

UNIVERSITY OF KWAZULU-NATAL

Lean Manufacturing Implementation:  
*A perspective on key success factors*

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## ABSTRACT

The interest on lean production is mostly based on the empirical evidence that it improves the company's competitiveness. However, the implementation of lean manufacturing harbours enormous difficulties due to a broad-spectrum of variables, compounded by lack of standardised mechanisms within organisations of analysis and measure of value-adding capabilities.

The purpose of this study was to understand from both a management and employees' perspective, the relative importance of key success factors, specifically training, for successful implementation of the lean principles and to understand the impact of training on employees perceptions of the lean programme.

A quantitative research methodology was conducted in a packaging manufacturing company and data, collected using a questionnaire from a sample size of 54 employees, was analysed using SPSS software.

Employees were found to have developed good perceptions about the impact that training had in their own jobs and also perceived that the lean program overall added value in their organisation. Employees considered training and management commitment as the most critical factors for a successful lean implementation.

For lean implementation to be successful employees must be given training that is relevant to their work and senior management of the organisation must show (display) commitment towards the lean program being implemented by making necessary resources (time, funds ) available for lean activities.

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# CHAPTER ONE

## INTRODUCTION

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### 1.1 Introduction

Lean manufacturing is defined as a production practice that uses fewer resources when compared to traditional manufacturing. It requires the reduction of any activity that does not add value to the customer. For example, Lean uses less human effort than traditional manufacturing because one person could be trained to operate several machines which are arranged in a U- shape cell layout (Lynch, 2005).

The term Lean production evolved from the Just-In-Time (JIT) production concepts which were pioneered at Toyota in Japan and was widely adopted in the 1990s to emphasise the goal of systematically eliminating waste throughout the supply chain (Jacobs, Chase and Aquilano, 2009).

The term “Lean” with its reference to frugality, was actually coined by James Womack in his book titled “The machine that changed the world” to characterise the Toyota manufacturing system (Pieterse, Lourens, Louw, Murray, Van der Merwe, 2010).

This study, “Lean Manufacturing Implementation: A perspective on key success factors”, was aimed at investigating the impact of training on Lean implementation and specifically the impact on employees’ perceptions about the Lean program.

In order to answer the research question, a quantitative research methodology was adopted whereby a research instrument (questionnaire) was designed and used to collect research data, results of which were analysed using SPSS software. This chapter serves to introduce the research topic and presents motivations for the study, clearly outlining how the different stakeholders would benefit from the findings of the study as well as stating the research problem.

## **1.2 Motivation for the study**

The motivation for the study stemmed from the fact that there is empirical evidence that Lean improves a company's competitiveness (Sanchez and Perez, 2001).

Although many organisations have adopted Lean principles, the South African context ("our environment and customs") differs vastly from the idealised conditions encountered in Japan, where Lean originated and to improve the chances of implementing Lean successfully these differences must be taken into account (Pieterse, Lourens, Louw, Murray, Van der Merwe, 2010).

There is therefore a need to conduct research on the subject of Lean to develop a better understanding of the application of Lean principles within the context of the South African environment.

The study was focussed on training from a perspective of its influence on employees' perceptions rather than the content and delivery of the training materials being offered.

The results of the research were intended to benefit organisations wanting to implement Lean principles providing insight on some of the key variables they could focus on. Similarly, organisations that are experiencing difficulties in successfully implementing Lean principles could refresh their approach as guided by the findings of this research.

Consultants on the subject of Lean could also benefit from the findings of the study as they could enhance their services by incorporating the findings of this study into the delivery of their services. Employees can use the findings of the study to engage with management during the process of implementing Lean principles.

## **1.3 Focus of the study**

The study was conducted in a packaging manufacturing company based in KwaZulu-Natal, South Africa.

While there may be many variables that can impact the implementation of a Lean program this study focussed specifically on training. The study was pitched to look at training from a perspective of its influence on employees' perceptions rather than looking at the content and delivery of the training materials being offered.

There was therefore an underlying assumption that the content of the training being offered to employees is relevant, being delivered effectively and would improve employees' competencies.

There are a number of tools and principles that are associated with Lean manufacturing such as Autonomous Maintenance, 5s etc. This study focused on the specific Lean tools that had been implemented (or were being implemented) in the organisation at which the study was conducted.

#### **1.4 Problem statement**

The implementation of Lean manufacturing principles remains a tool with which to improve competitiveness as organisations take strategic measures to remain profitable during periods of economic downturn. However as with many improvement programs Lean principle implementations have not succeeded universally in their applications due to a number of variables that may impact implementation of such initiatives (Worley, J. and Doolen, T, 2006).

Typical benefits associated with successful Lean implementation include reduced inventory levels, reduced lead-times, and improved knowledge management, less rework, financial savings, increased process understanding and less process waste (Melton, 2005).

In another case study of Lean implementation, as an example, an Indian manufacturing industry witnessed 92.58% reduction in lead time, 2.17% reduction in processing time, 97.1% reduction in work-in-progress and 26.08% reduction in manpower requirement (Singh, Garg, Sharman and Grewal, 2010).

Whilst there is a rich body of research, conducted internationally, on the impact of different variables such as training, worker empowerment, labour policy (Friel, 2003), communication and management support (Worley and Doolen, 2006) little research has been done to establish the impact of such variables on the implementation of Lean principles in South African companies.

## **1.5 Research questions**

The following research questions were formulated:

1. Does training influence employees' perception of the impact of Lean tools on their own jobs?
2. What impact does employee training have on employees' perceptions of value added by a Lean program in their own organisation?
3. What other factors are perceived by employees to be important for a successful Lean implementation?

## **1.6 Objectives**

The purpose of this study was to understand, from both a management and employees' perspective, the relative importance of key success factors, specifically training, for successful implementation of Lean principles and as well as the impact of training on employees perceptions of the Lean program.

The aim and objective of the study was to research and investigate the impact that Lean training has on employees' perceptions of Lean tools in their own workplace and the overall impression of the Lean program in their organisation. The following four research objectives were established:

1. Determine what Lean training has been given to employees;
2. Determine employees' perceptions of the impact of Lean tools on their own work;
3. Determine employees' perceptions of the relative success of a Lean program in their organisation;

4. Determine what other factors are considered important by employees for a successful Lean implementation.

## **1.7 Limitations of the study**

The following are some of the limitations identified in the study:

### **Sample size**

Although the total staff compliment of the organisation the study was conducted at amounted to 120 employees, only 58 responses were obtained of which 4 were spoiled, thus limiting the sample size to a maximum of 54 employees.

### **Sample demographics**

The purpose of the study was to investigate the impact of Lean training from both employees' and managers' perspectives. However, the sample demographics with regards to level of positions (employment level) were skewed towards non-management with, 89% of respondents representing this category.

The study was conducted in one organisation located in one province and this should be taken into account, so the findings may not be generalisable to other organisations.

## **1.8 Summary**

This chapter introduced the research topic by providing a broad definition of the subject of Lean manufacturing and its origins. The benefits of a successful Lean implementation such as reduced inventory process waste, improved knowledge management, reduced lead times, reduced rework etc. were highlighted.

The research problem was formulated by presenting the benefits associated with Lean, highlighting the difficulties that surrounds Lean implementation and highlighting the shortage of research in the field from the South African perspective. The research questions and the objectives of the study were presented.

The next chapter covers the literature review on the subject of Lean. The definition of Lean and anecdotal historical context of the subject of Lean with regards its origin, will be presented in detail. In line with research questions and objectives of the study as presented in this chapter, a detailed review of the Toyota Production System will be presented while success factors and barriers for successful Lean implementation will also be highlighted.

# CHAPTER TWO

## LEAN THEORY

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### 2.1 Introduction

The interest in Lean production is mostly based on the empirical evidence that it improves the company's competitiveness (Sanchez and Perez, 2001). However, as with many improvement programs, Lean manufacturing implementations have not succeeded universally in their application and there are different variables that may impact a Lean implementation (Worley and Doolen, 2006). This view is supported by Achanga, Shehab, Roy and Nelder (2006) who assert that compounded by lack of standardised mechanism within organisations of analysis and measure of value-adding capabilities such as Lean, the implementation of Lean manufacturing harbours enormous difficulties.

Looking at the subject from the South African perspective it is argued that the South African context ("our environment and customs") differs vastly from the idealised conditions encountered in Japan, where Lean originated, and to improve the chances of implementing Lean successfully these differences must be taken into account (Pieterse, Lourens, Louw, Murray, Van der Merwe, 2010).

Although there is a broad spectrum of variables that could impact the Lean implementation process, this research focuses on investigating the impact of one such key variable i.e. training, on employees' perceptions of Lean implementation (Worley and Doolen, 2006).

This chapter (chapter 2) focuses on the historical background of Lean principles and definitions. A view of Lean principles and Lean tools is provided, followed by a discussion of some of the problems organisations encounter in implementing Lean principles before concluding the chapter with a summary.

## **2.2 The roots of Lean principles**

The roots of Lean manufacturing originate with early automobile manufacturing. The master craftsmen who first built individual cars possessed a wide range of skills and abilities, but with low efficiency and at high cost. Henry Ford, in the early 1900s, recognised these limitations, applied techniques which are consistent with some of the current Lean philosophies, and broke the assembly process down into 30-second tasks, which were performed almost a thousand times a day (Worley and Doolen, 2006).

The term Lean production evolved from the Just-In-Time (JIT) production concepts which were pioneered at Toyota in Japan and was widely adopted in the 1990s to emphasise the goal of systematically eliminating waste throughout the supply chain (Jacobs, Chase and Aquilano, 2009).

The term “Lean” with its reference to frugality, was actually coined by James Womack in his book titled “The machine that changed the world” to characterise the Toyota manufacturing system (Pieterse et al., 2010).

## **2.3 Definitions of Lean**

Lean production is an integrated set of activities designed to achieve production using minimal inventories of raw materials, work-in-progress, and finished goods (Jacobs, Chase and Aquilano, 2009).

Worley and Doolen (2006) however define Lean simply as the systematic removal of waste by all members of the organisation from all areas of the value stream. Value stream being defined as all of the activities that contribute to the transformation of a product from raw material to finished product including design, order taking, and physical manufacture.

Waste is anything, other than the minimum amount of equipment, effort, materials, parts, space and time that is essential to add value to the product (Jacobs, Chase and Aquilano, 2009). According to Singh, Garg, Sharman and Grewal (2010) waste takes many forms

and can be found at any time and in any place. It consumes resources but does not add value to the product.

Schroeder (2008) defines waste more simply and plainly by saying that waste is anything that does not contribute to adding value to the product.

However, according to Pieterse et al. (2010) defining Lean through waste would be similar to naming someone after his appearance. The authors therefore argued that the purpose of Lean is really to satisfy the customer through faster, cheaper, and better quality products or services and therefore define waste from the eyes of the customer as activities that customers would not want to pay for if they knew they were happening.

According to Schroeder (2008) the Japanese, owing to a lack of space and lack of natural resources, developed an aversion to waste. Hence Lean is a management philosophy focused on identifying and eliminating waste throughout a product's entire value stream, extending not only within the organisation, but also along its entire supply chain network.

Lean is achieved through a set of mutually reinforcing practices, including total quality management, continuous improvement, supplier management, integrative information systems, and effective human resource management (Boyle and Scherrer, 2009).

Davis and Heineke (2005) define Lean as an integrated set of activities designed to achieve high-volume flexible production using minimal inventories of raw materials. It is based on the premise that nothing will be produced until it is needed. A signal is generated when material and components are needed at a work station and they arrive "just-in-time" to be used.

Sawhney and Chason (2005) state that Lean production is not limited to manufacturing alone but encompasses activities such as product development, procurement and distribution and there are examples of successful Lean implementations in service industry as well.

## **2.4 The Toyota Production System**

According to Jacobs, Chase and Aquilano (2009) the Toyota Production System (TPS), commonly regarded as the benchmark for Lean manufacturing, was developed to improve quality and productivity and is based upon two philosophies central to the Japanese culture: elimination of waste and respect for people.

According to Bhasin and Burcher (2006), Taiichi Ohno, the mastermind of the Toyota Production System (TPS), identified seven types of manufacturing waste as:

### *2.4.1 Overproduction*

This type of waste is generated by producing more than the customer demands (Poppendieck, 2002).

Excess production creates excess inventory and wastes capacity on products that have no demand. Producing too early creates similar waste as the inventory level is increased and time is added to the cash-to-cash cycle. There is also a risk of damage that will detract from the quality of the products (Finch, 2006).

The corresponding Lean principle is to manufacture according to a pull system, or producing products just as customers order them. Anything produced beyond this (buffer or safety stocks, work-in-process inventories, etc.) ties up valuable labour and material resources that might otherwise be used to respond to customer demand (Melton, 2005).

### *2.4.2 Excess Inventory*

Inventory waste consists of excess inventory, over and above that which is necessary. It wreaks havoc with costs, lead times, quality and flexibility (Melton, 2005).

Related to overproduction, inventory beyond that needed to meet customer demands negatively impacts cash flow and uses valuable floor space (Cachon and Terwiesch, 2009).

Under a JIT philosophy, all inventories become a target for elimination by tackling the causes of inventory (Evans and Lindsay, 2008). It is for this reason that one of the most

important benefits for implementing Lean principles in manufacturing organizations is the elimination or postponement of plans for the expansion of warehouse space (Poppendieck, 2002).

#### *2.4.3 Extra Processing Steps (Processing waste)*

Some of the more common examples of this are reworking (the product should have been done correctly the first time), deburring (parts should have been produced without burrs, with properly designed and maintained tooling), and inspecting (parts should have been produced using statistical process control techniques to eliminate or minimise the amount of inspection required (Melton, 2005).

A technique called Value Stream Mapping (VSM) is frequently used to help identify non-value added steps in the process. The VSM technique originated at Toyota where it was referred to as “Material and Information Flow Mapping”. VSM is an enterprise improvement tool used to assist in visualizing the entire production process, representing both material and information flow. The goal of conducting VSM is to identify all types of waste in the value stream and to take steps to eliminate them (Singh et al., 2010).

According to Pieterse et al. (2010) a unique advantage of the VSM tool is that it is used in conjunction with other Lean tools and it therefore provides a link between Lean principles and Lean tools. By applying VSM users can clearly see how the Lean principles guide the use of the Lean tools which prevents the tools from being used in isolation.

#### *2.4.4 Excess motion*

This type of waste (unnecessary motion) deals with human resources and how workers perform their tasks. When jobs require repetitive activities, ineffective job design can result in substantial wastes of labour resources over time (Cachon and Terwiesch, 2009). Unnecessary motion is caused by poor workflow, poor layout, housekeeping, and inconsistent or undocumented work methods

Symptoms of motion waste are when components and controls are outside easy reach, double handling, widely spaced equipment and operators bending, long walking distances

and centralised facilities (Melton, 2005).

#### 2.4.5 Defects

Product defect waste results from products that do not meet customer specifications for quality (Finch, 2006).

Production defects and service errors waste resources in four ways. First, materials are consumed. Second, the labour used to produce the part (or provide the service) the first time cannot be recovered. Third, labour is required to rework the product (or redo the service). Fourth, labour is required to address any forthcoming customer complaints (Cachon and Terwiesch, 2009).

#### 2.4.6 Waiting

According to Finch (2006) waiting time wastes results from customer order, inventory, completed products and even customers waiting in queue for a process to begin. While a product or order is waiting, no value is being added, but financial costs are mounting and the wait time for the customer is increasing.

Lean demands that all resources are provided on a JIT basis – not too soon, not too late (Evans and Lindsay, 2008).

#### 2.4.7 Transportation

Material should be delivered to its point of use. Instead of raw materials being shipped from the vendor to a receiving location, processed, moved into a warehouse, and then transported to the assembly line, Lean demands that the material be shipped directly from the vendor to the location in the assembly line where it will be used. The Lean term for this technique is called point-of-use-storage (POUS) (Melton, 2005).

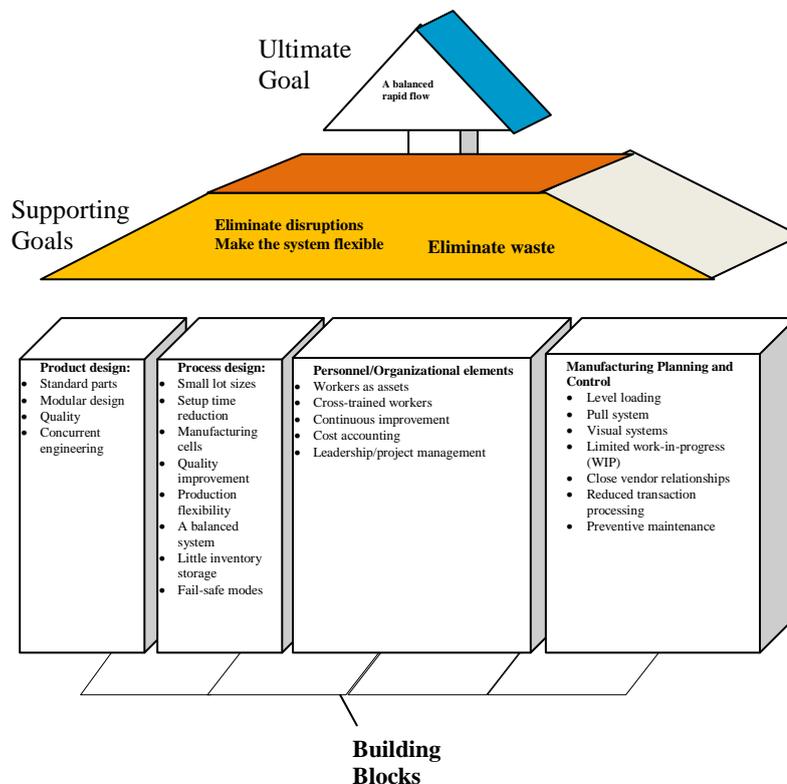
Other authors have started to add on the list an eighth waste as *underutilisation of people* i.e. waste of not using the creative potential of every person in the factory (McBreen, 2008).

With the eighth waste as described above Pieterse et al. (2010) suggested the acronym DOWNTIME to describe all the eight wastes as follows:

- Defects
- Overproduction
- Waiting
- Non Value Added Processing
- Transportation
- Inventory (Excess)
- Motion (Excess)
- Employee Knowledge, Skills and Abilities (Not used)

The TPS represents a philosophy that encompasses every aspect of the process, from design to after the sale of a product. The philosophy is to pursue a system that functions well with minimal levels of inventories, minimal space, and minimal transactions (Stevenson, 2009).

The ultimate goal of a Lean operation is to achieve a system that matches supply to customer demand in a smooth, uninterrupted flow as depicted in figure 2.1 below.



**Figure 2.1 An overview of the goals and building blocks of Lean system**

Adapted from: Stevenson, WJ. (2009, p696.) **Operations Management**, 10th Edition. New York:Irwin\McGrawHill.

According to Stevenson (2009) there are four building blocks of the Lean system as depicted in Figure 2.1.

1. Product design

Four elements of product design are important: Standard parts (workers have fewer parts to deal with, and training times and costs are reduced), modular design (clusters of parts are treated as one to simplify purchasing, handling and training), capable production systems (quality built into the system, production is stopped when there are quality problems until they are resolved) and concurrent engineering (bringing design and manufacturing engineering people together in the design phase to simultaneously develop the product and process).

2. Process design

Eight aspects of process design are particularly important for Lean production systems and these are:

#### **Small lot sizes**

Small-lot production is the primary means of matching production rate to demand rate. The ability to produce a small quantity of parts or products and then switch equipment over to produce a small batch of another part or product enables manufacturer to match the demand rate in relatively small time increments. However, the difficulty in producing frequent small quantities is that this increases the number of times the equipment must be changed over (Davis and Heineke, 2005).

In the Lean philosophy, the ideal lot size is one unit, a quantity that may not always realistically be possible due to practical considerations requirement of minimum lot sizes. However small lot sizes in both the production process and deliveries from suppliers have some benefits that enable Lean systems to operate effectively e.g. in-process inventory moving through the system is considerably less and greater flexibility in scheduling can be achieved (Nahmias, 2009).

#### **Setup Time Reduction**

Setup time is the time required to change equipment from producing one product or

service to another (Finch, 2006:108).

Small lots sizes and product mixes may require frequent setups, which could be expensive and costly due to machine down time and increased in-process inventory holding. By making use of systems such as Single-Minute Exchange of Die (SMED) set up activities are streamlined and grouped into internal and external activities. Internal activities are those that can be done only when the machine is not running whereas external activities involves those activities that do not require the machine to stop as they can be done before or after the changeover (Nagarajan, 2009).

### **Manufacturing cells**

According to Jacobs and Chase (2008) a manufacturing cell is a dedicated area where products that are similar in processing requirements are produced. These cells are designed to perform a specific set of processes and the cells are dedicated to a limited range of products. The benefits of this include reduced changeover times, high utilisation of equipment, and ease of cross-training operators.

### **Quality Improvement**

This is a never ending quest to continuously improve the quality of the product by focussing on finding and eliminating causes of defects in the process e.g. through the use of automation (i.e. a combination of men and machine) whereby defects during production are automatically detected (Evans and Lindsay, 2008).

### **Work Flexibility**

According to Heizer and Render (2001) work cells should be designed so they can easily be rearranged to adapt to changes in volume, product improvements, or even new designs. This concept of layout flexibility aids the changes that result from product and process improvements that are inevitable with a philosophy of continuous improvement.

In line with the overall goal of a Lean system, the process should be designed to

create the ability to process a mix of products or services in a smooth flow by removing or reducing the bottlenecks from the process i.e. reduce areas in the process that are overloaded (Stevenson, 2009).

### **A Balanced System**

This involves distributing the workload evenly among workstations and helps to achieve a rapid flow of work through the system. Time required for work assigned to each workstation must be less than or equal to the cycle time, normally referred to as *takt* time. Takt time (derived from the German word **Taktzeit** which translates to cycle time) is the cycle time needed in a production system to match the pace of production to the demand (Webster, 2008).

### **Inventory storage**

According to Cachon and Terwiesch (2009) Lean system is designed to minimise inventory storage. Excessive inventory tends to cover up recurring problems that are never resolved either because they aren't obvious or because the presence of excessive inventory makes them seem less serious. Advantages of lower inventories include less carrying costs, less space needed, less tendency to rely on buffers, less rework if defects occur.

### **Fail-safe Methods**

This refers to building safeguards into the process to reduce or eliminate the potential for errors during the process. The Japanese also call this *poka-yoke* (which is the Japanese word for mistake proofing) (Stevenson, 2009).

According to Jacobs, Chase and Aquilano (2009) there are a wide variety of poka-yokes, ranging from a bin (to ensure that the right numbers of parts are used in assembly) to sophisticated detection and electronic signalling devices. A poka-yoke is therefore a fool proof device or a technique that ensures production of good units every time by avoiding errors and providing quick feedback of problems (Heizer and Render, 2001). An example of a *poka-yoke* system could be an alarm that goes off when the product unit is underweight or has missing parts (Stevenson, 2009).

### 3. Personnel/Organisational elements

There are five elements of personnel and organisation that are particularly important for Lean systems (Stevenson, 2009):

#### **Workers as assets**

Well-trained and motivated workers are the heart of the Lean system. They are given more authority to make decisions than their counterparts in more traditional systems, but they are also expected to do more (Nahmias, 2009).

According to Pieterse et al (2010) an environment must be created in which people have an impact on decisions and actions that affect their jobs and this concept, which they refer to as employee involvement, should be adopted as a philosophy (rather than a tool) about enabling people to contribute to continuous improvement and the sustained success of their employer.

Heizer and Render (2001) insisted that firms need to take full advantage of the employee training investment by enriching jobs. The authors further argued that enriching jobs and empowering employees would benefit companies from mutual commitment and respect on the part of both employees and management.

#### **Cross-trained workers**

To increase flexibility, workers are cross-trained to perform several parts of the process and operate a variety of machines. Cross-training employees greatly increases employees' contribution to the organisation and more importantly workers who move around in the organisation performing different responsibilities find their work more interesting (Finch, 2006).

#### **Continuous Improvement**

A central theme of the Lean approach is to work towards continual improvement of the system – reducing inventories, reducing setup cost and time, improving quality, increasing the output rate and generally cutting waste and inefficiency (Evans and Lindsay, 2008).

#### 4. Manufacturing planning control

Seven elements of manufacturing planning and control are important for Lean systems:

##### **Level loading**

Level loading (referred to by the Japanese as Heijunka) means to achieve stable, level daily mix schedules the master production schedule is developed to provide level capacity loading. Once established production schedules are fixed over a short time horizon (normally 3 months) thereby providing certainty to the system (Davis and Heineke, 2005).

According to Jacobs, Chase and Aquilano (2009) the advantages for level loading are:

1. “The system can be planned to minimise inventory and work-in-process
2. Product modifications can be up-to-date because of the low amount of work-in-process
3. There is smooth flow throughout the system
4. Purchased items from vendors can be delivered when needed, and, in fact, often directly to the production line.”

##### **Pull System**

The terms push and pull are used to describe two different system of moving work through a production process. In a traditional production environment a push system is used in a way that where when work is finished at a workstation, the output is pushed to the next station or in case of final operation it is pushed on to final inventory. However in a pull system control of moving the work following with the next operation i.e. each workstation pulls work from the preceding workstation as it is needed and output of the final operation is pulled by customer demand or the master schedule (Nahmias, 2009).

##### **Visual systems**

To effect the pull system as described above, a process for the system to

communicate such demand could be in a variety of ways, including shout and a wave, but the most commonly used device is the Kanban card. *Kanban* is a Japanese term meaning “signal” or “visible record” (Finch, 2006).

When a worker needs materials or work from the preceding station he or she uses the Kanban card. Hence the Kanban card could be regarded as the authorisation to move or work on parts. The two types of Kanbans are:

1. *Production Kanban (p-Kanban)*: signals the need to produce parts
2. *Conveyance Kanban (c-Kanban)*: signals the need to deliver parts to the next work station (Nahmias, 2009).

### **Limited Work-in-Process (WIP)**

Movement of materials and work-in-process (WIP) in a Lean system is carefully coordinated, so they arrive at each step in a process just as they are needed. There are two general approaches to controlling WIP; one is Kanban and the other is constant work-in-process (CONWIP). Whilst Kanban's control focuses on individual work stations CONWIP's focus is on the system as a whole. With CONWIP, when a job exits the system, a new job is allowed to enter which results in a constant level of WIP (Davis and Heineke, 2005).

### **Close Vendor Relationship**

According to Jacobs and Chase (2008) just as customers and employees are key complements of Lean systems, suppliers are also important to the process. If the firm shows its usage requirements with its vendors, they have a long-run picture of demands that will be placed on their production and distribution systems. Maintaining stock at a Lean level requires frequent deliveries during the day. Some suppliers even deliver to a location on the production line.

Traditionally buyers have assumed the roles of monitoring the quality of purchased goods inspecting shipments for quality and quantity and returning poor-quality goods to vendor for reworking. With Lean systems the responsibility for quality checks is vested on the suppliers who are expected to deliver high quality goods

just in time (Stevenson, 2009)

## 2.5 Lean Principles (Lean Thinking)

According to Pieterse et al (2010) since Taiichi Ohno, the production genius at Toyota, did not exactly provide details of instructions on how to adopt his way of thinking and the tools that are used Womack and Jones attempted to bridge this gap when they published in 1996 their book titled “Lean Thinking” which was a follow up to their initial book titled “The machine that changed the world”.

The five-step thought process for guiding the implementation of Lean techniques is depicted on the diagram as follows:



**Figure 2.2** Five-step Lean thinking

Adapted from: Lean Enterprise Institute (2010).

### 1. Identify value

Lean thinking must start with a conscious attempt to precisely define value in terms of specific products with specific capabilities offered at a specific process through a dialogue with specific customers (Melton, 2005).

### 2. Map the value stream

According to Mcbreen (2003) value stream is all the actions needed to bring the product to the customer. Value Stream Mapping is an enterprise improvement tool to assist in visualizing the entire production process, representing both material and information flow. The goal of conducting VSM is to identify all types of waste in the value stream and to

take steps to eliminate them. If the processes and equipment in assembly line do not talk (i.e. not harmonised) duplicate steps will exist (Singh et al., 2010).

### **3. Create flow**

This step entails making the value-creating steps occur in tight sequence so the product will flow smoothly toward the customer. This can be achieved, as example, by learning to change set-ups from one product to the next fast and the use of smaller, moveable machines which can increase productivity (Nagarajan, 2009).

### **4. Establish pull**

This entails designing, scheduling and making exactly what the customer wants just when the customer wants which means you can throw away sales forecast and simply make what the customers actually tell you they need. Put simply, let the customer pull the product from you. The principle is you sell one and then make one (Cachon and Terwiesch, 2009).

### **5. Seek perfection**

As value is specified, value streams are identified, wasted steps are removed, and flow and pull are introduced, begin the process again and continue it until a state of perfection is reached in which perfect value is created with no waste (Principles of Lean, 2009).

## **2.6 Benefits of Lean**

### **Elimination of zero-value activities**

According to Sanchez and Perez (2001) one of the primary goals of Lean production is the elimination of everything that does not add value to the product or service. Storage of inventory, as an example, does not add value to the product and should be eliminated whenever possible. Inventory levels could be reduced by reducing the time the machines spend standing due to breakdowns and malfunction through preventative and predictive maintenance. Other techniques for reducing inventory could be simultaneous reduction in manufacturing lot sizes and set-up times and the use of common parts to manufacture different products.

Another source of zero-value activities is the transport of parts within the company. This activity does not add value to the product but increases lead times. In Lean production the machines are laid out in flexible work cells to eliminate the frequency of movements among machines (Webster, 2008).

According to Keyes, Nahn and Lauver (2009) the reduction of non-value adding activities improves operational efficiency which in turn can provide increased opportunity for profitability and enhanced position among the competition. The authors conducted a case study aimed at measuring the effect of Lean implementation at a low-volume high variety manufacturer. Performance measures in different categories such as financial (gross profit), operational and materials management were identified and measured three months before and three months after the implementation of Lean. As expected the organisation's financial measures i.e. gross profit improved after implementation of Lean. The financial improvement was recognised due to the reduction in cost of goods sold. The cost of goods sold had reduced due to reduction of manufacturing costs. Prior to Lean implementation the cost of goods as a percentage of sales averaged 86% and following the implementation of Lean the cost of goods sold as a percentage of sales reduced to 76%.

A study of Italian manufacturing companies showed that Lean production companies used more teams in problem solving, that workers performed a higher variety of tasks, and that the proportion of implemented employees' suggestions was higher than in non-Lean production companies (Sanchez and Perez, 2001).

In another case study of Lean implementation using VSM an Indian manufacturing industry witnessed 92.58% reduction in lead time, 2.17% reduction in processing time,

97.1% reduction in work-in-progress and 26.08 % reduction in manpower requirement (Singh et al., 2010)

According to Singh et al (2010) the goal of Lean manufacturing is to reduce waste in human effort, inventory, time to market and manufacturing space to become highly responsive to customer demand while producing quality products in the most efficient and

economical manner.

It is for the same reasons as above that Lean manufacturing is often associated with benefits such as reduced inventory, reduced manufacture times, increased quality, increased flexibility, and increased customer satisfaction (Worley and Doolen, 2006).

Lean implementation results in improved output and quality levels, and achieves this using fewer resources, such as raw materials and employee effort. With international dominance across a multitude of industries, this philosophy of production originally developed for the Japanese auto industry, has proven its value far beyond its original industrial sector and geographic region. Recently, Lean is applied to a wide variety of industries of varying sizes, ranging from global aerospace companies to small community hospitals (Boyle and Scherrer, 2009).

## **2.7 Lean Tools**

Some of the practices of Lean manufacturing include Five S events, Kaizen events, Kanbans, pull production, quick changeovers, and value stream mapping. Table I provides a summary of the definitions of some common Lean practices (Worley and Doolen, 2006).

**Table 2.1: Examples and definitions of common Lean practices**

Source : (Worley and Doolen, 2006,236).

Lean practice	Definition
Five S events	Defined as the five dimensions of workplace organisation. The events are designed to organise and clean. Five S events are often incorporated with Kaizen events. The Five S's are defined as sort (identify unnecessary equipment), straighten (arrange and label the area so all tools have a specific home), shine (clean the area and maintain equipment daily), standardise (establish guidelines and standards for the area), and sustain (maintain the established standards)
Kaizen events	Defined as continuous improvement in small steps. Organisations typically use kaizen events to focus on improving a specific process
Kanban	Defined as a system that uses a card to signal a need to produce or transport a container of raw materials or partially finished products to the next stage in the manufacturing process. This applies both to delivery to the factory and delivery to each workstation. The result is the delivery of a steady stream of containers of parts throughout the day. Each container holds a small supply of parts or materials. New containers are delivered to replace the empty ones
Pull production	Characterised by the manufacture of product only when a customer places an order
Quick changeovers	Characterised as a method for minimising the amount of time it takes to change a machine's setting or to prepare an area to begin processing a new product
Value stream mapping	Defined as investigating the flow of material through the manufacturing process from the customer's point of view. The end result highlights areas of waste.
Heijunka	Variations in production volume lead to waste. The workload must be levelled; volume and variety must be averaged to achieve a steady flow of work.
Jidoka	Quality at the source. Each worker is expected to perform on-going quality assurance. The objective is to avoid passing defective products to the following workstation, and to make workers aware of quality (Stevenson 2009).
Team concept	Use small teams of workers for process improvement (Stevenson, 2009)
Poka-yoke	Safeguards built into the process to reduce the possibility of committing an error (Stevenson, 2009).

## 2.8 Critical success factors

### 2.8.1 *Multiskilling (Training)*

Lean systems use much less of certain resources than typical mass production systems use – space, inventory and workers – to produce a comparable amount of output. Lean systems therefore require the use of a highly skilled workforce and flexible equipment (Lynch, 2005).

This view is shared by Schroeder (2008) who asserted that one of the critical things needed to make a Lean system work is multifunction workers. In most cases, each worker must be able to operate several machines in a group, going from one to the next to make the parts required. Since parts are not produced unless they are needed, the worker must be able to switch off the machine and move on to another job where parts are needed. The worker must be able to set up machines, do routine maintenance, and inspect the parts. This obviously requires workers who are cross-trained in several different skills.

In a study conducted to establish critical success factors for Lean implementation within ten Small Medium Enterprises (SME's) based in the East of the UK it was found that there were four key main factors that were fundamental hence critical for the implementation of Lean manufacturing and in proportion these were: leadership (50), finance (30), skill and expertise (10) and organisational culture (10) (Achang, Shehab, Roy and Nelder, 2006).

### 2.8.2 *Worker empowerment*

Another key to successful Lean production is worker empowerment, defined as giving workers more responsibility and control of the manufacturing process, as well as increased levels of training to build the skills needed to effectively exercise increased responsibility. Since workers are such a key component of Lean production, care must be taken to ensure their input is maximized (Webster, 2008).

A very large part of the Lean culture as described in the TPS is considered to reside in respect for the people of the organisation. It is a known fact that the hardest part of the implementation of Lean is in the changing of the attitudes and habits of people in the

organisation. Top management needs to understand that their commitment and involvement will be required over an extended period while the organisation converts its procedures, habits and methods. Middle management will have to understand how to implement and support the practices, and understand that they may have to relinquish some authority as workers get empowered (Pieterse et al., 2010).

### *2.8.3 People requirements*

According to Sawhney and Chason (2005) a successful Lean organisation, be it a manufacturing or a service industry, depends on its people – both management and the workforce. Transition from a traditional top Lean environment is as much, if not more, about culture change in the organisation than about manufacturing issues. During the transition to Lean few of the major hurdles come from changes being made in the technical work system. Most problems are associated with the workforce, for example, resistance to change, lack of necessary job skills, low morale and decisions to recruit new employees or to retain current work force.

In addition to eliminating waste, Lean has a second major tenet in its philosophy – utilising the full capability of the workers and suppliers. As an example workers and suppliers are also charged with improving the production process through quality teams, suggestion systems, and other forms of participation by workers and suppliers. The capabilities of workers and suppliers are therefore used to a much greater extent in the Lean system than in traditional production approaches (Schroeder, 2008)

However, the increase in the number of tasks accomplished by each worker requires the company to take a greater effort on quality control, maintenance and so on. Moreover the implementation of multifunctional teams requires potential workers to overcome resistance to increase the number of tasks they perform. Whilst the training makes this adjustment easier but there must be some changes as well in the compensation system in order to remunerate explicitly this new flexibility (Sanchez and Perez, 2001).

Another key consideration is the workers union dynamics. Special efforts are needed to use Lean in a unionised environment. Labour unions are often organised along skill or craft

lines, and they do not tend to encourage flexibility in the workforce. As a result management will need to work closely with the union to develop the kind of workforce needed for Lean systems (Schroeder, 2008).

Lean is a knowledge-intensive process and as such relies heavily on the skills of people and how they respond to change. Also in the context of Lean philosophy of minimising waste it is important not only to eliminate material waste but waste caused by human behaviour (Sawhney and Chason, 2005).

## **2.9 Implementation barriers**

The implementation of Lean manufacturing is believed to harbour enormous difficulties (Achanga, Shehab, Roy and Nelder, 2006).

According to Worley and Doolen (2006) Lean implementations have not succeeded universally in their applications with many different variables in existence that may impact a Lean implementation. The authors further argued that literature contains examples of both Lean manufacturing implementation successes and failures (Worley and Doolen, 2006).

The difficulties associated with implementing Lean was highlighted by Bhasin (2008) who claimed that less than 10% of UK organisations accomplish successful Lean implantations.

The importance of the human element in Lean implementation was emphasized by Sawhney and Chason (2005) who argued that Lean is a knowledge-intensive process and as such relies heavily on the skills of the people and how they respond to changes. The authors further argued during the transition to Lean most of the major hurdle encountered do not come from changes made in the technical work system but from the human element associated with work force, for example, lack of necessary job skills, low morale, resistance to change etc.

Some of the reasons cited as reasons for failure in transition to Lean are (Sawhney and Chason, 2005):

- Long-time employees resisting change
- Management focussed on point solutions instead of systems
- Lack of true worker participation and involvement
- Production schedules that override improvement efforts
- Failure of those who understand more to help others to learn
- Lack of integration among change efforts and operations
- Failure to continue with improvement efforts over the long term
- Lack of top management support
- Lack of shared operating data
- Lack of worker and management trust
- Alienation of line leaders
- Confusing Lean objectives
- Expecting employee training to make Lean manufacturing happen
- Implementing Lean as a program
- Relying too much on Kaizen workshops

Most of the above listed causes of failure are indicative of problems that arise in the human element during a changeover to Lean. For a successful Lean transition it is therefore important to first understand the people, job design and expectations from the workforce (Sawhney and Chason, 2005).

According to Awad (2010) many companies do realise improvements in their processes immediately after implementing Lean principles but find it difficult to sustain the high level of standards attained at the beginning of the implementation process. Backsliding or lack of the ability to sustain change is a common phenomenon faced by the industry and is one primary reason for Lean implementation failures.

## **2.10 Improving the chances of sustainability**

Pieterse et al (2010) suggested the following steps in order to ensure the initiative (Lean implementation) survives and grows:

- Management must continue showing and demonstrating their commitment and enthusiasm
- Staff must be trained and retrained. The improvement tools must become second nature and they must be fully aware of the uses and benefits of the Lean tools
- Allay the fears that staff has. Make sure you understand the underlying reasons for resistance and these questions are answered.
- There must be monitoring systems in place and they must be maintained to measure aspects such as housekeeping and improvements in quality, delivery and cost.
- The reward system must be maintained rigorously. If staff notices a slacking in the appreciation of their effort, they become sceptical and the contributions will end.
- Comparisons with other factories are to be encouraged. It is easy to become complacent until one sees what has been achieved elsewhere.
- Keep staff informed about the benefits of the Lean implementation. They must see that their efforts have a meaningful effect.
- Avoid the impression that the implementation is solely the task of management or workers
- Keep the initiative going through thick and thin. Starting and stopping as the need arises creates the impression that the implementation is imposed and ‘something extra’, instead of being part of the culture of the organisation.

## **2.11 Summary**

The principles of Lean philosophy developed in Japan (Toyota) have all been established with one single aim of eliminating or reducing waste throughout the value chain. The Lean principles can be applied in both manufacturing and service organisations.

The seven types of waste are: Overproduction, Waiting, Inventory, Defects, Motion, Transportation and Processing.

There are a number of Lean tools that can be utilised to progress the aim and objectives of Lean principles such as 5s, preventative maintenance, pull system, failure mode analysis, value stream mapping etc.

The benefits of implementing Lean principles include reduced inventory, reduced manufacture times, increased quality, increased flexibility, increased customer satisfaction, improved output and quality levels and more importantly this is achieved using fewer resources, such as raw materials and employee effort. Indeed there is empirical evidence that Lean production improves the company's competitiveness.

However for Lean implementation to be successful and for the above benefits to be realised the process relies heavily on multi-skilling of employees. The impact of human element on the success of Lean implementation programs is well covered in the literature. Employees operating under Lean production systems are expected to do more tasks; operate more equipment and carry on more responsibilities generally. Hence the success of Lean implementation hinges heavily on employee training (multi-skilling).

The objective of this dissertation is to understand the impact of training on employees' perceptions of the Lean principles in their own work and their perception of value added by Lean implementation in their own organisation.

The following chapter (Chapter 3) will provide the context of the Research Methodology adopted in order to answer the research questions that have been developed.

# **CHAPTER THREE**

## **Research Methodology**

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### **3.1 Introduction**

Jankowicz (2006) defined a research method as a systematic and orderly approach taken towards the collection and analysis of data so that information can be obtained from those data. However, according to Kothari (2006) research methods can be understood as all those methods/techniques that are used for conduction of research e.g. research questionnaire, analytical tools etc. On the other hand, research methodology could be understood as a way to systematically solve the research problem and not only talks of research methods but covers a wider scope and also considers the logic behind the methods we use in the context of our research study and explains why we are using a particular method or technique and why we are not using others so that the research is capable of being evaluated either by the researcher himself or by others.

The literature review, covered in the preceding chapter, provided a critical review of major references on the subject of Lean. More importantly the theory on the vulnerability of Lean implementation to a spectrum of factors was covered and specifically the reliance of Lean on employees' up-skilling for Lean implementation to be successful.

This chapter provides details of the research methodology that was adopted in order to answer the developed research questions. In addition this chapter will provide key motivations for the research, data types, data collection methods, research instrument, type of questions used, survey population and sample size determination and data handling. Ethical considerations are also discussed before ending the chapter with a summary.

### **3.2 Aim and Objectives of the Study**

The implementation of the Lean manufacturing principle remains a tool to improve competitiveness as organisations take strategic measures to remain profitable during periods of economic downturn. However, like many improvement programs, Lean

principles implementations have not succeeded universally in their applications due to a number of variables that may impact implementation of such initiatives (Worley and Doolen, 2006).

The need of the study was underpinned by the value associated with Lean principles if implemented properly as supported by literature. On the contrary, literature also suggests that lack of commitment by employees and management on the Lean principles can lead to value destruction. Therefore an understanding of how Lean principles impact both employees and management provides an opportunity for organisations to amend their approach or emphasise relevant aspects of the Lean implementation process if necessary.

The aim of this study is to understand the impact that training has on employees' perceptions of Lean program in their workplace.

The purpose of the study is to answer the research question:

Does training have an impact on employees' perceptions of impact of a Lean program in their organisation?

The following research questions have been developed:

1. Does training influence employees' perception of the impact on Lean tools on their own jobs?
2. What impact does employee training have on employees' perceptions of value added by a Lean program in their own organisation?
3. What other factors are perceived by employees to be important for a successful Lean implementation?

The objective of the study is to research the impact that Lean training has on employees' perceptions of Lean tools in their own workplace and the overall impression of the Lean program in their organisation. This can be broken down to the following four objectives:

1. Determine what Lean training has been given to employees;

2. Determine employees' perceptions of impact of Lean tools on their own work;
3. Determine employees' perceptions of relative success of Lean program in their organisation;
4. Determine what other factors are considered important by employees for a successful Lean implementation

### **3.3 Participants and Location of Study**

The study was conducted at a packaging manufacturing company, which is a division of an international organisation, located in KwaZulu-Natal, South Africa.

The participants of the research study were selected from personnel, across the board, in the employ of the organisation the study was conducted at. This included operators, supervisors (first line managers), junior and senior managers.

The location and review of study was the packaging manufacturing company located in KwaZulu-Natal, South Africa.

### **3.4 Data Types**

Research data for the purpose of this research are from primary and secondary sources.

#### **3.4.1 Primary Data**

Primary data are data one has collected for oneself specifically for one's projects whereas secondary data are data other people have collected for their own research projects or commercial purpose with the main difference between the two being that one (primary data) is 'new' data whilst the other one (secondary) is 'reused' data (Maylor and Blackmon, 2005).

#### **3.4.2 Secondary Data**

Secondary sources are interpretations of primary data. Encyclopaedias, textbooks,

handbooks, magazine and newspaper articles, and most news casts are considered secondary information sources (Cooper and Schindler, 2003).

All reference materials used in the literature review would fall under the category of secondary sources as described above.

Maylor and Blackmon (2005) argued the point that as a researcher, your distance from the source of the data will affect the quality of the data and ultimately the quality of your findings or recommendations.

In this research primary data was collected by means of a questionnaire which was used by the respondents to provide information.

### **3.4.3 Quantitative data**

Quantitative data is obtained from gathering numerical data using structured questionnaires or observation guides to collect primary data from individuals. The data range from beliefs, opinions, attitudes, behaviour and lifestyles to general background information on individuals such as gender, age, education and income. Business researchers often refer to quantitative data collection as survey research (Hair Jnr, Money, Samouel and Page, 2007).

### **3.4.4 Qualitative data**

Qualitative data represents descriptions of things that are made without assigning numbers directly and the data is generally collected using some type of unstructured interviews or observation (Hair Jnr et al., 2007).

Cooper and Schindler (2003, p271) provided a verbal picture of the two different techniques (quantitative versus qualitative) as follows:

“Quality is the essential character or nature of something; quantity is the amount. Quality Qualitative is the what; quantity the how much. Quality refers to the meaning, the definition or analogy or metaphor characterising something, while quantitative assumes the meaning and refers to a measure of it.....the difference lies in the description of the

Mexican Sierra, a fish from the sea of Cortez. One can count the spines on the dorsal fin of a pickled Sierra, 17 plus 15 plus 9. But if the Sierra strikes hard on the line so that our hands are burned, if the fish sounds and nearly escapes and finally comes in over the rail, his colours pulsing and his tail beating the air, a whole new relational externality has come into being. Qualitative research would define the being of fishing, the ambiance of a city, the mood of citizen, or the unifying tradition of a group.....”

The data obtained for the purpose of this research using a questionnaire was quantitative in nature whilst literature review as covered in the previous chapter would be qualitative in nature.

### **3.5 Methods and instrument of data collection**

There are many research designs that could be used to study business problems. Researchers generally choose from among (1) exploratory; (2) descriptive or (3) causal design (Hair Jnr et al., 2007).

An exploratory project is useful when the research questions are vague or when there is little theory available to guide the development of hypothesis. It is designed to discover new relationships, patterns, themes, ideas and so on. Thus it is not intended to test specific research hypotheses (Hair Jnr et al., 2007).

Descriptive research is designed to obtain data that describes the characteristics of the topic of interest in the research. As an example, question like: Who is likely to be most satisfied? When should we maximise production? How much investment is required? Studies tracking seasonal changes are good examples of descriptive studies (Hair Jnr et al., 2007).

Causal research tests whether or not an event causes another. Does X cause Y? More precisely, a causal relationship means a change in one event brings about a corresponding change in another event. Causality means a change in X (the cause) makes a change in Y (the effect) occur (Hair Jnr et al., 2007).

### **3.5.1 Construction of the Instrument (Questionnaire)**

(Refer to appendix for a copy of the research questionnaire)

Hair Jr et al (2007) defined a questionnaire as a prepared set of questions (or measures) used by respondents or interviewers to record answers (data). Questionnaires are a structured framework consisting of a set of questions and scales designed to generate primary data.

According to Lee and Lings (2008) without a good instrument, research data will never be of high quality and of course this will mean that the research will also be less than adequate. The authors further insisted that the length of the questionnaire is probably the single most important factor in influencing how many people are going to respond to your questionnaire.

With the above in mind the research instrument (questionnaire) was designed in two main parts. The first part of the research questionnaire is a covering letter to the respondent which provides information about the research topic, the university and business school, names of the researcher and supervisor followed by a short paragraph which provides the title of the research and also informs the respondent about the voluntary nature of his/her participation and the fact that there is no monetary reward for participating in the research.

The first part of the questionnaire was designed to address the principle of informed consent. According to Gray (2009) participants should be provided with sufficient information about the project so that they can make an informed decision as to whether to become involved or not.

The second part of the instrument is the questionnaire itself which on part one seeks permission from the respondents for the responses to be used for academic research purposes.

Part two of the questionnaire is made up of questions which are designed specifically to answer the research questions. The first four questions were designed to provide the demographic profile of the respondents in terms of their age, gender, race and level of

position in the organization. The last five questions of the questionnaire were designed to answer the research questions.

### **3.5.2 Developing the questionnaire**

The research instrument used was the questionnaire which was specifically developed to provide answers to the research questions.

A total of nine questions were formulated with the first four questions seeking to establish the demographic profile of the participants with respect to their gender, race, age and their position within the company's organogram structure.

### **3.5.3 Scale construction (Rating scales)**

In order to quantify dimensions that are essentially qualitative ratings, ranking scales are used in the construction of the questionnaire so as to improve the usefulness of responses (Cooper and Schindler, 2003).

Examples of rating scales are:

**Simple category scale** offers mutually exclusive response choices such as agree or disagree, yes or no or any other set of discrete category (Cooper and Schindler, 2003).

This type of scaling was preferred for gender determination of research participants on question 3.

**Multiple choices, single response scale** is useful when there are multiple options for the respondent but only one answer is sought (Cooper and Schindler, 2003).

This scaling was applied on demographic questions (question 1, 2 and 4).

**Multiple choice, multiple-response** scale allows the rater to select one or several alternatives (Cooper and Schindler, 2003).

This scaling was preferred for questions 5 and 6 of the questionnaire. Respondents were also guided by the text 'cross as many as applicable'.

According to Bryman and Bell (2007) the Likert scale is the most frequently used variation of the summated rating scale. Summated scales consist of statements that express either a favourable or unfavourable attitude toward the object of interest. The respondent is asked to agree or disagree with each statement. Each response is given a numerical score to reflect its degree of attitudinal favourableness and the scores may be totalled to measure the respondent's attitude.

Likert scale helps us to compare one person's score with a distribution of scores from a well-defined sample group (Cooper and Schindler, 2003). The Likert five point scale was used for questions 7 to 9.

### **3.6 Recruitment of Study Participants (Sample)**

The population for this research study was the total staff compliment of the organisation the study was conducted in.

The questionnaire (in hard copies) was distributed throughout the organisation by the Continuous Improvement manager through the First Line Management team ensuring that employees who were on night shift duty at the time were also involved in the data gathering.

### **3.7 Validity**

According to Bryman and Bell (2007) validity is concerned with the integrity of the conclusions that are generated from a piece of research. Types of validity that are typically distinguished are:

#### ***Measurement (Construct) validity***

When we measure something, for example, a variable, with an instrument, the instrument we use to measure the variable must measure that which it is supposed to measure.

In other words construct validity has to do with the question of whether or not a measure that is devised of a concept really does reflect the concept that it is supposed to be denoting.

### ***Internal validity***

Internal validity is concerned with the question of whether a conclusion that incorporates a causal relationship between two or more variables holds water. If we suggest  $x$  causes  $y$ , can we be sure that it is  $x$  that is responsible for variations in  $y$  and not something else that is producing an apparent causal relationship?

### ***External validity***

This issue is concerned with the question of whether the results in a study can be generalised beyond the specific research context.

In this case a questionnaire was sent to the Continuous Improvement manager of the organisation in which the research was conducted for validation. The final questionnaire was sent to the ethics board at the university and full approval was received.

To test the authenticity of the respondents in answering the questionnaire, and thereby further validating the questionnaire, one of the Lean tools included in the list to choose from was a specific Lean tool which was known to have not been implemented.

## **3.8 Statistical Significance**

One difficulty when working with data derived from a sample is that there is often the lingering worry that the findings may not be generalizable to the population from which the sample was drawn due to sampling error and if that happens the sample will be unrepresentative of the wider population and therefore any findings will be invalid. To make matters worse there is no feasible way of finding out whether or not the findings in fact apply to the population. This is where statistical significance and the various tests of statistical significance come in (Bryman and Bell, 2007). According to Lind, Marchal and Wathen (2008), to test the degree of confidence we can have in our findings when

exploring relationships between variables the following steps can be followed:

### ***Set up null hypothesis***

Hypothesis is a statement about a population parameter subject to verification. A null hypothesis, designated  $H_0$ , stipulates that the two variables being analysed are not related in the population e.g. there is no relationship between gender and visiting gym in the population from which the sample was drawn (Bryman and Bell, 2007). The alternate hypothesis,  $H_1$ , is that there is a relationship between the variables in the population as observed in the sample (Lind, Marchal and Wathen, 2008).

### ***Establish level of statistical significance***

The level of significance is the probability of rejecting the null hypothesis when it is true. Put differently, it is the risk one takes of rejecting the null hypothesis (implying that there is a relationship in the population) when it should be supported (Lind, Marchal and Wathen, 2008).

According to Hair Jnr et al (2007), the convention amongst business researchers is that the maximum level of statistical significance that is acceptable is  $p < 0.05$ , which implies that there are fewer than 5 chances in 100 that a sample shows a relationship when there is not one in the population.

### ***Determine the statistical significance***

The Chi-square ( $X^2$ ) test which is used as the test statistic is applied to the contingency tables so as to establish the confidence level in asserting that there is relationship between the two variables in the population. It works by calculating for each cell in the table an expected frequency or value - that is, one that would occur on the basis of chance alone. The Chi-square value is then calculated by calculating the difference between the actual and expected values for each cell in the table and then summing those differences (Bryman and Bell, 2007).

### ***Formulate decision rule***

A decision rule is a statement of the specific conditions under which the null hypothesis is rejected and the conditions under which it is not rejected. If the findings are statistically

significant at the 0.05 significance the null hypothesis is rejected, which would imply that the results are unlikely to have occurred by chance or sampling error (Bryman and Bell, 2007).

### **3.9 Administration of the Questionnaire**

Permission was requested and granted by the gatekeeper to conduct research in the organisation (Please refer to appendix for Ethical clearance approval letter).

Hard copies of the questionnaire were distributed through the First Line Management team across all the shifts and once completed they were collated and submitted to the Continuous Improvement manager.

Using Microsoft Excel a table format was designed to collate answers of all returned copies of the questionnaires. The data was then transported into SPSS for analysis.

### **3.10 Summary**

The research methodology introduced the concept of business research. It illustrated that the aim and objectives of the research was determined by collecting and analysing data.

The data is needed to solve the research problem. Different types of data were explained. Primary data for the purpose of this study was obtained using the questionnaire whilst literature review from chapter 2 provides secondary data. The questionnaire was designed to collect data which is quantitative in nature.

The questionnaire was adopted as an instrument suitable for collecting required data. Hence data collection strategies focused on a questionnaire.

The participation and location of study identified the personnel in the employ of the packaging manufacturing company located in KwaZulu-Natal, South Africa, as participants in the research study.

Research design and methods described the purpose of the study. Construction of the questionnaire, interview questions and recruitment of study participants required careful planning. Ethical considerations were adequately covered.

Presentation, validation and administration of the questionnaire provided the processes for quality data collection. The analysis of data by means of simple (but useful) descriptive, and frequency statistics was adopted for the research study.

The following chapter (Chapter 4) presents all the findings from the survey that was conducted. The findings are displayed in graphical and statistical format.

# **CHAPTER FOUR**

## **RESULTS**

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### **4.1 Introduction**

The previous chapter (Chapter three) outlined the research methodology adopted in order to answer the developed research questions and key concepts such as data types and research instruments that were identified and presented. A detailed explanation on the construction of the questionnaire was provided.

This chapter presents the results (data) that were obtained through the questionnaire and any other discussions (phenomenological discussions) that were held with management and or respondents. The data was analysed using descriptive statistical methods in order to summarise the data (using descriptive stats) and also establish relationships amongst variables. Frequency tables, charts and cross tables form part of the descriptive data analysis that was used.

### **4.2. Demographic Description of samples**

The demographic statistics of the respondents are shown below.

The population size of the study was 120 people which represent all employees who were employed by the organisation in which the study was conducted at the time the research was being done.

A total of 90 questionnaires were distributed and 58 of them were returned. This represents 64 % response rate.

Only four out of the returned 58 were spoilt, meaning 6.9% of the returned questionnaires could not be used.

The demographic analysis will be useful in establishing correlation relationships between variables and developing an understanding of how the demographic variables such as age

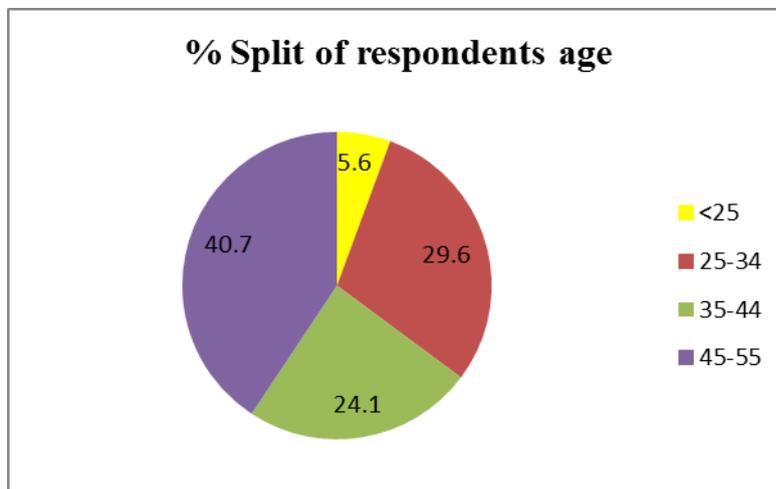
correlate with other variables in the research study.

#### 4.2.1 Age of respondents

The demographic spread of respondents in terms of age is shown in Table 4.1 and figure 4.1 below.

Age Group	Frequency	Percent	Valid Percent	Cumulative Percent
<25	3	5.6	5.6	5.6
25-34	16	29.6	29.6	35.2
35-44	13	24.1	24.1	59.3
45-55	22	40.7	40.7	100.0
Total	54	100.0	100.0	

**Table 4.1** Age of respondents



**Figure 4.1** Respondents' age pie chart

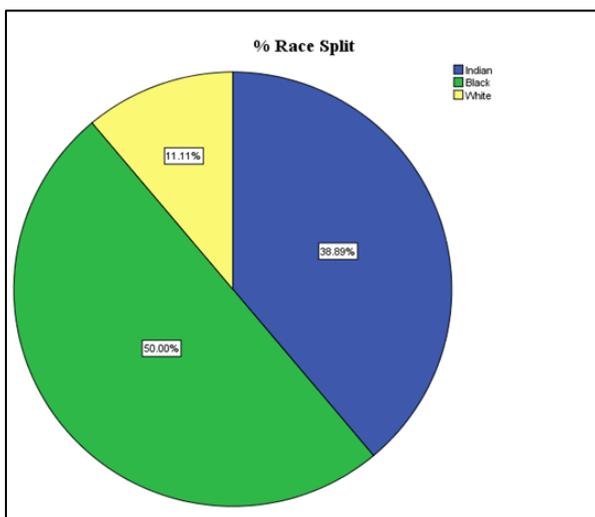
Figure 4.1 is a pie chart diagram depicting the age spread of respondents in percentages. As depicted in figure 4.1 the majority of respondents were in the age group category of 45-55 years. The respondents in this age group category made up to 40.7 % of the respondents followed by age group category 25-34 years at 29.6% and then by age group category 35-44 which constituted 24.1% of respondents. Only 5.6% of the respondents were below 25 years old, meaning 94.4 % of respondents were 25 years and above.

### 4.2.2 Race

The demographic spread of respondents in terms of age is shown in Table 4.2 and figure 4.2 below.

Race	Frequency	Percent	Valid Percent	Cumulative Percent
Indian	21	38.9	38.9	38.9
Black	27	50.0	50.0	88.9
White	6	11.1	11.1	100.0
Total	54	100.0	100.0	

**Table 4.2 Respondents' Race**



**Figure 4.2 Respondents' Race pie chart**

Table 4.2 is a cumulative frequency table of race split of the respondents whilst figure 4.2 depicts the pie chart of same information in percentages.

The majority of respondents were blacks, making 50% of the respondents followed by Indians who constituted 38.9% of the respondents. White people constituted the least of the respondents as they were only 11.1% of the respondents.

### 4.2.3 Gender

Gender		Frequency	Percent	Valid Percent	Cumulative Percent
	Female	6	11.1	11.1	11.1
	Male	48	88.9	88.9	100.0
	Total	54	100.0	100.0	

**Table 4.3 Respondents' gender**

Table 4.3 is a frequency table for respondents' gender split and as depicted 89% of the respondents were males with females making the balance (11%).

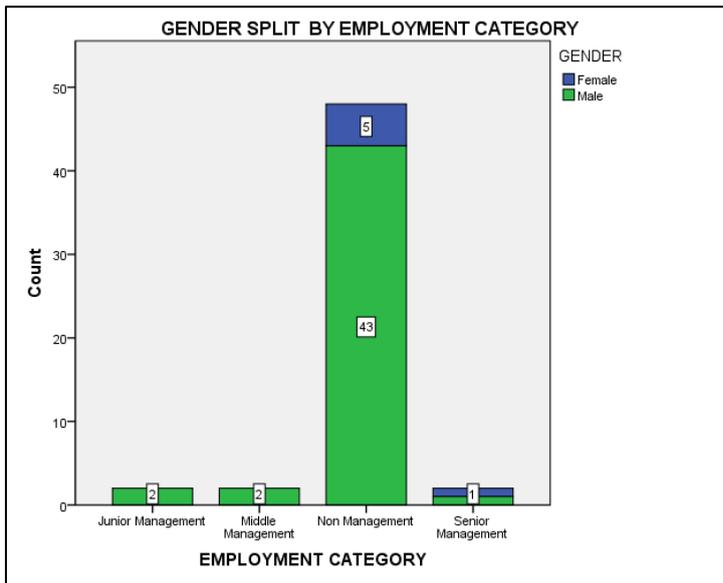
### 4.2.4 Employment Level (Position)

		Frequency	Percent	Valid Percent	Cumulative Percent
	Non-Management	48	88.9	88.9	88.9
	Junior Management	2	3.7	3.7	92.6
	Middle Management	2	3.7	3.7	96.3
	Senior Management	2	3.7	3.7	100.0
	Total	54	100.0	100.0	

**Table 4.4 Employment position**

Table 4.4 is a cumulative table depicting the levels in which the respondents operate within the company's reporting structure. The majority of respondents were non-management making up to 89% of the respondents. The balance of the respondents was an equal split with 2 employees each (3.7%) in each employment category namely, junior management, middle management and senior management.

The gender split within each level of operation is shown in figure 4.4 below.



**Figure 4.3 Gender Split by employment category**

Figure 4.3 depicts the gender split of respondents within the company’s reporting structure. One out of two, which is 50%, of senior management respondents was a female. There were no female respondents in the junior management and middle management categories. A total of 48 respondents were non-management of which 10.4% of them (5 out of 48) were females.

### **4.3 Employees’ confirmation of Lean implementation**

The following series of frequency tables, table 4.5 to table 4.10, provide information with regards respondents’ understanding (knowledge) of which Lean tools have been implemented in their organisation.

This is important to check employees understanding of which Lean tools have been implemented against what actually has been implemented as presented by the World Class Manufacturing (WCM) Manager of the organisation the study was conducted in.

YES/NO	Frequency	Percent	Valid Percent	Cumulative Percent
No	1	1.9	1.9	1.9
Yes	53	98.1	98.1	100.0
Total	54	100.0	100.0	

**Table 4.5 Respondents' confirmation of 5s implementation**

Table 4.5 shows respondents' confirmation of 5s implementation. Five S (5S) refers to five dimensions of workplace organisation designed to organise and keep the workplace Clean and the five S's are defined as sort, straighten, shine, standardise and sustain (Lynch 2005). Overwhelming majority of respondents (98%) agreed that 5s was one of the tools that have been implemented.

YES/NO	Frequency	Percent	Valid Percent	Cumulative Percent
No	51	94.4	94.4	94.4
Yes	3	5.6	5.6	100.0
Total	54	100.0	100.0	

**Table 4.6 Respondents' confirmation of Kanban implementation**

Table 4.6 shows respondents' confirmation of Kanban implementation. Kanban is a system that uses a card to signal a need to produce or transport a container of raw materials or partially finished products to the next stage in the manufacturing process (Webster, 2008). Only 5.6% of respondents were of the understanding that the Kanban system has been implemented in the factory.

YES/NO	Frequency	Percent	Valid Percent	Cumulative Percent
No	12	22.2	22.2	22.2
Yes	42	77.8	77.8	100.0
Total	54	100.0	100.0	

**Table 4.7 Respondents' confirmation of Focussed Improvement implementation**

Table 4.7 shows respondents' confirmation of Focussed Improvement (FI) implementation.

Focused improvement is a process of continuously reviewing and improving process standards. A total of 78% of respondents were of the understanding that FI was one of the pillars of Lean program implemented in the organisation.

YES/NO		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	7	13.0	13.0	13.0
	Yes	47	87.0	87.0	100.0
	Total	54	100.0	100.0	

**Table 4.8 Respondents' confirmation of Kiazen implementation**

Table 4.8 shows respondents' confirmation of Kaizen implementation. Kaizen is defined as continuous improvement in small steps (Nahmias, 2009). The majority of respondents (87%) knew about Kaizen as part of the Lean tools that have been implemented.

YES/NO		Frequency	Percent	Valid Percent	Cumulative Percent
	No	4	7.4	7.4	7.4
	Yes	50	92.6	92.6	100.0
	Total	54	100.0	100.0	

**Table 4.9 Respondents' confirmation of Autonomous Maintenance implementation**

Table 4.9 shows respondents' confirmation of Autonomous Maintenance (AM) implementation. Autonomous Maintenance refers to a process whereby operators are up-skilled through training to be able to do minor machine adjustments and machine lubrication tasks that were previously done by engineering personnel (Pollitt 2010).

An overwhelming majority of respondents (93%) confirmed that AM was implemented as part of the Lean tools in their organisation.

YES/NO		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	11	20.4	20.4	20.4
	Yes	43	79.6	79.6	100.0
	Total	54	100.0	100.0	

**Table 4.10 Respondents' confirmation of Preventative Maintenance implementation**

Table 4.10 shows respondents' confirmation of Preventative Maintenance (PM) implementation. A total of 20% of the respondents did not know about implementation of preventative maintenance as part of Lean program.

#### 4.4 Employees' confirmation of Lean training

The following series of frequency tables, table 4.11 to table 4.16, provide information with regards respondents' confirmation of training they have received on each of the Lean tools.

This information is important as the research will seek to establish a correlation on the impact of training and how this affects employees' perception of the Lean program.

YES/NO		Frequency	Percent	Valid Percent	Cumulative Percent
	No	6	11.1	11.1	11.1
	Yes	48	88.9	88.9	100.0
	Total	54	100.0	100.0	

**Table 4.11 Confirmation of 5s training**

Table 4.11 shows respondents' confirmation of 5s training. A total of 89% of the respondents confirmed having received training on 5s.

YES/NO		Frequency	Percent	Valid Percent	Cumulative Percent
	No	52	96.3	96.3	96.3
	Yes	2	3.7	3.7	100.0
	Total	54	100.0	100.0	

**Table 4.12 Confirmation of Kanban training**

Table 4.12 shows respondents' confirmation of Kanban training.

The majority of employees (96%) indicated that they did not receive any training on Kanban.

		Frequency	Percent	Valid Percent	Cumulative Percent
	No	21	38.9	38.9	38.9
	Yes	33	61.1	61.1	100.0
	Total	54	100.0	100.0	

**Table 4.13 Confirmation of Kaizen training**

Table 4.13 shows respondents' confirmation of Kaizen training.

As depicted on Table 4.13 above a total of 61% of the respondents confirmed that they were trained on Kaizen principles.

		Frequency	Percent	Valid Percent	Cumulative Percent
	No	30	55.6	55.6	55.6
	Yes	24	44.4	44.4	100.0
	Total	54	100.0	100.0	

**Table 4.14 Confirmation of Focussed Improvement (FI) training**

Table 4.14 depicts the respondents' confirmation of having received training on FI tools. It was an almost equal split with 44% of the respondents acknowledging to have received training on the FI tool.

		Frequency	Percent	Valid Percent	Cumulative Percent
	No	12	22.2	22.2	22.2
	Yes	42	77.8	77.8	100.0
	Total	54	100.0	100.0	

**Table 4.15 Confirmation of Autonomous Maintenance (AM)**

Table 4.15 shows the respondents' split in terms of confirmation of AM training. The majority of respondents acknowledge having received AM training.

		Frequency	Percent	Valid Percent	Cumulative Percent
	No	29	53.7	53.7	53.7
	Yes	25	46.3	46.3	100.0
	Total	54	100.0	100.0	

**Table 4.16 Confirmation of Preventative Maintenance training**

Table 4.16 depicts respondents' confirmation of whether they have received training on Preventative Maintenance or not. As can be seen an almost equal split of answers were received on this question as 46% of respondents confirmed that they did receive training on Preventative Maintenance.

		Frequency	Percent	Valid Percent	Cumulative Percent
	No	49	90.7	90.7	90.7
	Yes	5	9.3	9.3	100.0
	Total	54	100.0	100.0	

**Table 4.17 Confirmation of Other training**

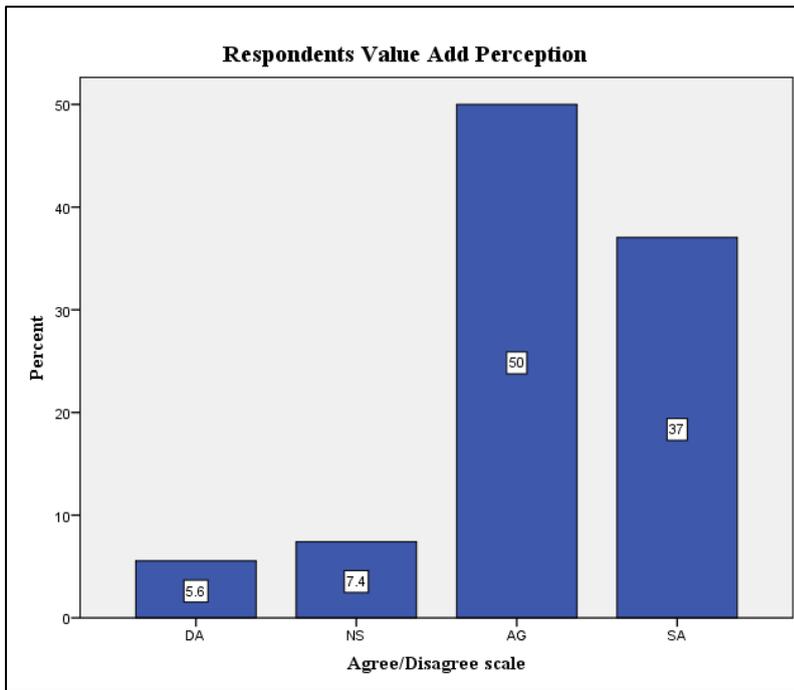
Table 4.17 depicts the respondents' confirmation of having received other type of training on Lean tools. Only 9.3% of the respondents indicated they have received Lean tools training other than the ones that had been stipulated on the questionnaire.

## 4.5 Value Add Perception

Employees were specifically asked to rate, on a 5-likert scale ranging from strongly agree to strongly disagree, their perceptions of the impact of the Lean implementation in their organization. Table 4.18 (frequency table) and Figure 4.4 (bar chart) depict respondents' perception as they answered the question.

		Frequency	Percent	Valid Percent	Cumulative Percent
	Disagree	3	5.6	5.6	5.6
	Not Sure	4	7.4	7.4	13.0
	Agree	27	50.0	50.0	63.0
	Strongly Agree	20	37.0	37.0	100.0
	Total	54	100.0	100.0	

**Table 4.18 Value Add Perception**



**Figure 4.4 Value Add Perception**

A total of 50% of the respondents agreed that the implementation of Lean has indeed added value in their organisation whilst 37% of the respondents strongly agreed with the value add notion. This means that 87% of the respondents at least agreed that Lean implementation did add value in their organisation. A total of 5.6% of the respondents at least disagree that Lean implementation added value in their organisation.

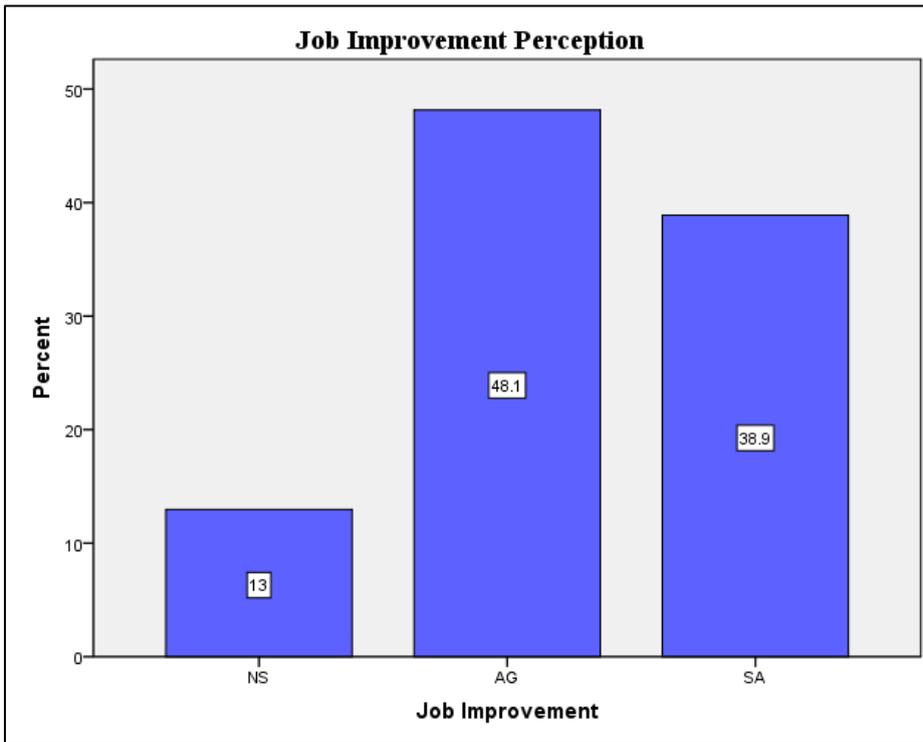
## 4.6 Job Improvement Perception

Table 4.19 below is a frequency table showing respondents' perception of whether their jobs did improve because of Lean implementation and training.

Figure 4.5 is a bar chart depicting the same.

	Frequency	Percent	Valid Percent	Cumulative Percent
Not Sure	7	13.0	13.0	13.0
Agree	26	48.1	48.1	61.1
Strongly Agree	21	38.9	38.9	100.0
Total	54	100.0	100.0	

**Table 4.19 Respondents perception of job improvement**



**Figure 4.5 Employees' perceptions of job improvement**

As depicted above a total of 48% of the respondents agreed that their jobs did improve as a result of Lean implementation and training. A further 39% of the respondents strongly agree with the notion. Meaning 87% of the respondents at least agree that their jobs have improved attributable to Lean implementation.

#### **4.7 Cross Tables: Training versus Value Add**

The following series of cross tables, table 4.20 to table 4.25, depict the gathered information on training and value add variables.

			Value Adding Perception				Total
			Disagree	Not Sure	Agree	Strongly Agree	
<b>Training 5S</b>	<b>No</b>	Count	2	0	3	1	6
		% within Training 5S	33.3%	.0%	50.0%	16.7%	100.0%
	<b>Yes</b>	Count	1	4	24	19	48
		% within Training 5S	2.1%	8.3%	50.0%	39.6%	100.0%
Total		Count	3	4	27	20	54
		% within Training 5S	5.6%	7.4%	50.0%	37.0%	100.0%

**Table 4.20 Cross table of 5s training and value add perception**

A total of 48 respondents (89% of sample size) confirmed to having been trained on 5s and 50% of them (24 respondents) agreed that they believed the implementation of Lean program has added value in their organization with another 40% of the respondents strongly agreeing. This means that 90% of respondents who acknowledged 5s training at least agree that Lean program has added value in their organization.

There were only 2% of respondents who had acknowledged 5s training and disagreed that the implementation of the Lean program has added value in their organization.

None of the respondents strongly disagreed that the implementation of Lean program has added value in their organization.

			Value Adding Perception				Total
			Dis Agree	Not Sure	Agree	Strongly Agree	
<b>Training Kanban</b>	<b>No</b>	Count	3	4	26	19	52
		% within Training Kanban	5.8%	7.7%	50.0%	36.5%	100.0%
	<b>Yes</b>	Count	0	0	1	1	2
		% within Training Kanban	.0%	.0%	50.0%	50.0%	100.0%
Total		Count	3	4	27	20	54
		% within Training Kanban	5.6%	7.4%	50.0%	37.0%	100.0%

**Table 4.21 Cross table of Kanban training and value add perception**

Only 2 employees (3.8% of respondents) of the respondents indicated they have received Kanban training. The majority of respondents (52 in total) indicated they have not received Kanban training and 50% of them agreed that the implementation of Lean program did add value in their organization with a further 36.5% strongly agreeing.

Only 5.6% of the respondents strongly disagreed with the notion of value add with another 7.4% of the respondents not sure.

			Value Adding Perception				Total
			DA	NS	AG	SA	
Training Kaizen	No	Count	0	0	14	7	21
		% within Training Kaizen	.0%	.0%	66.7%	33.3%	100.0%
	Yes	Count	3	4	13	13	33
		% within Training Kaizen	9.1%	12.1%	39.4%	39.4%	100.0%
Total		Count	3	4	27	20	54
		% within Training Kaizen	5.6%	7.4%	50.0%	37.0%	100.0%

**Table 4.22: Cross table of Kaizen training and value add perception**

A total of 33 employees (61% of respondents) confirmed to have been trained on Kaizen principles out from which there was an equal split of 39% who agreed and strongly disagreed with the value add notion, meaning there was 78% of respondents who had been trained on Kaizen principles who at least agreed with the value add notion.

Only 9% of the respondents who had been trained on Kaizen principles disagreed with the value add notion.

There were 21 respondents who had not been trained on Kaizen principles but still all of them at least agreed with the value add notion.

			Value Adding Perception				Total
			DA	NS	AG	SA	
Training FI	No	Count	3	2	16	9	30
		% within Training Focussed	10.0%	6.7%	53.3%	30.0%	100.0%
	Yes	Count	0	2	11	11	24
		% within Training Focussed	.0%	8.3%	45.8%	45.8%	100.0%
Total		Count	3	4	27	20	54
		% within Training Focussed	5.6%	7.4%	50.0%	37.0%	100.0%

**Table 4.23: Cross table of FI training and value add perception**

A total of 30 out of 54 respondents (55%) had not been trained on FI but 53% of them agreed with the value add notion with a further 30% of them strongly agreeing and only 10% of them disagreeing.

A total of 44% of the respondents had been trained on FI principles and 91.6% of them at least agreed with the value add notion.

None of the respondents strongly agreed whilst only 7.4% of the respondents being not sure of the value add notion.

			Value Adding Perception				Total
			DA	NS	AG	SA	
<b>Training AM</b>	<b>No</b>	Count	2	0	6	4	12
		% within Training AM	16.7%	.0%	50.0%	33.3%	100.0%
	<b>Yes</b>	Count	1	4	21	16	42
		% within Training AM	2.4%	9.5%	50.0%	38.1%	100.0%
<b>Total</b>		Count	3	4	27	20	54
		% within Training AM	5.6%	7.4%	50.0%	37.0%	100.0%

**Table 4.24: Cross table of AM training and value add perception**

A total of 77% of the respondents had received AM training and 50% of them agreed with the value add notion with a further 38% strongly agreeing. Meaning 88% of the respondents who had been trained on AM at least agreed with the value add notion.

Only 2.4% of respondents who had been trained on AM disagreed whilst 16.7% of respondents who had not been trained on AM disagreed.

			Value Adding Perception				Total
			DA	NS	AG	SA	
<b>Training Preventative Maintenance</b>	<b>No</b>	Count	3	2	14	10	29
		% within Training PM	10.3%	6.9%	48.3%	34.5%	100.0%
	<b>Yes</b>	Count	0	2	13	10	25
		% within Training PM	.0%	8.0%	52.0%	40.0%	100.0%
<b>Total</b>		Count	3	4	27	20	54
		% within Training PM	5.6%	7.4%	50.0%	37.0%	100.0%

**Table 4.25: Cross table PM training and value add perception**

A total of 25 respondents confirmed to have received PM training of which 52% of them agreed with the value notion with a further 40% of them strongly agreeing.

A total of 14% of respondents who had not been trained on PM agreed with the value add notion with a further 34.5% of them strongly agreeing.

Only 10% of the respondents who had not been trained on PM disagreed.

#### 4.8 Cross tables: Training versus Job Improvement

The following series of cross tables, table 4.26 to table 4.31, depict the gathered information on the training and job improvement variables.

			Job Improvement Perception			Total
			NS	AG	SA	
Training 5S	No	Count	1	3	2	6
		% within Training 5S	16.7%	50.0%	33.3%	100.0%
	Yes	Count	6	23	19	48
		% within Training 5S	12.5%	47.9%	39.6%	100.0%
Total		Count	7	26	21	54
		% within Training 5S	13.0%	48.1%	38.9%	100.0%

**Table 4.26: Cross table on 5s training and job improvement perception**

The majority of respondents (48/54) had been trained on 5s principles of which 48% of them agreed that Lean tools training did result in an improvement in the way they do their jobs with a further 40% strongly agreeing with the job improvement notion.

Only 12.5% of respondents that have been trained on 5S were not sure of job improvement.

Only 6 employees had not been trained on 5s but still 83% of them at least agreed that Lean tools training did improve the way they do their jobs.

None of the respondents disagreed with the job improvement notion.

			Job Improvement Perception			Total
			NS	AG	SA	
Training Kanban	No	Count	7	25	20	52
		% within Training Kanban	13.5%	48.1%	38.5%	100.0%
	Yes	Count	0	1	1	2
		% within Training Kanban	.0%	50.0%	50.0%	100.0%
Total		Count	7	26	21	54
		% within Training Kanban	13.0%	48.1%	38.9%	100.0%

**Table 4.27: Cross table on Kanban training and job improvement perception**

The majority of respondents (96%) confirmed not to have received any Kanban training however 87% of them acknowledged job improvement due to Lean tools training.

Only 13% of the total respondents were not sure of the job improvement notion.

			Job Improvement Perception			Total
			NS	AG	SA	
Training Kaizen	No	Count	4	9	8	21
		% within Training Kaizen	19.0%	42.9%	38.1%	100.0%
	Yes	Count	3	17	13	33
		% within Training Kaizen	9.1%	51.5%	39.4%	100.0%
Total		Count	7	26	21	54
		% within Training Kaizen	13.0%	48.1%	38.9%	100.0%

**Table 4.28: Cross table on Kaizen training and job improvement perception**

A total of 33 respondents (61% of respondents) had received Kaizen training of which 91% of them at least agreed with the job improvement notion with only 9.1% of them not being sure.

A total of 39% of the respondents had not received Kaizen training but 81% of them at least agreed that their jobs did improve as a result of Lean tools training.

			Job Improvement Perception			Total
			NS	AG	SA	
<b>Training FI</b>	<b>No</b>	Count	5	18	7	30
		% within Training FI	16.7%	60.0%	23.3%	100.0%
	<b>Yes</b>	Count	2	8	14	24
		% within Training FI	8.3%	33.3%	58.3%	100.0%
<b>Total</b>		Count	7	26	21	54
		% within Training FI	13.0%	48.1%	38.9%	100.0%

**Table 4.29: Cross table of FI training and job improvement perception**

As per table 4.27 above 44% of the respondents confirmed that they have received FI training and the majority (58%) of these employees who have been trained on FI strongly agreed that their jobs improved due to Lean tools training with a further 33% of them just agreeing with the job improvement notion.

Although a significant number of respondents (55%) had not been trained on FI none of them disagreed with the notion that their jobs did improve. A total of 83% of respondents who had not been trained on FI at least agreed with the job improvement notion.

			Job Improvement Perception			Total
			NS	AG	SA	
<b>Training AM</b>	<b>No</b>	Count	4	4	4	12
		% within Training AM	33.3%	33.3%	33.3%	100.0%
	<b>Yes</b>	Count	3	22	17	42
		% within Training AM	7.1%	52.4%	40.5%	100.0%
<b>Total</b>		Count	7	26	21	54
		% within Training AM	13.0%	48.1%	38.9%	100.0%

**Table 4.30: Cross table of AM training and job improvement**

A total of 78% of the respondents confirmed that they have been trained on AM and 52% of them agreed with the job improvement notion with a further 40.5% strongly agreeing. Meaning, 93% of the respondents who had been trained on AM at least agreed with the job improvement notion.

Respondents who had not been trained on AM made 22% of the total respondents and amongst them there was an equal split of 33.3% of employees who were not sure, agree and strongly agree with the job improvement notion.

			Job Improvement Perception			Total
			NS	AG	SA	
<b>Training PM</b>	<b>No</b>	Count	4	13	12	29
		% within Training PM	13.8%	44.8%	41.4%	100.0%
	<b>Yes</b>	Count	3	13	9	25
		% within Training PM	12.0%	52.0%	36.0%	100.0%
<b>Total</b>		Count	7	26	21	54
		% within Training PM	13.0%	48.1%	38.9%	100.0%

**Table 4.31: Cross table of PM training and job improvement**

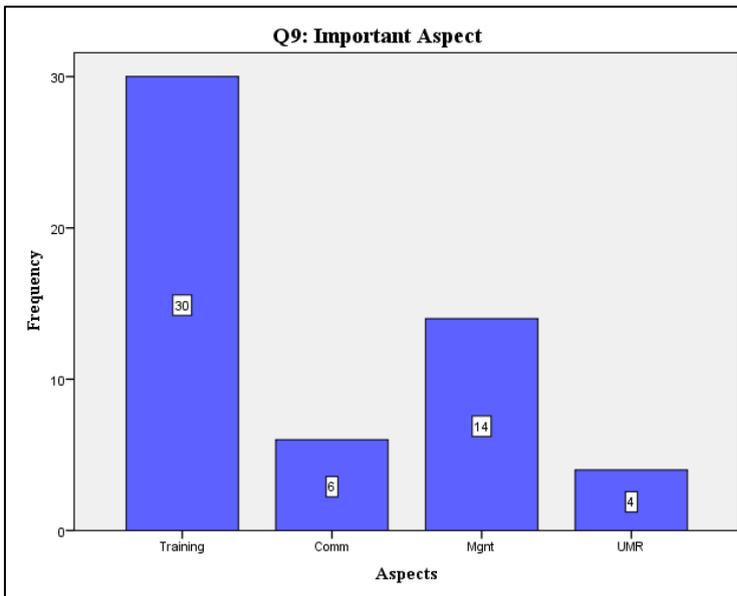
The majority of respondents (54%) did not receive PM training. However 86% of those who had not been trained on PM at least agreed that the way they do their jobs improved as a result of Lean tools training.

Employees who acknowledge PM training were 46% of the total respondents and within them 52% of them agreed with the job improvement notion whilst a further 36% of them strongly agreed.

Only 13% of employees who had been trained on PM were not sure as to whether the way they do their jobs had improved due to Lean tools training.

#### **4.9 Most important aspect for a successful Lean implementation**

Question 9 of the questionnaire requested employees to select one out of four items they consider to be important. Figure 4.6 below depicts the results.



**Figure 4.6 Important aspect frequencies**

Figure 4.6 is a bar chart diagram depicting the frequencies of how the respondents chose what they rated as the most important aspect for a successful Lean implementation as required by question 9 of the questionnaire.

As can be seen on figure 4.6 the majority of respondents rated training as the most important aspect for a successful Lean implementation. A total of 30 respondents (56%) rated training as the most important aspect followed by management commitment (26%).

Communication and Union Management relationship received the least rating with only 11% and 7% of the respondents respectively.

#### **4.10 Chi-Square (X<sup>2</sup>)**

Table 4.32 below is a frequency table depicting results of question 9 and test statistics results

### Q9: Important aspect frequencies

	Observed N	Expected N	Residual
Training	30	13.5	5.0
Communication	6	13.5	-13.0
Management commitment	14	13.5	17.0
Union-management relationship	4	13.5	-9.0
Total	<b>54</b>	<b>54</b>	

Table 4.32: Important aspect

### Test Statistics

	Important aspect
Chi-square	31.037 <sup>a</sup>
Df	3
Asymp. Sig.	.000

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 13.5

## 4.11 Summary

Descriptive statistical methods were used to analyse the data provided by the respondents through the questionnaire. The demographic patterns of the respondents were presented both in tabular and graphical formats. The frequency table was used to capture the age demographic information of the respondents whilst the pie chart diagram was used to depict the same information, showing the relative size of each age group. Similarly the respondents' gender information was captured using the frequency table whilst the stacked bar chart was used to depict the relative size of each gender group across the employment positions.

Frequency tables were used to depict respondents' answers confirming their understanding of which Lean tools (e.g. Kanban, 5S, Focussed Improvement, Kaizen and Autonomous Maintenance) have been implemented in their organisation.

Cross tables were used to map the correlation between training and other variable such as value add and job improvement.

The next chapter provides a detailed discussion and analysis of the results in the context of literature review and study objectives.

# CHAPTER FIVE

## DISCUSSION

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### **5.1 Introduction**

A detailed statistical analysis of the questionnaire results was presented in the preceding chapter (Chapter 4). Simple descriptive statistical methods were used to analyse the data.

In this chapter the analytical results obtained in the previous chapter are used to develop an understanding of whether the objectives of the study were met or not and also provide a perspective of how consistent the results are with the theory and findings from other studies as covered in chapter 2 of the research study.

The objectives of the study will be revisited before the research results are discussed to establish the extent to which the objectives were met.

An explanation will also be provided of how the questionnaire was constructed in line with the objectives of the study and how the questionnaire results relate to both study objectives and theory.

A chapter summary will conclude the chapter by outlining key aspects as discussed in this chapter.

### **5.2. Aims and Objectives of the study**

The purpose of this study was to understand from both a management's and employees' perspective the relative importance of key success factors, specifically training, for successful implementation of Lean principles and to understand the impact of training on employees perceptions of Lean program.

The objective of the study is to research the impact that Lean training has on employees' perceptions of Lean tools in their own workplace and overall impression of the Lean

program in their organisation. The following four research objectives were established:

1. Determine what Lean training has been given to employees;
2. Determine employees' perceptions of impact of Lean tools in their own work;
3. Determine employees' perceptions of relative success of Lean program in their organisation;
4. Determine what other factors are considered important by employees for a successful Lean implementation,

The results of the research are intended to benefit organisations that intend to implement Lean principles to develop insight on some of the key factors they could focus on. Similarly, organisations that are experiencing difficulties in successfully implementing Lean principles could refresh their approach as guided by the findings of this research.

The questionnaire was therefore specifically designed to provide information aimed at establishing facts in line with the four research objectives as outlined above and the results of which are discussed below.

### **5.3 Demographics of Respondents**

The demographic profile of the respondents was skewed in many instances towards certain profiles e.g. for gender 89% were males, for race, Indians and blacks made 89% of respondents.

It is however the employment category (level of employment) of respondents that could have more direct bearing or impact on the research study. Whilst the purpose of the study was aimed at developing an understanding of both *management* and *employees' (non-management)* perceptions on the subject of Lean it is important to note that the majority of respondents (i.e. 89% of the respondents) were non-management.

It is therefore prudent to maintain a perspective that the 89% of questionnaire results are a reflection of perception by non-management personnel in the sample.

## 5.4 Lean tools implemented

The research was conducted with the assistance of the World Class Manufacturing (WCM) manager who had provided relevant information pertaining to the scope and breadth of the Lean program in the organisation.

It was confirmed with the WCM manager that the following pillars of WCM had been implemented - Focused Improvement, Autonomous Maintenance, Equipment Maintenance, Planned Maintenance, Safety and Health, Quality Maintenance and Environment.

It was important to establish the understanding of the respondents with regard to the elements of WCM that have been implemented in the organisation and the specific Lean tools training they have received as this would show understanding of WCM principles by the employees. This was addressed in the questionnaire through questions 5 and 6 which requested respondents to confirm elements of Lean principles that have been implemented (question 5) by selecting from the list and also confirmed the specific training they themselves received (Question 6).

The respondents did show to have a great knowledge of Lean tools that have been implemented and consistent with management information that was provided they confirmed that the following Lean tools have been implemented as follows (% of Yes responses in brackets): 5s (98%), FI (78%), Kaizen (87%), Autonomous Maintenance (93%), Preventative Maintenance (80%).

Employees would have been exposed to Lean tools that are relevant to their type of work e.g. PM would be specifically relevant for employees in the Engineering department whereas 5s is relevant to all personnel including office admin personnel. Hence 5s Lean tool received the highest confirmation of implementation. This should then explain the variation in the level of implementation confirmation for the Lean tools as per the questionnaire.

To test the authenticity of the respondents in answering the questionnaire one of the Lean tools included in the list to choose from was Kanban which was known to have not been implemented.

It is for this reason that 5.6% of the respondents who ticked yes for Kanban implementation are regarded as potentially a misunderstanding of the question by the respondents.

The overall response on question 5 therefore provides good ground to suggest that the respondents were generally familiar with the Lean tools that have been implemented in their organisation which provided a reasonable platform to establish a correlation between the Lean training respondents they received and perceptions on value added by Lean implementation.

## **5.5 Lean training value add perception**

The question that specifically dealt with this issue was question 7 of the questionnaire. As reflected in the results chapter of this dissertation the outcome of this question indicated that overall a significant majority of the respondents (87%) in a 5-likert scale at least agreed that the implementation of the Lean program has added value in their organisation.

It was evident in the results that employees were quite clear on which Lean tools training they have received. This ranged from the most trained Lean tool of 5s (89%) to Kanban which had not been trained at all. However, irrespective of whether employees had received a specific training or not the respondents were consistent in their perception of Lean program. As an example, 86% of the 96% of the respondents who had correctly identified that they had not been trained on Kanban had agreed that the Lean program has indeed added value. Even on some of the Lean tools that had an almost equal split of trained and not trained such as FI, a total of 83% of the FI trained and 96% of the FI not trained employees believed that Lean had added value in their organisation.

The positive perception does not seem to stem from specific Lean tool training. As long as

employees had received Lean training relevant to their work they had positive perception about the Lean program.

This finding is very consistent with the Lean theory as covered in chapter 2 which suggested employee training as the heart of Lean program and more importantly having positive impact on employee morale.

## **5.6 Job improvement perceptions**

Has my job (or the way I do my job) improved since I was trained on Lean tools? This was the essence of question 8 of the questionnaire.

Overall 87% of the respondents irrespective of which Lean tool training they had received indicated they believed their jobs had improved due to Lean tool training. It is also important to highlight that whilst there was 5.6 % of respondents who at least disagreed with the value add notion, none of the respondents disagreed or strongly disagreed with the notion of job improvement.

This may suggest that job improvement perception does not necessarily correlate with the perception of value add of the Lean program. Meaning employees who believe their jobs have improved due to Lean training may not necessarily believe that overall the Lean program has added value in the organisation.

Similar to the value add perception findings, respondents seemed to have a positive perception about job improvement irrespective of type of training they have received. As an example even though employees had not been trained on the Kanban principle, a total of 87% of the employees who had correctly answered this question still believed that their jobs had improved due to Lean training. This is because even though they may not have been trained on Kanban specifically they would have been trained on other relevant Lean tools.

## 5.7 Which factors are important?

One of the research objectives was to establish which factors are regarded as important for successful Lean implementation by employees. This was addressed by question 9 of the questionnaire.

Employees were given four choices to choose one from as follows:

Training

Communication

Management commitment

Union-management relationship

The results depicted an unequal distribution of observed frequencies across all four aspects with 56% and 26% of the respondents choosing training and management commitment respectively as the most important aspects for a successful Lean implementation. This question is critical to answer before assumptions about the sample are made based on these results.

The Chi-square test (Goodness-of-Fit Test) is applied to answer the above question as described by Lind, Marchal and Wathen (2008).

The null hypothesis,  $H_0$ , would be that there is no difference between the set of observed frequencies and the set of expected frequencies. Meaning the difference between expected frequencies and observed frequencies could be attributed to sampling chance. The alternative hypothesis,  $H_1$ , is that there is a difference between the observed and expected sets of frequencies. Meaning, the difference between the two sets of frequencies is not a sampling error but a reflection of the sample.

The level of significance selected is 0.05.

The degrees of freedom (df) is  $k-1 = 4-1 = 3$ , where  $k$  is the number of categories.

The critical value for  $df = 3$  and 0.05 significance level is obtained using the Chi-square table and is determined to be 7.815.

Because the obtained Chi-square value is 31.037 which is higher than the critical value of 7.815 it stands to follow that the null hypothesis must be rejected and the alternative hypothesis be accepted. Meaning the differences between the observed sets of frequencies and expected sets of frequencies is not a sampling chance.

It is therefore accepted as a finding of this study that the fact that 56% and 26% of the respondents regarded training and management commitment respectively as the most important aspects for a successful Lean implementation as not being a sampling chance.

There is however an interesting observation in that the majority of the respondents were non-management, however, union–management relationship received the least voting with only 4.7% of respondents voting this aspect as the most important amongst the four choices that were provided, which are training, communication, management commitment and union – management relationships.

## **5.8 Summary**

The objectives of the study were revisited and the statistical results of the data were in line with the study objectives.

It was established that respondents had a good understanding of the Lean tools that have been implemented in the organisation and which Lean tools they have received training for.

Overall, respondents had a good perception of the Lean program and believed that the implementation of this program in their organisation did add value to their organisation.

Similarly the majority of respondents believed that their jobs improved due to Lean training.

It was however interesting to learn that positive perception of job improvement did not automatically translated into positive perception of value add of the Lean program in the organisation. The positive perceptions of value add and job improvement were not necessarily correlated to specific Lean tool training.

Another interesting observation of the study was that union-management relationship was regarded as the least important aspect for a successful Lean implementation. Respondents regarded training as the most important aspect for a successful Lean implementation program.

It is the purpose of the next chapter to discuss and provide context of the findings made in this chapter with regards implications of the findings and to provide recommendations for future studies.

## **CHAPTER SIX**

### **CONCLUSIONS AND RECOMMENDATIONS**

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#### **6.1 Introduction**

The findings of this study as discussed in the previous chapter (chapter 5) and the literature review covered in chapter 2 provide a basis for making recommendations that should be useful to a range of stakeholders such as management, consultants and employees as identified in chapter 1 of the study.

The purpose of this chapter is to therefore provide a context of the extent to which the research question, which was presented in chapter 1, was answered and to provide recommendations and conclusions based on the findings of this study.

Recommendations for future studies will be made before concluding the chapter with a summary.

#### **6.2 Does training have an impact on employees' perceptions?**

Overwhelmingly employees had a very positive perception about the impact of Lean training on their own jobs. Employees believed that the way they do their jobs did improve as a result of Lean training.

The research findings further suggest that the respondents had a positive perception about the value added overall in the organisation by the Lean program. There is however evidence to suggest that positive perception about job improvement may not necessarily mean employees will also have a positive perception about value that the Lean program adds in the organisation.

Employees consider training, followed by management commitment, as the most important aspects for a successful Lean implementation.

### **6.3 Findings and implications of the study**

In line with the literature review and the findings of this study it is suggested that Lean training should be regarded as an important aspect (critical factor) for a successful Lean implementation.

A positive mind-set about Lean training should also contribute positively on employees' morale and consequently employees' commitment towards the Lean program should be enhanced.

Another important finding of the study is that the positive impact of training is not necessarily correlated to any specific Lean tool training and therefore it is important employees are provided with Lean training that is relevant to their jobs.

Responses to question 9 of the questionnaire reflected that the majority of respondents (59%) considered training as a critical factor for a successful Lean implementation. This was followed by management commitment with 26% of the respondents. Employees therefore regard management commitment as another important aspect for a successful Lean program. It is therefore important that senior management of the organisation must show (display) commitment towards the Lean program being implemented.

Management can show their commitment by making necessary resources (time, funds etc.) available for Lean activities. Management can also design performance linked reward and recognition systems to keep employees motivated and committed to the program.

Organisations that are in the process of implementing Lean can review the programs in line with the findings of this study and specifically review their training programs and align senior management's organisational performance priorities to the Lean program.

## 6.4 Recommendations for Future Studies

Based on the findings as presented above it is recommended that management should review the training being offered to employees to ensure it is relevant to their jobs and to ensure that all employees are indeed trained. This would create a critical mass of employees who are positively influenced by the training offered on their jobs and improved perceptions of the Lean program overall.

This study was conducted in one organisation and it would therefore be recommended that before the findings of this study are applied in other organisations a repeat of the study is conducted across different organisations in different industries possibly across different provinces (geographic locations).

There were some interesting findings coming out of the study that raises pertinent questions, that were beyond the scope of this study to establish, and therefore would require further investigation. Results of question 7 (value add perception question) and question 8 (job improvement perception problem) show that there was some respondents (5.6%) who disagreed with the value add notion even though none of the employees disagreed with the job improvement notion. The question is therefore why would some employees feel good about Lean training with regards job improvement but not necessarily believe that a Lean program as a whole is adding value in the organisation?

The majority of respondents were non-management (89%) but nonetheless only 7% of them regarded union-management relationship as important. The question is why would employees who are predominantly non-management and presumably unionised not regard union-management relationship as a critical factor for a successful Lean program.

A qualitative study of the same topic could enhance the findings of this study by providing benefits associated with qualitative studies such as unstructured interviews that will not limit respondents to provide information as directed and restricted to questions in the questionnaire.

There are also a number of variables that can be investigated that never were part of the scope of this study such as:

- The impact of South African labour law on Lean manufacturing;
- The impact of employees' literacy level on Lean manufacturing;
- The impact of management style and organisational culture on Lean manufacturing.

## **6.5 Summary**

The objective of the study was to research and investigate the impact that Lean training has on employees' perceptions of Lean tools in their own workplace and the overall impression of the Lean program in their organisation.

So, does training have an impact on employees' perceptions of a Lean implementation? The findings from this study showed that employees had a very good positive perception of the impact that the Lean training had on their jobs. They overwhelmingly believed that their jobs did improve due to Lean training; Employees in general also believed that the Lean program being implemented in their organisation was adding value. The perceptions that employees had about job improvement and value add were not necessarily linked or correlated to specific Lean tool training. Employees' also considered training as the most important aspect of Lean implementation followed by management commitment whilst communication and union-management relationship were deemed least important. The research findings therefore fully answer the research question.

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# APPENDIX 1



**UNIVERSITY OF  
KWAZULU-NATAL**

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03 December 2010

Mr K J Makhomu  
Graduate School of Business  
WESTVILLE CAMPUS

Dear Mr Makhomu

**PROTOCOL: Lean Manufacturing (LM) implementation: A perspective of key success factors**

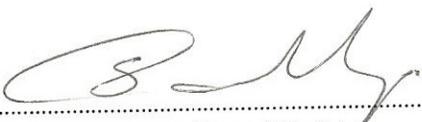
**ETHICAL APPROVAL NUMBER: HSS/1382/2010 MBA: Faculty of Management Studies**

In response to your application dated 03 December 2010, Student Number: **202517295** the Humanities & Social Sciences Ethics Committee has considered the abovementioned application and the protocol has been given **FULL APPROVAL**.

**PLEASE NOTE: Research data should be securely stored in the school/department for a period of 5 years.**

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

  
.....  
**Professor Steve Collings (Chair)**  
**HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE**

SC/sn

cc: Dr B Rhodes (Supervisor)  
cc: Mrs C Haddon



**MBA Research Survey Informed Consent**

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**MBA Research Project**

**Researcher** : Jeremiah Makhomu (031 365 7037)/(082 937 4595)

**Supervisor** : Danny L. McCabe (031-764 5939)/(082 567 8998)

**Research Office** : Tel : 031 - 260 1553

Dear Respondent,

I, Jeremiah Makhomu, an MBA student at the Graduate School of Business of the University of Kwazulu Natal, invite you to participate in a research project entitled **Lean Manufacturing (LM) implementation: A perspective of key success factors**.

The aim of this study is to understand both from management's and employees' perspective the relative importance of some of the key success factors to successfully implement lean principles by SA companies specifically in the Kwazulu-Natal province.

Through your participation I hope to understand more about factors that are considered both by management and employees to be of importance for an organisation to successfully implement LM principles. The results of the research are intended to benefit organisations that intend to implement Lean principles to have insight on some of the key variables they could focus on. Similarly for organisations that are experiencing difficulties in successfully implementing lean principles they could refresh their approach as guided by the findings of this research.

Your participation in this project is voluntary. You may refuse to participate or withdraw from the project at any time with no negative consequence. There will be no monetary gain from participating in this survey/focus group. Confidentiality and anonymity of records identifying you as a participant will be maintained by the Graduate School of Business, UKZN.

If you have any questions or concerns about completing the questionnaire or about participating in this study, you may contact me or my supervisor at the numbers listed above.

The survey should take you about 5 minutes to complete. I hope you will take the time to complete this survey.

Sincerely

A handwritten signature in black ink, appearing to read "Jeremiah Makhomu". The signature is written in a cursive style with a large initial "J".

---

**Jeremiah Makhomu**

## APPENDIX 3

### PART 1: PERMISSION TO USE MY RESPONSES FOR ACADEMIC RESEARCH

I hereby give Mr. KJ Makhomu permission to use my responses for academic purpose towards his MBA dissertation, provided that my identity or the identity of this company is not revealed in any way in the published records of the research.

Initials and Surname: \_\_\_\_\_

Postal Address: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Contact numbers: \_\_\_\_\_

Signature : \_\_\_\_\_ Date: \_\_\_\_\_

### PART 2 : GENERAL QUESTIONS

#### Note to the respondent

Please select your answer (s) by placing an X in the box  
Please answer the questions as truthfully as you can  
What you say in this questionnaire will remain confidential

#### 1. Age group:

<25

25 -34

35-44

45-55

>55

#### 2. Race:

Black

Coloured

Indian

White

Other, please specify \_\_\_\_\_

## APPENDIX 3

### 3. Gender:

- Male
- Female

### 4. Employment status:

- Senior Management
- Middle management
- Junior Management (supervisory)
- Non-management

### 5. The following tools of lean principles have been implemented in our organisation:

(Cross as many as applicable)

- 5S
- Kanban
- Kaizen
- Focussed (Continuous) Improvement
- Autonomous maintenance
- Preventative maintenance
- Other, please specify \_\_\_\_\_

### 6. I have received training on the following lean tools

(Cross as many as applicable)

- 5S
- Kanban
- Kaizen
- Focussed (Continuous) Improvement
- Autonomous maintenance
- Preventative maintenance
- Other, please specify \_\_\_\_\_

## APPENDIX 3

**7. I believe the implementation of lean tools in my organisation has added value to the organisation**

(Cross only one)

- Strongly agree
- Agree
- Not sure
- Disagree
- Strongly disagree

**8. The implementation of lean tools has improved the way I do my job**

(Cross only one)

- Strongly agree
- Agree
- Not sure
- Disagree
- Strongly disagree

**9. In my view the most important aspect to successfully implement lean principles is:**

(Cross only one)

- Training
- Communication
- Management commitment
- Union-management relationship

Thank you for helping me with this survey.

# APPENDIX 4

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### Lean Manufacturing Implementation: A perspective of key succesfull factors

BY KHATHUTSHELO MAKHOMU

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#### ABSTRACT

<sup>2</sup> The interest on lean production is mostly based on the empirical evidence that it improves the company's competitiveness. However the implementation of lean manufacturing harbours enormous difficulties due to a broad-spectrum of variables, compounded by lack of standardised mechanism within organisations of analysis and measure of value-adding capabilities like Lean.

The purpose of this study was to understand from both a management's and employees' perspective the relative importance of key success factors, specifically training, for successful implementation of lean principles and to understand the impact of training on employees perceptions of lean program.

A quantitative research methodology was conducted in a packaging manufacturing

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