

**UNIVERSITY OF KWAZULU-NATAL**

**IMPACT OF LEAN SIX SIGMA STRATEGY ON OPERATIONAL  
PERFORMANCE: A study of ZIMCO Group Pty (Ltd) manufacturing companies**

**BY**

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## DECLARATION

I **Noble Siyabonga Ngcobo student number 215067643** declare that:

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## ABSTRACT

The current study evaluated the benefits of the implementation of the Lean Six Sigma strategy on the operational performance in the Associated Additives (AA); an operations division of the ZIMCO. The aim of the study was to recommend an operations strategy that is predicated on the Lean Six Sigma (LSS). This strategy provides a view by which operations within a manufacturing organisation may be improved. As a manufacturing base, South Africa is considered as 20% more expensive than other countries including those in Europe and China. This disparity has been largely linked to factors such as the unavailability of skilled workforce, inadequate knowledge of rivals as well as operational inefficiencies linked to internal process challenges. Several scholars have argued that South African organisations should consider the adoption of more robust business models in order to be able to adjust to the evolving environment. The study was triggered by the researcher's commitment to analyse and understand the impact of the LSS strategy in the business operational performance and how customers could benefit from the approach. In the face of limited studies focusing on these issues, a study was required in order to increase knowledge on the diagnostic potential of the application of the LSS in improving operational performance in organisations.

The study employed the quantitative research methodology. The population of the study was 62 employees. Thus, all the employees were considered for the study. However, a total of 48 managed to complete the questionnaire. Data was analysed using SPSS in order to generate accurate results. The Spearman rank correlation test was used to assess the level of link between variables. Kolmogorov-Smirnov test was used for analysis trying to determine if two datasets differ significantly. The study found that the implementation of the LSS could reduce the organisation's operation costs; reduce waste; improve work and product quality; and reduction operation costs. The study also established the reasons for failure in the implementation of the LSS. These included; the lack of competency by managers; inappropriate LSS implementation; and lack of proper employee training. It is recommended that more training be provided for both employees and managers. Communication between employees and managers also need to improve. Future research needs to concentrate on the content and nature of the training that should be provided to employees in the AA. Future studies should also focus on how employee income can influence the implementation of LSS in organisations.

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## ACRONYMS

AA	: Associated Additives
BSC	: Balanced Score Card
DMAIC	: Define, Measure, Analyse, Improve, and Control
KZN	: KwaZulu-Natal
LSS	: Lean Six Sigma
ROI	: Return on Investment
TQM	: Total Quality Management

## **CHAPTER ONE: INTRODUCTION**

### **1.1. Introduction**

In the contemporary world, organisations are rapidly acknowledging the fact that they need to engage to step up in competition, not only for the realisation of profits, but also for their own basic survival. An assessment of the global economy reveals that being good is not enough, but rather, organisations should do more to stand up to competition as well as to satisfy their customers. This implies that every organisation needs to strive for excellence if it wants to stay in the market. In recent years, most companies have realised that traditional management, manufacturing processes, and other historic approaches are no longer adequate in a rapidly changing world. More effective methods such as the Six Sigma, the lean manufacturing and the recently combined Lean Six Sigma need to be actively adopted and adapted in order to move businesses forward. The Lean Six Sigma deployment is the foundation on which Operational Excellence may be achieved (Datta and Roy, 2011).

The current study evaluates the benefits of the implementation of the Lean Six Sigma strategy on the operational performance in the Associated Additives (AA), an operations division of the ZIMCO. The aim of the study is to recommend an operations strategy that is predicated on the Lean Six Sigma. The strategy provides a view by which operations within a manufacturing organisation may be improved (Psychogios, Atanasovski and Tsironis, 2012).

The first chapter introduced the study by way of providing a brief background. It outlined the problem statements and presented research objectives as well as research questions. A brief discussion on the motivation for the study has also been made together with the kind of methodology that was employed.

### **1.2. Motivation of the study**

As a manufacturing base, South Africa is considered as 20% more expensive than other countries including those in Europe and China (Rathilall and Singh, 2018). This disparity has been largely linked to factors such as the unavailability of skilled workforce; inadequate knowledge of rivals as well as inefficiencies in operations which are linked to internal organisation process

challenges (Naude and Badenhorst-Weiss 2011). In the face of these challenges, scholars have argued that South African organisations should thus consider the adoption of more robust business models in order to be able to adjust to the evolving environment (Naude and Badenhorst-Weiss 2011). This view is pushed forward by Ndaita, Gachie and Kiveu (2015) who posit that recent global processes have time and again motivated companies to adopt mechanisms that will allow them to adapt to volatility.

Several empirical investigations have established that one such inventiveness that can help institutions to deal with the challenges of competition in the rapidly changing environment is the integrated LSS (Antony, 2011; Chiarini, 2011; Laureani and Antony, 2015). In recent years, the tool has increasingly been recommended as the best tool that offers the “experience, concepts and methods to lead change and sustain global competitiveness” (Albliwi, et al., 2015:665). The method emanates from the “synthesising standalone Lean and Six Sigma systems into a unified approach to increase process performance” (Rathilall and Singh, 2018:1015). Institutions that implement the LSS efficiently can produce considerable savings per annum as witnessed many manufacturing industries across the world (Laureani and Antony 2015).

The manufacturing industry in South Africa still lacks in this regard. It is therefore important for South African leader to adopt and deploy improvement mechanism that can ladder their respective organisations out of the current malaise. The leaders should move away from deploying the Lean or Six Sigma techniques not as standalone, but rather as integrated tools. An investigation of newspaper articles, journals, books, periodicals, websites and consultation with organisational leaders and academics seems to highlight a general lack of the deployment of the LSS in the ZIMCO manufacturing and its AA division in KwaZulu-Natal (KZN), South Africa. This argument is supported by Zhang, Irfan, Khattak, Zhu and Hassan (2012) who found that the integrated LSS tool was only being used in the education sector in the country. Thus, a study which focuses on the manufacturing sector is required in order to indorse thought for the use of the LSS as tool to attain improved corporate outcomes.

The current study was motivated by the researcher’s need to analyse and understand the impact of the Lean Six Sigma strategy in the business operational performance and how customers could benefit from the approach. In the face of limited studies focusing on these issues, a study is required in order to increase knowledge on the diagnostic potential of the application of the Lean

Six Sigma in improving operational performance in organisations. Consequently, studies are also required in order to understand methods of formulating good competitive operations strategies for organisations including manufacturing companies.

This study could benefit site management teams by enabling them to maximise and leverage the operations function using Lean Six Sigma at site in line with ZIMCO objectives. It could also benefit site employees by improving their understanding of organisational operations. Lastly, the study could enable operations managers to have more understanding of the operational challenges within the context of their own organisation.

### **1.3. Focus of the Study**

The study is predicated on the LSS; which is tool mainly employed to eliminate discrepancy from processes so as to produce the best products that are not below standard. It is based on the abbreviation DMAIC which stands for: Define, Measure, Analyse, Improve, and Control (Rathilalland Singh, 2018). This is the basis and the systematic five-step method of solving problems which is adopted to establish the reasons of discrepancy production processes (Psychogios, Atanasovski and Tsironis, 2012). The DMAIC cycle defines a process by which to improve, measure the baseline and target performance of the process. It is also used to assess the various data processes that may be useful in determining the quality and level of output.

As standalone business tool, the LSS have different performance measures which can be focused on in order to help develop and improve businesses to reach the best international levels where they can compete successfully. The model consists of tools that are already proven to help in the realisation of business goals. However, although the tool can produce several benefits, when it is used alone such benefits may not be realised since it also has its own weaknesses (see Chapter Two). It is for this reason that several scholars have recommended for the integration of the SS and the LSS.

The study focused on assessing the perceptions of AA employees and management with regard to operations function, effectiveness of operations strategy and adoption of the LSS as a method to ensure development of operations efficiency areas at AA. The study also focused on

understanding the views and perceptions of employees in this particular division with regard to how they viewed the impact of the Lean Six Sigma in their division.

#### **1.4. Problem Statement of the study**

The AA currently faces several challenges including increased competition from other organisations that provide similar products. This has been worsened by contemporary worldwide developments such as globalisation which have open up borders, and has allowed products produced in other parts of the world to be sold in South Africa. In the face of these challenges, there is a need by the AA to consider the diagnostic potential of implementing the LSS as part of its continued effort to offer the best products to its clients.

Although the Lean Six Sigma is expensive with respect to the costs of training, development and deployment, it is a rigorous and systematic process to enhance competitive advantage, new processes, products or services design. While there exist no clear-cut processes on the implementation of the LSS in the operations at AA, it is important to investigate its potential benefits to the organisation. Such an evaluation should take into account the suitability and acceptability of the strategy in this particular organisation. At the current moment, the benefits and challenges of adopting and implementing this strategy are not known in the case study organisation.

#### **1.5. Objectives**

The overall purpose of this study is to evaluate the impact of Lean Six Sigma within the AA. The specific objectives are:

1. To assess the impact of implementing Lean Six Sigma strategy within AA;
2. To analyse the relationship between Lean Six Sigma and operational performance within the AA.
3. To assess customer benefits in Lean Six Sigma strategy within the AA.

## **1.6. Research Questions**

The major research question was phrased as follows: “*How can the impact of Lean Six Sigma within the AA be evaluated?*”

1. Is there any impact in implementing Lean Six Sigma strategy at AA?
2. Is there a relationship between Lean Six Sigma and operational performance?
3. Is there any customer benefit in Lean Six Sigma strategy?

## **1.7. Methodology**

The study employed the quantitative research methodology (see Chapter Three). Quantitative research focuses on phenomena that can be observed and measured empirically (Leedy and Ormrod, 2015). It is linked to positivist approach and “reflects a deterministic philosophy in which causes probably determine effects or outcomes” (Creswell, 2014:17). Its advantages include that it places great emphasis on objectivity and reliability of findings and encourages replication (Saunders, Lewis and Thornhill, 2015). The approach was used in this research study to establish the relationship between Lean Six Sigma and operational performance in the view of operations employees at the AA division of ZIMCO due to their perceived knowledge on the subject (Sekaran and Bougie, 2016).

An operations performance was used to test the theory of good improvement of operations that predicts that Lean Six Sigma can positively influence the operations within the context of AA. The questionnaire was the major instrument used in the study and it explored the benefits of deploying the Lean Six Sigma in the AA. The reason for collecting quantitative data was to analyse the perceived knowledge and benefit of the Lean Six Sigma.

## **1.8. Chapter outline**

The study is divided into six chapters namely;

### **Chapter One: Introduction**

The first chapter introduced the study by way of providing a brief background. It outlined the problem statements and presented research objectives as well as research questions. A brief discussion on the motivation for the study has also been made together with the kind of methodology that was employed.

### **Chapter Two: Literature Review**

This chapter reviews the literature that is relevant to the topic. The impact of Lean, Six Sigma and Lean Six Sigma in an organisation. Emphasis is placed on how the Lean Six Sigma impacts the operational performance. More than 80% of the sources are taken from the peer reviewed sources which are from sources such as science direct journals and other sources like books. Presentations and written articles are used.

### **Chapter Three: Research Methodology**

The research methodology used is presented in this chapter. The quantitative research method was chosen in order to measure the data collected from the employees. The population and sampling method used is also discussed. The research purpose, research objectives, the research paradigm, and data collection strategies are discussed in this chapter.

### **Chapter Four: Data Presentation**

This chapter presents the results that were gathered during the fieldwork in the case study company. Results are presented in graphs and tables.

## **Chapter Five: Discussion of Results**

This chapter makes a discussion on the study results.

## **Chapter Six: Conclusion and Recommendations**

This is the last chapter of the research and it consists of conclusions and recommendations of the study. The recommendations for future studies are also included in this chapter.

### **1.9. Chapter Summary**

This chapter provided a general introduction and background to the study and also outlined the problem statement; objectives of the study and research questions; the rationale of the study; the research methodology; the limitations of the study as well as the research outline. The chapters of the study follow the sequence shown in section 1.8 on the structure of the dissertation.

The next chapter is on literature review.

## **CHAPTER TWO: REVIEW OF LITERATURE**

### **2.1. Introduction**

This chapter reviews the literature is related to the study in order to establish what is known so far around the same topic. The study discusses the various conceptual and theoretical frameworks in order to give a background around which the study was conducted. In this study, the aim of literature was to understand what is already known on operational performance and on LSS. Literature was also reviewed in order to examine what the main trends within the literature are. The chapter is divided in to the following sections: Operational Performance, An overview of the SS and LSS, LSS benefits, LSS sustainability factors, LSS cultures and LSS in manufacturing studies with critical factors for the success of LSS.

### **2.2. Operational Performance**

In implementing every business development strategy, the organisation need to monitor the production system all the time in order to ensure the success of the strategy (Yang, Hong and Modi, 2010). In order to be able to monitor, a performance measuring mechanism needs to be in place so that outcomes can be measured against such a mechanism. Monitoring can also be done by placing results against goals and objectives (Cabrita, et al., 2015). The running of operations at reduced costs to attract and retain customers as well as continuously developing the nature of constitute the pillars of engendering an operations strategy in enterprises that focus on greater success (Datta and Roy,2011). The reviewed literature indicates that successful organisations are those that deploy strategies which are focused on operational performance (Douglas, Douglas &Ochieng, 2015; Svensson, Antony, Ba-Essa, Bakhsh and Albliwi, 2015). The developers of the balanced score card (BSC), Kaplan and Norton (1992) are of the view that conventional measuring methods such as those focusing on financial performance are no longer relevant in the contemporary business world which is rapidly evolving. Thus, it is argued that methods focus on operational performance are needed as they directly assess and target the satisfaction of customers who are the bedrock of every business enterprise. This method also examines organisational processes and activities that are directed at business development and innovation which will subsequently results in future financial returns.

Manufacturing performance is thus frequently made use of in operations management as a discipline. Operational performance measuring methods are basic in the measuring of the operational performance of every organisation (Strauss and Du Toit, 2010). Many enterprises have their own different targets against which they measure their own performance. These targets are usually different for every company although companies may be in the same business field. Few of these measurements used in the current study include customer satisfaction, productivity, costs and quality.

A company normally evaluates itself in terms of operational performance within its own industry. Normally, keeping a high score on the measurement shows that an enterprise's operational performance is not bad (Singh, 2011). The measurements which in the longer-run determines the company's operational performance are very useful imperative as they help to establish the various areas in which the organisation needs to work on to boost its performance (Psychogios, et al., 2012). An organisation that has an operational performance that is high is very esteemed by all stakeholders. Hence all companies are continuously trying to improve their performance. Operational performance takes into consideration the company's performance in achieving its basic objectives, that is, productivity, quality and service.

Ndaita, et al., (2015) argued that whatever systems of evaluation, if they are not correctly developed, can even conceal the core developments and mislead the views of leaders. In the context of companies that are doing very well in their operations, the assessment of performance is an intrinsic element of the strategy (Ndaita, et al., 2015). The current study evaluates the impact of Lean Six Sigma strategy on costs, quality, productivity and customer service measurements.

### **2.3. Overview of Lean Six Sigma**

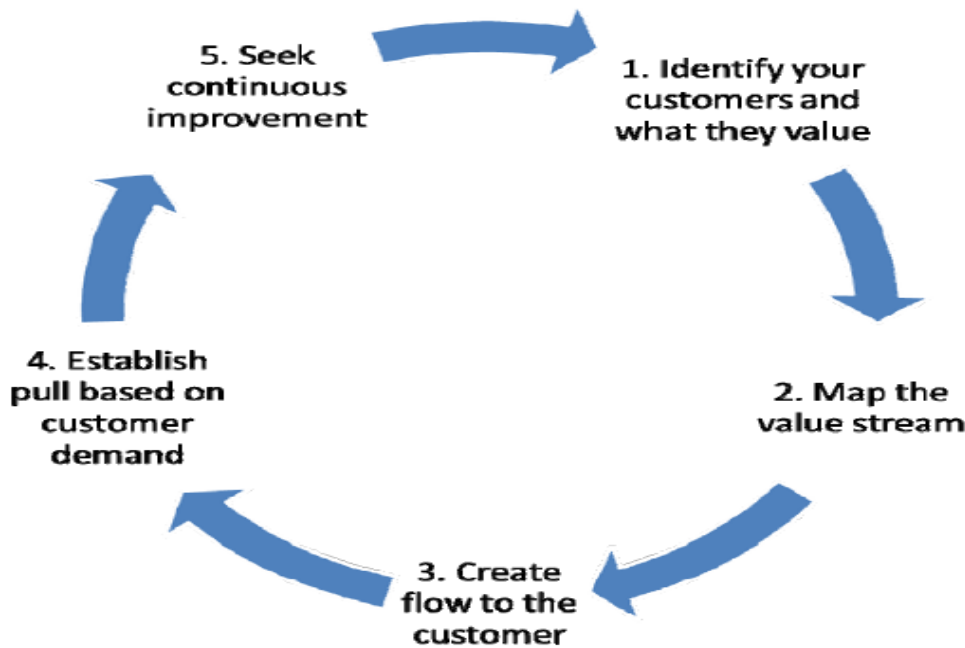
The LSS is a methodology for business improvement and it is aimed at maximising the ability of organisations in terms of operational efficiency and effectiveness by improving speed, product quality, the satisfaction of customers, and by reducing costs both of production and of purchase by customers (Laureani and Antony, 2015; Naude and Badenhorst-Weiss, 2011). The LSS is able to achieve this by integrating principles and tools borrowed from both the Lean and Six Sigma. The LSS was first developed to ensure the reduction of waste in organisations. It was also meant

to ensure the improvement of quality within manufacturing. The terms Lean and Six Sigma were first surfaced in the 1980s and they have followed different paths since then (Bhat, et al., 2014; Karthi, et al., 2011).

Lean is a methodology that was designed for organisational development. It is a methodology designed to reduce waste during production and also produce products and services faster, and at a lower cost (Laureani and Antony, 2015; Naude and Badenhorst-Weiss, 2011). The first lean applications were deployed by Ford in 1913. Womack and Jones (1997) posits that the LSS is a technique to postulate value, design the actions of creating value, implement those activities with no disruption, and undertake them more efficiently. The lean is also a method to identify and eradicate wastage through unremitting improvement through producing products that will attract and satisfy customers (Brue and Howes, 2006).The method facilitates that all sectors of an organisation can reach their operation performance (Strauss and Du Toit, 2010).

According to Womack and Jones (1997), there are five principles of lean as shown in Figure 2.1

**Figure 2.1: Five Lean Principles**



Adapted from Womack and Jones (1997)

According to Womack and Jones (1997), the five lean principles are a guidance to lean implementation. These principles are:

1. Define Value: The value of the product or the service provided by an organisation is usually defined by the customer. In this view, the first task by an organisation is to identify its customers. The organisation needs to find out what its customers value most in products and services and what the customers expect. Ask yourself, what does the customer value? After this, the organisation need to classify all organisational activities into Non-Value added, Value-added and Enabling value added.
2. Map the value stream: Shaping the value stream indicates the workflow practice for a product or service. This helps in the identification and elimination of NVA actions. Subsequently, this helps the organisation to improve product/service quality through the reduction of process delays.
3. Create Flow: The organisation needs to create a flow to the customer by making sure that there is nonstop flow system in the production of products or services. The creation of flow will ensure a maximisation of process efficiency.
4. Establish Pull: The organisation also needs to establish pull approach. This can only be ensured if the organisation is able to meet its target every time. The term 'beat time' refers to the amount of time it takes for the organisation to have the product or service available to customers.
5. Seek Continuous Improvement: the organisation should also be always focused and determined in its pursuit for continuous improvement in order to always ensure that customers' demands are met. This enables the organisation to be able to eliminate wastages and also ensure that any products produced are free from defects.

According to Yusr, Othman and Mokhtar (2011), the elimination of waste need to be always viewed as one of the most important ways by which organisational profitability can be realised. Organisations always need to know that every process they embark on either adds value to the product or service or else it causes waste in the production of goods or services. The seven wastes are a practice which first emerged in Japan where waste is known as "*muda*". This

method of categorizing waste was originally developed by Toyota and is now known as Lean Manufacturing (Womack and Jones,1997). In order for organisations to be able to grapple with and successfully eliminate waste, it is essential that they understand exactly what waste is and where it is located within the organisation. While products among organisations, their wastes are however similar. There is a specific way of eliminating each type of waste. If a waste is successfully eliminated, the organisation will then realise an overall improvement both in its own performance as well as in the quality of the products and services it offers.

#### **2.4. Wastes in Manufacturing according to Capital (2004) :**

- **Transportation** – During the transportation process, waste may be in the form of parts and materials which are being moved from one place to another.
- **Inventory** – These are products or parts which are not delivered. Overstocking with equipment that may be in need somewhere in the future.
- **Motion** – unnecessary movement of employees or machinery.
- **Waiting** – waiting for goods to be delivered.
- **Overproduction** – too many items produced “just in case.”
- **Over-processing** – Spending a lot of time on a given task. Adding a feature that doesn’t bring value.
- **Defects** – broken parts or defected parts that need to be reworked.

The SS as it is known today was a product of the Motorola since the 1980s (Brady and Allen, 2006). It is basically a statistical concept of solving a problem. The method allows organisations to reduce the number of products which are defective during manufacturing. Diverse writers defined SS as outlined below:

- A business improvement technique which is used to ensure profitability through cost reduction and efficiency (Lowenthal,2002).
- It is a data driven tactic for eliminating defects (Mark and Birkinshaw,2015).

- It is a viewpoint used to find and eradicate the causes and defects in business developments through a focus on the outputs that are imperative to customers (Anthony and Ferguson,2004).

The SS is implemented as a five-stage process namely; Define, Measure, Analyse, Improve and Control (DMAIC) as shown in Figure 2.2 below (Shankar,2009).

**Figure 2.2: Process improvement using Six Sigma**



Adapted from Shankar (2009)

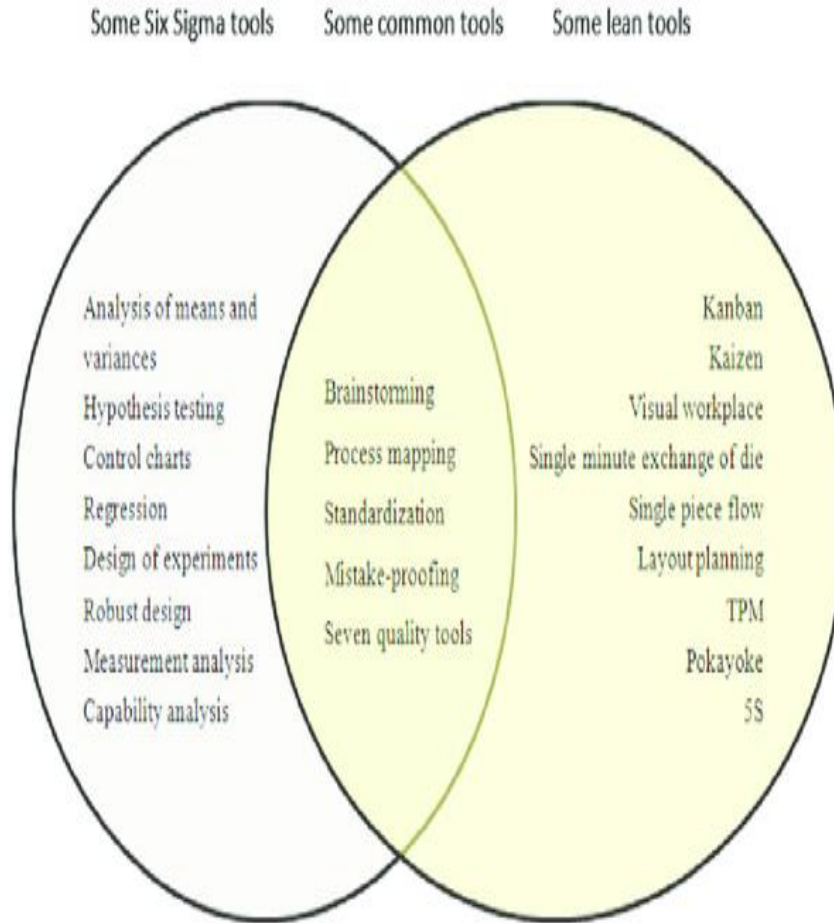
DMAIC - Improvement Cycle is a universally applicable method of gradual improvement which is an integral part of the method Six Sigma. It is used to drive improvements in quality of products, services and processes. Each stage in the cycle helps achieve a real

improvement (Shankar,2009). According to Shankar (2009), the stages of improvement cycle phases are defined as per below:

- D (Define) -The problem and/or process should be linked to organisational priorities and has management support.
- M (Measure) -The aim of the ‘measure phase’ is to collect baseline data about the procedure that has to be improved. Identify crucial to quality factors.
- A (Analyse) -To fix which inputs hold a weighty and vital impact on the creation of defects.
- I (Improve) -To model the procedure scientifically in terms of inputs and outputs and their relationships so as to comprehend the behaviour of the process.
- C (Control) –In this phase, controls are placed on the changes of noteworthy variables that can improve the output.

The LSS is a business improvement methodology that aims to increase shareholder value through the improvement of by customer satisfaction, quality, productivity, and costs. This is achieved by through the merging of tools and principles from both the lean and the SS (Svensson, et al., 2015). Naslund (2008) however posit that the lean and the SS are not completely new method. They are just repackaged versions of methods which already existed before such as the just-in-time (JIT) and total quality management (TQM). Figure 2.3 presents the sigma, lean and common tools.

**Figure 2.3: The Six Sigma and Lean tools**



Adapted from Antony, Escamilla and Caine (2003); Pepper and Spedding (2010); Salah, Rahim and Carretero (2010)

According to Pepper and Spedding (2010), LSS common tools are utilised in order to improve processes and services in operations. Brainstorming, process mapping, standardisation, mistake proofing and seven quality tools are common tools between lean and Six Sigma.

Lean Six Sigma combines the strategies of Lean and Six Sigma to improve process performance Figure 2.4.

**Figure 2.4: The Lean-Six Sigma Nexus**

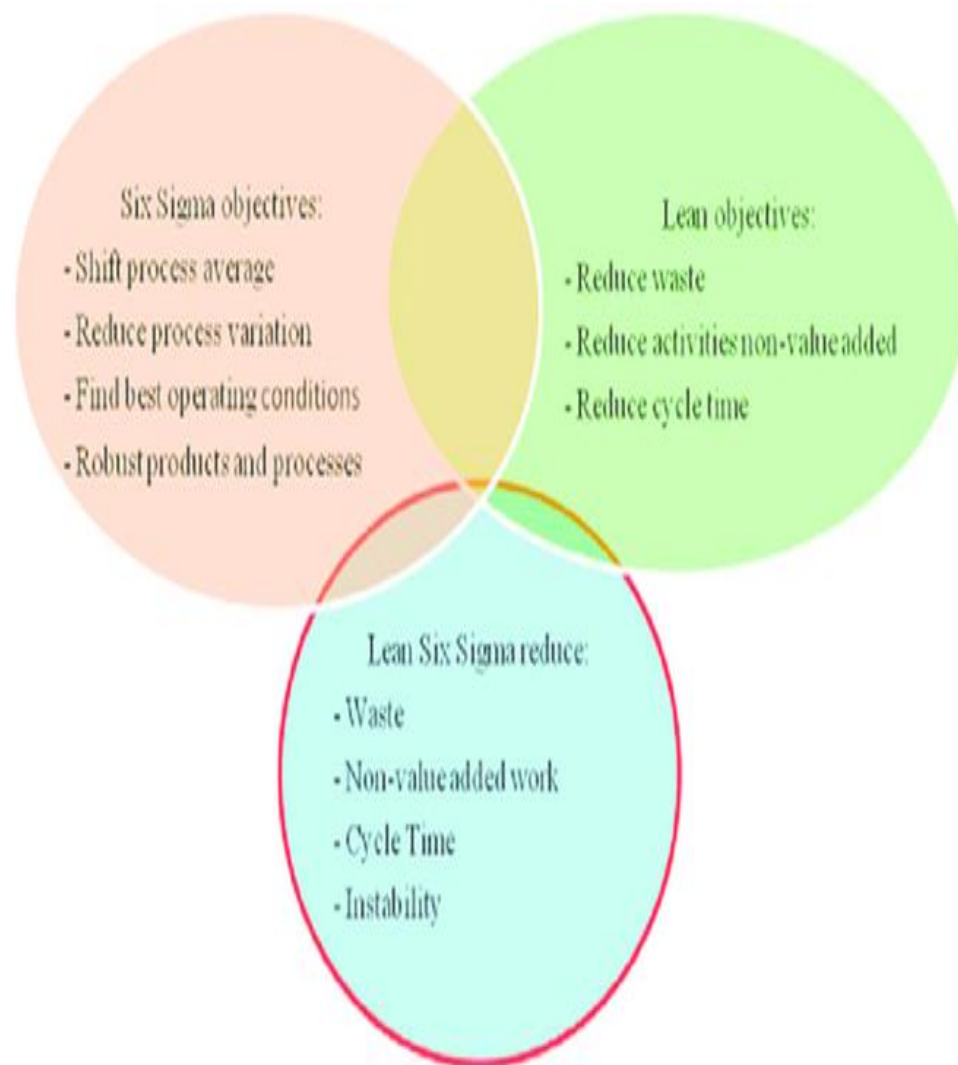


Adapted from Circle 6 Consulting,2017

Lean principles are essential in realising the reduction or elimination of process wastes as in Figure 2.4. The SS focuses on improving the probability of business by means of reducing whatever costs and wastages that may hamper profitability. In this view, it can be opined that the LSS principles help improve the total organisation operation performance.

Figure2.5 presents the improvements objectives of integration of SS and lean.

**Figure 2.5: Improvement objectives of the LSS**



Adapted from Snee (2010)

Both Lean and Six Sigma have the same objectives which are aligned to improve processes and services (Snee,2010). LSS reduce waste, non-value-added work, cycle time and instability. Table2.1 shows the lean-Six Sigma nexus.

**Table 2.1: Synergies between the Lean and Six Sigma**

Lean	Six Sigma
<ul style="list-style-type: none"> <li>• Establish methodology for improvement</li> <li>• Customer value focus</li> <li>• Project-based implementation use, Project management skills Understanding of existing situations</li> <li>• Reduce cycle times, product defects, changeover time, equipment failures, etc.</li> <li>• Test to confirm improvement</li> <li>• Calculate process capacity and Takt time Data Plan new layouts</li> </ul>	<ul style="list-style-type: none"> <li>• Policy deployment methodology</li> <li>• Customer requirements measurement, cross functional management knowledge discovery</li> <li>• Seven management tools, seven quality control tools, design of experiments</li> <li>• Data collection tools and techniques,</li> <li>• Process control planning Cause-and-effect, FMEA</li> </ul>

Adapted from Pepper and Spedding (2010).

Pepper and Spedding (2010) indicated the synergies of both the using Lean and SS. The striking results which were produced by companies like Toyota, Motorola, and many others through the use of either the SS or the Lean have encouraged other organisations to deploy the same tools. Consequently, each and every company is currently making use of one of these tools if not both at the same time.

However, there are inherent weaknesses in making use of only one of the methods. This is because there are already identifiable weaknesses and limitations in each of the tools (Bhat et al., 2014). For instance, the SS can reduce or even eliminate the chances of defects but it cannot resolve the challenge of how the process flow can be optimised. On the other hand, the Lean principles excludes the most advanced statistical tools which are often needed in order to attain the process capabilities which are needed in order to be truly 'lean'. Thus, organisational experts

advice that these two be combined by organisations. The tools are more effective if they are used together than when used separately.

## **2.5. LSS Benefits on Operational Performance**

The LSS combines the two tools and therefore offers a better option instead of the adoption of a stand-alone methodology (Bhat, et al., 2014; Douglas, et al., 2015). The following is a summary of the available definitions contributed by different scholars.

- Achieve superior performance in competitive priorities like quality, reliability and speed (Drohomeretski, da Costa, de Lima and da Rossa, 2012).
- Improved quality, reduced cycle times and creating value for stakeholders (Naslund, 2008).
- Culture change, productivity improvement, customer satisfaction, cost reduction and defect reduction (Su, Chiang and Chang, 2006).
- Improves company overall competitiveness (Chen, Li and Shady, 2010).
- Increase revenue, decrease costs, improve efficiency and develop effective people/employees (GoLeanSixma, 2012).
- Improves overall performance, reduce costs and reduce errors (Knapp, 2015)

## **2.6. Sustainability of LSS and Factors Affecting Success**

There are several factors that can affect sustainability of implementing a successfully LSS strategy to drive operations improvements and assess existing process whether they meet customer needs. Sustainability denotes the organisation's continued creation of value in products and service. This value creation should always be in line with the LSS principles of LSS (Kowang, Yong, Rasli, Long, 2016). The term 'sustainability' is usually used to refer to the ability for an organisation to be able to performance at the similar rate or even better both now and the in the future without disadvantaging protection of attributes and the future operations. Thus, sustainability from LSS principles includes waste elimination and adds value to products and services and also improves the overall accuracy and effectiveness of organisational processes (Eiling, 2008). Kowang, Yong, Rasli and Long (2016) proposed some sustainability factors for

LSS after conducting a study in automotive company and some are included in the below discussions.

## 2.7. Summarising the Lean and Six Sigma Strengths and Weaknesses

**Table 2.2: Strengths and Weaknesses of the Lean and Six Sigma**

<b>Variable</b>	<b>Leans</b>	<b>Six Sigma</b>
<b>Strengths</b>	Waste reduction	Elimination of defects
	Reduction in lead time	Save money
	Reduction of cycle time	Uniform process output
	Reduction of the reports on instances of work-in-progress	Defect reduction
	Ensures quick delivery times	Culture change
	Ensures that space is saved	Customer satisfaction
	Reduces the number of equipment needed	Detailed statistical analysis for improvement
	Efficiency driven	Excellence driven
	Flow in processes improvement	Reduce variation
	Clean environment	Structured problem-solving methodology
<b>Weaknesses</b>	Numerical scrutiny not valued	Processes are developed separately.
	Process instability and incapability	No specific speed technique
	Lacks systematic problem-solving tools	SS is not critical of existing methods of operations.
	No link to quality and statistical tools used to diagnose processes	No consideration for capital invested in inventory.

**Source:** Rathilall and Singh, 2018:3).

## **2.8. Senior Management Commitment and Approach**

The nature of management's approach to sustainable development remains a key factor in whatever business strategy which is going to be adopted by that particular organisation. Management needs to be able to generate, communicate and also implement a clear vision that will be able to move the organisation forward (Knapp,2015). The LSS requires a senior manager, as a champion, to oversee an improvement projects (Knapp,2015). Management commitment and involvement remains the most vital constituent to the realisation of LSS (Rajesh, Pugazhendhi, Ganesh, Ducq and Koh, 2012).

It is also important to always have support from top management for the employees to be able to achieve the change that is needed in organisation. A well-motivated workforce will be able to contribute its time, energy and zeal towards the implementation and realisation of LSS strategy to the business. Maleyeff, Arnheiter and Venkateswaran (2012) found that lack of leadership support or inappropriate leadership style can undermine the organisation's commitment to the implementation of strategies that can take the company forward. In this view, it is always important that, starting at the recruiting stage, organisations should ensure that only suitable personnel are recruited in managerial positions. The human resources department, which is responsible for the placement of staff in the organisation needs to be trained enough so that it can ensure that the organisation has the right quality of workers.

## **2.9. Organisational Culture**

Organisational culture is defined as shared values and beliefs (Schein, 2010). These values are the basic beliefs and views as well as philosophies that are shared by all actors in the organisation and that ensure that particular organisation's survival. Culture is also the total sum of all what the organisation stand for. It encompasses what the organisation believes are the appropriate procedures of conducting business, how it has to relate to other businesses as well as how it relates to its customers. The culture of an organisation is so influencing to such an extent that if the culture is wrong, such an organisation may fail (Knapp, 2015). In the context of the current study, organisational leaders need to create a vision that is influenced by a commitment to the realisation of LSS. In actual fact, both the vision and mission of every organisation is derived from that culture that is practiced in that particular organisation. the culture also needs to be

supported by all relevant actors of the organisation including managers, employees, customers and all the communities that are contagious to the organisation.

## **2.10. Continuous Improvement and Innovation Culture**

Continuous improvement is a process that encompasses the entire organisation, and it is predicated on the generation of deep and wide-ranging innovation (Assarlind, Gremyr and Backman, 2012). The Continuous Improvement (CI) according to the LSS point, is a culture of based improvement which is predicated on continued elimination of waste within the organisation. In order to achieve this, all actors in the organisation are mobilised to come on board and to contribute their level best as part of the collective effort to work towards the realisation of the organisational good. In this way, all stakeholders could be commitment in identifying causes of problems and also coming with various ways to minimise and ultimately eliminate organisational problems (Corbett, 2011; Hoerl and Snee, 2010). It is always important that CI be integrated into the everyday activities of employees so that it does not a burden to them. In this way, it will be easier for organisation to realise sustainability as argued by organisational experts (Oguz, Kim, Hutchinson and Han, 2012; Taylor, 2014).

Gelei, Losonci and Matyusz (2015) mentioned that the formation of supportive LSS organisational openness, teamwork, interest and data sharing as an organisational culture is a crucial base for developing LSS sustainability. It is in very considered view that organisational leaders should be very sober and aware of the kind of culture which they motivate (Gershon and Rajashekharaiyah, (2011).

CI culture is the vital component for LSS sustainability while innovation is the vital source of competitiveness *via* the sustainable implementation of LSS (Chiarini, 2011). Studies by researchers such as Assarlind, Gremyr and Backman (2012) and Svensson et al., (2015) argued that CI is capable of improving of providing some clear-cut directions by which organisations can gain competitiveness through the adoption of conducive cultures. This can be achieved more easily when organisational leaders are committed to solving problems that constrain profitability and efficiency (Rathilall and Singh, 2018).

Both innovative and continuous culture endorse sustainable business approaches that can help organisations to meet the needs of their customers.

### **2.11. Communication**

Communication is also considered by various scholars as one of the major factors that is able to sustain the successful implementation of the LSS in organisations that seek to improve their operation performance. Albliwi et al (2015) posted that frequent communication amongst organisational stakeholders, ranging from top management and managers to new recruits has the capacity to guide all actors towards the appropriate application of the LSS which is likely to bring about positive results in a company. Organisational leaders therefore always need to be well aware of the mission and vision of the organisation so that they can be able to communicate it clearly to other actors (Knapp,2015). In most organisations that are failing or underperforming today, in-depth investigations reveal that improper or lack of communication among actors resulted in ethical misbehavior or in the improper execution of tasks (Jeyaraman and Teo,2010). In order to be able to grapple with the fear that usually accompany change initiates in organisations, it is important for management to establish proper and clear communication lines across all levels in the organisation. this will help management to be able to educate all employees about the LSS and its benefits to the organisation as well as to them as employees. If communications lines are clear, employees are less likely to resist change in organisations (Chiarini, 2011).

### **2.12. Employee LSS knowledge and Training**

A sustainable CI culture within an organisation should be implemented in line and appropriately combined with the LSS principle in order to make sure that a maintainable LSS ambition is realised. Training plays a crucial role in the success of LSS. The knowledge and understanding of employees on LSS principle is important in adding value to the organisation. Employee knowledge has also the capacity to reduce variation. In order for employees to be able to make meaningful contribution towards the realisation and implementation of the LSS, organisations need to provide the necessary training. This implies therefore that training should not be considered as an appendage, but rather part of the prerequisite requirements for the success of

LSS implementation. Training is an important technique organisations should use in order to achieve LSS sustainability (Douglas et al., 2015).

### **2.13. Chapter Summary**

The current chapter made an extensive review of the literature that is available on LLS and organisational performance. Reviewed literature indicated that in the contemporary world where the success of business is hinged on successfully competing with others, the adoption and implementation of the LSS as a strategy to boost business through the promotion of efficiency and effective presents the only best and promising tool. The chapter also reviewed literature that revealed communication and employee training as some of the important factors which organisational leaders to invest in in order to have all stakeholders particularly employees to take part more dutifully and responsibly in the implementation of the LSS.

The research method that was used in the study is presented in the next chapter.

## **CHAPTER THREE: RESEARCH METHODOLOGY**

### **3.1. Introduction**

One of the most important aspects in conducting a research study is the ability to make an informed choice in terms of choosing the appropriate methodology for the study. In this chapter, the various methods of research that were used in the study are presented. The researcher also explains the purpose of the study, the designs that were followed, approaches and philosophies as well as the instrument that was deployed. Ethical matters also make part of this wide-ranging discussion.

### **3.2. Aim of the Study**

Every research study that is conducted should have a clearly defined purpose (Sekaran and Bougie, 2016). There are many purposes for conducting research studies. These include the need to deeply understand certain issues; to increase familiarity around certain aspects; to be able to make recommendations; to submit in partial or in fulfillment of university studies, and so forth. The aim of the current study was to assess the employees' perceptions towards operations function using LSS. Employee perceptions about performance were thus used to test the theory of good improvement of operations that predicts that LSS will positively influence the operations strategy for associated additives (AA) at Durban, Jacobs.

The study also aimed to assess the effectiveness of the current operations strategy within the case study organisation and the propose formal adoption of LSS as an approach that can ensure improvement of operations efficiency and effectiveness performance areas. It is in this considered view that a business performance analysis in cost, quality, customer service, productivity and knowledge of LSS was used in the study.

### **3.3. Research Design and Methods**

Research design comprises the several technical and logical aspects which are usually made use of by researchers to ascertain the question of the research, to assemble information and to analyse it (Welman, Kruger and Mitchell, 2012). There are many types of research designs

namely; exploratory, description and explanation. In social sciences, investigators may conduct a study so as to boost their knowledge on a certain issue (Creswell, 2014). The need to increase one's knowledge on a certain topic occurs when one researcher comes encounters an unexplored subject and then gets fascinated by it. The topic or subject unfamiliarity attracts the need for research in order to gain a chance to access information in an area that has never been explored (Babbie, 2011). However, unfamiliarity usually makes it uneasy for researchers to make ground-breaking conclusions (Welman et al., 2012).

Descriptive research design gives researchers a chance to observe and then to provide explanations to events (Babbie, 2011). Research is not simply carried out for no reason or else that such a research is a waste of resources and effort (Babbie, 2013). Thus, the importance of every study lies in the use to which the results are put.

In view of the quantitative requirements of the research problem and questions posited in the first chapter, the descriptive design option was considered the most suitable for the study. A survey was considered suitable since it can ask several respondents about many things at the same time (Babbie, 2013). This was perhaps the most suitable method because the researcher sought to collect data that would be used to describe a populace too large to be observed directly (Babbie, 2013).

The current study was however also exploratory both in the collection and its interpretation of data. The advantage of an exploratory design was its ability to boost understanding on the impact of LSS on operational performance as understood by the employees. In addition, the exploratory approach enhanced flexibility during the fieldwork (Saunders, Lewis & Thornhill, 2013).

There are two main research methods used by researchers namely qualitative and quantitative. The qualitative methodology is a holistic method that involves and culminates in new discoveries. The approach is considered as an investigative model that takes place in natural settings where researchers can attain a high level of involvement in order for them to have an in-depth comprehension of phenomena (Creswell, 2014). The approach allows the researcher to have a view from inside.

Leedy and Ormrod (2015) argue that the qualitative research is one that is less structured in its descriptions as it formulates and generates new theories. The qualitative study options include:

case study, ethnography study, phenomenological study, grounded theory study, and content analysis. Qualitative research is predicated on inductive reasoning and not on deductive. In the qualitative empirical research, data is gathered from the participants' own views is used to make sense of phenomena (Bryman, 2012). The qualitative approach is different from the quantitative approach.

Leedy and Ormrod (2015:102) posit that “Quantitative researchers seek explanations and predictions that will generate to other persons and places. The intent is to establish, confirm, or validate relationships and to develop generalisations that contribute to theory”. Quantitative research commences with a problem and entails the formulation of a hypothesis, a literature review, and a statistical data interpretation. Creswell (2014:18) argues that the approach “employs strategies of inquiry such as experimental and surveys, and collect data on predetermined instruments that yield statistical data”. The quantitative approach gathers data that is able to reduceable to numbers during interpretation so that the results can be used to support or reject “alternate knowledge claims” (Creswell, 2014:153).

Table 3.1 summarises concepts usually associated with quantitative and qualitative research methods

**Table 3.1: Comparing Quantitative and Qualitative Methods**

	<b>Qualitative method</b>	<b>Quantitative method</b>
Type of reasoning	Induction Subjectivity Meaning	Deduction Objectivity Causation
Type of question	Open-ended Process-oriented	Pre-specified Outcome-oriented
Data collection	Observation Interviews Documentary analysis, case study, action research, researcher’s impressions,	Questionnaires, standardised/structured interviews, tightly structured observation, document/secondary analysis and

	photographs, videos	official statistics
Sample	Participants, informants. Sampling units such as place, time and concepts. Purposive and theoretical sampling. Flexible sampling that develops during research. Sample is small.	Respondents, participants. Randomised sampling. Sample frame fixed before research starts. Sample is large
Relationships	Direct involvement of researcher. Research relationship close.	Direct involvement of researcher. Research relationship close.
Type of analysis	Narrative description Constant comparison Grounded theory	Numerical estimation Statistical inference
Outcome	A story, an ethnography, a theory	Measurable results
Rhetoric	Informal and detailed descriptions	Formal and neutral
Rigour	Trustworthiness, authenticity. Typicality and transferability.	Internal/external validity, reliability. Generalisability.

**Sources:** Bryman (2012); Babbie (2013); Creswell (2014).

The quantitative research method was used for this research so as to be able to make a comparison between theory and the actual opinions of AA operation employees based on their experiences with regard to LSS. Quantitative research examines the rapport among variables. Variables can be measured so that they can be analysed using statistical procedures/methods (Creswell, 2014). Mchunu (2010) defines quantitative analysis as applying numerical and statistical data to investigate solution to a problem. Quantitative research can be carried out with positive attitude and generalisation of results (Sekaran and Bougie, 2013).

### 3.4. Research paradigm

A paradigm is a point of reference (Chowdhury, 2014) held by researchers of similar interests regarding how the data for certain topics should be collected, analysed and interpreted. There are two most popular paradigms namely; the positivism and interpretivism discussed by scholars. The positivist paradigm which used here is built on August Comte's views on truth and validity. The philosophy seeks to establish facts which are gathered by directly observing and also and measuring the gathered results empirically using statistical methods (Saunders et al., 2013). It

“reflects a deterministic philosophy in which causes probably determine effects or outcomes” (Creswell, 2014:77). Easterby-Smith et al (2012:7) posits that positivists “pursue causality and fundamental laws. At the ontological level, positivists assume that knowledge is objective and that it can be quantified”. Scholar, however, question the appropriateness of this paradigm for social science research (Babbie, 2013).

Another paradigm, which was however not used in the current study, is the interpretivism - associated with qualitative approaches of gathering data due to its emphasis on language as well its subjective nature (Creswell, 2014). The focus of the researcher in this paradigm is to understand the sense and understanding of “social actors” (those being researched) from their own perspective (Saunders et al., 2013).

Understanding positivism as a theoretical framework was important since it was the researcher’s conviction that business studies can be considered a social science.

Table 3.2 below shows that there are opposing views on the aims and validity of scientific research between the two paradigms underlying quantitative and qualitative research.

**Table 3.2: Paradigms associated with quantitative and qualitative research**

Characteristic	Quantitative Research	Qualitative Research
Research objective	<ul style="list-style-type: none"> <li>▪ Explanation and prediction</li> <li>▪ Confirmation and validation</li> <li>▪ Theory testing</li> </ul>	<ul style="list-style-type: none"> <li>▪ Description and explanation</li> <li>▪ Exploration and interpretation</li> <li>▪ Theory building</li> </ul>
Research process	<ul style="list-style-type: none"> <li>▪ Focused, Known variables</li> <li>▪ Context-free, Detached view</li> </ul>	<ul style="list-style-type: none"> <li>▪ Holistic, Unknown variables</li> <li>▪ Context-bound, Personal view</li> </ul>
Data Analysis	<ul style="list-style-type: none"> <li>▪ Deductive reasoning, Descriptive and inferential statistics</li> </ul>	<ul style="list-style-type: none"> <li>▪ Inductive reasoning, Identification of major themes</li> </ul>
How findings are communicated	<ul style="list-style-type: none"> <li>▪ Numbers, statistics</li> <li>▪ Scientific style</li> </ul>	<ul style="list-style-type: none"> <li>▪ Words, narratives</li> <li>▪ Literary style</li> </ul>
Advantage	<ul style="list-style-type: none"> <li>▪ Large sample, statistical validity</li> </ul>	<ul style="list-style-type: none"> <li>▪ Rich, in depth, narrative description of sample</li> </ul>
Disadvantage	<ul style="list-style-type: none"> <li>▪ Abstract comprehension of participants’ thoughts and feelings</li> </ul>	<ul style="list-style-type: none"> <li>▪ Small sample, not generalizable to the population at large.</li> </ul>

Leedy and Ormrod (2015),

For this study, the method of research that was used was quantitative. The reason was that the method would satisfy the objectives, research questions as well as the research design as outlined in the first chapter.

### **3.5. Study setting**

Associated Additives (AA) is ZIMCO group division plant and distributor of specialty chemicals in Jacobs, in Durban. AA has been in operation since 1954. AA is a labour intensive manufacturing plant with highly batch production processes. Implementing the LSS in the organisation is currently expensive with respect to costs of training, development and deployment. However, it is a rigorous and systematic process to enhance competitive advantage, new processes, products or services design. Although the lean six sigma methodology process does exist at a limited scale within the company, it is currently being evaluated to determine whether it is appropriate (suitable and acceptable) for the organisation, taking into account its impact and the benefits on the operations strategic objectives, profits, costs and productivity.

### **3.6. Population and sample of the study**

A sample is a section of a population – the rest of the units from which the sample is taken from (Bryman, 2012). Sekaran and Bougie (2014) opine that the task of making out a correct sample size from a population is often very complex. This is usually because the value of the sample is normally linked to the statistical power of the test. The decision of the sample size is influenced by nature of the study being conducted. The objectives of the study, the characteristics of the population as well the method of data analysis to be used have also an important influence. Scholars such as Bryman (2012) argue that the sample size for a study may also depend on the size of the population and the tolerable margin of error. Table 3.3 below is recommended for sample size selection (Leedy and Ormond ,2015).

**Table 3.3: Sample size selection table**

<b>Population Size</b>	<b>Sample Size</b>
Small population < 100	Use entire population
Approximately 500	250 (50%)
Approximately 1 500	300 (20%)
Large population > 5 000	400

Leedy and Ormond (2015:207).

There was a total of 62 employees in total within the case study division – the AA. These employees included operators of machinery, some supervisory as well as management. Considering that there were only 62 employees which is less than 100, scholars such as Leedy and Ormond (2015) commend that the entire population should be used as a sample (Table 3.3). A survey was conducted to collect the data.

### **3.7. Sampling method**

According to Babbie (2013) is a research process that allows researcher to select a portion of units (or) people from the larger collection (population) in order to meet the requirements of their study. It is not always possible for researcher to study the whole population. This is only possible where the population is very small, for example, as was the case in this study. However, where the population is larger, researcher may not be able to include all units for a number of reasons including time challenges and issues of budget (Sekaran and Bougie, 2014). It is for these reasons that researcher will therefore settle for a sample. Scholars like Creswell (2014) advise researcher to provide clear and inclusive definition of what their samples constitute in order to avoid making glossa mistakes that will invalidate their work. This is because, as Babbie (2013) posits, the sample quality has an important and lasting bearing on the nature of the results that will be gathered by a study. The population of the study was only 62 and hence all employees were considered for the study.

### 3.8. Construction of the Instrument

According to Babbie (2013), a questionnaire is a collection of question items that are asked to different participants in order to obtain information on specific issues. Sekaran and Bougie (2014) therefore advise that when developing a questionnaire, researcher need to ensure that the questionnaire is written in languages understood by interviewees and that they need to be comprised of clear questions. A question needs to have a clear and clean structure that can be followed by those who are taking part in the study. This is not only good for participants, but could also assist researchers themselves during data analysis. A well-developed questionnaire is easy to analyse. Flick (2014) posits that a good questionnaire is one that is concise, short, specific and has easily logical items and coherent questions.

The structure for the questionnaire that was used in this study is summarised in Table: 3.4 below. The sample questionnaire is attached as Appendix 1.

**Table 3.4: Structing of question items in the questionnaire**

<b>Section</b>	<b>Category</b>	<b>Questions</b>
Section A	LSS impact on Quality at AA	A1 to A3
Section B: <b>RQ 1</b>	LSS impact on Costs at AA	B1 to B3
Section C: <b>RQ 2</b>	LSS impact on Productivity at AA	C1 to C3
Section D: <b>RQ 3</b>	LSS impact on Customer at AA	D1 to D3
Section E: <b>RQ 4</b>	LSS level of importance and commitment within AA	E1 to E6

### 3.9. Data collection

The data of the study was collected through the use of the questionnaire has already detailed above. The collection of the data took about a month. The questionnaire was sent to all employees for completion. Completed questionnaires would be sent back. The duration of one

full month was considered as enough for all employees to participate at their own pace. However, as indicated, only a total of 48 questionnaires were completed. The advantages of the questionnaires were that they allowed participants to take part away from the researcher who, by his presence, would probably make them present certain responses in order to please the researcher who also happen to be the managing director in the same organisation. the questionnaire also made it easier to analyse the data. In addition, the questionnaire was short and precise.

### **3.10. Data analysis**

Data analysis is the procedure whereby researchers gain an understanding of the information they will have collected during fieldwork (Sekaran and Bougie, 2014). In data collection, information is usually scattered across the many different instruments that the researcher will have made use of. The analysis process therefore gives the researcher an opportunity to make sense of the data and also to present it (Creswell, 2014). The analysis of quantitative data is very important as it allows the researcher discern the link between variables using evocative and inferential statistics (Babbie, 2013). By use of descriptive statistics, the researcher was able to quickly observe information such as frequencies, percentages, means and standard deviations. Inferential statistics on the other hand afforded the researcher to go deeper and to summarise all information in the descriptive statistics (Saunders et al. 2013).

In this study, the data was analysed using SPSS in order to generate accurate results. Kolmogorov-Smirnov test was used for analysis trying to determine if two datasets differ significantly.

### **3.11. Reliability and validity**

Marr-Lyon et al (2013) posit that reliability relates to the consistency that is achieved by a research instrument when it is used in different studies. An instrument that is considered reliable is one that produces analogous results every time. In the current study, reliability was estimated by use of the Cronbach's Alpha coefficient.

internal consistency was estimated by combining statements the stressed similar themes in the questionnaire (Tavakol and Dennick, 2011). These reliable estimates are factor analysis, generalisability theory, item-response theory, half-split techniques and Cronbach “alpha index.

Tavakol and Dennick (2011) promote the Cronbach alpha coefficient named after by Lee Cronbach as the most reliable measure of internal consistency. A similar view is shared by Gliem and Gliem (2003) who advocate the use of Cronbach alpha to report internal consistency when using Likert type scale. Marr-Lyon et al, (2013) describe Cronbach’s alpha as the accurate estimation of reliability. The Cronbach alpha as defined by Tavakol and Dennick (2011) is expressed as a number between 0 and 1 covering the different acceptability ranges as reported in Table 3.5.

**Table 3.5: Cronbach acceptability ranges**

Alpha > 0.9	Excellent
0.7 < Alpha < 0.9	Good
0.6 < Alpha < 0.7	Satisfactory
0.5 < Alpha < 0.6	Poor
Alpha < 0.5	unacceptable

**Source:** Gliem and Gliem (2003)

The reliability of this research was determined using Cronbach’s alpha, due to the following reasons:

- Most reliable measure of internal consistency for social sciences or business research.
- Research questions in a questionnaire are grouped in a set of 4 questions per objective (making it easier to measure reliability as questions measure the same theme).
- The questions had a Likert-scale as recommended by Gliem and Gliem (2003)

Validity is the confirmation that the study measures what it intended to measure and reliability is measure through recurrence of study results over a period of time (Wood, et al., 2008). Validity strengthens the research conclusions, inferences and propositions. Tavakol and Dennick (2011) defined additional types of validity generally tested in social research:

- Ending validity which explores the relationship between the two variables.

- Internal validity that explores the causal relationship.
- Construct validity, difficult to understand as it seeks to generalise.
- External validity which is the capability to apply the result of the research to general settings.

### **3.12. Elimination of Bias**

The bias in the current work included that the questionnaire that used was built on the supposition that AA operation employees were much more in a position to understand the topic on LSS, hence their answers would be more accurate to questions asked. This bias was eliminated through checking up such assumptions with the participants of the study themselves. The researcher also extensively engaged with available literature in order to reduce the impact of bias. In addition, the researcher continuously engaged with the study supervisor who actively provided advise on how bias could be overcome. The researcher also actively engaged fellow students in order to get assistance on how bias could be eliminated.

### **3.13. Ethical considerations**

Ethical clearance certificate was obtained from UKZN ethics committee and that was prior to the data collection (see Appendix 2). Ethical conduct of this research study was of importance and the researcher upheld the privacy, confidentiality, informed consent and anonymity of the participants. The purpose and intentions of the study were declared to the participants, so that they could make an informed decision on participating or not. The explanation and the goal of the study were shared with the participants so that they could choose to participate or not.

The information that was used from participants is protected and it will not be harm in any way be it physically or otherwise. The participant's names, responses and other relevant individual details as part of right to privacy are fully protected. Lastly the information gathered is kept on a lockable place for privacy.

### **3.14. Chapter Summary**

In this chapter, the researcher presented the methodology that was used in the study. The nature of the research, as indicated in the introductory chapter required that the quantitative research methodology be used in a descriptive and exploratory design. Due to the need for a research instrument that would bring about the results that would answer the various question of the study, the questionnaire was deemed as the most suitable instrument. This instrument allowed for easy data analysis was which conducted using the SPSS system. It was the researcher's view that considering the methods adopted, data was reliable and therefore valid to make overall statements about the AA as an organisation.

The presentation of results follows next.

## CHAPTER FOUR: DATA PRESENTATION

### 4.1. Introduction

After collecting data, researchers need to make the data sensible and then present it in simple formats for others to see and access. In the current chapter, using Tables and Figures, the researcher presents the data that was collected using the questionnaires as detailed in chapter three. Data is presented in form of percentages and the actual numbers of employees in some instances. The chapter is divided into three major sections namely; the introduction, results and chapter summary.

### 4.2. Results

A total of 48 participants out of the 62 employees who made the population took part in the study. The Cronbach's Alpha value was 0.811 which implies that the data would be reliable (see Table 4.1).

- **Reliability Analysis**

**Table 4.1: Reliability Analysis Output**

Reliability analysis	
Cronbach's Alpha	N of Items
.811	18

**Figure 4.1: Quality Level**

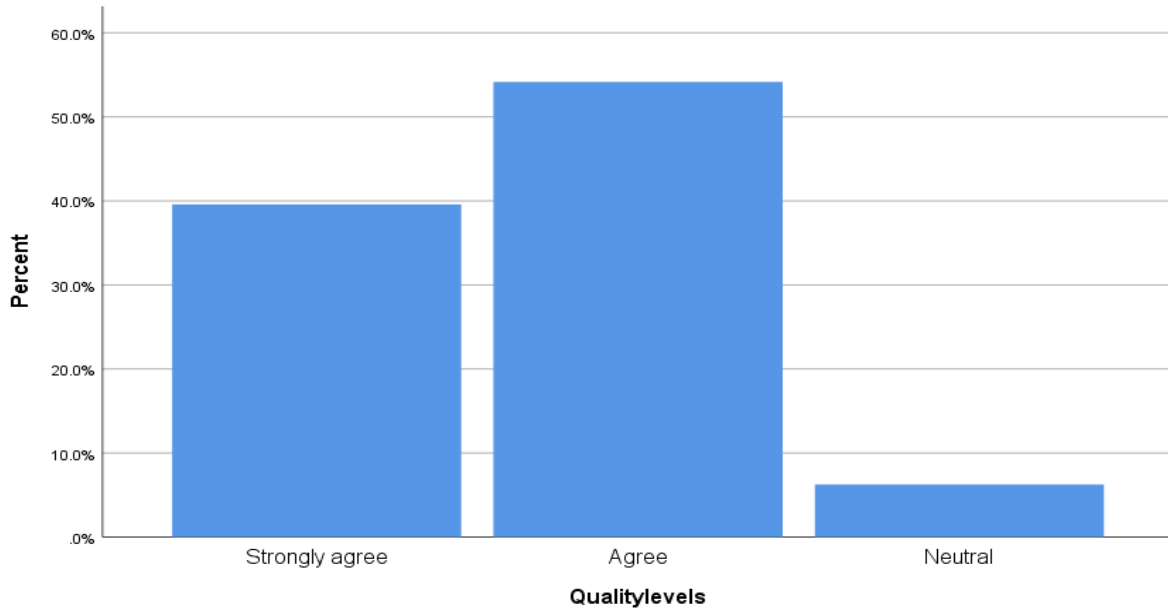
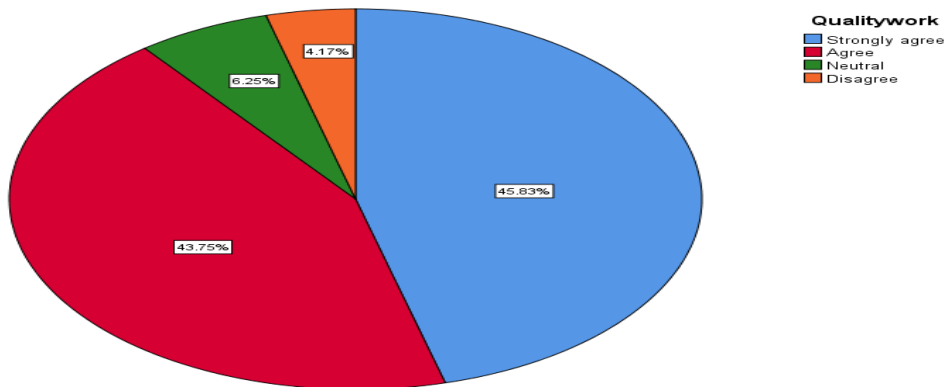


Figure 4.1 above shows that most of the participants positively responded about the quality level (94%).

- **Quality of work**

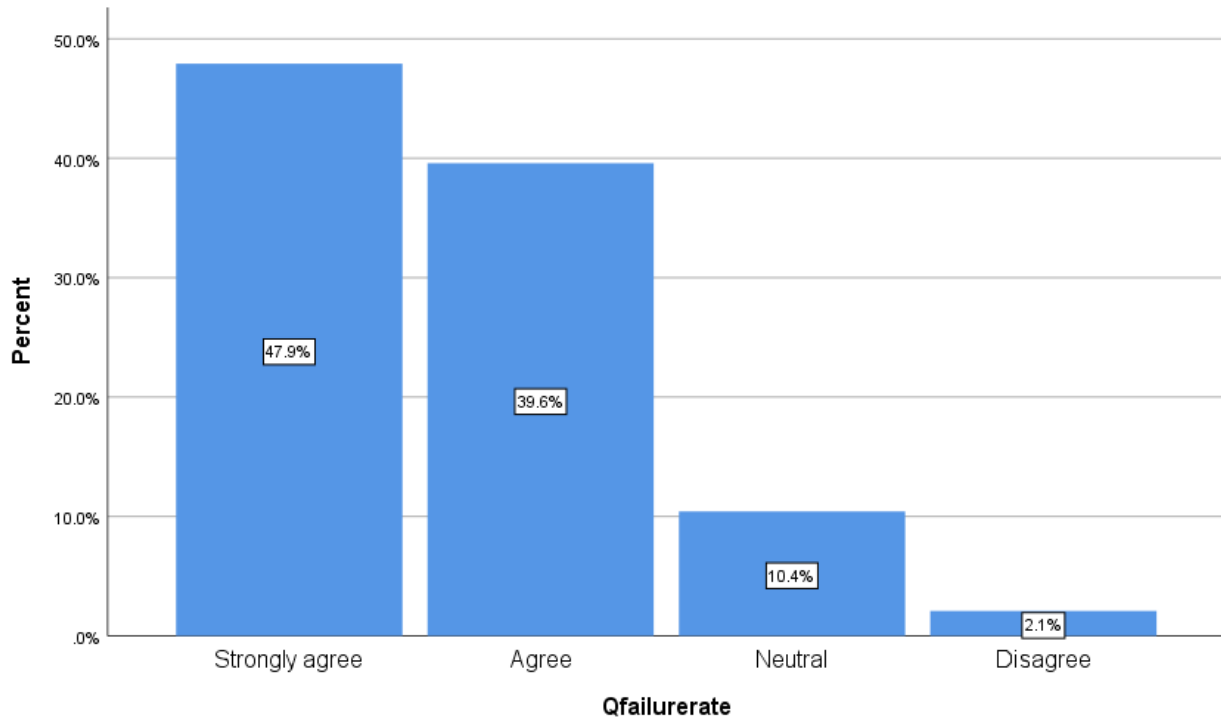
Regarding quality of work, 90% of the participants agreed or strongly agreed to it (Fig 4.2).

**Figure 4.2: Quality of Work**



- **Failure rate**

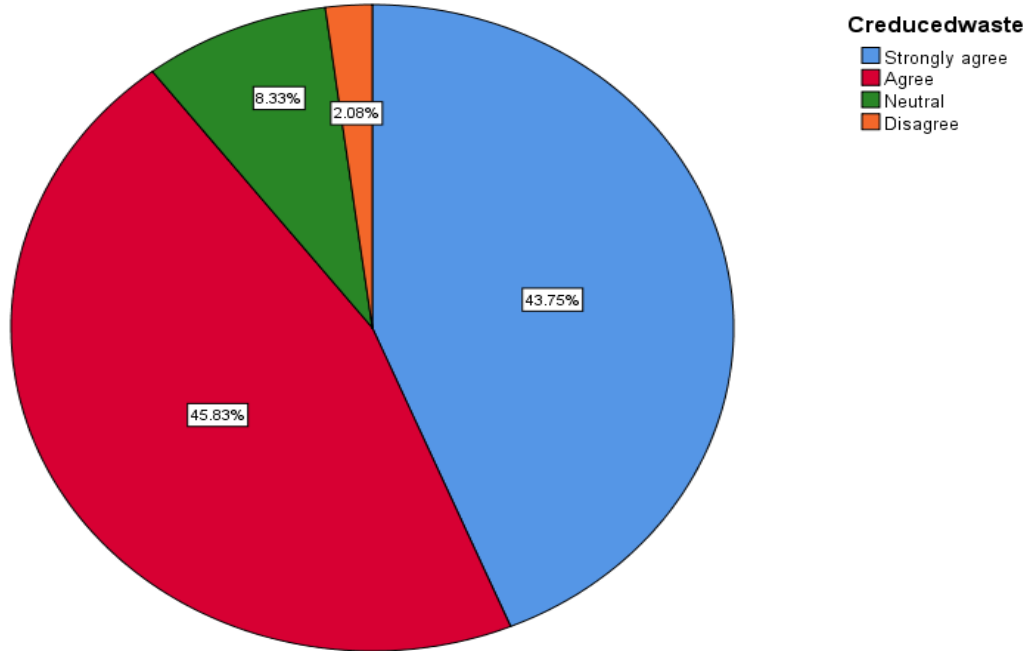
**Figure 4.3: Failure Rate**



Results showed that 48% of the participants strongly agreed about the failure rate (Figure 4.3). Another 39.6 simply agreed, 10.4% remained neutral while about 2.1% disagreed.

- **Waste Reduction**

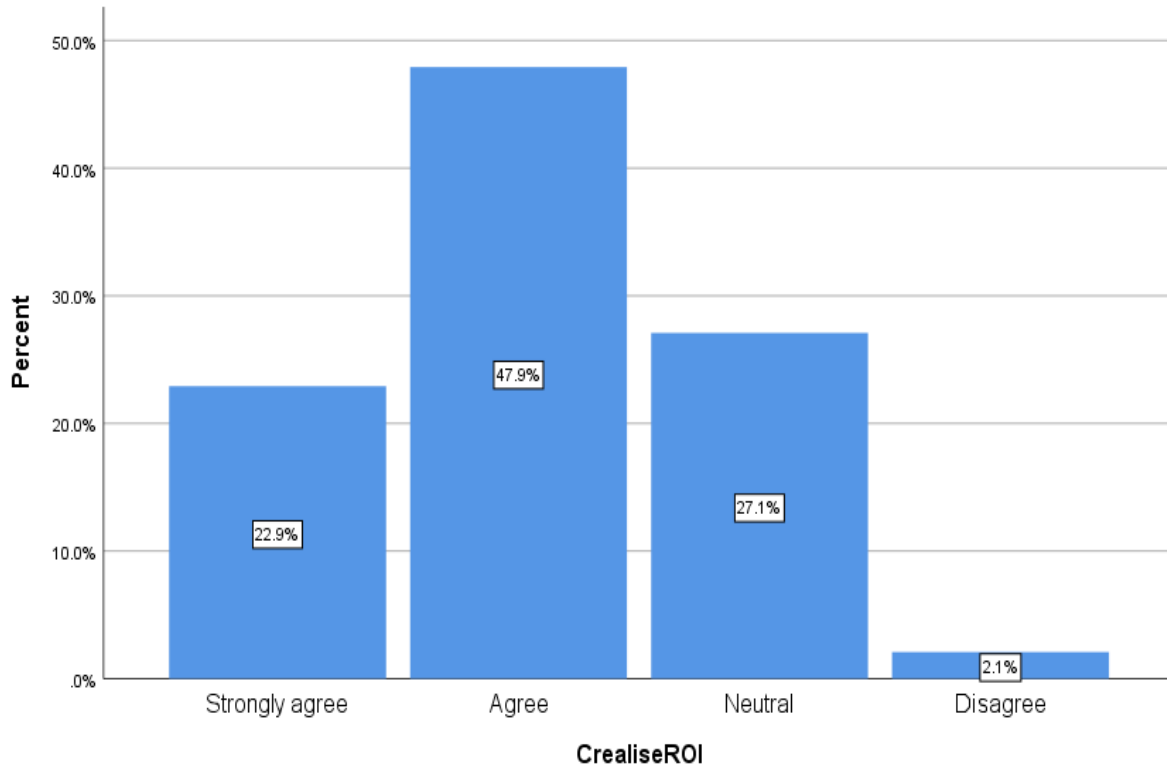
**Figure 4.4: Reduce Waste**



Most of the participants positively reported about the waste reduction (90%). A total of 43.75% strongly agreed, 45.83% agreed, 8.33% remained neutral while only 2.08% disagreed.

- **ROI Realisation**

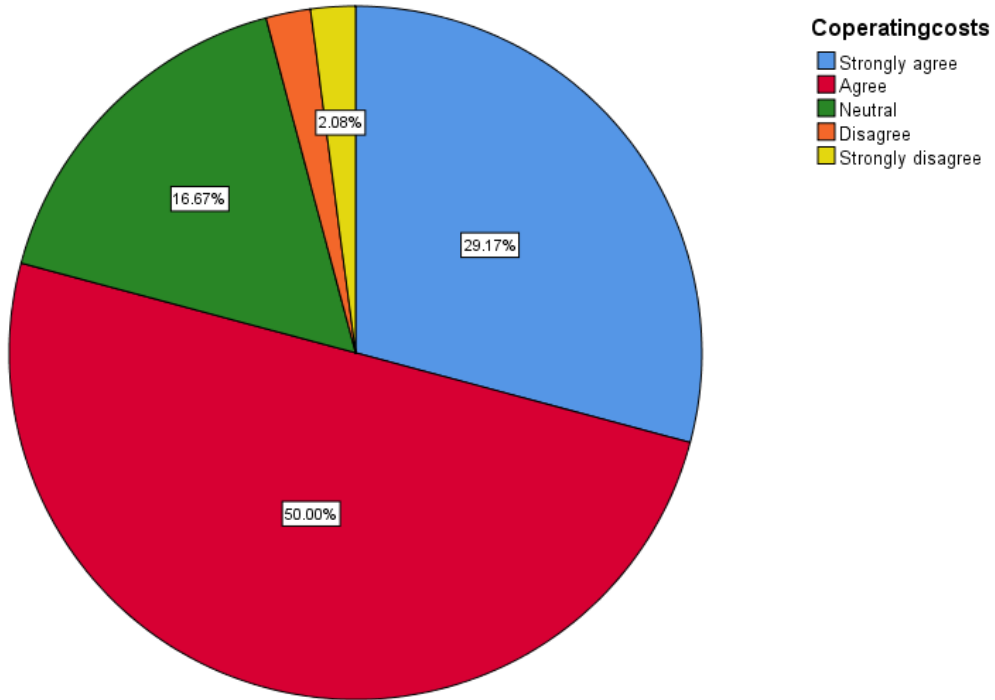
**Figure 4.5: Realisation of ROI**



About three-quarter of the participants (71%) agreed or strongly agreed about realisation of ROI. A total of 22.9% strongly agreed, 47.9% agreed, 27.1% remained neutral while 2.1% disagreed.

- **Operation Cost**

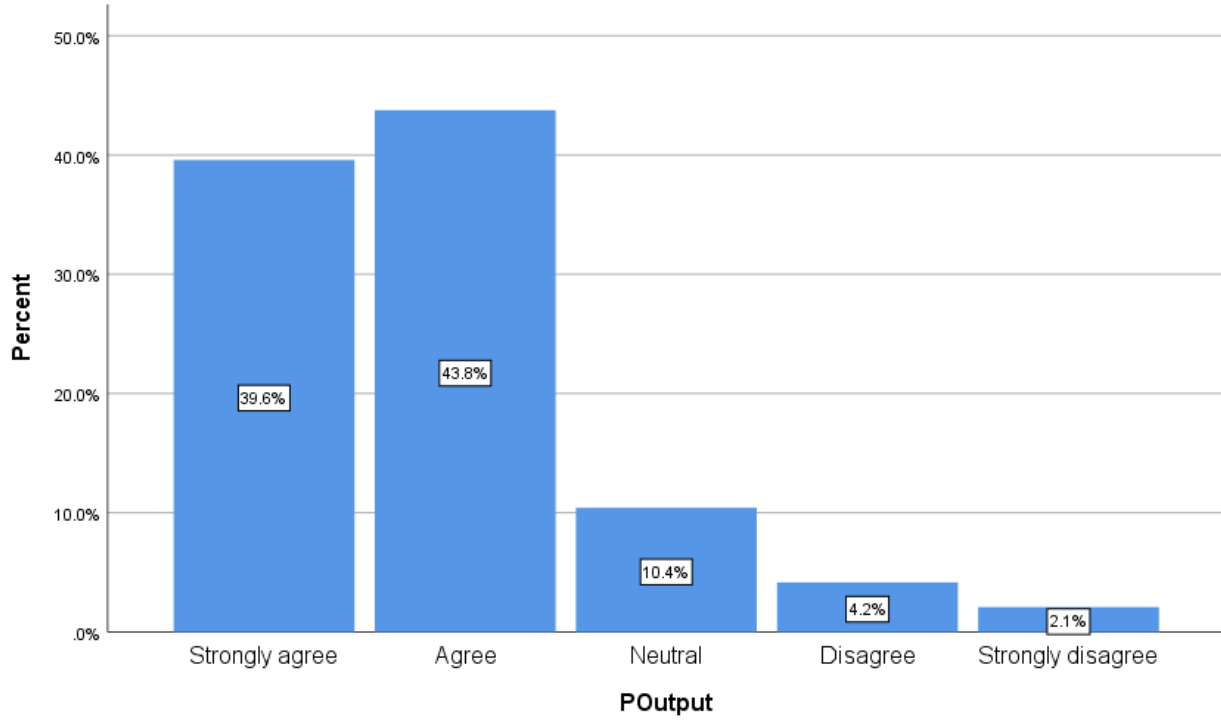
**Figure 4.6: Operating Cost**



It was found that 29% of the participants strongly agreed about the operating cost. A total of 29.17% strongly agreed, 50% agreed, 16.67 remained neutral, 2.08% disagreed while another 2.08 strongly disagreed.

- **Output**

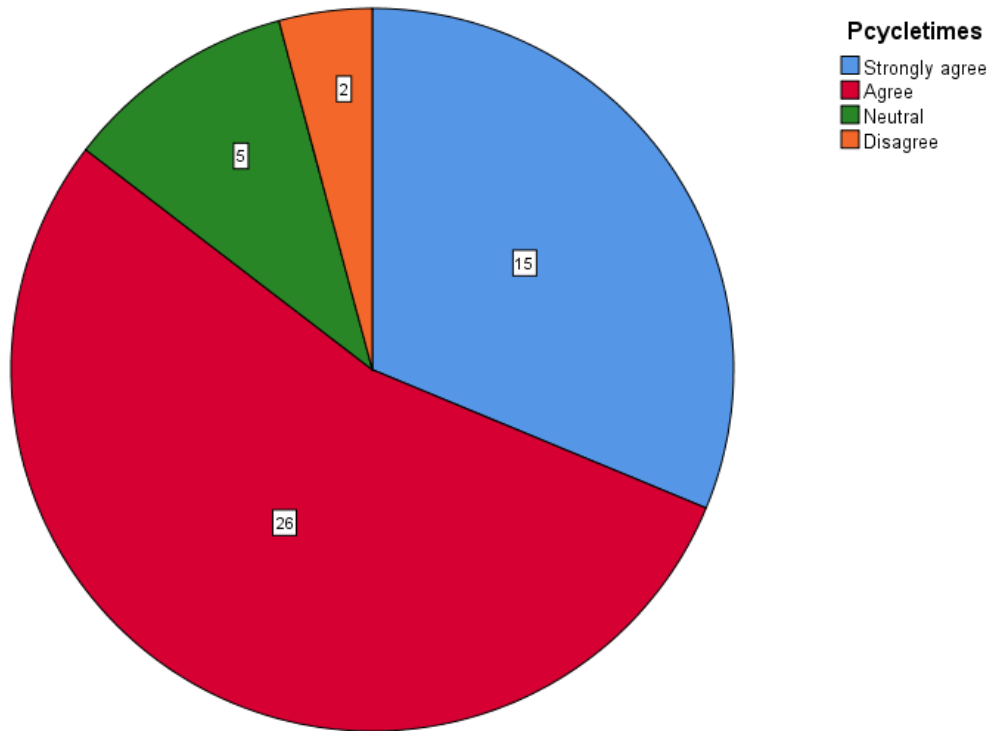
**Figure 4.7: Output details**



A total of 36.6% strongly agreed that the output was good, 43.8% simply agreed while 10.4% were neutral. Only about 4.2% disagreed while another 2.1% strongly disagreed.

- **Cycle Times**

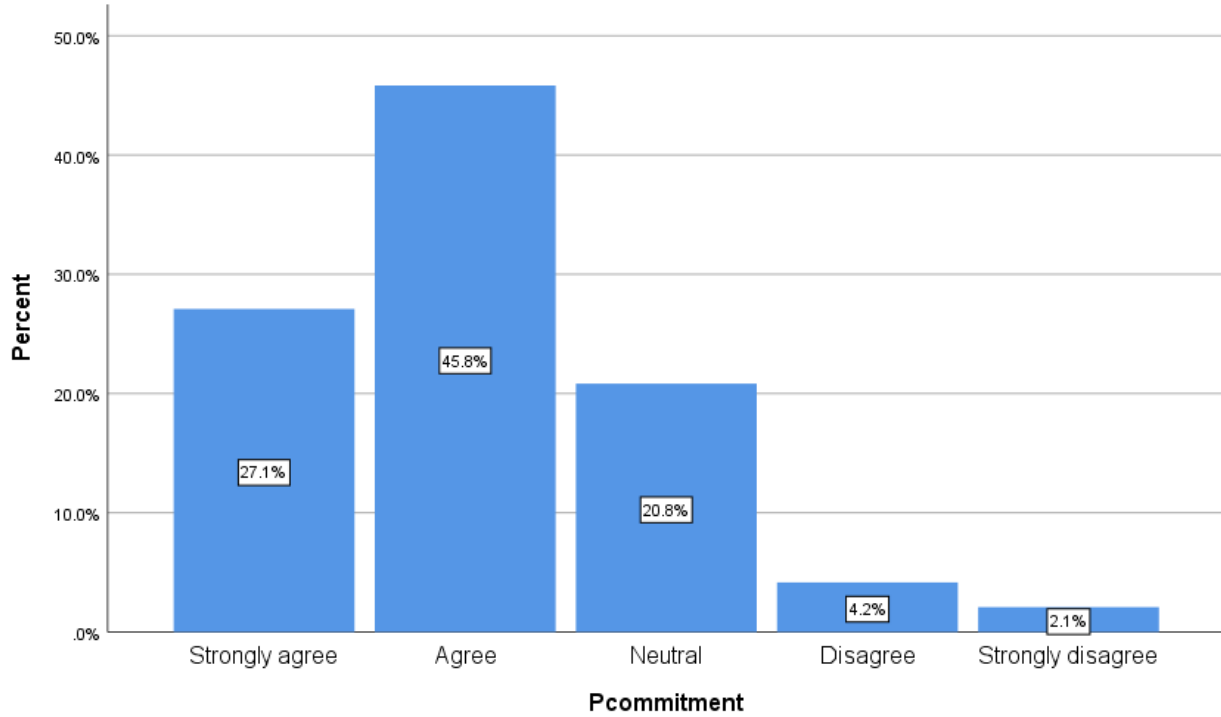
**Figure 4.8: Cycle Times**



Regarding cycle times, about a third (31%) strongly agreed to it.

- **Commitment**

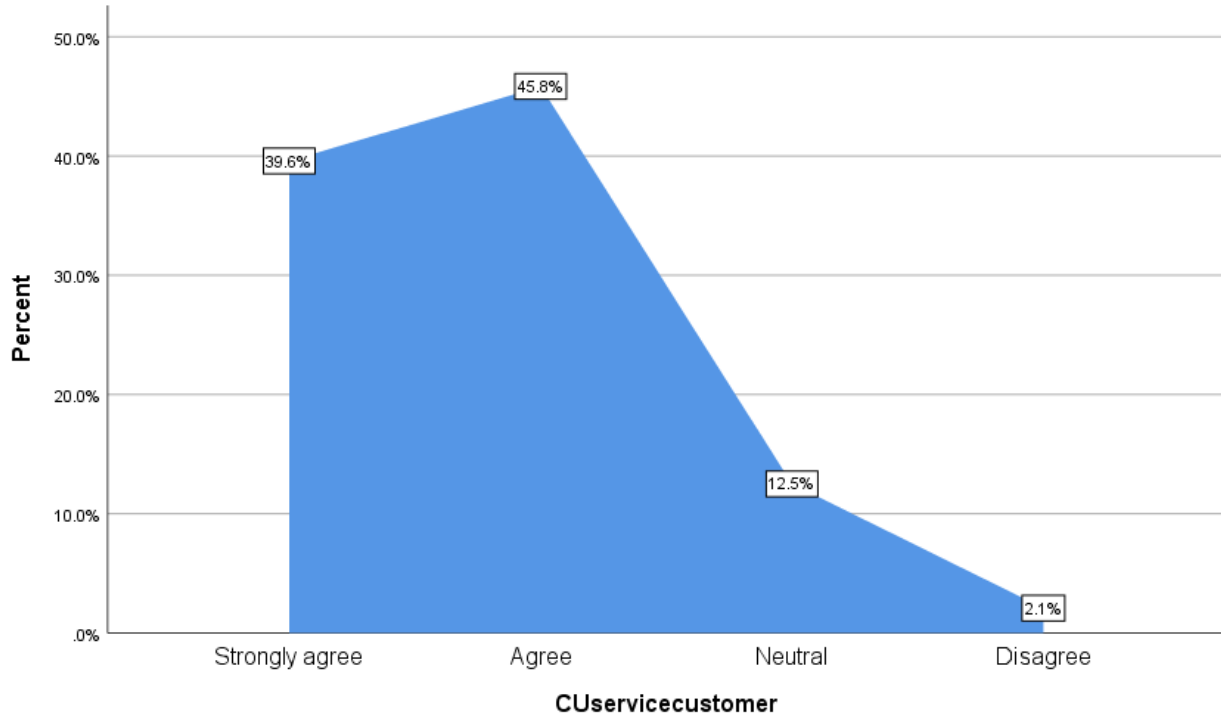
**Figure 4.9: Commitment**



For commitment, 46% of the participants agreed to it and 27% strongly agreed to it. About 27.1% strongly agreed while 2.1% strongly disagreed. A total of 20.8% remained neutral.

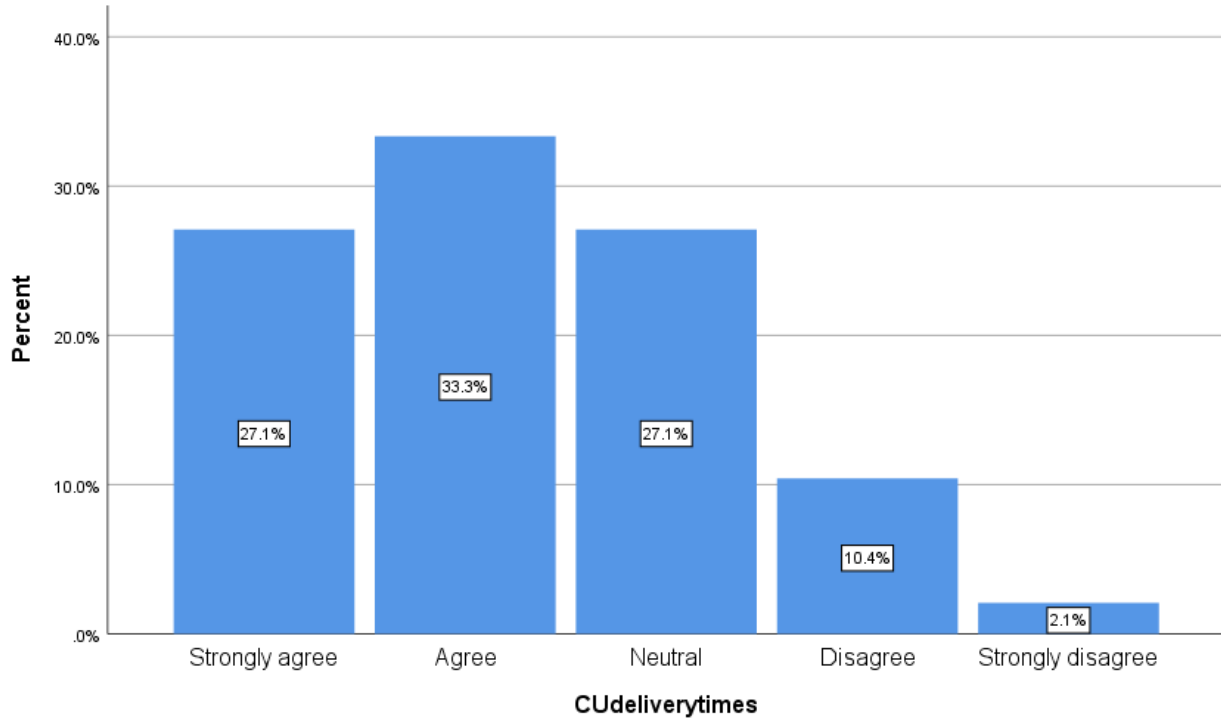
- **Customer Service**

**Figure 4.10: Customer Service**



A total of 39.6% of the participants strongly agreed, 45.8% simply agreed, 1.5% remained neutral while only 2.1% disagreed.

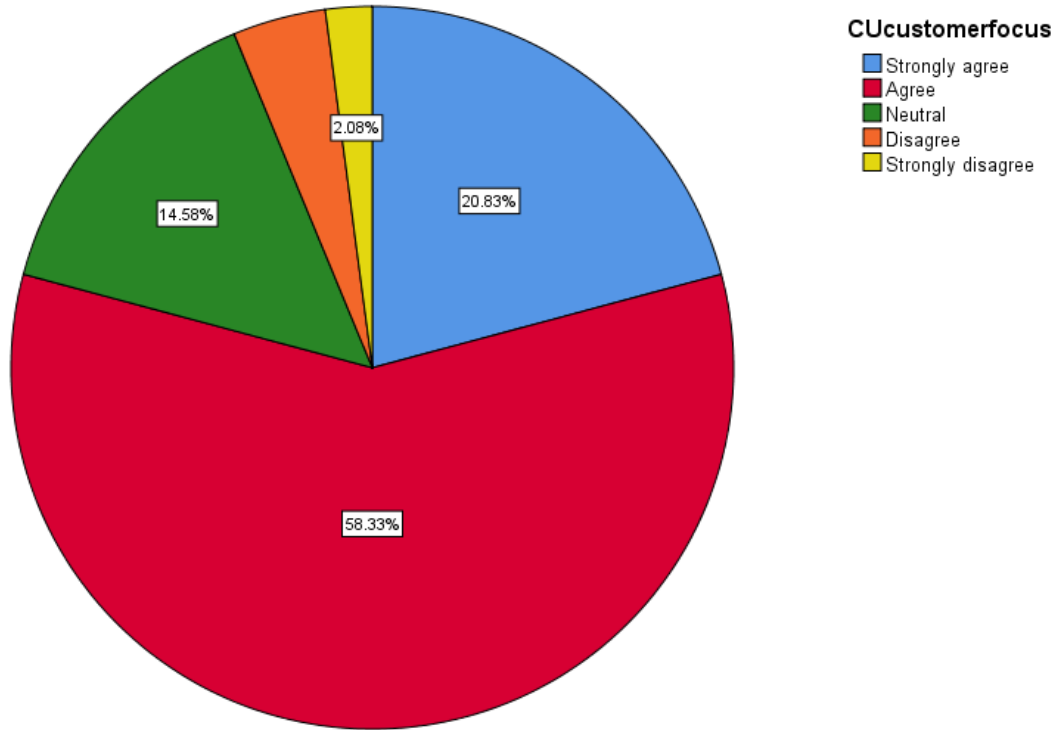
- **Delivery times**



Regarding delivery times, 27.1% strongly agreed, 33.3% agreed, 27.1% remained neutral while 10.4%. Another 2.1% strongly disagreed.

- Customer focus

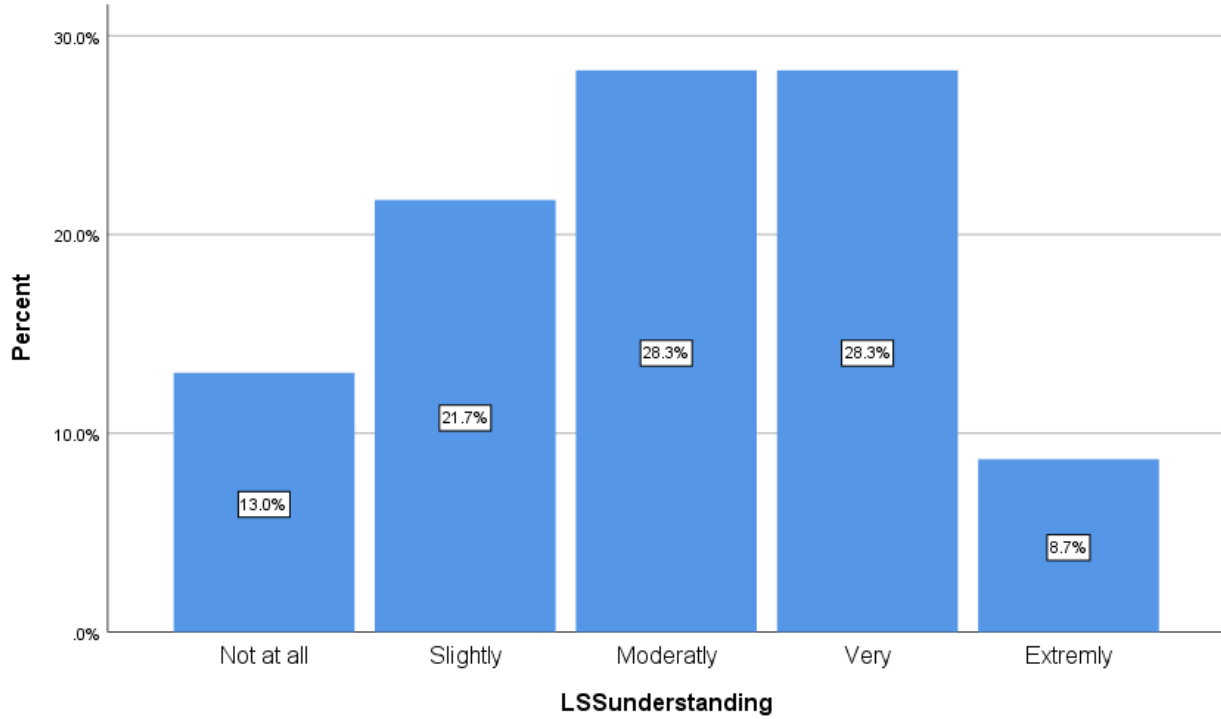
Figure 4.12: Customer Focus



A total of 20.83% strongly agreed that there was customer focus, a staggering 58.33% simply agreed while 14.58% remained neutral. Only a total of 2.08% disagreed.

- **Understanding**

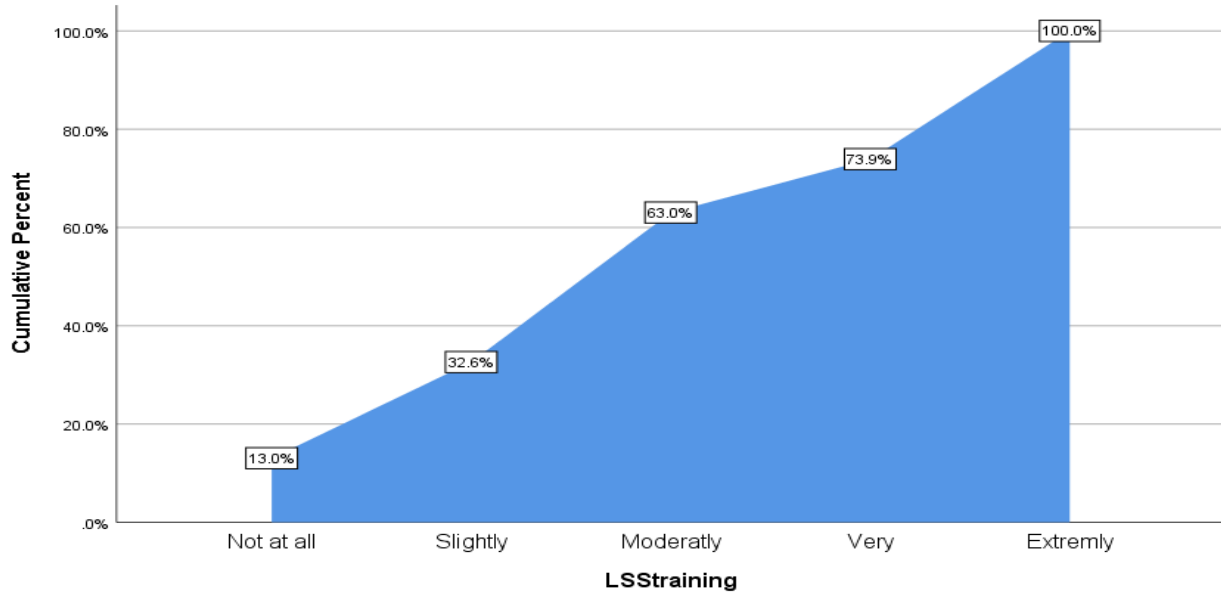
**Figure 4.13: Understanding**



Regarding LSS understanding, 13% indicated that not all actors understood, 21.7% only slightly understood while 28.3% moderately understood. A total of 28.3% indicated they understood very well while 8.7% extremely understood.

- **LSS training**

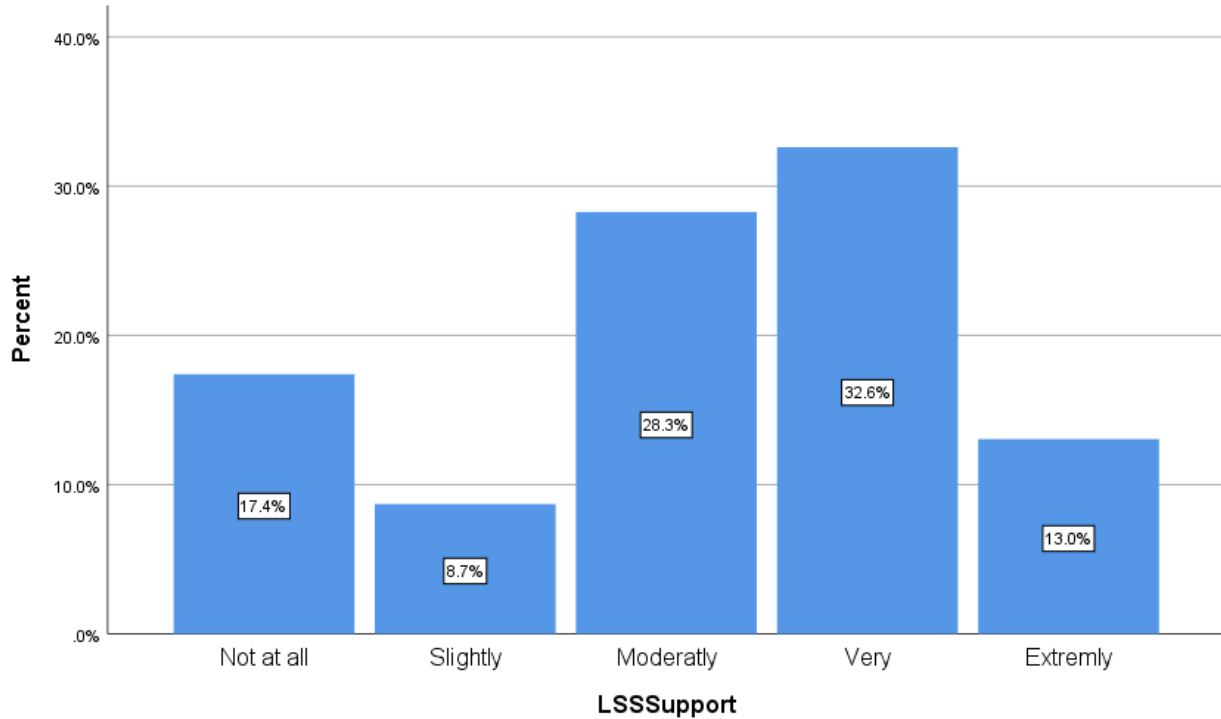
**Figure 4.14: Training**



Results showed a total of 13% reported that LSS training was not available at all, 32.6% slightly agreed that there was some LSS training in the organisation, 63% thought training was moderate while 73.9% thought it was well-done

- **Support**

**Figure 4.15: Support**



For LSS support, 17.4% of the participants indicated that it was not available at all while 13% mentioned that it is extremely available. Only about 8.7% of the participants indicated that there was slight support. A staggering total of 28.3% reported that support was only moderate while 32.6% mentioned that there was enough support. These mixed views by participants indicate that not all employees re on board at the AA with regard to the adoption of the LSS.

- Resources

**Figure 4.16: Resources**

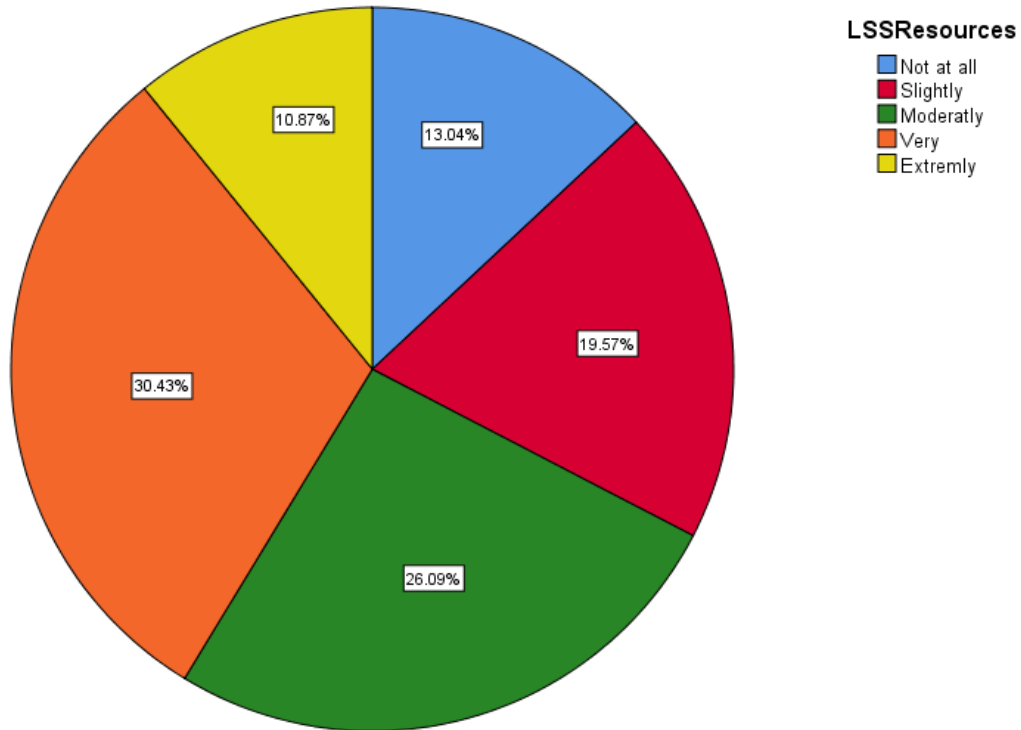
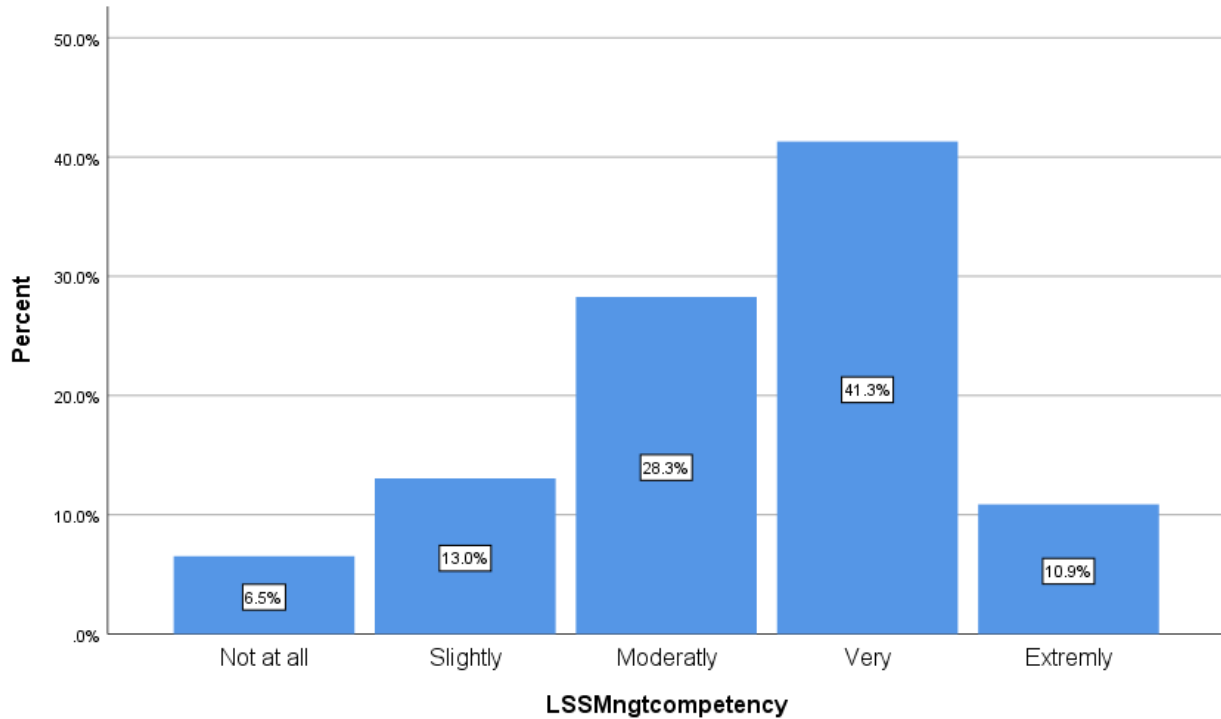


Figure 4.16 shows that a total of 13.4% reported that they were not being provided with enough resources to make a meaningful contribution towards the realisation of the LSS, 19.57% indicated that although they were provided with resources, the resources were not enough while 13.4% mentioned that there were no resources provided at all. A total of 26.9% indicated that resources were moderate, 19.57% reported that the provision of resources was very good while 10.87% mentioned that the provision was extremely good.

- **Management Competency**

**Figure 4.17: Management Competency**



Regarding management competency, 6.5% indicate that management was not competent, 13% reported that management was slightly competent, 28.3% revealed that it was only moderate while 41.3% mentioned that management was very competent. A further total of 10.9% indicated that management was extremely competent.

**Figure 4.18: Management Interest**

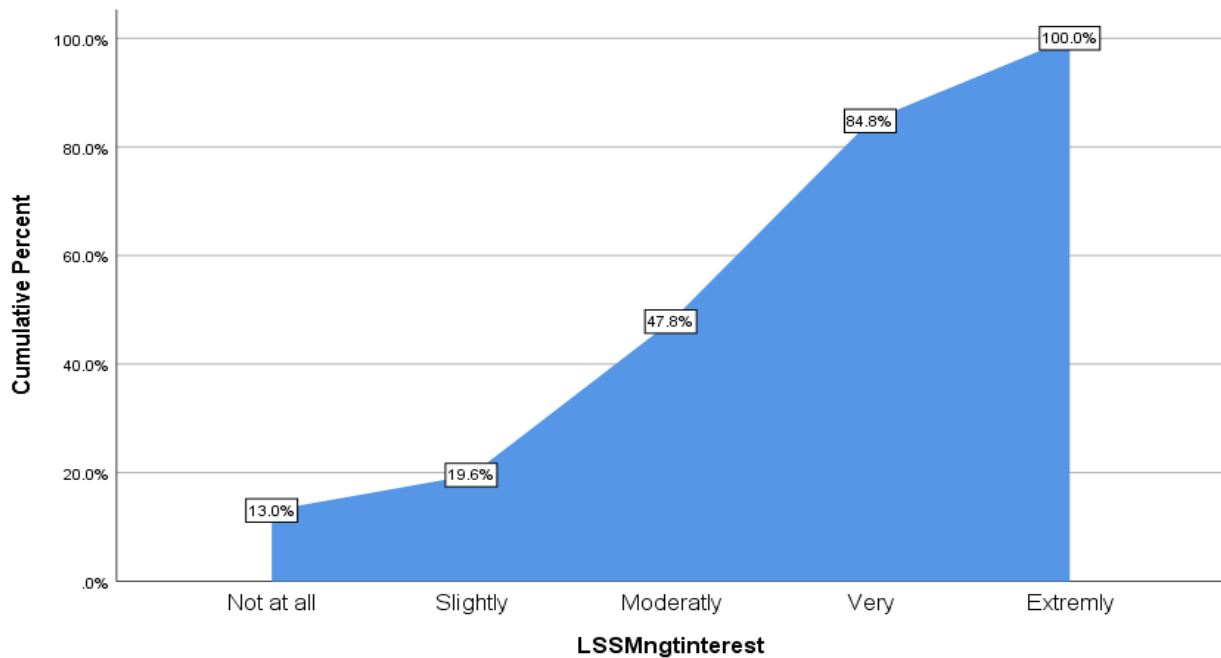


Figure 4.18 reveals that 13% of the participants viewed management as lacking an interest in LSS, 19.6% reported that management showed a partial interest in LSS while 47.8% reported that the interest of management was moderate. A staggering total of 84.8% however reported that management showed much interest in LSS.

For further analysis, all the scores for each of the constructs were added to get the overall scores. The scores were afterwards tested for normality (Kolmogorov-Smirnov test). The normality test showed that the overall scores were not normally distributed. Therefore, Spearman rank correlation test was conducted to determine the relationship among the constructs.

**Table 4.2: Test of normality output**

	Kolmogorov-Smirnov <sup>a</sup>		
	Statistic	df	Sig.
Section A	.166	46	.003
Section B	.136	46	.032
Section C	.207	46	.000

Section D	.141	46	.023
Section E	.099	46	.045

\*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

The correlation test showed that section A was significantly moderately positively correlated with all other constructs except section E which was negatively correlated with section A ( $p < 0.05$ ).

**Table 4.3: Correlation test output**

			Section A	Section B	Section C	Section D	Section E
Spearman's rho	section A	Correlation Coefficient	1.000	.601**	.683**	.613**	-.306*
		Sig. (2-tailed)	.	.000	.000	.000	.039
		N	48	48	48	48	46
	section B	Correlation Coefficient	.601**	1.000	.663**	.692**	-.092
		Sig. (2-tailed)	.000	.	.000	.000	.542
		N	48	48	48	48	46
	section C	Correlation Coefficient	.683**	.663**	1.000	.657**	-.136
		Sig. (2-tailed)	.000	.000	.	.000	.369
		N	48	48	48	48	46
	section D	Correlation Coefficient	.613**	.692**	.657**	1.000	-.154
		Sig. (2-tailed)	.000	.000	.000	.	.308
		N	48	48	48	48	46
	section E	Correlation Coefficient	-.306*	-.092	-.136	-.154	1.000
		Sig. (2-tailed)	.039	.542	.369	.308	.
		N	46	46	46	46	46
**. Correlation is significant at the 0.01 level (2-tailed).							
*. Correlation is significant at the 0.05 level (2-tailed).							

### **4.3. Chapter Summary**

The current chapter presented the results that were gathered for the study using the research methodology presented in Chapter Three. The results have been presented in the order of the research questionnaire that was used. Graphs and tables have been used in order to summarise the results.

The next chapter makes a discussion of the results presented in this chapter.

## **CHAPTER FIVE: DISCUSSION OF RESULTS**

### **5.1. Introduction**

This chapter focuses on discussing all the data that was presented in the previous chapter. The aim to try and make sense of the data that was presented and also to make explanations on why certain data emerges as it is. The overall appearance of the data indicates that there are mixed views and perceptions within the AA in terms of the implementation of the LSS. While other participants indicated that the methodology gained inroads in the division, there were others who associated it with various challenges particularly those linked to lack of training on the part of employees as well as management's lack of commitment in the implementation of the methodology. The chapter discussed the impact of LSS on work quality, quality of products and many other items as presented in chapter four.

### **5.2. The LSS and Quality Levels**

The participants of the study revealed that the LSS had the potential to improve the quality levels of operations. Figure 4.1 shows that 39% of the participants strongly agreed, 54% simply agreed while 5% remained neutral. The view of participants in the AA organisation concur with reviewed literature where it was found that the LSS could improve business and also maximise organisational effectiveness by improving speed, reducing costs, meeting customer needs, and so forth (Gelei et al., 2015; Gershon and Rajashekharaiyah, 2011). This is one of the most important aims of the LSS as it seeks to achieve high quality levels by integrating tools and principles from both Lean and the SS. After all, the LSS was initially devised to improve manufacturing quality through the reduction, and possibly alleviation of waste. In this view, it is therefore not surprising that employees in the AA organisation confirmed that the LSS has the capacity to improve the quality of level in this institution.

### **5.3. LSS and the Quality of Work**

The quality level also comes with the quality of work itself. A target on high quality levels eventually enables the organisation to diminish the process hiccups, and thus improve quality of

products and services. In the study, a total of 45.83% of the participants strongly agreed that the successful implementation of the LSS improved the quality of work. Another 43.75% simply agreed while only 4.17% disagreed (see Figure 4.2). This indicates that the majority of participants agreed. As an organisation starts to prioritise high quality levels, it will then start to seek continuous improvement (Jeyaraman and Teo, 2010). The purpose of the LSS itself is to drive improvements in quality of products, services and processes. The LSS methodology thus requires an organisation to put unswerving efforts so as to be able to remain relevant and profitable in a highly changing business world characterised by evolving customer needs. This will then ensure that wastages during production and the defection of products during manufacture.

#### **5.4. Failure Rate in the Implementation of the LSS**

The study also sought to understand the success of the implementation of the LSS in the organisation. Figure 4.3 reveals that a total of 49.7% of the participants strongly reported that the LSS failed to bring about the anticipated results in the AA organisation. Another 39.6% simply agreed that indeed the LSS faced challenges, and therefore failed to bring about the results as would be expected. Only a total of 2.1% thought the LSS was very successful in the organisation while the other 10.4% remained neutral. There however might be many issues resulting in the failure rate of successfully adopting the LSS mechanism in the organisation needs to be supported by all actors in the organisation for it to bring about the much-needed change (Laureani and Antony, 2015). Both management and employees must stand together and ensure that each of them makes a contribution that can result in the success realisation of the mechanism. In working together, stakeholders will be able to lessen cycle times, reduce the number of products that are defective, reduce the instances of equipment failure, and so forth (Maleyeff et al., 2012).

#### **5.5. Waste Reduction**

Figure 4.4 indicates that most of the participants positively reported about the waste reduction (90%). A total of 43.75% strongly agreed, 45.83% agreed, 8.33% remained neutral while only 2.08% disagreed. Indeed, when successfully implemented, the LSS should be able to ensure that

the amount of wastage in organisations is reduced. This was the primary purpose of the strategy. The views of participants in this study was confirmed in the reviewed literature where it was found that, in actual fact, the Lean is a mechanism meant for improving organisational operations so as to be able produce goods faster, better and at reduced costs by eliminating wastages (Ndaita et al., 2015).

## **5.6. Realisation Return on Investment**

Figure 4.5 indicates that about three-quarter of the participants (71%) agreed or strongly agreed about realisation of ROI. A total of 22.9% strongly agreed, 47.9% agreed, 27.1% remained neutral while 21% disagreed. This statistical evidence concurs with reviewed literature which indicated that the LSS is capable of providing a range of benefits outlined below.

- Attain high-level performance in competitive in business through the production of customer satisfactory goods that are not defective (Drohomeretski, et al,2012)
- Improved quality, reduced cycle times and creating value for stakeholders (Rajesh, et al., 2012)
- Culture change, productivity improvement, customer satisfaction, cost reduction and defect reduction (Rathilall and Singh, 2018)
- Improves company overall competitiveness (Chen,Li and Shady,2010)
- Increase revenue, decrease costs, improve efficiency and develop effective people/employees (GoLeanSixma,2012)
- Improves overall performance, reduce costs and reduce errors (Knapp,2015)

In the view of the above, the views of the participants with regard to ROI in the AA are justifiable.

## **5.7. Operating Cost**

Figure 4.6 reveals that 29% of the participants strongly agreed about the operating cost. A total of 29.17% strongly agreed, 50% agreed, 16.67 remained neutral, 2.08% disagreed while another 2.08 strongly disagreed. The evidence above shows that participants agreed that the LSS had the potential to lower operation costs within the organisation. The ability to reduce the length of duration on certain activities, reduction of wastage, and so forth ensured that the costs of

operation with an organisation are reduced. This subsequently lowers the total operation costs. This is also in line with reviewed literature which indicated that the LSS is a mechanism developed to improve business operations in order to enable the business to meet its needs in terms of producing quality goods and services that are highly appreciated by customers. The mechanism also ensures that the organisation produces more and better without incurring unnecessary wastages. The method also increases revenue, decrease costs, improve efficiency and develop effective people/employees (GoLeanSixma,2012).

### **5.8. The LSS-Output Nexus**

Figure 4.7 shows that a total of 36.6% strongly agreed that the output was good within the AA organisation, 43.8% simply agreed while 10.4% were neutral. Only about 4.2% disagreed while another 2.1% strongly disagreed. This evidence is very important in that it highlights that a properly implemented LSS can in actual fact bring about the intended results. The methodology, according to the literature, presents tools and methods which can organisations can invest in as they are able to eliminate wastes that may cause organisations to record high costs in production. The mechanism can also assist the organisation to produces products that can meet customer expectations (Rathilall and Singh, 2018). The central aim of the LSS is to boost the output of manufacturing organisations.

### **5.9. The LSS and Cycle times**

When asked about the impact of the LSS on cycle times, about 26 participants (54%) confirmed that the strategy improved cycle times. The use of the LSS strategy allows organisations meet the beat time system which is the frequency at which a product should be available to the customer (Smalley, 2013). LSS reduces waste, non-value-added work, cycle time and instability. However, despite these results, it remains worrying why the AA organisation continue to struggle and also to have larger percentages of participants who question the effectiveness of the strategy within the organisation as a whole.

### **5.10. Stakeholder Commitment to LSS In the AA Organisation**

Figure 4.9 shows that with regard to commitment, about 46% of the participants confirmed the existence of some commitment in the organisation and 27% strongly agreed to it while 2.1% strongly disagreed. A total of 20.8% remained neutral. This indicates that participants saw some form of commitment by all stakeholders in the organisation with regard to the implementation of the LSS. Commitment is at the centre of the success of the implementation of the LSS. The support of top management is always imperative in achieving the change of culture that is usually required by organisations in order to motivate their workers towards the institution of an LSS strategy. According to Svensson et al., (2015), if top management is not committed and involved in whatever nature of development in the organisation, that development is likely to fail. The top management must therefore always be at the forefront of any efforts that are meant to move the organisation forward. The top management must contribute not only their expertise and experience to the organisation, but must also contribute their time (Knapp, 2015). It is this commitment that is likely to take any ambitious organisation forward.

### **5.11. Customer service**

Figure 4.10 shows that a total of 39.6% of the participants strongly agreed that LSS improved the organisation's customer service, 45.8% simply agreed, 1.5% remained neutral while only 2.1% disagreed. The statistical evidence above shows that the majority of participants agreed that the implementation of the LSS strategy boosted the organisation's ability to provide satisfactory service. Conducting business at the reduced costs with greater satisfaction to the customer as well as improving organisational processes continuously are the building blocks of developing operation strategies in organisations (Datta and Roy, 2011).

### **5.12. Delivery times**

Figure 4.11 shows that regarding delivery times, 27.1% strongly agreed, 33.3% agreed, 27.1% remained neutral while 10.4%. Another 2.1% strongly disagreed. The participants confirmed that the LSS enabled the organisation to meet its delivery times. In this view, it can be posited that the implementation of the LSS as a strategy within the AA has not only boosted business operations but has also motivated employees by ensuring that they do not operate under pressure

in order to meet delivery deadlines. The motivation of employees also results in employee retention and satisfaction at work.

### **5.13. Customer focus**

The study also sought to establish whether the implementation of the LSS enabled the AA to be more focus on customers or not. Figure 4.12 shows that a total of 20.83% strongly agreed that due to the implementation of the LSS, there was customer focus in the organisation, a staggering 58.33% simply agreed while 14.58 remained neutral. Only a total of 2.08% disagreed. Every organisation, of necessity, needs to have a strong customer focus in order to remain existing. Without customer satisfaction, organisations are likely to fail. The aim of the LSS in the first place is to maximise the efficiency and effectiveness of organisation through improving production speed, realisation of quality products, and reducing the costs of production in order to meet customer satisfaction. Scholars such as Albliwi et al., (2015) and Chiarini (2011) posit that this indicates that customer satisfaction is at the centre of the LSS. This view was confirmed by the participants of the study as described in Figure 4.12 above.

### **5.14. The Understanding of the LSS within the Organisation**

In order to fully investigate the impact of the LSS in an organisation, it is always essential to first establish whether the relevant stakeholders understand such strategy in the first place. This was the stance adopted by the current study. Figure 4.13 shows that 13% indicated that not all actors understood, 21.7% only slightly understood while 28.3% moderately understood. A total of 28.3% indicated they understood very well while 8.7 extremely understood. In view of the large percentages of the number of participants who understood or who only understood partially, it may be argued that the levels of LSS understanding within the AA organisation leaves a lot to be desired. In order to be able to benefit from the LSS, there is need for an understanding that is strong.

### **5.15. Training**

The results of the study showed that a total of 13% reported that LSS training was not available

at all within the AA organisation, 32.6% slightly agreed that there was some LSS training in the organisation, 63% thought training was moderate while 73.9% thought it was well-done. Employee training remains one of the most important strategies for every successful organisation. Training which is focused improving the organisation continually is important. This form of training should be able to engender better knowledge of customers, increase knowledge on competition and thus equips employees with the ability to make a meaningful contribution to the organisation (Kowang, et al., 2016). Training plays a critical role in the success of LSS. LSS uses champions - black belts and green belts - to lead and implement the LSS initiatives.

### **5.16. Support**

Figure 4.15 shows that for LSS support, 17.4% of the participants indicated that it was not available at all while 13% mentioned that it is extremely available. Only about 8.7% of the participants indicated that there was slight support. A staggering total of 28.3% reported that support was only moderate while 32.6% mentioned that there was enough support. These mixed views by participants indicate that not all employees re on board at the AA with regard to the adoption of the LSS. In order for the realisation of an effective implementation of an LSS, there is an incessant need for support from all stakeholders. Without support from management, the LSS initiative will slowly disappear. Reviewed literature shows that it is also important to have support from management as they assist in engendering organisational cultural change (Foster, 2010; Laureani and Antony, 2015).

### **5.17. Resources**

Figure 4.16 shows that a total of 13.4% reported that they were not being provided with enough resources to make a meaningful contribution towards the realisation of the LSS, 19.57% indicated that although they were provided with resources, the resources were not enough while 13.4% mentioned that there were no resources provided at all. A total of 26.9 indicated that resources were moderate, 19.57% reported that the provision of resources was very good while 10.87% mentioned that the provision was extremely good. Resources are needed by any organisation in order to be able to outperform their competitors in an industry (Kowang, et al.,

2016). Without adequate resources, even with the best skilled workforce, an organisation is likely to fail.

### **5.18. Management Competency**

Figure 4.17 revealed that regarding management competency, 6.5% indicate that management was not competent, 13% reported that management was slightly competent, 28.3 revealed that it was only moderate while 41.3% mentioned that management was very competent. A further total of 10.9 indicated that management was extremely competent. There remains an important need for competency by management in order for a successful implementation of strategies. It is for these reasons that organisation must invest in the recruitment of competent employees particularly at managerial level. The organisation needs to have managers who are qualified educationally. In addition, managers also need to have a wider experience of the department in which they are located. This allow them to make a meaningful contribution by way of integration both academic theory and practical experience. The LSS requires a senior manager as a champion to oversee an improvement projects (Knapp, 2015).

### **5.19. Management interest**

Figure 4.18 reveals that 13% of the participants viewed management as lacking an interest in LSS, 19.6% reported that management showed a partial interest in LSS while 47.8% reported that the interest of management was moderate. A staggering total of 84.8% however reported that management showed much interest in LSS. These figures are however contradictory. The main explanation for this may be explained by the fact that some participants entered different responses more than ones. As already indicated in the previous section, the success of the LSS is based on management's commitment and competency to have such as project be implemented (Kowang, et al., 2016). This is also linked to management's ability and willingness to motivate a positive organisational culture and also to communicate effective with all relevant stakeholders.

## **5.20. Chapter Summary**

The current chapter discussed the results of the study. The chapter revealed mixed views and perceptions with regard to the impact of the implementation of the LSS within the AA organisation. Participants however confirmed that was established in the literature that LSS offers a variety of benefits which include cost and waste reduction, motivation of employees, improvement of delivery times, improve quality of products, and so forth. There were however mixed views on the role of top management in overseeing the implementation of this process. Some participants mentioned that the management within the AA played a very passive role. Others thought management was doing enough. The data however managed to clearly show the relationship that exists between LSS and operational performance within the context of the AA.

The conclusion of the study is made in next chapter.

## **CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS**

### **6.1. Introduction**

The previous two chapters respectively presented and discussed the data that was gathered for the current work in the AA. The current chapter pulls together the study as a whole from the first to the last chapter. The chapter presents major conclusions, presents the various implications of the study, outlines the various challenges that were encountered during the course of the study. The chapter brings together all the major issues that were raised in the other five chapters and then makes the overall conclusions of the study. In view of the conclusions that are made, the chapter also makes some recommendations and also highlights the various areas in which more research activities can be more useful.

### **6.2. Conclusions**

In light of the various findings of the current study, the following conclusions were made:

- **Work Quality**

The implementation of the LSS in the AA organisation could not only improve quality level, but also the quality of work itself. A target on high quality levels could eventually lead the organisation to lower instances of delays during operations and thus advance the quality of outcomes. This view was confirmed by a total of 45.83% of the participants strongly agreed that the successful implementation of the LSS improved the quality of work. The view is also supported by literature which indicated that as an organisation starts to prioritise high quality levels, it will then start to seek continuous improvement (Jeyaraman and Teo, 2010).

- **Waste Reduction**

The successful implementation of LSS in the AA could result in waste reduction. Figure 4.4 indicates that 90% of the participants confirmed this view. Reviewed literature also revealed that

when successfully implemented, the LSS should be able to ensure that the amount of wastage in organisations is reduced (Bhat et al., 2014).

- **Return on Investment**

A successful implementation of LSS results in the realisation of ROI. This view was stressed by a total of 71% of the participants (Figure 4.5). This statistical evidence concurred with reviewed literature which indicated that the LSS is capable of providing a range of benefits namely; improve organisational performance in order to realise quality of products and services (Drohomeretski, et al, 2012); Improved quality, reduced cycle times and creating value for stakeholders (Rajesh, et al., 2012); Culture change, productivity improvement, customer satisfaction, cost reduction and defect reduction (Rathilall and Singh, 2018); Improves company overall competitiveness (Chen, Li and Shady,2010); Increase revenue, decrease costs, improve efficiency and develop effective people/employees (GoLeanSixma,2012); Improves overall performance, reduce costs, and reduce errors (Knapp,2015).The statistical evidence in these first three conclusions satisfied the first research objective as outlined in Chapter One, which was to assess the impact of implementing Lean Six Sigma strategy in the AA.

- **Reduction of Operation Cost**

The implementation of the LSS could reduce the organisation's operation costs. This view was taken up a total of 29.17% who strongly agreed and another 50% who simply agreed. This is also in line with reviewed literature which indicated that the LSS is a mechanism designed to improve business operations and aims to maximise efficiency and effectiveness by improving reducing and hence, costs. The method also increases revenue, decrease costs, improve efficiency and develop effective people/employees (GoLeanSixma,2012). This evidence satisfied the third research objective of the study which was to assess customer benefits in Lean Six Sigma strategy within the AA.

- **LSS boosted Output**

The second research of the study was to analyse the relationship between Lean Six Sigma and operational performance within the AA. The study found that a total of 36.6% strongly agreed that the output was good within the AA organisation while 43.8% simply agreed (Figure 4.7). This was also supported by reviewed literature which revealed that the central aim of the LSS is to boost the output of manufacturing organisations (Rathilall and Singh, 2018).

- **Manage Competency Questionable**

The ability of managers in the AA to successfully motivate and implement the LSS is questionable. Figure 4.17 revealed that 6.5% indicate that management was not competent, 13% reported that management was slightly competent. There remains an important need for competency by management in order for a successful implementation of strategies (Knapp, 2015).

- **Failure in the Implementation of the LSS**

Figure 4.3 reveals that a total of 49.7% of the participants strongly reported that the LSS failed to bring about the anticipated results in the AA organisation. Another 39.6% simply agreed that indeed the LSS faced challenges, and therefore failed to bring about the results as would be expected. This evidence also helped to satisfy the third research objective of the study as outlined in Chapter One.

### **6.3. Implications of the Research**

The continued and sustained growth of businesses particularly the manufacturing sector in which the AA is located is crucial especially in South Africa's economy that is struggling and is focused on improving employment levels which stand at 36% as of 2017 (Stats SA, 2017). The manufacturing is capable of offering a number of job opportunities to a number of employees. The manufacturing sector has, since time immemorial, not only provided household heads with a source of livelihoods but have also enhanced their skills which they can use even after retirement. It is therefore of extreme importance that the manufacturing sector be strengthened through the adoption and implementation of models such as the LSS that offer several benefits than is normally appreciated.

This study contributes to manufacturing as well as business development debates as evidenced by how the study closely examined the application of the LSS in a manufacturing organisation, the AA in order to establish the views of employees on the potential benefits of the model in the organisation as well as its associated challenges. This study makes empirical contributions on manufacturing and business studies bringing experiences from South Africa into mainstream business debates that have been dominated by the Global North.

Furthermore, the study contributes towards business studies scholarship as these findings add more knowledge to existing literature. By using the AA as a case study, the study demonstrates how studies of a similar nature can be conducted in different organisations.

The study also demonstrates to the AA organisation how and where they need to improve. It also shows the organisation how it can benefit through the deployment of the LSS as an improvement model.

Lastly, the study made recommendation which other organisations can also benefit from. The recommendations are not just limited to the AA organisation, but they also apply to other organisations of a similar nature.

#### **6.4. Limitations of the Study**

Findings from this study are derived from a single organisation and thus are not generalisable to other manufacturing industry contexts. Rather, a closer examination this organisation provides localised understanding of complex interplay between business and development. However, despite this supposed drawback, it is the researcher's opinion that the AA itself can benefit from the results that were produced.

This study did not collect data on incomes (wages, salaries) across levels, gender and race. Income has a direct influence on employee motivation, satisfaction and how, even in the presence of adequate resources, employees can still be frustrated and demotivated by their incomes to successfully implement the LSS. The researcher could not address these given the fact that income of workers is personal and private. Provision of such data would have added more value and insight on what is happening in the organisation and enriched findings of the study. However, it could be a possible aspect for further studies.

Time constraints in terms the period given to participants to make a contribution could also have impacted on the study. The researcher would have loved to include as many participants as possible. However, this was not possible due to time constraints. Nonetheless, it is the researcher's view that other researcher will make a contribution to supplement the arguments pushed forward by this study.

## **6.5. Recommendations for the Research Problem**

In line with the findings of this study, both from the literature that was reviewed and from the primary data collected in the AA organisation, the following recommendations are made:

- **Improve Resource Availability**

In order for employees to do their work well, they need adequate resources. Likewise, for a successful implementation of the LSS to be realised, there remains the need to for the AA to put in place enough resources for employees. Figure 4.16 shows that a total of 13.4% reported that they were not being provided with enough resources to make a meaningful contribution towards the realisation of the LSS, 19.57% indicated that although they were provided with resources, the resources were not enough while 13.4% mentioned that there were no resources provided at all. Resources are needed by any organisation in order to be able to outperform their competitors in an industry (Kowang, et al., 2016). Without adequate resources, even with the best skilled workforce, an organisation is likely to fail.

- **Need for Communication**

There is always an important need for communication within the AA. There is need for an improvement in the communication methods used in the organisation. communication should also not just be top-down or bottom-up, but it should also be horizontal so that everybody accesses and understands what is taking place in the organisation (Zhang, et al., 2012). The AA should invest in developing its communication networks.

- **LSS needs the support of all Stakeholders**

There were many issues resulting in the failure rate of successfully adopting the LSS mechanism in the organisation. The LSS mechanism needs to be supported by all actors in the organisation for it to bring about the much-needed change (Laureani and Antony, 2015). Both management and employees must stand together and ensure that each of them makes a contribution that can result in the success realisation of the mechanism. In working together, stakeholders will be able to improve operations and reduce costs much to the profitability of the organisation.

- **Need for Employee Training**

In addition to adequate resources, employees need to be trained in order for a successful implementation of LSS to be realised. The results of the study showed that a total of 13% reported that LSS training was not available at all within the AA organisation, 32.6% slightly agreed that there was some LSS training in the organisation while 63% thought training was moderate. Employee training remains one of the most important strategies for the AA organisation. Training increases the workers' knowledge about customers and their needs or what makes customers to be happy. If workers have got this knowledge, and if they are well motivated, they are likely to contribute their level best to make products that will satisfy customers. Consequently, this will increase the competitiveness of the organisation competition (Kowang, et al., 2016).

## **6.6. Future Research Directions**

Future research directions ought emphasise on the content and nature of the training that should be provided to employees in the AA. Future studies should also focus on how employee income can influence the implementation of LSS in organisations. In pursuing these issues, it is important that future studies make use of mixed methods instead of depending on a single research method.

## **6.7. Chapter Summary**

The was a summary of the study as a whole. It summarised all the first five chapters and also revisited the objectives as presented in Chapter One. The chapter presented the major conclusions of the study; established both from the literature and from the primary study within the AA. The chapter also presented the contributions of the study, outlines the study limitations and also pointed at several areas that need further research.

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## **APPENDICES**

## APPENDIX 1: QUESTIONNAIRE

IMPACT OF LEAN SIX SIGMA STRATEGY ON OPERATIONAL PERFORMANCE					
<b>Operational performance indicators</b>					
<b>A1-3</b>					
<b>Assessment of impact on quality</b>	<b>Strongly agree</b>	<b>Agree</b>	<b>Neutral</b>	<b>Disagree</b>	<b>Strongly disagree</b>
Has Lean/Six sigma improved overall product quality levels ?					
Has Lean/six sigma improved quality of work in the company?					
Has Lean/Six sigma reduced failure rates ?					
<b>B1-3</b>					
<b>Assessment of impact on costs</b>	<b>Strongly agree</b>	<b>Agree</b>	<b>Neutral</b>	<b>Disagree</b>	<b>Strongly disagree</b>
Has Lean/Six sigma reduced waste in the factory ?					
Has Lean/Six sigma projects realised return on investment (ROI)					
Has Lean/Six sigma improved operating costs ?					
<b>C1-3</b>					
<b>Assesment of impact on productivity.</b>	<b>Strongly agree</b>	<b>Agree</b>	<b>Neutral</b>	<b>Disagree</b>	<b>Strongly disagree</b>
Has Lean/Six sigma improved production output levels ?					
Has Lean/Six sigma improved cycle times/reduced turnover times ?					
Has Lean/Six sigma improved employee commitment ?					
<b>D1-3</b>					
<b>Assesment of impact on customer .</b>	<b>Strongly agree</b>	<b>Agree</b>	<b>Neutral</b>	<b>Disagree</b>	<b>Strongly disagree</b>
Has Lean/Six sigma improved service to customer ?					
Has Lean/Six sigma reduced customer delivary times ?					
Has Lean/Six sigma increased customer focus ?					
<b>E1-6</b>					
<b>Suggest the level of importance placed on the activities involved in the Lean six sigma commitment within your company</b>	<b>Not at all</b>	<b>slightly</b>	<b>Moderatly</b>	<b>Very</b>	<b>Extremly</b>
Staff understand the Lean/SIX SIGMA Concept					
Staff receive Lean/Six sigma training					
Staff have the necessary Lean/Six sigma support					
Staff have the necessary resources for Lean/Six sigma					
Management have the right competency of Lean/Six sigma					
Management take great interest in Lean/Six sigma work					

## APPENDIX 2: ETHICAL CLEARANCE



08 March 2018

**Mr Noble Siyabonga Ngcobo (215067643)**  
Graduate School of Business & Leadership  
Westville Campus

Dear Mr Ngcobo,

**Protocol reference number: HSS/0239/017M**  
**Project title: Impact of lean six sigma strategy on operational performance: A study of ZIMCO Group Pty (Ltd) manufacturing companies**

**Approval Notification – Amendment Application**  
This letter serves to notify you that your application and request for an amendment received on 06 March 2018 has now been approved as follows:

- Change in Supervisors

Any alterations to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form; Title of the Project, Location of the Study must be reviewed and approved through an amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

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

The ethical clearance certificate is only valid for period of 3 years from the date of original issue. Thereafter Recertification must be applied for on an annual basis.

Best wishes for the successful completion of your research protocol.

Yours faithfully

.....  
Professor Shenuka Singh (Chair)

/ms

Cc Supervisor: Professor Muhammad Hoque  
Cc Academic Leader Research: Dr Emmanuel Mutambara  
Cc School Administrator: Ms Zarina Bullyraj

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Humanities & Social Sciences Research Ethics Committee  
Professor Shenuka Singh (Chair)

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Website: [www.ukzn.ac.za](http://www.ukzn.ac.za)



Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville



**ASSOCIATED ADDITIVES**

13 March 2017

Dear Sir

To Whom It May Concern

**APPROVAL TO CONDUCT RESEARCH ON THE ZIMCO BUSINESS MANUFACTURING SITES**

This letter serves to confirm our approval and agreement to support and participate in the research to be conducted by Mr Noble Siyabonga Ngcobo (Student no. 215067643).

The topic is proposed as follows:-

*The impact of lean six sigma strategy on operational performance: A study of Zimco manufacturing companies*

We hereby grant access/permission to the following from our manufacturing companies

1. Company background (2 companies)
2. Usage of lean six sigma strategy
3. Key operational performance indicators (reports, data)
4. Observation of company practices
5. Personal interviews including questionnaires

Upon completion of the study, a bound copy of the full research report must be made available to ZIMCO Group (Pty) Ltd.

Should you have any queries in this regard, please contact the undersigned.



**Kevin Carlisle**  
Managing Director

Associated Additives  
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Associated Additives Directors: K Carlisle (Managing), C Gratton, W Verwey

## APPENDIX 3: TURNITIN REPORT

215067643UKZN			
ORIGINALITY REPORT			
<b>7%</b>	<b>4%</b>	<b>1%</b>	<b>6%</b>
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS
PRIMARY SOURCES			
1	Submitted to Mancosa Student Paper		2%
2	Submitted to University of South Africa Student Paper		2%
3	Submitted to University of KwaZulu-Natal Student Paper		1%
4	www.tandfonline.com Internet Source		<1%
5	Submitted to Leeds Beckett University Student Paper		<1%
6	researchspace.ukzn.ac.za Internet Source		<1%
7	sajems.org Internet Source		<1%
8	eprints.undip.ac.id Internet Source		<1%
9	www.greycampus.com Internet Source		<1%