Division Head: The score of 4.00 (80.00%) out of five as illustrated in figure 9 indicates they Agree that customer oriented process are in place.

- Organisation: The score of 4.20 (83.97%) out of five as illustrated in figure 9 indicates they Agree that customer oriented process are in place.
B4 All leaders can identify how standard work benefits their daily performance.

- Group leader: The score of 4.59 (91.80%) out of five as illustrated in figure 9 indicates they Strongly Agree that standard work benefits their daily performance.

- Supervisor: The score 4.45 (88.98%) out of five illustrated in figure 9 indicates they Strongly Agree that standard work benefits their daily performance.

- Manager: The score of 4.62 (92.31%) out of five as illustrated in figure 9 indicates they Strongly Agree that standard work benefits their daily performance.

- Division Head: The score of 4.33 (86.67%) out of five as illustrated in figure 9 indicates they Strongly Agree that standard work benefits their daily performance.

- Organisation: The score of 4.53 (90.63%) out of five as illustrated in figure 9 indicates they Strongly Agree that standard work benefits their daily performance.

The results follow a similar trend that the shift in perception is the same between the leadership levels. The Manager level significantly indicate that processes are customer oriented and leader standard work is beneficial to their performance.
B5 The focus from the leaders is adding value to customers and society.

- **Group leader:** The score of 4.59 (91.80%) out of five as illustrated in figure 10 indicates they Strongly Agree with adding value to customers and society.

- **Supervisor:** The score of 4.47 (89.39%) out of five as illustrated in figure 10 indicates they Strongly Agree with adding value to customers and society.

- **Manager:** The score of 4.62 (92.31%) out of five as illustrated in figure 10 indicates they Strongly Agree with adding value to customers and society.

- **Division Head:** The score of 4.00 (80.00%) out of five as illustrated in figure 10 indicates they Agree with adding value to customers and society.
Organisation: The score of 4.53 (90.63%) out of five as illustrated in figure 10 indicates they Strongly Agree with adding value to customers and society.

B6 Standard work is regularly reviewed by the next level as monitoring and trend analysis.

Group leader: The score of 4.30 (85.90%) out of five as illustrated in figure 10 indicates they Strongly Agree that standard work is regularly reviewed.

Supervisor: The score of 4.10 (82.04%) out of five as illustrated in figure 10 indicates they Agree that standard work is regularly reviewed.

Manager: The score of 4.31 (86.15%) out of five as illustrated in figure 10 indicates they Strongly Agree that standard work is regularly reviewed.

Division Head: The score of 4.00 (80.00%) out of five as illustrated in figure 10 indicates they Agree that standard work is regularly reviewed.

Organisation: The score of 4.21 (84.29%) out of five as illustrated in figure 10 indicates they Agree that standard work is regularly reviewed.

The question of sustainable implementation is answered by the strong indication that leaders focus on adding value to customers by reviewing actions on a regular basis.
4.4 SECTION C PROCESS – ELIMINATE WASTE

This section is aimed to establish the degree of process awareness is present in the Leadership positions in the organisation.

**FIGURE 11: PROCESS - ELIMINATE WASTE**

- **Group leader:** The score of 4.03 (80.06%) out of five as illustrated in figure 11 indicates they Agree to Process awareness.

- **Supervisor:** The score of 4.06 (81.22%) out of five as illustrated in figure 11 indicates they Agree to Process awareness.

- **Manager:** The score of 4.03 (80.77%) out of five as illustrated in figure 11 indicates they Agree to Process awareness.

- **Division Head:** The score of 3.94 (78.89%) out of five as illustrated in figure 11 indicates they are Uncertain about Process awareness.

- **Organisation:** The score of 4.04 (80.82%) out of five as illustrated in figure 11 indicates they Agree to Process awareness.
4.4.1 PROCESS - IDENTIFICATION PHASE

FIGURE 12: PROCESS IDENTIFICATION PHASE

C1 Process followed when things run smoothly, but abandoned when problems occur.

- **Group leader:** The score of 3.18 (63.61%) out of five as illustrated in figure 12 indicates they Strongly Disagree that processes are abandoned when problems occur.

- **Supervisor:** The score of 3.02 (60.41%) out of five as illustrated in figure 12 indicates they Strongly Disagree that processes are abandoned when problems occur.

- **Manager:** The score of 2.69 (53.85%) out of five as illustrated in figure 12 indicates they Strongly Disagree that processes are abandoned when problems occur.

- **Division Head:** The score of 3.67 (73.33%) out of five as illustrated in figure 12 indicates they are Uncertain that processes are abandoned when problems occur.
Organisation: The score of 3.08 (61.59%) out of five as illustrated in figure 12 indicates they Strongly Disagree that processes are abandoned when problems occur.

C2 Pull/Flow systems are implemented to avoid overproduction.

- Group leader: The score of 4.10 (81.97%) out of five as illustrated in figure 12 indicates they Agree that systems are implemented to avoid overproduction.

- Supervisor: The score of 4.24 (84.90%) out of five as illustrated in figure 12 indicates they Agree that systems are implemented to avoid overproduction.

- Manager: The score of 4.00 (80.00%) out of five as illustrated in figure 12 indicates they Agree that systems are implemented to avoid overproduction.

- Division Head: The score of 4.00 (80.00%) out of five as illustrated in figure 12 indicates they Agree that systems are implemented to avoid overproduction.

- Organisation: The score of 4.14 (82.86%) out of five as illustrated in figure 12 indicates they Agree that systems are implemented to avoid overproduction.

The low scoring results indicates the need to address this issue of abandoning processes when problems occur. A more positive result is found in the next question, systems are seen as implemented to avoid forms of overproduction.
4.4.2 PROCESS - SYSTEMATIC STABILISATION

FIGURE 13: PROCESS SYSTEMATIC STABILISATION

C3 Leaders focus on process e.g. Standardised work, labour planning and Employee empowerment.

- Group leader: The score of 4.34 (86.89%) out of five as illustrated in figure 13 indicates they Strongly Agree with focus on process.

- Supervisor: The score of 4.39 (87.76%) out of five as illustrated in figure 13 indicates they Strongly Agree with focus on process.

- Manager: The score of 4.38 (87.69%) out of five as illustrated in figure 13 indicates they Strongly Agree with focus on process.

- Division Head: The score of 3.67 (73.33%) out of five as illustrated in figure 13 indicates they Agree with focus on process.

- Organisation: The score of 4.35 (86.98%) out of five as illustrated in figure 13 indicates they Agree with focus on process.
C4 Cultivating a culture of stop to fix problems gets quality right first time.

- Group leader: The score of 4.23 (84.59%) out of five as illustrated in figure 13 indicates they Agree to stop and fix problems.

- Supervisor: The score of 4.18 (83.67%) out of five as illustrated in figure 13 indicates they Agree to stop and fix problems.

- Manager: The score of 4.31 (86.15%) out of five as illustrated in figure 13 indicates they Strongly Agree to stop and fix problems.

- Division Head: The score of 4.00 (80.00%) out of five as illustrated in figure 13 indicates they Agree to stop and fix problems.

- Organisation: The score of 4.21 (84.29%) out of five as illustrated in figure 13 indicates they Agree to stop and fix problems.

This systematic stabilisation is important to ensure leaders are process focussed and adopt a culture of stop to fix problems.
4.4.3 PROCESS - SUSTAINABLE IMPLEMENTATION

**FIGURE 14: PROCESS SUSTAINABLE IMPLEMENTATION**

C5 Regular reviews of production processes, routine audits to maintain (5S, TPM, Pull systems)

- **Group leader:** The score of 4.26 (85.25%) out of five as illustrated in figure 14 indicates they Strongly Agree that regular reviews and audits are done.

- **Supervisor:** The score of 4.31 (86.15%) out of five as illustrated in figure 14 indicates they Strongly Agree that regular reviews and audits are done.

- **Manager:** The score of 4.31 (86.15%) out of five as illustrated in figure 14 indicates they Strongly Agree that regular reviews and audits are done.

- **Division Head:** The score of 4.00 (80.00%) out of five as illustrated in figure 14 indicates that they Agree that regular reviews and audits are done.
 Organisation: The score of 4.28 (85.56%) out of five as illustrated in figure 14 indicates they Agree that regular reviews and audits are done.

C6 Visual controls are regularly analysed to identify line stoppers which problem solving.

 Group leader: The score of 4.07 (81.31%) out of five as illustrated in figure 14 indicates they Agree that visual controls are analysed to drive problem solving.

 Supervisor: The score of 4.22 (84.49%) out of five as illustrated in figure 14 indicates they Agree that visual controls are analysed to drive problem solving.

 Manager: The score of 4.54 (90.77%) out of five as illustrated in figure 14 indicates they Strongly Agree that visual controls are analysed to drive problem solving.

 Division Head: The score of 4.33 (86.67%) out of five as illustrated in figure 14 indicates they Strongly Agree that visual controls are analysed to drive problem solving.

 Organisation: The score of 4.18 (83.65%) out of five as illustrated in figure 14 indicates they Agree that visual controls are analysed to drive problem solving.

The range between leader groups are very narrow, signify that operational and strategic levels are aligned. Regular reviews are conducted and visual controls are utilised to resolve line stoppers.
4.5 SECTION D PEOPLE AND PARTNERS

This section is aimed to establish the degree of People and partners awareness present in the Leadership positions in the organisation.

![Graph of People & Partners](image)

**FIGURE 15: PEOPLE AND PARTNERS**

- **Group leader:** The score of 4.17 (83.50%) out of five as illustrated in figure 15 indicates they Agree with People and Partners.

- **Supervisor:** The score of 4.04 (80.88%) out of five as illustrated in figure 15 indicates they Agree with People and Partners.

- **Manager:** The score of 4.11 (82.31%) out of five as illustrated in figure 15 indicates they Agree with People and Partners.

- **Division Head:** The score of 4.11 (82.31%) out of five as illustrated in figure 15 indicates they are Agree with People and Partners.

- **Organisation:** The score of 4.11 (82.33%) out of five as illustrated in figure 15 indicates they Agree with People and Partners.
4.5.1 PEOPLE AND PARTNERS – IDENTIFICATION PHASE

**FIGURE 16: PEOPLE AND PARTNERS – IDENTIFICATION PHASE**

D1 Leaders are role models of the company’s philosophy and of doing business.

- Group leader: The score of 4.13 (82.62%) out of five as illustrated in figure 16 indicates they Agree with being role models.

- Supervisor: The score of 4.12 (82.45%) out of five as illustrated in figure 16 indicates they Agree with being role models.

- Manager: The score of 4.23 (84.62%) out of five as illustrated in figure 16 indicates they Agree with being role models.

- Division Head: The score of 4.00 (80.00%) out of five as illustrated in figure 16 indicates they Agree with being role models.

- Organisation: The score of 4.13 (82.70%) out of five as illustrated in figure 16 indicates they Agree with being role models.
D2 Company values and beliefs are widely shared / lived out.

- Group leader: The score of 3.98 (79.67%) out of five as illustrated in figure 16 indicates they Agree that values and beliefs are displayed.

- Supervisor: The score of 3.94 (78.78%) out of five as illustrated in figure 16 indicate they Agree that values and beliefs are displayed.

- Manager: The score of 4.00 (80.00%) out of five as illustrated in figure 16 indicates they Agree that values and beliefs are displayed.

- Division Head: The score of 4.00 (80.00%) out of five as illustrated in figure 16 indicates they Agree that values and beliefs are displayed.

- Organisation: The score of 3.97 (79.37%) out of five as illustrated in figure 16 indicates they Agree that values and beliefs are displayed.

The leaders of the organisation are viewed as the role models who live out the company’s philosophy through its business. However an area of opportunity was determined with regard to the company values and beliefs which seem not to be lived out.
4.5.2 PEOPLE AND PARTNERS – SYSTEMATIC STABILISATION

D3 Cross functional teams improve quality / productivity.

- Group leader: The score of 4.21 (82.26%) out of five as illustrated in figure 17 indicates they Agree that cross functional teams make improvements.

- Supervisor: The score of 4.12 (82.45%) out of five as illustrated in figure 17 indicates they Agree that cross functional teams make improvements.

- Manager: The score of 4.38 (87.69%) out of five as illustrated in figure 17 indicates they Strongly Agree that cross functional teams make improvements.

- Division Head: The score of 4.67 (93.33%) out of five as illustrated in figure 17 indicates they Strongly Agree that cross functional teams make improvements.

- Organisation: The score of 4.21 (84.13%) out of five as illustrated in figure 17 indicates they Agree that cross functional teams make improvements.
D4 Individuals work together as teams toward common goals.

- Group leader: The score of 4.13 (82.62%) out of five as illustrated in figure 17 indicates they Agree that teams work toward common goals.

- Supervisor: The score of 4.12 (82.45%) out of five as illustrated in figure 17 indicates they Agree that teams work toward common goals.

- Manager: The score of 4.23 (84.62%) out of five as illustrated in figure 17 indicates they Agree that teams work toward common goals.

- Division Head: The score of 4.00 (80.00%) out of five as illustrated in figure 17 indicates they Agree that teams work toward common goals.

- Organisation: The score of 4.13 (82.70%) out of five as illustrated in figure 17 indicates they Agree that teams work toward common goals.

An overall high scoring section of the questionnaires indicating that team work has a positive effect on results. Also this indicates that individuals prefer working together rather than on their own.
D5 Developing exceptional people/teams to achieve exceptional results.

- Group leader: The score of 4.23 (84.59%) out of five as illustrated in figure 18 indicates they Agree with developing exceptional people to achieve results.

- Supervisor: The score of 4.08 (81.63%) out of five as illustrated in figure 18 indicates they Agree with developing exceptional people to achieve results.

- Manager: The score of 4.23 (84.62%) out of five as illustrated in figure 18 indicates they Agree with developing exceptional people to achieve results.

- Division Head: The score of 4.00 (80.00%) out of five as illustrated in figure 18 indicates they Agree with developing exceptional people to achieve results.
- Organisation: The score of 4.17 (83.33%) out of five as illustrated in figure 18 indicates they Agree with developing exceptional people to achieve results.

D6 Respect extend network of partners/suppliers by challenging/assisting them to improve.

- Group leader: The score of 4.20 (83.93%) out of five as illustrated in figure 18 indicates they Agree with respecting and assisting of suppliers.

- Supervisor: The score of 4.04 (80.82%) out of five as illustrated in figure 18 indicates they Agree with respecting and assisting of suppliers.

- Manager: The score of 3.85 (76.92%) out of five as illustrated in figure 18 indicates they are Uncertain with respecting and assisting of suppliers.

- Division Head: The score of 3.67 (73.33%) out of five as illustrated in figure 18 indicates they Disagree with respecting and assisting of suppliers.

- Organisation: The score of 4.09 (81.75%) out of five as illustrated in figure 18 indicates they Agree with respecting and assisting of suppliers.

This section of the questionnaire indicates growth opportunity to develop suppliers to improve their respective operations.
4.6 SECTION E PROBLEM SOLVING – CONTINUOUS IMPROVEMENT

This section is aimed to establish the degree of Problem solving present in the Leadership positions in the organisation.

FIGURE 19: PROBLEM SOLVING - CONTINUOUS IMPROVEMENT

- **Group leader:** The score of 4.26 (85.25%) out of five as illustrated in figure 19 indicates they Strongly Agree with Problem solving and Continuous improvement initiatives.

- **Supervisor:** The score of 4.25 (85.03%) out of five as illustrated in figure 19 indicates they Strongly Agree with Problem solving and Continuous improvement initiatives.

- **Manager:** The score of 4.46 (89.23%) out of five as illustrated in figure 19 indicates they Strongly Agree with Problem solving and Continuous improvement initiatives.

- **Division Head:** The score of 3.94 (78.89%) out of five as illustrated in figure 19 indicates they are Uncertain with Problem solving and Continuous improvement initiatives.

- **Organisation:** The score of 4.27 (85.42%) out of five as illustrated in figure 19 indicates they Strongly Agree with Problem solving and Continuous improvement initiatives.
E1 Leaders begin to ask why and purse root causes for major problems.

- Group leader: The score of 4.33 (86.56%) out of five as illustrated in figure 20 indicates they Strongly Agree with questioning root causes of major problems.

- Supervisor: The score of 4.43 (88.57%) out of five as illustrated in figure 20 indicates they Strongly Agree with questioning root causes of major problems.

- Manager: The score of 4.54 (90.77%) out of five as illustrated in figure 20 indicates they Strongly Agree with questioning root causes of major problems.

- Division Head: The score of 4.33 (86.67%) out of five as illustrated in figure 20 indicates that they Strongly Agree with questioning root causes of major problems.

- Organisation: The score of 4.39 (87.78%) out of five as illustrated in figure 20 indicates they Strongly Agree with questioning root causes of major problems.
E2 Waste is easily identified and using continuous improvement (kaizen) to eliminate it.

- Group leader: The score of 4.34 (86.89%) out of five as illustrated in figure 20 indicates they Strongly Agree with waste identification and elimination thereof.

- Supervisor: The score of 4.14 (82.86%) out of five as illustrated in figure 20 indicates they Agree with waste identification and elimination thereof.

- Manager: The score of 4.46 (89.23%) out of five as illustrated in figure 20 indicates they Strongly Agree with waste identification and elimination thereof.

- Division Head: The score of 3.67 (73.33%) out of five as illustrated in figure 20 indicates they Disagree with waste identification and elimination thereof.

- Organisation: The score of 4.26 (85.24%) out of five as illustrated in figure 20 indicates they Strongly Agree waste identification and elimination thereof.

Leadership has adopted a questioning culture to determine root causes, in so doing resolve problems which hinder performance.
4.6.2 PROBLEM SOLVING – SYSTEMATIC STABILISATION

FIGURE 21: PROBLEM SOLVING – SYSTEMATIC STABILISATION

E3 Many leaders use some form of structured problem solving techniques.

- **Group leader:** The score of 4.33 (86.56%) out of five as illustrated in figure 21 indicates they Strongly Agree with the use of structured problem solving techniques.

- **Supervisor:** The score of 4.33 (86.53%) out of five as illustrated in figure 21 indicates they Strongly Agree with the use of structured problem solving techniques.

- **Manager:** The score of 4.54 (90.77%) out of five as illustrated in figure 21 indicates they Strongly Agree with the use of structured problem solving techniques.

- **Division Head:** The score of 3.67 (73.33%) out of five as illustrated in figure 21 indicates they Disagree with the use of structured problem solving techniques.

- **Organisation:** The score of 4.33 (86.67%) out of five as illustrated in figure 21 indicates they Strongly Agree with the use of structured problem solving techniques.
E4 Solve problems and improve processes by going to the source (Gemba).

- Group leader: The score of 4.31 (86.23%) out of five as illustrated in figure 21 indicates they Strongly Agree with Problem solving is done at the source.

- Supervisor: The score of 4.27 (85.31%) out of five as illustrated in figure 21 indicates they Strongly Agree with Problem solving is done at the source.

- Manager: The score of 4.38 (87.69%) out of five as illustrated in figure 21 indicates they Strongly Agree with Problem solving is done at the source.

- Division Head: The score of 4.33 (86.67%) out of five as illustrated in figure 21 indicates they Strongly Agree with Problem solving is done at the source.

- Organisation: The score of 4.30 (86.03%) out of five as illustrated in figure 21 indicates they Strongly Agree with Problem solving is done at the source.

The result was constant, with this set of statements, as it refers directly to the area when the leaders are functioning. They are operational requiring systematic implementation to secure stable output.
4.6.3 PROBLEM SOLVING – SUSTAINABLE IMPLEMENTATION

E5 Decisions are made by consensus after considering all options with rapid implementation.

- Group leader: The score of 4.00 (80.00%) out of five as illustrated figure 22 indicates that they Agree with consensus decisions and rapid implementation.

- Supervisor: The score of 3.94 (78.78%) out of five as illustrated in figure 22 indicates they are Uncertain there is consensus decisions and rapid implementation.

- Manager: The score of 4.31 (86.15%) out of five as illustrated in figure 22 indicates they Strongly Agree consensus decisions and rapid implementation is taken.

- Division Head: The score of 4.00 (80.00%) out of five as illustrated in figure 22 indicates they Agree that consensus decisions and rapid implementation is taken.
 Organisation: The score of 4.01 (80.16%) out of five as illustrated in figure 22 indicates they Agree with consensus decisions and rapid implementation is taken.

E6 Routine and systematic use of the 8 Step problem solving (A3 Sheet) and 5 Why’s.

 Group leader: The score of 4.26 (86.89%) out of five as illustrated in figure 22 indicates they Strongly Agree that routine and systematic problem solving steps is used.

 Supervisor: The score of 4.41 (82.86%) out of five as illustrated in figure 22 indicates they Agree that routine and systematic problem solving steps are used.

 Manager: The score of 4.54 (89%) out of five as illustrated in figure 22 indicates they Strongly Agree that routine and systematic problem solving steps are used.

 Division Head: The score of 3.67 (73.33%) out of five as illustrated in figure 22 indicates they Disagree that routine and systematic problem solving steps are used.

 Organisation: The score of 4.33 (86.67%) out of five as illustrated in figure 22 indicates they Strongly Agree that routine and systematic problem solving steps are used.

4.7 CONCLUSION

In this chapter, the results of the empirical study were presented. The responses from the respondents were all illustrated using graphs.

In the next chapter the final conclusion and recommendations will be discussed.
CHAPTER 5
CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

In the previous chapter, the results of the empirical study were presented by using graphs to illustrate the responses to the measuring instrument.

In this chapter an analysis, interpretation and the literature review will be conducted. The objective is aimed at providing an answer to the original problem statement.

5.2 FINDINGS

The primary objective of this study was to analyse the sustainability of the Lean manufacturing principles which are implemented at Volkswagen Group South Africa. Gain insight into the challenges which exist and how these can be resolved to improve sustainability.

In order to resolve the primary objective the following secondary objectives have been identified:

I. Investigate the contribution of the application of the Philosophy of long-term thinking to the sustainability of the implementation of Lean.

II. Investigate the contribution of the application of lean manufacturing processes to the sustainability of the implementation of Lean.

III. Investigate the contribution of people and partners to the sustainability of the implementation of Lean.

IV. Investigate the contribution of the application of problem solving methods to the sustainability of the implementation of Lean.
The feedback from respondents who participated in the study indicated that the Lean Manufacturing implementation is sustainable. There were no significant gaps revealed when interpreting the analysed data.

- **Philosophy**
  The result has shown that there was a significant focus on Philosophy as strategic decisions and standard work forms part of the daily routine. Most leader scores compared within a narrow margin of the organisational mean of 4.32 (86.51%).

  However the overall analysis and interpretation of the results indicate that Division Heads differed significantly with the perception of the leaders at lower levels. These leaders strongly agreed with the statements, whilst Division Heads only agreed. A possible reason for this could be the higher expectations which are set for these leaders to achieve.

- **Process**
  The result indicates a low level of awareness and requires more intervention from management and leadership to improve. The scores were lowest for the first question which in fact was deliberately posed as a negative statement. The overall mean scores were within a small margin of the organisational mean 4.04 (80.82%).

  These confirms that between the operational, systematic and strategic leaders, no differences are evident that suggests that the process of waste elimination is not been executed. Ultimately these levels are responsible implement and sustain these activities to gain the competitive advantage which the organisation seeks to gain over it competitors.
People and Partners

The results have shown that there was a significant focus on People and Partners with emphasis to encourage teamwork. All leader scores compared within a narrow margin of the organisational mean of 4.11 (82.33%).

The point of cross divisional or functional teams was scored significantly higher by Division Heads as compared to the lower levels of leadership. The reason driving this perception lies in the fact that they are responsible to champion these initiatives. The benefactors do not view the results gained by these teams as improvements.

Problem Solving

The result shows a strong tendency that this is being sustained successfully. However a closer view indicates more training in this aspect needs to be done, in terms of the problem solving tools which are available. The overall mean scores differed to that of the organisational mean 4.27 (85.42%).

The analyses indicated a discrepancy between the Division Heads and Managers clearly evident. The Managers perceived that all problem solving techniques were sufficiently implemented and sustained. The Division Heads vastly disagreed with this view as indicated in the results.

By implementing Lean manufacturing, organisations become more competitive in the market. However the key to continual success is having a system which is sustainable.

5.2 RECOMMENDATIONS

The primary objective was to an analysis the sustainability of the Lean manufacturing implementation at Volkswagen Group South Africa.
This objective was met through the consultation with various literature sources and an empirical study.

The literature review revealed various strategies that the organisation could utilise to sustain the implementation of Lean Manufacturing. The implementation of these strategies could enable the organisation to become more competitive. The feedback received from respondents who participated in the survey indicated that Lean Manufacturing is sustained in the production environment.

- **Philosophy**
  Standard leader work should implemented to ensure guided disciplined is sustained at leadership levels. Importantly the next level needs to engage lower levels in reviewing current practices with the focus of sustainment.

- **Process**
  This should become the focal point to make quick financial gains by involving the shop floor employees. Training them in continuous improvement initiatives will have a greater impact versus the top down approach to reduce waste.

- **People and Partners**
  Importantly people should not be regarded as resources rather tapping into the limitless potential which exist. Management must drive Idea schemes which reward implementation of waste and cost reduction ideas.

- **Problem Solving**
  Introduce weekly performance reviews per operational process. This affords leaders to explain their own performances and get the right support or resources allocated to improve and eliminate problems.
5.3 FUTURE RESEARCH OPPORTUNITIES

This study can serve as the basis to conduct future research on the same topic, as new developments and changes are introduced.

- Investigate the contribution of sustainable Lean Manufacturing implementation in other processes of the organisation other than those studied in this research.

- The implementation of Lean Manufacturing at the suppliers of OEM’s.

- The relationship between continuous improvement and problem solving between the different employee levels in the organisation.

5.4 CONCLUSION

The South African automotive manufacturers are under tremendous pressure to improve quality, reduced costs and customer delivery time. This transformation needs to be part of the business strategy supported by management as leaders and drivers of this culture. Therefore to conclude, sustainable Lean Manufacturing must be viewed as a strategic long term view to ensure survival in a very competitive industry.
6. REFERENCES


Comment (online) Available http://www.naamsa.co.za/comment/
(accessed 25.02.2008)


Kobayashi, I.1990. 20 Keys to workplace improvement. Portland, Productivity Press


Volkswagen Group (Online). Available [http://volkswagenag.com/content/vwcorp/content/en/the_group/strategy.html](http://volkswagenag.com/content/vwcorp/content/en/the_group/strategy.html) (accessed 08/11/2012)


APPENDIX 1

CONSENT FORM

AN ANALYSIS OF THE SUSTAINABILITY OF THE LEAN MANUFACTURING IMPLEMENTATION AT VOLKSWAGEN GROUP SOUTH AFRICA

I, Anand Williams, will be conducting this research study aimed at determining your perception of lean implementation and the sustainability of this philosophy at VWSA.

The results of this research study will be submitted to the Nelson Mandela Metropolitan University (NMMU) in partial fulfilment of a Master’s degree in Business Administration (MBA).

Kindly assist by completing the accompanying questionnaire which will take about 10 minutes. Your name will not be required on the questionnaire. Therefore your responses will be strictly confidential and will remain anonymous.

Please sign this form, if you are willing to participate in this research study.

If you have any questions regarding this research study, please contact:

Prof. J.J. Pieterse
NMMU Business School
Telephone : 041-504 3774
Email : JJ.Pieterse@nmmu.ac.za

Thank you for your participation.

……………………………  ……………………
Participant Signature     Date
### APPENDIX 2

#### SECTION A  BIOGRAPHICAL INFORMATION

<table>
<thead>
<tr>
<th></th>
<th>What is your position in the organisation?</th>
<th>Division Head</th>
<th>Manager</th>
<th>Supervisor</th>
<th>Group Leader</th>
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<th>In which manufacturing plant do you work?</th>
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#### SECTION B  PHILOSOPHY : LONGTERM THINKING

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<th>The organisational strategy is known and understood by all leaders.</th>
<th>Strongly Agree</th>
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<th>Uncertain</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<table>
<thead>
<tr>
<th></th>
<th>Management decisions are based on long term philosophy at the expense of short term financial gain.</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
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<th>Strongly Disagree</th>
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<th></th>
<th>Customer oriented processes drive long term approach to building flexible &amp; learning organisation</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<thead>
<tr>
<th></th>
<th>All leaders can identify how standard work benefits their daily performance.</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<thead>
<tr>
<th></th>
<th>The focus from the leaders is adding value to customers and society.</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<table>
<thead>
<tr>
<th></th>
<th>Standard work is regularly reviewed by the next level as monitoring and trend analysis.</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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#### SECTION C  PROCESS : ELIMINATE WASTE

<table>
<thead>
<tr>
<th></th>
<th>Process followed when things run smoothly, but abandoned when problems arise.</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<table>
<thead>
<tr>
<th></th>
<th>Pull/Flow systems are implemented to avoid overproduction.</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<table>
<thead>
<tr>
<th></th>
<th>Leaders focus on processes e.g. Standardised work, labour planning and employee empowerment.</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<table>
<thead>
<tr>
<th></th>
<th>Cultivating a culture of stop to fix problems, get quality right first time.</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<td>C4</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>Regular reviews of production processes, routine audits to maintain (5S, TPM, Pull systems).</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<table>
<thead>
<tr>
<th></th>
<th>Visual controls are regularly analysed to identify line stoppers which drive problem solving.</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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#### SECTION D  PEOPLE AND PARTNERS

<table>
<thead>
<tr>
<th></th>
<th>Leaders are role models of the company’s philosophy and of doing business.</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<table>
<thead>
<tr>
<th></th>
<th>Company values/beliefs are widely shared/ lived out.</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<tbody>
<tr>
<td>D2</td>
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<thead>
<tr>
<th></th>
<th>Cross functional teams improve quality/productivity</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<table>
<thead>
<tr>
<th></th>
<th>Individuals work together as teams toward common goals.</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<tbody>
<tr>
<td>D4</td>
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<table>
<thead>
<tr>
<th></th>
<th>Developing exceptional people/teams to achieve exceptional results</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<tbody>
<tr>
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<table>
<thead>
<tr>
<th></th>
<th>Respect extend network of partners/suppliers by challenging/assisting them to improve.</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<tbody>
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#### SECTION E  PROBLEM SOLVING

<table>
<thead>
<tr>
<th></th>
<th>Leaders begin to ask why and pursue root causes for major problems.</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<table>
<thead>
<tr>
<th></th>
<th>Waste is easily identified and using continuous improvement (kaizen) to eliminate it.</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<table>
<thead>
<tr>
<th></th>
<th>Many leaders use some form of structured problem solving techniques.</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
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<th>Strongly Disagree</th>
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<tr>
<th></th>
<th>Solve problems and improve processes by going to the source, (Gemba)</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<tr>
<th></th>
<th>Decisions are made by consensus after considering all options with rapid implementation.</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<table>
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<tr>
<th></th>
<th>Routine and systematic use of the 8 Step problem solving (A3 Sheet) &amp; 5 Why’s.</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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