UNIVERSITY OF ZIMBABWE

MASTER OF BUSINESS ADMINISTRATION DEGREE

GRADUATE SCHOOL OF MANAGEMENT

AN INVESTIGATION INTO STRATEGIES FOR TRANSFORMING DAIribord ZIMBABWE Pvt LTD (DZPL) ICE CREAM STICKS PRODUCTION SECTION INTO A LEAN SIX SIGMA PROFITABLE ENTERPRISE AFTER A PARTIAL INITIAL TRIAL.

By

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2016

A Dissertation submitted in Partial fulfilment of the Requirements for the Master of Business Administration Degree (MBA)

Supervisor: Dr. S Ruturi
DECLARATION

Student`s declaration- I, Nyasha Chistain Chidzambwa, do hereby declare that this dissertation is the result of my own investigation and research, except to the extent indicated in the acknowledgements, references, and by comments included in the body of the report, and that this dissertation is therefore my original work and has not been presented in part or in full for any other degree in any other University

Signature.......................................................... Date.........................................................

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STUDENT NUMBER: R0101466

Supervisor`s declaration- I Dr. Sam Ruturi confirm that the work reported in this dissertation was carried out by the candidate under my supervision as a School supervisor. This dissertation has been submitted with my approval as School supervisor

Signature.......................................................... Date.........................................................

NAME: DR. S. RUTURI
DEDICATION

I dedicate this piece of work to my supportive wife, Tafadzwa and our two lovely sons, Jordan and Aydan. These are the important people in my life who inspire me to strive for excellence. The Almighty lord will always take all the glory in everything I do.
ACKNOWLEDGEMENTS

The MBA journey, including this dissertation has been a challenging and exciting one at the same time. This study could not have been a success without the immense support and contribution from a number of people.

My supervisor, Doctor Sam Ruturi has been exceptional in his guidance and advice for me to complete this study. Dr Ruturi possesses a wealth of knowledge and expertise stemming from his experience in both the corporate world and the academia. His knowledge and experience were the cornerstone of this study and I will forever be grateful for his influence in my study.

The University of Zimbabwe, Graduate School of Management staff, Lecturers and my fellow MBA colleagues were very helpful in my study, I acknowledge and thank them for their support.

I want to extend my gratitude to the staff and management at Dairibord Zimbabwe Private Limited for giving me the support. My superiors at work, Mr T M Mutsvairo, Mr T Mabika, Mr T Napata and the Group Chief executive Mr A Mandiwanza were extremely generous in allowing me to pursue this study and for availing financial support, I will forever be grateful for that.

My pillar of strength and inspiration remains my wife Tafadzwa and our two boys, I acknowledge the support she afforded me throughout the duration of this study. Despite her very busy schedule, she remained resolute in her support and she continued to believe in me. She allowed me to be absent from her and our sons during weekends, public holidays and some nights in my quest to complete the course.

All the glory goes to my lord and saviour, Jesus Christ for giving me the gift of life and good health that made it possible for me to complete this study.
ABSTRACT

The purpose of this research was determine the strategies that could be adopted to implement Lean Six Sigma at Dairibord Zimbabwe (DZPL) in the Ice cream sticks section. The research also sought to assess the initial trial implication that was tried in July 2015 as a test. This research was inspired by the need to improve yields and efficiencies in the ice cream sector as a business strategy to reduce production costs in this highly competitive environment. Improving efficiencies and yields during production will result in better profitability and in a deflationary environment like the one we find ourselves in, such a strategy will unlock value for the shareholder and ensures business continuity.

The research sought to achieve this purpose through the use of secondary data in the SAP ERP system to assess the performance of previous years, a research questionnaire was then designed and it sought to get the opinions of DZPL staff in the manufacturing section on how they view LSS. Their opinions were to be drawn from their assessment of the initial trial run as well as their general knowledge and understanding of LSS. The Likert scale analysis was used to gather the view of the employees in terms of the knowledge on LSS, Impact that LSS will have on the production efficiencies if fully implemented, strategies that could be implemented in order to fully benefit from the LSS system. Data was collected from staff and it was analysed quantitatively to determine the trends. The normality tests and the reliability tests were carried out.

The data was found to be non-parametric. The Cronbach Alpha coefficient showed that the reliability of the data was good. The Chi square test was used to test if there was any significant change in yields after the partial trial implementation of LSS and it showed that the LSS system resulted in yield improving. However the ANOVA analysis could not support the assertion on yields.

The study managed to show that the LSS concept, though alien to the Zimbabwean industry can result in significant improvement in yields that would result in better profitability in this harsh economic climate. The study also showed that for DZPL to fully implement and benefit from the LSS system, there is need for training, training should be the basis for fully implementing the LSS system at DZPL. DZPL needs to fully embrace and implement the LSS system for better profitability.
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An investigation into strategies for transforming Dairibord Zimbabwe Pvt Ltd (DZPL) ice cream sticks production section into a Lean Six Sigma profitable enterprise after a partial initial trial.
An investigation into strategies for transforming Dairibord Zimbabwe Pvt Ltd (DZPL) ice cream sticks production section into a Lean Six Sigma profitable enterprise after a partial initial trial.

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LIST OF ACCRONYMS AND ABBREVIATIONS

DZPL: Dairibord Zimbabwe Private Limited
LSS: Lean Six Sigma
JIT: Just In Time
FSMS: Food Safety Management system
SPSS: Statistics Package for Social Scientists
QFD: Quality Function Deployment
DMAIC: Define, Measure, Analyse, Improve, Control
FMEA: Failure Mode Efficiency Analysis
OEE: Overall Equipment Effectiveness
ISO: International organisation for standardisation
QMS: Quality Management System
TPS: Toyota Production System
VSM: Value Stream Mapping
PCE: Process Cycle Mapping
DMADV: Define, Measure, Analyse, Design, Verify
TQM: Total Quality Management
MBB: Master Black Belt
CBP: Competence Based Perspective
PP: Production Planning
USL: Upper Specification Limit
LSL: Lower Specification Limit
UTL: Upper Tolerance Limit
LTL: Lower Tolerance Limit
Cp: Process Capability
Cpk: Process performance
CHAPTER ONE: INTRODUCTION

1.1 Introduction to the study

The research explores the feasibility of integrating the Lean Six Sigma system as a complimentary system to the ISO 22000:2005 Food Safety management system in order to improve the production efficiencies in the manufacture of ice cream sticks at Dairibord Zimbabwe Pvt Ltd. Despite successfully implementing the ISO 22000:2005 Food Safety Management system, Dairibord Zimbabwe Pvt Ltd (DZPL) still finds itself facing challenges in terms of achieving high production efficiencies on the ice cream sticks production line. The ISO 22000:2005 Food Safety Management System addresses food safety concerns and its successful implementation means that the food produced by DZPL is safe for the consumer but it does not address the production efficiencies aspect of the process.

This study is made relevant by the fact that the business environment in Zimbabwe has become very competitive, there are a lot of dairy processors that have invaded the market space previously monopolised by Dairibord Zimbabwe Pvt Ltd (DZPL). DZPL used to enjoy a monopoly in the dairy sector in Zimbabwe after acquisition of Lyons Zimbabwe which ensured that DZPL was the only major player in the Dairy sector in Zimbabwe. However, market liberalisation allowed other local players such as Kefalos, Den Dairy, Alpha Omega, and Kershelmar among others to enter the fray and offer stiff competition to DZPL. This, coupled with the high influx of imports mainly from South Africa has resulted in a highly competitive business environment in Zimbabwe. The continuous fall of the South African Rand against the US Dollar (which is the major currency of trade in Zimbabwe) has made imports to Zimbabwe even more favourable, the Zimbabwean traders can get more South African Rand per US dollar and hence they are incentivised to go to South Africa and import products, including ice creams and sell them here in US dollars at a higher profit, albeit still at lower prices than offered by local manufacturers. The competitive environment that DZPL finds itself in requires that the unit cost of production be as minimal as possible and machine efficiency be at its best in order to remain competitive. The profit margins in our deflationary economy are very thin and there is no room to increase prices at the moment, the only way to ensure profitability is to cut down on costs. This research is going to focus on reducing production costs as a way of increasing profitability. The management problem that the research seeks to address is the issue of low efficiencies caused by high wastages during the production process of ice cream sticks at Dairibord Zimbabwe Pvt Ltd. Low efficiencies during production...
increase the unit cost of production and hence eats into the profit margins of the products produced. This research seeks to explore the feasibility of implementing the Lean Six Sigma system as a complimentary system to the current ISO 22000: 2005 system in order to address the challenge of poor yields or low efficiencies during the production of ice cream sticks. The successful integration of the two systems will improve the efficiencies resulting in high yields which translate to better profitability. The company will therefore stand a better chance against competition. This research is aimed at ensuring business continuity for DZPL in the ice cream sticks sector due to improved profit margins, the margins of which will be unlocked by low wastages and high machine efficiencies due to the implementation of the Lean Six Sigma system in conjunction with the ISO 22000:2005 Food Safety Management system. A partial trial of the Lean Six Sigma methodology was carried out in the Ice cream stick section, this study assesses that trial as well seeks the employees’ opinions on the LSS methodology.

1.2 What is Lean Manufacturing?

Lean as an adjective and in reference to an industry or a company, according to the oxford dictionary refers to an efficient industry with no or very little wastage. According to the oxford dictionary, with reference to a person or animal, a lean animal or person is person that does not contain superfluous fat, e.g. “His lean muscular body”. The same is very true for an organisation or a process in a manufacturing set up. Becoming lean can be defined as a way of eliminating waste with the aim of creating value. (Wilson, 2010)

Lean Manufacturing represents a management approach for driving innovating processes inside a company in order to achieve superior results. It involves a practical analysis based on facts, aiming the innovation and growth, not only the efficiency of processes. It is a long term process of gradual and continuous improvement. The application of Lean Six Sigma in companies led to attaining superior financial performance by addressing new needs, by differentiating the products and services or by adjusting the business lines to new processes (Dumitrescu, 2011). Quality is more than making things without errors. It is about making a product or service meet the individual perception of a customer about the quality or value.

Lean manufacturing, an approach that depends greatly on flexibility and workplace organization, is an excellent starting point for companies wanting to take a fresh look at their current manufacturing methods. Lean techniques are also worthy of investigation because they eliminate large capital outlays for dedicated machinery until automation becomes absolutely necessary. Indeed, the concept of lean manufacturing represents a significant departure from the automated factory so popular in recent years. The “less is better”
An investigation into strategies for transforming Dairibord Zimbabwe Pvt Ltd (DZPL) ice cream sticks production section into a Lean Six Sigma profitable enterprise after a partial initial trial.

1.3 What is Six Sigma?

The word sigma refers to the Greek symbol(s) (σ) that represents the amount of variation in a process (Lloréns-Montes & Molina, 2006:486). Larson (2006:46) states that sigma is applied to today’s business processes as a metric, a methodology and a management system; in statistical terms, sigma measures how well a process performs and represents the number of defects (defined as anything that fails to meet customer requirements) likely to occur per one million opportunities. Table 2.1 illustrates the different levels of sigma.

Six Sigma is defined as a quality improvement program designed to reduce process variations so that there are no more than 3.4 defects or errors per million opportunities or activities (Thompson, Strickland & Gamble, 2005:351; Jutras, 2006:36). Hill (2005:558) reiterates that six sigma is a statistically based philosophy that aims to reduce defects, boost productivity, eliminate waste, and cut costs throughout the company. Six Sigma initiatives have proven to be an effective technique for improving quality in manufacturing (Gowen, Stock and McFadden, 2008:6781).

The Six Sigma System is a measure of quality and defines a disciplined method for measuring and eliminating defects, as you approach near perfection in a given process (Gray, 2006:8). On the same note, Scheidt, Thibadoux and Rosener (2009:20) observe that in order to ensure maximum productivity, profitability, and quality of complex tangible goods and intangible services, companies are using the sophisticated Six Sigma business management strategy. Similarly, Cheng (2009:311) states that implementing Six Sigma can lead to quality improvements, increase productivity and reduce costs.

From the above observations that have been articulated by different researchers and scholars of the Six Sigma System, it is clear that the system is a useful management tool. Lee and Choi (2006:894) state that Six Sigma
helps decision makers to conceive ideas and it supports the systematic solution of problems in this complicated marketplace. The strength of this system is that it fosters a data-driven analysis and decision-making process—not someone's opinion or gut feeling. Saunders (2010:42) observes that Six Sigma differs from previous productivity improvement methods in that it emphasizes an increased focus on quality as defined by the customer, reduced defects and variation and rigorous statistical methods.

Tiwari, Antony and Montgomery (2008:6563) state that any enterprise is required to regularly review its activities and planning to deal with the fiercely competitive, rapidly changing and dynamically shrinking world market. In the same context, DZPL may have to consider reviewing its current QMS to verify whether it is still relevant in the current marketplace for the company to remain competitive.

1.4 Background to the study

The Zimbabwean economy is currently undergoing a deflationary phase during which consumer prices are stagnant and are actually going down in some instances; this is fuelled by the high influx of imports mainly from South Africa, which are fuelled by the continuous fall of the South African Rand against the US Dollar, which is the main trading currency in Zimbabwe. The implication is that imports are able to land in Zimbabwe at cheaper prices than locals products. This creates a problem for local processors such as Dairibord Zimbabwe Pvt Ltd. This competition means that consumer prices cannot be increased but local processors have to match or have lower prices than these imports in order to remain competitive. The only way local processors can compete with imports in terms of prices is to have the minimal production costs so that the margins can be freed. This is the challenge that many Zimbabwean companies are facing and as a result many are actually closing shop as a result of failing to adapt to this challenge.

Dairibord Zimbabwe Pvt Ltd has been enjoying a competitive advantage in terms of ice cream sticks as they had been the only company to have that line for a long time. However, the entry of imports has seen the influx of competing ice cream sticks with such brands as the magnum ice cream (Nestle product) coming in from South Africa. Recently, a competitor Alpha Omega Dairies also commissioned an ice cream sticks line. This has resulted in more pressure on Dairibord Zimbabwe Pvt Ltd to be more efficient on that line as they no longer enjoy the monopoly, the competitive pressure thereof calls for more efficiency. The machine efficiencies (yields) that have been coming from the ice cream sticks machine have not been very pleasing, this study seeks to address that challenge by investigating the feasibility of implementing a more robust system that ensures maximum efficiency is realised on the ice cream sticks machines. DZPL currently implements
the internationally recognised ISO 22000:2005 system which is a food safety management system, however, the system does not really address machine efficiency and yields. This is the problem that this study seeks to address. In order to put everything in to perspective, the machine efficiencies achieved at the Ice creams sticks production line for the past three and half years are as tabulated below.

An analysis of the efficiencies in terms of kgs of packaging material and then in terms of value as measured in $US equivalent will be done in the diagrams below and the pie chart that follows will illustrate the major causes of such in efficiencies.

![Graphical Analysis of Material Yields between 2012 and mid 2015](image)

**Figure 1.1 A graphical representation of material usage in the ice cream sticks section for the period 2012 to mid-2015.**

**Source: Derived from DZPL Production records in the SAP-ERP system**

The diagram above depicts the negative variances that are a result of over usage of materials in the ice cream section, this is depicts an undesirable state of affairs. The 2015 numbers are for the half year, however, there is still a negative variance in terms of material usage coupled with low production volumes. The decline in production volumes as is depicted on the 2015 half year numbers calls for the organisation to operate even more efficiently because the advantage of economies of scale is fast diminishing.
An investigation into strategies for transforming Dairibord Zimbabwe Pvt Ltd (DZPL) ice cream sticks production section into a Lean Six Sigma profitable enterprise after a partial initial trial.

Graphical Analysis of lost value due to poor production efficiencies.

![Graphical Analysis of lost value due to poor production efficiencies.](image)

**Fig 1.2 A graphical analysis of the variances in terms of US$ caused by poor production efficiencies for the period between 2012 and mid-2015.**

**Source: Derived from DZPL Production records in the SAP-ERP system**

The graph in Figure 1.2 represents the same information as in figure 1.1 but this time it has been presented in terms of value (US$). The negatives on the graph represents the losses that will directly affect the organisation’s bottom line, this needs to be addressed.

From the two graphs above, it is clear that the issue of production inefficiencies needs to be addressed in order to wipe out the negative variances on both materials and value being lost in terms of $US.

The production inefficiencies are result of a number of challenges, some of which are listed in the table below.

**Table1.1 Major Causes of poor production efficiencies on the ice cream stick lines**

<table>
<thead>
<tr>
<th>Major causes of poor production efficiencies</th>
<th>% Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine breakdowns</td>
<td>29%</td>
</tr>
<tr>
<td>Refrigeration challenges</td>
<td>22%</td>
</tr>
<tr>
<td>Human resource aspect (lack of skills, lack of motivation)</td>
<td>12%</td>
</tr>
<tr>
<td>Inconsistent supply of utilities</td>
<td>1%</td>
</tr>
<tr>
<td>Poor production planning</td>
<td>15%</td>
</tr>
<tr>
<td>Poor material quality</td>
<td>6%</td>
</tr>
<tr>
<td>Poor adherence to preventive maintenance schedule</td>
<td>15%</td>
</tr>
</tbody>
</table>

**Source: DZPL production records (process Control forms)**
The table above (Table 1.1) demonstrates some of the major causes of down time in production that end up affecting production efficiencies. The causes have been ranked based on down time recorded by machine operators on the production floor in the ice cream section of the plant.

<table>
<thead>
<tr>
<th>Cause</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor adherence to preventive maintenance schedule</td>
<td>15%</td>
</tr>
<tr>
<td>Poor material quality</td>
<td>6%</td>
</tr>
<tr>
<td>Poor production planning</td>
<td>15%</td>
</tr>
<tr>
<td>Inconsistent supply of utilities</td>
<td>1%</td>
</tr>
<tr>
<td>Human resource aspect (lack of skills, lack of motivation)</td>
<td>12%</td>
</tr>
<tr>
<td>Refrigeration challenges</td>
<td>22%</td>
</tr>
<tr>
<td>Machine breakdowns</td>
<td>29%</td>
</tr>
</tbody>
</table>

**Figure 1.3 Graphical representation of major causes of poor efficiencies on ice cream sticks**

**Source: DZPL Production Reports 2012-2015**

The graph above (graph 1.3) illustrates the information given in table 1.1 above and it paints the same picture as highlighted in the table. Machine breakdowns remain a key challenge that needs to be tackled. As can be seen from the graph, there are several causes of poor production efficiencies. The net effect of all the challenges is a decline in efficiency. Although the challenges are many, the comforting fact is that they are not caused by some unsolvable causes or a natural phenomenon of some sort, these challenges can be solved by human beings in as much as they are also caused by human beings. There is a real need of a system that will challenge and address the issues highlighted in the graph in figure 1.3.
The table below illustrates the sigma capabilities of a processes.

**Table 1.2 Sigma capabilities**

<table>
<thead>
<tr>
<th>Sigma Capability (σ)</th>
<th>Defects per Million Opportunities (DPMO)</th>
<th>Yield (no defects) %</th>
<th>% Defects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>690,000</td>
<td>31%</td>
<td>69%</td>
</tr>
<tr>
<td>2</td>
<td>308,537</td>
<td>69.1%</td>
<td>30.9%</td>
</tr>
<tr>
<td>3</td>
<td>66,807</td>
<td>93.3%</td>
<td>6.7%</td>
</tr>
<tr>
<td>4</td>
<td>6,210</td>
<td>99.4%</td>
<td>0.6%</td>
</tr>
<tr>
<td>5</td>
<td>233</td>
<td>99.97%</td>
<td>0.03%</td>
</tr>
<tr>
<td>6</td>
<td>3.4</td>
<td>99.99966%</td>
<td>0.00034%</td>
</tr>
</tbody>
</table>

**Source: An Introduction to Six Sigma – Are Near-Perfect Processes Possible (2006: 47)**

An analysis of the information above indicates that DZPL is currently operating at a sigma level of between 3 and 4, this is not good enough in a highly competitive environment and there is need to improve the sigma level in order to improve profitability. The defect per million opportunities need to be at least 3.4 for a six sigma level to be attained. The situation currently pertaining on the Ice cream sick production line cannot be left unattended.

**1.5 Statement of the problem**

DZPL is bedevilled by chronic low production efficiencies in the ice cream stick production section. Despite the perennially poor production efficiencies, little has been done to abate this problem. Although there has been marginal increases in efficiency levels over the three and half year period from 2012 to half year 2015, there is a lot more that still needs to be done in order to transform this section into a Lean process with high levels of efficiency. Despite a number of interventions having been undertaken, the problem is still persistent and wreaking havoc to the organisation. If this problem is not addressed, losses will continue to grow in the ice cream sticks sector and ultimately the section might be forced to close down due to excessive competitive pressures resulting in job losses and reduction in revenue of the organisation. Ice cream sticks contribute about 9% of the total revenue of the organisation and such a loss will be felt heavily if it were to happen. The image
of the organisation would be ruined if the ice cream stick line was to close and the share price would likely suffer since DZPL is a listed entity. The social impact will be devastating as people will lose their jobs resulting in the untold suffering of families.

1.6 Research Objectives / Questions

There are several research objectives that will turn into research questions as discussed below

1.6.1 Major Research Objective

The major research objective of this study is to check if Lean Six Sigma can help to transform the DZPL`s ice cream sticks production line into a lean six sigma enterprise after assessing the trial implementation of LSS.

Specific Objectives

i. To identify the potential benefits that DZPL could derive from implementing Lean Six Sigma on the ice cream sticks section.

ii. To establish the feasibility of the adoption of the Lean Six Sigma at the ice cream section at DZPL in terms of knowledge and expertise.

iii. To determine the applicability of Lean Six Sigma in the food manufacturing industry in Zimbabwe to improve production efficiencies.

iv. To identify strategies that can be deployed in order to successfully implement the Lean Six Sigma system in the ice cream sticks production section.

v. To assess if the trial run of Lean Six Sigma resulted in better production efficiencies.

1.7 Research Questions

There are several research questions that stem from the research objectives as outlined below

The main research question for the study is:

Can the full implementation of Lean Six Sigma help to transform the DZPL ice cream sticks production line into a Lean processes that operates at six sigma level?
The sub-questions that arise out of the main research question are:

i. Are there any benefits to DZPL for implementing the Lean Six Sigma system in the ice cream stick production line?

ii. Does DZPL have the knowledge and expertise to adopt the Lean Six Sigma system in order to improve production efficiencies in the ice cream sticks section?

iii. Is the Lean Six Sigma system applicable in the food manufacturing industry in Zimbabwe in order to improve production efficiencies?

iv. What strategies can be undertaken in order to ensure that the Lean Six Sigma system is successfully implemented?

v. Did the initial trial run of Lean Six Sigma improve production efficiencies in the ice cream sticks section?

1.8 Research Hypothesis

The researcher makes the theoretical proposition that “The adoption and implementation of the Lean Six Sigma system in the manufacture of ice cream sticks will result in an improvement of efficiencies resulting in better profitability”. This is known as the Null hypothesis as depicted by $H_0$. The alternative hypothesis ($H_1$) will be as follows “The adoption and implementation of the Lean Six Sigma system in the ice cream sticks production section will not result in an improvement of the production efficiencies.

The research hypothesis can be presented as follows:

$H_0$: “The adoption and implementation of the Lean Six Sigma system in the manufacture of ice cream sticks at DZPL is possible and it will result in an improvement of efficiencies (yields)”

$H_1$: The adoption and implementation of the Lean Six Sigma system in the ice cream sticks production section will not result in an improvement of the production efficiencies (yields). Statistical tests will be used to assess the data.

1.9 Significance of the study

In Zimbabwe, organizations are facing an environment of rapid change and dramatically increasing customer expectations while the availability of internal resources is declining. The decline in human resources base is exacerbated by mass exodus of the technical and professional skills from the country to neighbouring countries whose economic positions are more stable.
In order to overcome these challenges and remain competitive in the marketplace, a more sophisticated approach to performance improvement is needed. Introduction of Lean Six Sigma System at ice cream sticks production line at DZPL, which involves training the internal human resource base on improving their analytical skills, may not only enhance product quality but also ensure a faster creation of value at the lowest possible cost; thus creating a competitive advantage through reduction in wastages resulting in more efficient processes, this frees up the profit margins.

The success of the Lean Six Sigma System will benefit the nation in many ways. Firstly, the prices of the ice cream sticks and other nutritious dairy products produced by DZPL will be affordable because of the reduced unit cost of production and hence the imported substitutes will have to follow suit in lowering the prices. Secondly, other organizations in the country would adopt the system and this will improve efficiencies in the whole industry. Improved efficiencies in the industry translate to production of goods and services that compete favourably in the export market, thus reducing the negative balance of payment in the country and the trade deficit and hence raise the standard of living of the population.

At a global level, the significance of Lean Six Sigma System in the food manufacturing business will ensure less starvation in the world. The improved efficiencies will have a positive knock-on effect on the prices thus ensuring affordability of nutritious food and beverages to the poor. This will also guarantee food safety by reducing product contamination in the supply chain of the product – i.e., from manufacturing to marketing.

At company level, the study will help DZPL to be more competitive in the market where the imports from South Africa are wreaking havoc, this has been exacerbated by the continued fall of the South African rand which has been recently aggravated by the deliberate move to devalue the Chinese Yen by the Chinese equivalent of the reserve bank or the central bank. The Lean Six Sigma system will help to reduce the cost of production at the firm level, this would help to open up margins and ensure better profits are realised and hence business continuity. Many companies in Zimbabwe have closed shop because they failed to adapt to the tough economic environment in Zimbabwe, this study is a step in the right direction that DZPL can take before they find themselves in a quagmire where reactive measures will not be of any use. The Lean Six Sigma strategy will help the organisation to be pro-active.
1.10 Limitations of the study

The novelty of the investigative topic (Lean Six Sigma) in Zimbabwe is likely going to restrict the researcher from getting practical examples within the country. This may be exacerbated by the unfavourable economic climate in the country which may prohibit the researcher from travelling to neighbouring countries such as South African to have first-hand experience of the Lean Six Sigma System. The objectives that are set by Lean Six Sigma System are too ambitious and therefore, it is most likely that top management may view them as unachievable and thus resulting in lack of commitment at that level. The time factor is also likely to limit this research, the system requires thorough research and training, this might result in a limitation to the researcher because the time is not very flexible since this research is done on a part time basis, the researcher is supposed to be at work as well.

1.11 Scope of the study

The research concentrates on data obtained from daily production figures at Harare Dairy on the ice cream sticks production line. The data will cover a 3.5 year period, i.e. from January 2012 to half year end of 2015.

1.12 Structure of the dissertation

This research paper is divided into five chapters; the first chapter is an introduction to the research paper. The first chapter deals with background to the study, statement of the problem, research objectives and research questions, a hypothesis will be declared. A research scope will be outlined and also the study will be justified. In the second chapter, relevant literature will be reviewed, the study has to be grounded in a theory hence the theoretical underpinnings of Lean Six Sigma and ISO 22000:2005 will be looked at in line with the research objectives. Chapter three focuses on the research methodology that was applied in the study. Chapter four focuses on research findings through data collection presentation and analysis. The last chapter, which is chapter five, concludes the research by looking at the conclusion and recommendations from the study.
1.13 Chapter Summary / Synthesis
The chapter started by introducing the study where the reason for embarking on this study was clearly outlined. The background to the study was then articulated, the global perspective was taken into consideration as the topic was being analysed. The research objective was then pronounced and it was followed by the specific research questions that this dissertation must answer. The whole of this study will be based on answering the research objective and the research questions. The following chapter reviews literature related to the research in question. The chapter will define relevant terms and literature to do with Lean Six Sigma and everything will be put into perspective. The literature review will also help to clarify the research gap that exists and that will form the basis for the methodology that is going to be adopted to carry out the research study.
CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter looks at theoretical background and academic views of different scholars and writers on the topic of Lean Six Sigma and its application in the manufacturing industry. The researcher is going to first review literature to do with Lean Manufacturing then literature to do with Six Sigma and then finally combine the two to look at the Lean Six Sigma literature review. The literature review was conducted in line with the research objectives, for every research objective, relevant literature was reviewed. This chapter reviewed literature to do with potential benefits that organisations can get by adopting the Lean Six Sigma system or the economic rationale of Lean Six Sigma. The feasibility of adopting the Lean Six Sigma system in terms of knowledge and expertise was assessed. The strategies that can be used to improve production efficiencies were reviewed in line with the applicability of Lean Six Sigma in the food processing industry. The specific strategies that can ensure the Lean Six Sigma system can be successfully implemented were assessed. This chapter also tries as much as possible to identify the relationship between the theoretical underpinnings of Lean Six Sigma and the real life practical situations in the manufacturing industry worldwide. A relationship with the Ice Cream sticks manufacturing process is established. The conclusion and chapter summary then follows at the end of the chapter.

2.1.1 General Overview of Six Sigma

Six Sigma is widely used to measure variations or differences in processes and it is a statistical method or measure, it also comes as a business strategy in management used mostly by manufacturing companies all around the world. This technique was developed and perfected by Motorola in 1981, with the aim of improving quality, identifying and solving the root causes of poor quality and non-conformities and minimising variation and defects within their value addition processes. Six Sigma programs are designed to achieve improvement and bettering of the competitiveness of an organisation and therefore increasing the value of the company as perceived by the buyer or consumer of the company’s goods and services. A Six Sigma program strives for the achievement of a quality level equal to (at worst) 3.4 rejects per every one million units produced, such an outcome is equivalent to is +/- six standard deviations from the mean or the average.
Motorola Corporation saved over US$17 billion in 2006 due to their adoption and implementation of the six sigma methodology. In today’s world the Six Sigma methodology has grown to be used for a variety of processes and fields of activity for the purpose of improving quality and ultimately company performance. The main of the Six Sigma methodology is to reduce variation and maintain consistency in processes. The result of such an intervention is more stability and predictable results, this allows for better planning and good decision making by management. It is argued that, the Six Sigma methodology draws its real strength from a well organised and planned management structure which is deliberately set up to execute projects such Six Sigma. Swartwood, (2003) argues that, a Six Sigma project that is properly executed will go a very long way in assisting the organisation to improve quality of their products and process efficiency with the ultimate result being a reduction in costs.

The strategy of Six Sigma relies on some basic principles that are as listed below:

- The Six Sigma methodology emphasises the need to focus on customer needs;
- The methodology continuously thrives to reduce process variation using statistical analysis;
- The need to improve, monitor and control manufacturing processes is a valid principle of this methodology;
- Six sigma encourages involvement from all levels of the organisation starting with top-level management whilst embracing the spirit of team work.

Brue & Howes, (2006) came up with definition of Lean manufacturing which is generally used and accepted and it states that Lean manufacturing is a system that aims at identifying waste and then eliminate the waste from processes, the waste is regarded as all non-value adding activities. The elimination of waste is achieved through continuous improvement initiatives such as following the customer pull when producing rather than using a production push approach, this helps to achieve excellence. It focuses on improving turnaround times by businesses in an attempt to be more responsive to customer demands and requirements while at the same time utilising and deploying fewer resources but improving products and processes. The ultimate result of such a system will be reduced costs, more productivity, and an increased production capability which is highly profitable and flexible at the same time. The net result will be an overall improvement in manufacturing and operational performance and efficiency leading to increased profitability.

In the 1990s the lean concept was popularised in American factories following a series of studies by the Massachusetts Institute of Technology. The Institute (in their studies) wanted to establish the effect (on
organisational performance) of departing from the production based approach that relies on mass production (production approach) to a more process-focused production methodology which relies heavily on discipline. According to ” Brue & Howes, (2006), “Lean” refers to removal of the “fat” (non-value adding waste) – this means that anything that does not bring any added value to the process or product or anything that the customer is not willing to pay for has to be discarded from the process, the process needs to be as lean (fat free) as possible. Lean aims to come up simple, efficient processes that add value and cut costs, hence increase profit margins from the value addition stage (production) without having to increase consumer prices. The Lean methodology aims to reduce the cost of inventory, achieve much better productivity in a flexible manner, and improve the response time by organisations to their customers. (Subramaniam, 2007).

Six Sigma, on the other hand, targets the following types of waste materialized in costs:

- Cost of rework;
- Cost of scrap;
- Cost caused by excessive cycle times and delays;
- Cost of partially satisfied or totally unsatisfied customers
- Opportunity costs as a result of unavailable resources for which to take advantage.
- Unsatisfactory product quality.

2.1.2 Six Sigma (Six Sigma Tools)

The (DMAIC) model is a typical Six Sigma tool that basically divides the problem into five phases in order to solve a given manufacturing or processing problem, the DMAIC is broken down as follows: D stands for the Define phase, M stands for the Measure phase, A stands for the Analyse phase, I stands for the Improve phase and C stands for the Control phase. This model is critical in reducing process variability and process waste, it also helps to select proper tools of analysis using statistics or other methods. (U.S. EPA, 2009, p26).

Define phase:
At this stage of the model, one is basically giving details about an identified problem (defining the problem), the existing processes are thoroughly examined and areas that need improvement are clearly spelt out and identified. This stage basically involves explicitly defining the problem for which six sigma can be applied as a solution. A problem that is well defined is as good as half solved so it is critical to define the problem well.
and accurately. The team has to be very clear of the nature and extend of the problem at hand and they have
to be agreement as a team.

**Measure phase:**
This involves assessing how deep the problem identifies goes, this is done through data collection using
relevant techniques. In other words, this stage involves collecting empirical evidence in order to assess the
extent of the problem in the target process. The current sigma level of the process will also be identified at
this stage.

**Analyse phase:**
The data collected during the measure phase is thoroughly examined by the team using a relevant statistical
tool to confirm the findings. Time lines are also drawn at this level of the process.

**Improve phase:**
At this stage, the solutions that would have been proffered after analysing the problem are implemented in
order to solve the problem. The aim will be to eliminate or significantly reduce defects and process variations
in order to improve product quality, process efficiency and organisational profitability.

**Control phase:**
This is the final stage, the aim of this stage is to keep the new and improved process in check, and it should
not spiral out of control again and result in defects and / or variations that would have been eliminated after
the improvement stage. Several control tools can be used in this phase in order to guarantee success, one such
tool is the mistake proofing “Poka-Yoke”. “This final performance should be monitored periodically to
guarantee the profits” (George L. M., 2002, ). The other technique that can be used to control the process is
the Failure Mode Efficiency Analysis (FMEA). This is a methodology that is employed to assess and analyse
the possible failures or non-conformities that may occur in a process, it also assesses the risk that these
potential failures may be associated with (Crow, K., 2002). The Pareto 80/20 methodology is a software that
was developed on the background of the Pareto Principle which stipulates that that the majority of the
challenges faced in a process normally emanate from the “vital few” causes (George L. M., 2002).
2.1.3 General Overview of Lean Manufacturing (Lean Tools)

Lean concepts are based on a number of tools, the lean tools include the post 5S programme, the 5 Ss’ are as follows: sort, set in order, shine, standardise, and sustain instead of the pre-5S programme that includes the Ss’ as listed, these are: scrounge, steal, stash, scramble, and search. The migration from the pre 5Ss to the post 5 Ss’ will have phenomenal results in terms of improving the processes and efficiency of the manufacturing process. (Lean Manufacturing Inc., 2008). In recent developments, a further S was added to the 5Ss to make it the 6 Ss’ model, the extra S is for safety. This development gave birth to the 6S model which was then introduced. The new model, the 6S model uses the five pillars of 5S and an added pillar for safety as alluded to earlier in the passage.

According to EPA, (2011) the 6S model endeavours to achieve a work environment that safe, clean, has a lot of order and is well organised. The 6S methodology draws a lot of inspiration from the five pillars (5S) of the Toyota Production System (TPS)’s visual work place model and it mostly forms the basis for implementing Lean manufacturing programmes in many situations, it is more like the foundation for such programmes. The synergy between the Lean Manufacturing methodology and the sixth S, which is safety brings about a lot of benefits to the organisation and its employees. Companies benefit from increased productivity, reduced failure rate (defects), reduced costs of production and minimised health risk for their employees as well as environmental safety. Incorporating the aspect of safety into methodologies that ensure efficient management of processes such as Lean manufacturing and Six Sigma, is a very smart way that businesses are adopting in order to improve quality and achieve waste reduction while maintaining environmental sustainability. In the Lean manufacturing process, one fundamental tool that is encompassed is Value Stream Mapping (VSM). VSM is the foundational tool in the Lean toolset, and it ensures that information flows from customers to suppliers so that customer needs are met and customers are satisfied. “VSM is generally utilised in the identification of non-value adding activities in the production process and therefore helps to make improvements for the future by developing applicable Lean practices”. (George L. M., 2002)

Another Lean tool that is very useful is what is known as the Process Cycle Efficiency (PCE), it is used to assess and evaluate the efficiency of a given process. It provides extremely useful feedback on the merit of some objects in the process and identifies areas where inefficiencies might be emanating from. George L.M., (2002) calculates PCE by diving the value-added time with the total lead time.
2.1.4 Lean Manufacturing and Six Sigma reviewed together.

There is a publication (a book) by Michael George which is entitled “*Lean Six Sigma: combining Six Sigma "quality" with Lean "speed"*”, the book emphasises the need to integrate Lean and Six Sigma in order to maximise the value that the shareholder will get from their investment. The shareholder wealth maximisation is achieved through better customer satisfaction, reduced costs, better quality, improved process speed and more funds available for investment purposes which allows business growth. His studies revealed that Lean alone is not adequate to achieve use statistical control techniques to improve quality, while, Six Sigma alone is also not adequate enough to improve process speed dramatically. The therefore implies that combining the two, Lean and Six Sigma to come up with Lean Six Sigma results in the achievement of both quality and speed, which represents a successful business model.

The integration of the Lean Principles into the Six Sigma model (or the opposite) allows for effective improvements to be made on processes. This synergy is therefore called Lean Six Sigma. Six Sigma makes use of the DMAIC model (Define, Measure, Analyse, Improve and Control) and the DMADV model (Define, Measure, Analyse, Design and Verify), the DMADV model is mainly utilised in designs and it brings out measurable and repeatable results. Lean utilises "Kaizen events" - intensive, typically week-long improvement sessions - to quickly identify and implement the improvement opportunities that would have been identified. The diagram, below illustrates the integration of Lean and Six Sigma to come up with Lean Six Sigma (LSS) as a process efficiency improvement tool in the manufacturing industry.

![Diagram of Lean Six Sigma integration](http://GoLeanSixSigma.com)

Fig 2.1 A diagrammatic representation of Lean + Six Sigma
Source: Adapted from: http://GoLeanSixSigma.com

The diagram above clearly illustrates the synergy between Lean and Six Sigma and the benefits that come with the system. The synergy results in reduction of waste and reduction of defects with a net effect of a more efficient system and process.

Lean and Six Sigma complement each other. Lean accelerates Six Sigma, delivering greater results than what would typically be achieved by Lean or Six Sigma individually. Combining these two methods gives your improvement team a comprehensive tool set to increase the speed and effectiveness of any process within an organisation – resulting in increased revenue, reduced costs and improved collaboration.

The table below indicates some few types of waste where Lean can be applied.

Table 2.1: Some type of waste on which Lean can be applied

<table>
<thead>
<tr>
<th>Type of waste</th>
<th>Content</th>
<th>Lean Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correction</td>
<td>Reworking and repairing</td>
<td>Solves the following: Inadequate process control; Poor Quality, Insufficient training; Poor product design.</td>
</tr>
<tr>
<td>Overproduction</td>
<td>Producing more than necessary or earlier than needed</td>
<td>Uses process automation; Smoothens scheduling.</td>
</tr>
<tr>
<td>Inventory and work in process</td>
<td>Excess inventory</td>
<td>Solves the following: Poor efficiencies; Product complexity; Poor scheduling; Inconsistent deliveries; Ineffective communication.</td>
</tr>
<tr>
<td>Unnecessary process steps</td>
<td>Non-value adding activities</td>
<td>Questions every step whether it is necessary</td>
</tr>
<tr>
<td>Wait</td>
<td>Being idle between operations or while a machine is processing</td>
<td>Maximizes the use of workers by analysing work load and work flow, production and maintenance schedules, sets up times and procedures</td>
</tr>
<tr>
<td>Transportation</td>
<td>Causing damage and waste of time by moving products/processes</td>
<td>Identifies the process flow, the inefficient site layout and lead-times</td>
</tr>
<tr>
<td>Motion</td>
<td>Unnecessarily shifting employees from one workplace to another or even relocating the whole organisation.</td>
<td>Focus on: Efficiency of motions; Most convenient workplace.</td>
</tr>
</tbody>
</table>

Source: Adapted from Brue & Howes (2006)
In order to determine how much variation is acceptable to customers, two sets of limits are generally set and used as reference points, these are: the lower limit known as the lower specification limit (LSL) and the upper limit known as the upper specification limit (USL), the LSL is sometimes also referred to as the lower tolerance limit (LTL) and the upper limit is similarly also referred to as the upper tolerance limit (UTL). Brue & Howes, (2006), argue that the main objective is to effectively reduce process variation to such an extent that 99.99966% of the total outputs will fall between the LTL and UTL. In addition, there are, two control limits that are generally utilised in process threshold design, these are: the lower control limit (LCL) and the upper control limit (UCL). A process whose control limits fall within the desired specification limits is said to be under control and is therefore declared to have the ability to meet specifications, in other words, the process complies with the specifications. Process capability points to a specific characteristic within a stable process and the ability of a given process to meet the given characteristic. It evaluates the ability of a process to produce outputs that comply with a given specification. It has been noted that, despite the fact that 3.4 defects per million opportunities is in reality equal an achievement of a 4.5 sigma level, allowance is given for shift overtime which needs to be compensated for hence the target is raised and upgraded to 6 sigma in light of that fact.

To accurately measure process capability, two common measures are currently being utilised, these are: Cp (process capability) and Cpk (process performance). Cp measures the breadth the process`outputs` distribution and Cpk relates the closeness of the mean value and the target value in a given process. An alternative method to measure process capability is the “ Rolled Throughput Yield’, which is generally defined as the likelihood (probability) that a single unit can pass through all the steps in a process free of defects? The cost of poor quality, another metric for Six Sigma, is the cost of not getting things done right the first time, i.e., doing things the wrong way. Both Lean and Six Sigma are anchored on the assumption that businesses are composed of processes that start with customer needs being the main motivation and should end with satisfied customers who will return and bring more business to the organisation. However, it should be noted that the Lean Six Sigma aims to achieve business growth, not just a mere reduction in production costs or costs of doing business. It aims at both effectiveness and efficiency of the methods and processes during the manufacturing process. If this approach is successfully implemented, management and staff at organisations that utilise the Lean Six Sigma approach will be motivated to not merely do things better, but to strive to do better things as well.
2.2 Potential benefits of adopting The Lean Six Sigma system

In an age of thin profit margin, corporations are diligently looking for ways to differentiate themselves from the competitors, to beat the competition, to expand market share, to create quality differences, and even to achieve zero quality defects (Ho and Chuang, 2006:167). Owing to these changes, focus has now been shifted from selling the product or services to capturing the voice of the customer most satisfactorily (Tiwari et al., 2008).

The goal of Six Sigma is value creation through quality improvement Van Iwaarden, Van Der Wiele, Dale, Williams and Bertsch, (2008). Thompson et al. (2005) and Jarman, (2005) buttress the same point by stating that the goal of Six Sigma is to increase profits by eliminating the variability, defects and waste that undermine customer loyalty and trust.

With the current Quality Management System (QMS) at Dairibord Zimbabwe Private Limited (DZPL), inefficiency losses are benchmarked using percentages and therefore, the monetary values of losses are usually high. (Kanji 2008) observes that in general, the cost of poor quality for a company is about 20 to 30% of the total cost. It has been observed that companies that adopted and applied the Six Sigma activities for long periods have benefited by achieving success which is driven by innovation activities and the result is great financial outcomes, these outcomes stem from cost reduction which is a result of process improvement” (Lee and Choi, 2006).

Several companies have achieved staggering gains through the use of Six Sigma methods, the gains have been known to run to billions of dollars, such companies include Motorola, Allied Signal and General Electric (GE) (Fisher and Nair, 2009). On the same note, (Edgeman and Dugan, (2008) observe that organisations that are serious on Six Sigma tend to impose financial return expectations so that monetisation of efforts is central to Six Sigma. The aspect of monetisation of efforts is silent with the current Food Safety Management System (FSMS), the ISO2200:2005. The whole idea of adopting and implementing the Lean Six Sigma system is to try and gain a competitive edge over our competitors in this very tough economic environment. The competitive edge will then result is smarter and more efficient production processes and at the same time guaranteed quality. This results in increased customer loyalty which translates in to increased revenue and ultimately high profitability.

Just to put things into perspective, the table below illustrates the financial benefits that other successful organisations have derived from implementing the Lean Six Sigma concept. The table below looks at empirical
evidence of the benefits that several companies obtained from implementing the Lean Six Sigma system over the years. The table below clearly reveals that the Lean Six Sigma methodology is a practical reality that can help organisations to improve their performance whilst at the same time keeping their work force highly motivated.

Table 2.2 Financial benefits of implementing Lean Six Sigma on other companies

<table>
<thead>
<tr>
<th>Company</th>
<th>Impact of Lean Six Sigma</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Electric</td>
<td>Added $2 billion in 1999 and $2.4 billion in 2000 to the bottom line</td>
</tr>
<tr>
<td>Motorola</td>
<td>Saved $1.5 billion in the first ten years of SS</td>
</tr>
<tr>
<td>Honeywell (former Allied Signal)</td>
<td>Reduced costs by $1.4 billion from 1992 through 1996; Reduced new product introduction time by 16%.</td>
</tr>
<tr>
<td>DuPont</td>
<td>Saved $1.6 billion in four years; Reduced environmental impact.</td>
</tr>
<tr>
<td>Johnson Controls</td>
<td>For the Ohio manufacturing plant: Reduced costs $800,000 per year.</td>
</tr>
<tr>
<td></td>
<td>For the automotive operations in Michigan: Saved $943,000 per year through greater engineer productivity.</td>
</tr>
<tr>
<td>Mount Carmel Health System</td>
<td>Financial return of $2.4 million after the first year of implementing SS; Saved $35, 8 million by early 2004 after investing only $600,000 in SS training and consulting.</td>
</tr>
</tbody>
</table>

Source: Adapted from Bruce & Howes (2006)

The table above clearly demonstrates that the concept of Lean Six Sigma and the benefits that come with it is not just a façade but a business reality that is worth pursuing by any organisation that is serious about improving production efficiencies and quality.

Bruce & Howes, (2006) estimate that, the return on investment that is expected in about one and a half year period (at the very minimum) from implementing the Lean Six Sigma Methodology is at pegged at three or four times the cost of implementing. Since the adoption and implementation of the Lean Six Sigma methodology involves huge financial outlays, the financial aspect is critical in determining whether to initiate the project or not, managers and shareholders are very interested in knowing the financial benefits that such a system will, i.e. Lean Six Sigma will bring to their organisations. Lean Six Sigma applied to the processes of a company can result in reduced costs of doing business, improved productivity, more satisfied and happy customers and this can stimulate growth and expansion into other geographical areas for the business, the
growth can even become international. One way to quantify the impact of implementing Lean Six Sigma to a business is computing several indicators as follows:

1. Customer satisfaction rate.
2. Customer penetration index
3. Rate at which customers are won
4. How flexible the supply chain is
5. Lead time reduction
6. Overall quality across the whole value chain.
7. Overall cost for individual processes.

Indicators from 1 to 6 refer to Six Sigma while indicator number 7 is specific to Lean. Results of implementing the Lean Six Sigma methodology can be seen in a time period that ranges from one year to three years depending on other variables such as funding, skills etc.

Nonfinancial or indirect advantages include (Bruce & Howes, 2006):

a. The customer will benefit greatly because they will access more quality, cheaper and faster services and products.

b. The employees stand to benefits immensely because they get to participate in decision making processes, their skills will improve, they will get more knowledge and they will be motivated.

c. The quality will improve and positive culture change will be born.

### 2.2.1 Challenges brought about by Lean Six Sigma implementation

Whilst the adoption and implementation of Lean Six Sigma brings about financial and other benefits to the organisation, it is worth noting that, it’s not all plain sailing, there are a number of challenges that come with this system. Companies that are implementing Lean Six Sigma methods are often able to track quality, measure and analyse data, and reduce defects (Brandt, 2007:32). When proven quality methodologies such as Total Quality Management (TQM), ISO 9000, Six Sigma, or Lean aren’t successful, it's typically not for reasons inherent in the particular methodology; more likely it is due to unrealistic expectations and failures in planning and executing the chosen methodology (Jacobsen, 2008:4).

The cornerstone to Lean Six Sigma is the belief that focusing on reduction of variation will solve process and business problems (Stephen, 2009:19). Some organizations worldwide (e.g. GE) have successfully
An investigation into strategies for transforming Dairibord Zimbabwe Pvt Ltd (DZPL) ice cream sticks production section into a Lean Six Sigma profitable enterprise after a partial initial trial.

implemented the Lean Six Sigma methodology and immensely benefited in their business due to improved market share, better customer satisfaction, improved reliability and performance of products, the financial savings that they achieved were very impressive. Other organisations could not successfully implement the methodology, due to several hurdles before, during and after implementation. Dijo and Rao (2005:722) outlined the Lean Six Sigma hurdles as follows:

a) **Failure to embrace the method by all parties (Lack of constancy of purpose)**

In some organisations, the decision to adopt and implement the Lean Six Sigma methodology may be taken at the corporate level of the organisation without involving the top management of the individual division or strategic business unit (SBU) or vice versa. This may create a discord as the SBU leaders may not be keen on implementation of such a strategy. In the same vein, the top management of a given business unit may be interested in implementation of the Lean Six Sigma methodology, but the middle level and juniors management or even the shop floor employees may not be as keen but these are the foot soldiers who drive implementation and if there is no buy in from them, the project is likely going to fail.

Froelich and Del Angel (2008:32) observe that high profile Six Sigma failures like Home Depot and 3M show that companies cannot focus on implementing Six Sigma in isolation – these examples prove the need for human involvement in corporate change. On the same note, Del Angel and Pritchard (2008:41) state that Lean Six Sigma is a set of process tools that should only be part of a more holistic process improvement strategy and for any of these tools to be used effectively, employee behaviour change must be an integral part of the program.

b) **“Foot in several boots”**

Several continual improvement initiatives at a time, such ISO 22000, Overall Equipment Effectiveness (OEE) Kaizen, and Lean Six Sigma may resultantly create a lot of confusion in the concepts and methodologies they may fail to integrate one with another resulting in failure of all. It’s better to maintain focus and avoid spread oneself too thin by having too much to do at one go.

Parkinson (2006:72) observes that Lean Six Sigma can conflict with innovation because it tries to eliminate different ways of doing things in favour of the "best" way. He goes on to state that when Lean Six Sigma starts
to be used as a universal solution for every possible challenge, it stops being a useful tool and becomes a religion; hence kills the innovative initiatives.

c) **Knowledge Gap in terms of expertise (Quality of Black Belts)**

To successfully implement Six Sigma, there is a serious need adequate knowledge, skill and expertise in the area of Six Sigma. The tools and techniques that are needed for the successful implementation of Six Sigma includes knowledge of programmes such as the Quality Function Deployment (QFD), a deeper understanding of inferential and descriptive statistics, experimental design as well people management skills. The successful implementation of Six Sigma requires a substantial quantity of Master Black Belts (MBBs) or consultants. Be that as it may, all MBBs or consultants might not possess all of the above-mentioned qualities. The same applies for Lean manufacturing, there is need for expertise. The fact that Lean Six Sigma combines Six Sigma and Lean to come up with Lean Six Sigma means that the master black belts in Six Sigma need to have knowledge in Lean as well and the Lean experts need to be equipped in Six Sigma in terms of knowledge, the integration of the two types of expertise of lack of it thereof is a critical factor in the success of Lean Six Sigma as a process efficiency improvement tool.

d) **Lack of patience to get Results**

Time will always determine the effectiveness of any methodology or programme, these new initiatives always require a certain amount of time before the full benefits are realised. Some organisations may grow restless and impatient to realise the benefits of Lean Six Sigma. The lack of patience may lead to the organisations running out of confidence and faith in the newly adopted methodology. The loss of faith and confidence in the project may ultimately lead to the project not being allocated enough funds and other resources and it may even end up being prematurely aborted or suffering a natural death due to lack of support. The other essential issue on adoption of Lean Six Sigma is change management. Considine (2006) observes that the reason many organisations fail to leverage the full potential benefits of Lean Six Sigma is because leaders fail to appreciate the enormous cultural challenges its practices demand – leaders must be top-down advocates and role models.

Management at Dairibord Zimbabwe Private Limited (DZPL) must be wary of the above hurdles which may hinder implementation of any continual improvement initiatives and in this particular case, the adoption of the
Lean Six Sigma methodology as a complementary Quality Management System in the processing of ice cream sticks.

2.3 Feasibility of adopting Lean Six Sigma in terms of knowledge and expertise

According to a theory known as the competency based perspective (CBP), for an organisation to successfully implement Lean Six Sigma, there is a definite need for resources, skills and assets necessary for such a project. The second critical element is that the company needs to possess the adequate expertise in order to integrate these assets to orchestrate a cohesive implementation of this program (Huq, 2006). The company must have in place a well-structured organisational structure so that they can totally achieve a cohesive implementation. This means that there must be a deliberate move by the company to have the have the right skills and expertise, training and related activities are very necessary.

Lee and Choi (2006:893) state that Lean Six Sigma methodology can and has always been used to effectively restructure an organisation management process. Various authors and researchers concur that the typical organizational structure for a Six Sigma System consists of the following personnel; Champions, Master Black Belts, Black Belts, Green Belts and Yellow Belts. They define the roles and functions of each level as follows:

1. **Champion** – This is the “go to person” when it comes to the day-to-day running of the Six Sigma methodology in order to improve business processes. The champion ensures that the Six Sigma project is well resourced so that it can be successfully executed. The champion needs to be someone who is senior in the organisation, someone who has real influence.

2. **Master Black belts** – This is a foot soldier who addresses some the most complex process improvement projects. He / She helps to provide solutions when the team is struggling for solutions. The MBB also helps with coaching and training to other Six Sigma experts such as the black belts and the green belts.

3. **Six sigma black belt** – This is an expert who possesses immense skills in statistical tools and methodologies which help to drive business process improvement initiatives.

4. **Six sigma green belt** – This is a Six Sigma practitioner who has been trained adequately to apply the methodology and the tools in order to achieve business process improvement. Green Belts may in
some instances act as team members under the direction of a black belt, however, in other cases, they may lead their own teams but under strict supervision of the black belt.

5. **Six Sigma Yellow Belt** – is “everyone else” and includes staff members, administrators, operations personnel, project team members, or anyone else – technical or non-technical.

It is worth noting that the above mentioned experts will then need to be trained in Lean manufacturing so that they integrate their knowledge of Six Sigma to the knowledge of Lean manufacturing so that they can successfully implement the Lean Six Sigma system.

Minter (2009:35) observes that Six Sigma projects may be the single most important way a company can improve its competitive position. The strength of Six Sigma rests in that the quality management processes are manned by thoroughly trained internal professionals. However, it should be noted that the adoption of Lean Six Sigma organisational structure calls for a significant investment in training and development of internal human resources. This is an investment that the organisation must be willing to make and if the organisation hesitates to fork out money for the training but still tries to implement the Lean Six Sigma system, the result will likely be a failure of the whole project.

### 2.3 Applicability of the Lean Six Sigma system in the food manufacturing industry.

Successful stories of Lean Six Sigma implementation are common in the general manufacturing industry worldwide especially in the developed countries. Unfortunately, the Lean Six Sigma methodology still has very limited applicability in the food industry in most countries particularly in Africa. However, a number of case studies that were done by the Lean Six Sigma experts have revealed this methodology can be successfully implemented in the food industry for continuous quality improvement (Kovach, T. & Cho, R., 2011).

A lot of academic research has been embarked on with the aim of assessing the prospects of applying Six Sigma in the food processing industry, similarly, the studies also looked at the applicability of Lean manufacturing in the food industry as well. The benefits associated with implementing these methodologies were also analysed and studied. The food and beverage industry has its own challenges that are slightly different from the general industry. Cutler, (2007) assets that the challenges that the food industry faces which may not be peculiar to other industries include very tough competition, very high variable material costs, strict regulatory requirements (naturally due to safety issues to do with food), as well as the ever present product
quality challenges. When compared to the automotive industry, there are several differences that exist in the food industry and these include issues to do with trust, the complexity of contracts between the suppliers and the buyers and the extent of involvement in the internal programmes by the suppliers. (Moore, M., 2007). The president of Escape Velocity Systems, Evan Garber said, “formulas are a proprietary competitive edge and critical to quality and safety control” (Cutler, R.T., 2007).

It is much more critical in the food industry to achieve quality control and continuous improvement using the Lean Six Sigma methodology than it is in other industries. There was an article entitled “Food Manufacturing and Six Sigma” which was written by Thomas R. Cutler, who is the president & CEO of Florida-based TR Cutler, Inc. The article alluded the fact that any food company will draw a lot of success in the food and beverage sector by developing and implementing a Lean Six Sigma methodology. Thomas introduced the DMAIC and the Quality Function Deployment (QFD) as recommendations for the food industry (Cutler, R.T., 2007). There is also an article that dwelled on the introduction of Lean in the food industry and it is from a publication called “Business Process Improvement and Innovation”. This article is testimony to the practical applicability of the Lean Six Sigma methodology in the food industry. According to the article, the critical success factors of Lean hinge around two important processes, these processes are: elimination of waste and Just in Time (JIT) delivery. A company that is involved in food although not exclusively a food company known as Tesco, which is an international grocery supply company, made use of a toolset of JIT called “Kanban”. It was through this intervention that they were able to successfully keep inventory at very low and manageable levels and they managed to achieve efficiency with a total reduction in losses (Moore, M., 2007).

An article written by Kovach T et al (2011) emphasised that the food industry can benefit from Lean Six Sigma, the article is titled “Better Processes Make Good Eats”. The authors of the article made an analysis of Six Sigma and food safety and they concluded that the two methodologies can work very well in synergy in order to achieve continuous improvement in quality in the food and beverage industry. Kovach, & Cho (2011) provided a theoretical case study on how one can start a Lean Six Sigma case and successfully implement it.

### 2.4 Strategies that can be adopted for successful implementation of the Lean Six Sigma system.

There are several factors that influence success in the implementation of Lean six sigma projects. Critical success factors in Lean Six Sigma projects include but are not limited to: training and development, culture change, top management involvement, project management and ability to put controls in place. It is a
methodology that crosses the entire company, i.e., it is not the isolated involvement of a team, but the involvement of all in the pursuit of the implementation of continuous improvement and customer satisfaction. “The adoption of the Lean Six Sigma methodology as a quality program in all agribusiness chain in general is still new, but it is important to highlight the potential of this method for improving the quality of food products and reduce production costs”. (Paiva, 2013)

The first step in implementing Lean Six Sigma (LSS) is to identify the critical components and pathway of a process. It is important for the team to look at the process capability and look for ways to bring stability into the process by reduction or elimination of variations. The vital few factors that important in order to eliminate process variations will then be tackled in order to bring consistency to the processes. It is therefore critical that the correct critical factors are identified so that time and resources are not wasted on non-critical factors which do not add any value in line with the objectives of Lean Six Sigma.

For total and effective integration of the LSS Methodology into the management system and approach, there is a real need for culture change at all levels of the organisation especially at senior and executive management levels. The top and executive managers must be willing to commit themselves in terms of their time and also they must be willing to commit resources to the Lean Six Sigma initiatives. It is imperative importance that all stake holders such as external ones that include suppliers are made part of the LSS initiative. The involvement of these external partners will help to have a seamless flow of activities and to make the whole process a lot easier and simplified. It is also importance that the aspect of experience be fully embraced in the LSS process. “Additionally, an organisation seeking to implement Lean Six Sigma should be having or hiring multi-skilled employees”. (Dumitrescu and Dumitrache, 2011) The organisation can come up with new and improved solutions, these include ways such as brainstorming, benchmarking of ideas, and analysis of data and root cause analysis.

Two basic causes of variation are known:

1) **Common causes** –Several factors that will be acting independent from each other and in a random way may cause random variation in the process which will have an impact on the efficiency of the process as well as quality.

2) **Special causes** – Unpredictable external factors may cause process variation, this kind of variation is known as non-random variation and its outcomes are unexpected.
It is important to know the type of variation that one is dealing with so that a strategy that is specific to that variation is formulated. Special variation causes need to be dealt with and removed first, these call for immediate action. The Lean Six Sigma methodology need to be extended to all of the company’s departments and processes, this can be achieved through use of integrated business support software. A good example of such a software is the SAP-ERP software, it may be used for the extension of the LSS process.

A specific example of implementing Lean strategy is the one that was adopted by Henry Ford for limiting the colours of the cars produced to only one – black. This wise move ensured consistent and cost effective production by Ford Motors because the black colour was the cheapest colour to purchase. They could also negotiate prices downwards from their suppliers since they were bulk buyers of the black paint. This move was a deliberate strategy to fully benefit from Lean manufacturing and Six Sigma. The food industry need to adopt such or similar strategies in order to fully implement the Lean Six Sigma strategy.

2.5 Chapter conclusion and summary

Lean Six Sigma is not a statistical program and it is not some abstract phenomena, it is a reality that exists in the manufacturing world today. This methodology makes use of statistical tools to analyse and interpret data. The implementation of Lean Six Sigma brings along the financial advantages to the organisation, benefits to the customers, to the employees as well as quality improvement. Lean Six Sigma does not only end in identifying and eliminating waste from within the company’s processes, it also goes further to address the source of waste. It is a system that is designed for the long term to achieve lower costs, improve processes faster, improve process efficiencies and address quality challenges. Different organisations choose to adopt different quality approaches or management approaches depending on the economy in which they operate as well as their size and financial muscle. For big companies whose problems are complex, Lean Six Sigma is one of the best solutions that they can adopt because they will also be able to meet the cost associated with the implementation of such a system. Unlike Kaizen, Lean Six Sigma is a top down approach, but Kaizen is the opposite, it is a bottom up approach. Application of Lean Six Sigma should be efficient and well planned so that it does not place a burden too big on the organisation on which it is being applied. It is important that the adoption and implementation of Lean Six Sigma keeps its focus more on the results rather than all other aspects to do with the methodology. The concept of Lean Six Sigma is a fairly new phenomenon in the food
industry but it has worked perfectly well in other industries with huge financial benefits. This concept can also be a huge success in the food industry if it is correctly implemented and supported by top management. This chapter started by introducing the layout of the chapter indicating areas to be covered by the chapter. A general overview of Six Sigma was then outlined followed by a general overview of Lean. The literature to do with the two concepts, i.e., Lean and Six Sigma was then reviewed in an overview of Lean Six Sigma. The literature review then looked at literature to do with each of the objectives of the study. Literature to do with potential benefits (both financial and non-financial) to be derived from implementing Lean Six Sigma was reviewed, some figures from those who were successful in implementing Lean Six Sigma were identified. The potential challenges that come with the implementation of Lean Six Sigma were also identified. The researcher then reviewed literature that relate to the applicability of the Lean Six Sigma system in the food processing industry and what needs to be done to ensure successful implementation. Strategies that can be adopted to ensure successful implementation of Lean Six Sigma were outlined. The following chapter looks at the methodology that will be used in the research.
CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter aims to show what the researcher actually did in order to fulfil the requirements of the research objectives, questions and hypothesis. The main purpose of this chapter is to make the research transparent and to make it possible for other researchers to replicate this study and to judge the quality of my study. This chapter reveals the theoretical and philosophical underpinnings that support how the research methodology used was chosen and how it works. This chapter will be broken down as follows, research objectives, questions, hypothesis will be re stated so as to enforce focus, research design, philosophical paradigms, approaches, strategies, data collection instruments, population and sampling, data analysis techniques, validity and reliability, limitations, ethical considerations and chapter summary.

3.2 Research Objectives

This research seeks to achieve the objectives listed below as is stated in chapter one of this paper.

Major Research Objective

The major research objective of this study is to identify strategies for transforming DZPL’s ice cream sticks production line into a lean six sigma enterprise.

Specific Objectives

1. To identify the potential benefits that DZPL could derive from implementing Lean Six Sigma on the ice cream sticks section.
2. To establish the feasibility of the adoption of the Lean Six Sigma at the ice cream section at DZPL in terms of knowledge and expertise.
3. To determine the applicability of Lean Six Sigma in the food manufacturing industry in Zimbabwe to improve production efficiencies.
4. To identify strategies that can be deployed in order to successfully implement the Lean Six Sigma system in the ice cream sticks production section.
5. To assess if the trial run of Lean Six Sigma resulted in better production efficiencies.
The methodology chosen and all the work that was done in this study was to aim to fulfil the objectives listed above.

### 3.3 Research Design

As this research was being conducted at DZPL in the Ice cream section, a research design was used and followed by the researcher. Research design outlines how the researcher strategized in order to answer the research questions in order to address the research objectives. A research design aims to outline how the researcher can conduct a study in such a manner that the information gathered is a true representation of reality. The research design that was chosen in this research paper was conducted in such a manner that similar results are obtainable if someone else is to replicate the study at a different time. In other words, according to Adams and Schvaneveldt (1991) the research design can be thought of as the ultimate structure of the research project, the glue that cements the various components together. Research design is generally categorised into three categories, i.e. exploratory, descriptive and explanatory, a more detailed insight into these categories is as outlined below.

#### 3.3.1 Exploratory Research

As the name suggests, exploratory research is all about venturing into unknown waters, it’s about seeking new insights that are useful in order to clarify the researchers understanding of the problem. Exploratory research is mostly used when problems are in their preliminary stages or when the issue at hand is new. This research did not utilise the exploratory research design because the problem under investigation was not new neither was it in its preliminary stage, as highlighted in chapter one, table 1.1, the problem has been resident with DZPL for a number of years. The above mentioned facts rule out this research design for this particular study hence no more time will be spent to this research design in this paper.

#### 3.3.2 Descriptive Research

This study also utilised descriptive research, the researcher knew exactly what needed to be studied (efficiencies in the ice cream sticks production section in relation to Lean Six Sigma) and he knew where to get the information. Secondary data that was utilised in the study was available from the DZPL SAP-ERP system with a special focus on production reports that are used to track yields (machine efficiencies) as well
as month end reports that are produced in the production section at DZPL. The variables to be studied in the research were already known to the researcher beforehand, these variables were, the ability to adopt the Lean Six Sigma methodology in order to improve efficiencies in the ice cream sticks production section. It must be noted that this study was not wholly descriptive in nature in terms of its design, but as stated earlier, it was explanatory as well.

3.3.3 Explanatory Research

This research is also called causal research it seeks to establish the causal relationships between variables, i.e., independent and dependant variables. This research utilised explanatory research design to a large extent because the variables were clearly defined. The main objective of this research was to test hypothesis (the hypothesis is stated in the next paragraph). The data that was obtained in this study was subjected to statistical tests in order to gain a full understanding of the gains that the company stands to derive from Lean Six Sigma. The study also sought to explain readiness of an organisation to adopt such a system in terms of knowledge and resources, these variables were already known so it was a question of seeking to explain if they could be used to test the proposed hypothesis in a practical manner.

3.3.4 The research design adopted

This research follows both the descriptive and the explanatory research designs as already stated. The descriptive study is utilised when the research attempts to describe how the Ice Cream stick production line at Dairibord Zimbabwe Pvt Limited (DZPL) can be transformed into a Lean Six Sigma enterprise, the fact that secondary data are available for the research further supports the adoption of the descriptive study method. At the same time, this study also utilises the explanatory research design because there is hypothesis testing involved. The hypothesis being tested is as below as outlined in chapter one:

\[ H_0: \text{“The adoption and implementation of the Lean Six Sigma system in the manufacture of Ice cream sticks will result in an improvement of efficiencies”} \]

\[ H_1: \text{The adoption and implementation of the Lean Six Sigma system in the ice cream sticks production section will not result in an improvement of the production efficiencies. Statistical tests will be used to assess the data.} \]

The results that were obtained in the study were conclusive and the variables were clearly indicated. This
research was mainly based on explanatory research than anything else although it made use of the descriptive approach as well.

3.4 Research Philosophy

According to Saunders et al., (2007), research philosophies are beliefs and assumptions about the way in which one views their world. Research philosophy determines the research strategy and methods used. Different philosophies influence researchers to study phenomena differently. The research philosophies can be classified into three categories i.e., epistemology, ontology and axiology (Saunders et al., 2007). The beliefs that a researcher has about the nature of reality is known as ontology while the means to generate or acquire knowledge is known as epistemology. On the other hand, axiology is mainly concerned about judgement about value.

3.4.1 Epistemology

Epistemology was the main focus for the purpose of this study. Epistemology can be further broken down to positivist approach, interpretivist approach and realist approach. Positivism can be defined as ‘research approaches that employ empirical methods and make extensive use of quantitative analysis or develop logical calculi to build formal explanatory theory. In positivism, two key assumptions are made, the first assumption is that reality is external and objective, the other assumption is that knowledge is based on observation. The mentioned assumptions have the following implications on the positivist research philosophy, there is independence, value freedom, operationalization of the research and generalisations can result from the assumptions.

The positivist approach was adopted in the analysis of primary data after empirical studies had been carried out.

As stated earlier, this study utilised the positivist approach because the research is mostly quantitative in nature, there was use of historical data on efficiencies in the ice cream sticks production line, the data was then analysed to come up with trends from which the problem was clearly identified. The solution offered seeks to address the challenges that were clearly articulated in the study.
3.4.2 Ontology (Praxis)

Ontology, as viewed by a realist takes the assumption that natural reality exists independently from human interference. However, a subjectivist view of ontology takes the stance that humans create their own reality. This means that subjectivist ontology assumes that there nothing that is “real” that exists on its own without having been created by humans somehow. Ontology also touches on pragmatism which tries to proffer solutions that are relevant to real life situations and at times it uses the mixed method approach as well.

3.5 Research Approaches: General Overview

Trochim (2006) points out at two basic methods that are generally utilised in research reasoning, these are the inductive approach and the deductive approach. The author defines inductive reasoning as an approach that involves movement from a specific position to a general position or understanding, deduction, on the other hand, involves moving from the general position to a specific position. Arguments that are based on rules, laws or other generally acceptable views and principles are best expressed in a deductive manner while those that rely on observation and experience are best expressed in an inductive manner. Creswell and Plano Clark (2007) point out that a person carrying out deductive research takes a top down approach, i.e. he/she works from a theory to develop a hypothesis and then adds the data to either support or deny the theory. Contrastingly, an inductive researcher is defined by the same authors as someone who takes a bottom up approach, the researcher collects views and data from different people and processes to come up with a theory that interconnects the themes. Quantitative research analysis is generally used for deductive research and qualitative research analysis id generally used for inductive research. These two research analysis techniques tend to converge in some instances, i.e., they may address the same question using different methods, they are not mutually exclusive. The authors do not seem to totally agree on the best method to be used during research and data collection.

There are two main research approaches, deduction and induction. The following paragraphs examine the two approaches in more detail, one at a time.

3.5.1 Deductive Approach (Quantitative Research)

Statistical analysis is utilised in quantitative research to establish a connection between the factors that are already known and those that need to be established via conducting research. This research was based on the
deductive research approach as will be discussed in section 3.4.3 of this paper. The researcher demonstrated a good understanding of how variables relate amongst each other through the use of descriptive and inferential statistics during collection and analysis of data for the purpose of this quantitative research. According to Gill and Johnson (2002), the deductive approach is the dominant research approach in scientific researches, it mainly involves the development of theories which then undergo thorough testing. In this study, the researcher was able to use visual representations through the use of pie charts, tables and figures as is seen from chapter one and throughout this paper. Quantitative analysis also guards against threats to validity of the research as much as possible. Deductive research is generally characterised by the following characteristics:

i. This type of research seeks to establish causal relationships between variables, for example one might seek to establish the main reason for poor production output in a manufacturing company, after studying they may discover that there seems to be a relationship between production output and delay in paying employee salaries. One can then develop a hypothesis that suggests that “low delaying employee salaries results in low production output”

ii. The other characteristic of this research is that concepts have to be operationalised in a manner that will allow for some form of quantitative measurement. In the above example, the delay in paying salaries will have to be measured against general market trends of how early or late other employees in the same sector are paid.

iii. The generalisations that are made from the study may have to be made in a way that only relates to the particular situation under study because trying to broaden such generalisations may be misleading. Since this was a case study, the generalisation from this case is peculiar to DZPL and may not necessarily be applicable to other players in the same sector

3.5.2 Inductive Research (Qualitative Research)

The case under study in this paper did not utilise the qualitative research approach and hence this paper will not dwell much on this research approach. This paper is mainly concerned about the quantitative research approach as is articulated in section 3.4.1. It must be noted though that there is no study that is purely qualitative or quantitative. However for the purpose of understanding and distinguishing the inductive research approach from the deductive research approach that was adopted for this research, the following paragraph shades some insight on the inductive approach.
Qualitative research is identified as a type of study that is normally conducted in natural environment or setting. In this study, the researcher is actually the instrument for data collection. The researcher gathers the views and opinions of the research participants and analyses these views by checking for areas of convergence or common themes among the views, he focuses on the meanings of what the participants say an uses both expressive and persuasive language to describe the process so that the participants truly understand the research and hence give their honest views and opinions (Creswell, 2005).

3.5.3 Research Approach adopted

As already stated in the paragraph above, no one study is purely quantitative or qualitative, this study however leans more on the quantitative side, a hypothesis has already been proposed in chapter one of this study. The major reason for using the quantitative approach is the mere fact that, we are dealing with a lot of figures and facts, no feelings or opinions are utilised. The production figures speak for themselves, however there is still some element of inductive reasoning in the research because of the setting in which the research is carried out. The research approach utilised self-administered questionnaires that used the Likert scale technique as will be explained more in this chapter. The data collected was analysed using the SPSS technique and it underwent the reliability and validity tests.

3.6 Research Strategy

There are several research strategies that are utilised in research in today’s world. These strategies involve experiments, surveys, case studies, grounded theory, action research, ethnography, archival research as well as practitioner research. Saunders et al (2009,) came up with a definition of research strategy which states that it is the blueprint of how the researcher intends to conduct himself/herself as he/she seeks to answer the research questions and achieve the research objectives. The strategy that was utilised in this research was based on the following factors: the knowledge gap that was identified on the subject area (Lean Six Sigma), available time, availability of resources and the underlying philosophy that the researcher had on the subject matter. In selecting the appropriate strategy for this research, three fundamental conditions were considered, these three are: the level of control that the researcher actually has on the process under research, the research questions and how they are structured as well the level of focus by the researcher on historical events (In chapter One, there is a historical perspective to the challenge as highlighted in figure 1.1 and 1.2. Given the
wide selection of strategies above, this research identified the case study strategy as the most appropriate one but it is coupled with archival analysis. The next paragraph delves deeper into the case study approach (the approach adopted for this study) in an attempt to gain more understanding of this research strategy.

3.6.1 Research Strategy adopted (Case Study)

This research is based on a case study coupled with archival analysis. Yin (2003:45) defined case study as an “empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident”. The case involving a small number of cases is known as a comparative case study while the case with one case is known as a single case study. This particular study was a single case study and generalisations that were drawn from this study are specific to DZPL ice cream sticks production set up. The case study was chosen because the researcher was not looking for comparisons or industry analysis, the problem at hand was very specific to DZPL and the study needed to tackle the identified problem head on in an attempt to unlock value that was being lost through inefficiencies in the ice cream sticks production area. In this study, the researcher sought to establish whether the organization, DZPL, was capable to adopt Lean Six Sigma System in order to improve production efficiencies in the Ice cream sticks production section. This case study also used the historical context as is highlighted in chapter one, this is normal with case studies as well. The case study approach therefore became more attractive for this study because of its versatility, the researcher was able to combine it with archival analysis to conduct this research in a natural production setting at DZPL.

The researcher notes that the case study approach also poses its own dark side. The case study approach tends to be biased, consumes too much time and lack rigor. The fact that case studies tend to be difficult to generalise as argued in literature was not really an issue for this study because the researcher was looking to draw generalisations, the idea was to find a practical solution to a real life problem in the ice cream sticks production section. To counter the issue of bias that is associated with case studies, the researcher used Archival analysis whereby the records used did not have anything to do with this research as they were recorded years ago but they still paint a picture that this research finds useful. The researcher also tried to be very objective and remained resolute on the fact that this research was not a witch hunting exercise but a real life attempt to proffer solution to a real challenge. To improve the quality of the results of a case study, which is an empirical research, certain common tests are carried out. These tests are: External validity test, internal validity test as
well as the reliability. Further discussions will be carried out on these tests later in this paper including the actual tests done on this study, these will be discussed in chapter four.

Archival analysis involves collecting secondary data then carrying out an analysis to interpret the data. For DZPL, it was relatively easy to collect such data because the organization has in place an integrated information system, the System Application Program Enterprise Resource Planning (SAP - ERP), which captures every essential data. The major module that was utilised is the Production Planning (PP) module which contains all the historical information on the production efficiencies. In this study, the researcher collected documentary data (for 6 months) on packaging materials indices for Ice Cream sticks product line, with the intention of establishing the current Sigma level that the company is operating on at this particular product line.

3.7 Time Horizons

The time that is taken to carry out research does not necessarily depend on the research methodology chosen to carry out the research.

There are two possible options when it comes to time horizons in research:

a. Cross Sectional Studies
b. Longitudinal Studies

3.7.1 Cross Sectional Studies

These are designed to obtain information on variables in different context, but at the same time. Normally, different organizations or groups of people are selected and a study is conducted to ascertain how factors differ, so it means, collecting data on more than one case at a single point of time. For example, if you are investigating labour turnover, you will need to select a sample of work groups where you know that labour turnover is different. One can then conduct statistical test to find out whether there is any correlation between variables. Cross sectional studies are conducted when there are constraints of time or resources. The data is collected once, over a short period of time before it is analysed and interpreted. Thus cross sectional studies take a snapshot of an ongoing situation.
3.7.2 Time Horizon adopted

This research made use of the cross sectional study as it relates well to a case study that is coupled with archival analysis. The fact that the information pertaining to efficiencies in the ice cream sticks production line for the six months period highlighted in chapter one was available made the cross sectional approach more relevant to this study. The cross sectional study sought to analyse the operational activities on the Ice Cream sticks production line at DZPL as they occurred in the given period. Given the challenges of poor yields and efficiencies as highlighted in chapter one, the study, through the cross sectional approach sought to establish the strategies that can be adopted to transform the Ice Cream sticks production line at DZPL into a Lean Six Sigma enterprise.

3.8 Data Collection Techniques

Data that is collected and used in research to answer research questions basically falls into two basic categories, i.e., primary data and secondary data.

3.8.1 Primary Data

Primary data refers to the data collected by the researcher from the original source (Yin, 1994). The data is usually collected through interviews, questionnaires, and observations. This means collecting primary data is very time consuming and costly. The major advantage of primary data is that it is reliable because it will be coming from people with first-hand experience or involvement on the activities that the research will be analysing. According to Saunders et al, (2007) the common techniques of primary data collection include semi structured in depth and group interviews, self-administered and interviewer administered questionnaires as well as observations.

3.8.2 Secondary data

In any research, if the required data had already been collected by some agencies or individuals and are now available in the published or unpublished records, they become known as secondary data (Saunders et al, 2007). Sources of secondary data can be categorised as internal or external sources. The financial statements and sales records of an organisation are examples of internal sources of secondary data while government
statistics, libraries and the internet can sources of external data. Secondary data offers the following advantages: it is fairly permanent in nature, less expensive to acquire and is generally easily and less timely consuming to acquire.

3.8.3 Primary and secondary data collection techniques adopted in this research

This research utilised both primary and secondary data in order to answer the research questions and address the research objectives. The primary data was collected from the organisation`s SAP ERP system and other production records that the researcher had access to. The major advantage of this primary data that was used for this study is that it was very reliable since it was coming directly from the company`s records and it was also quite inexpensive to obtain for the researcher. Interviewer and self-administered questionnaires were also utilised to collect the primary data in this research. The main difference between the two questionnaires was only the manner in which the questionnaires were delivered. The questionnaires that were self-administered were delivered to the respondents by the interviewer and the respondents had a chance to seek clarification on unclear questions, the response rate was therefore much higher than the self-administered questionnaires. In the event of the self- administered questionnaires, the respondents were left with the questionnaires and the interviewer collected the completed questionnaires after three days, the response rate was therefore much lower and in some cases, the questionnaires were not fully completed. The secondary data was collected from the organisation`s records and literature. The major source of the secondary data were the production reports that are generated on a daily basis and the cumulative reports that then become month end reports at the end of the month. The SAP-ERP system also provided very useful data and the researcher had to seek authority to utilise the information. Production process control forms that are used daily by machine operators and supervisors also provided very relevant secondary data for this study.

3.9 Population and Sampling

A target population was selected and there was a sampling method that was adopted the following two paragraphs delve deeper into target population and sampling with regards to this particular research.
3.9.1 Target Population

Saunders et al. (2005:151) defined a population as the full set of cases from which a sample is taken. The target population for this research consisted of Lean Six Sigma enthusiasts, DZPL staff members, mostly from production which was the primary area of the research focus, Senior, Middle and Line (Junior) Managers.

The production employees were the primary focus of the research, they were expected to provide key primary information based on their day to day observations and experiences in the production line. The line managers were then expected to provide broader information in terms of the implications of the low yields or inefficiencies on the production line and the likely causes.

The senior management was then supposed to provide buy in to the possibility of adopting the Lean Six Sigma method after having been aware of the potential financial benefits of adopting the Lean Six Sigma system.

3.9.2 Sampling

Saunders et al. (2005) define a sample as a subgroup or part of a larger population. Sampling is therefore a process of selecting a subgroup of the observations from a population to determine the characteristics. The two broad categories of sampling designs are probability sampling and non-probability sampling.

3.9.3 Probability Sampling

Probability sampling is defined as a sampling technique in which each member in the target population has a known chance of being selected and that chance is not zero. There are various types of probability sampling, these include simple random sampling, systematic sampling, stratified random sampling, and cluster sampling. This research adopted simple random sampling in conjunction with other techniques as will be highlighted in section 3.8.6

3.9.4 Non-probability Sampling

In contrast a non-probability sampling technique is defined by Saunders et al. (2005) as the sampling technique in which each member of the target population has an unknown chance of being selected. Under the umbrella of non-probability sampling, we have methods such as quota sampling, purposive sampling, snowballing, self-selection and convenience sampling method.
3.9.5 Sampling Frame

A sampling frame was designed to assist the researcher to collect data that was representative of the views of management and staff at DZPL at the various levels of management or hierarchy within the company as it were.

The sampling frame that was used for this study is as highlighted in table 3.1 below

*Table 3.1: The sampling frame that was used to collect data from DZPL staff and management*

<table>
<thead>
<tr>
<th>Strata</th>
<th>Population Size(N)</th>
<th>Age(Years)</th>
<th>Location</th>
<th>Sample Size (n)</th>
<th>Selection Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Senior Management</td>
<td>10</td>
<td>30-65</td>
<td>Harare</td>
<td>4</td>
<td>40%</td>
</tr>
<tr>
<td>Middle management</td>
<td>20</td>
<td>25-55</td>
<td>Harare</td>
<td>6</td>
<td>30%</td>
</tr>
<tr>
<td>Junior Management</td>
<td>20</td>
<td>25-50</td>
<td>Harare</td>
<td>15</td>
<td>75%</td>
</tr>
<tr>
<td>Non Managerial</td>
<td>42</td>
<td>18-60</td>
<td>Harare</td>
<td>8</td>
<td>19%</td>
</tr>
<tr>
<td>Others(Attachés)</td>
<td>4</td>
<td>18-25</td>
<td>Harare</td>
<td>2</td>
<td>50%</td>
</tr>
</tbody>
</table>

It must be noted that the big N represents the population size from which the sample was selected and the small n represents the actual sample that was randomly selected for this study.

3.9.6 Selection method (Sampling techniques)

The respondents were divided into different categories (strata) based on their level of management or lack thereof and the samples were randomly picked from within these strata. The method used to select the samples was stratified random sampling and the respondents were all conveniently located in Harare at the Harare Dairy factory. This method therefore encompassed both the probability sampling (stratified, and random sampling) as well as non-probability sampling (convenience). The selection of respondents was mainly based on their functional roles in the organisation. The targeted respondents were mostly production employees,
An investigation into strategies for transforming Dairibord Zimbabwe Pvt Ltd (DZPL) ice cream sticks production section into a Lean Six Sigma profitable enterprise after a partial initial trial.

most the junior managers who are on the ground most the time. When it came to the operatives, the numbers were limited because some of them do not possess adequate understanding and literacy to correctly answer the research questions.

3.10 Data collection

The data was that was collected was interval scaled data. It was collected through the use of 1-5 Likert scale. On this Likert scale, a 1 is considered to reflect a stronger perception than a 2. A 1 represents that the respondent strongly agreed with the assertion of the question while a 5 was the other extreme whereby the respondent strongly disagreed with the assertion of the question. The questionnaire was divided into two sections, the first section was mainly to do with demographic information of the respondent, it was concerned about the respondent’s level of management or lack of it thereof, experience within DZPL and knowledge about Lean Six Sigma. The second section involved data collection and there were four sections that commensurate with the research objectives that are highlighted earlier in this chapter and in chapter one. The first section which contained questions to do with benefits of adopting Lean Six Sigma in order to improve production efficiencies in the Ice cream stick production section had 32 questions that were broken down into 3 segments. The second section which was mainly concerned about knowledge and expertise of Lean Six Sigma had six questions. The third section that tallies with objective three which was checking on the applicability of Lean Six Sigma at DZPL had 17 questions. The fourth and final section which tallies with objective number four had 11 questions. All in all the questionnaire had 66 questions that were directly related to the findings obtained using SPSS, the other three questions were on demographics.

3.10.1 Data Analysis techniques

The Likert scale technique that was utilised is a psychometric test that seeks to measure opinions and beliefs of people. The Likert scale offers the distinct advantage that people are not forced to express an either or opinion because there is a scale, they can choose to be neutral if the not sure as is the case with option number 3 in our questionnaire. The Likert scale is also easy to understand and quick to complete because there are no open ended questions, this was the most appropriate method especially when we consider the time constraint because the respondents were at work during the data collection. After data was collected from the questionnaires, a descriptive analysis using the Statistical Package for Social Scientists (SPSS) and Excel Spreadsheets was carried out. The researcher used the statistical analytical methods such as graphs, simple
tables and pie charts to present and interpret the results. The results were the analysed and discussed in order to answer the research questions. Although good, it was noted that the Likert scale has a disadvantage that it’s difficult for a respondent to quantify how a 2 differs from a 3 or if a rating of 4 is twice as strong as a 2, this was neutralised by researcher explaining to respondents since it was interviewer administered.

3.11 Validity and Reliability

The data collection instrument (questionnaire was tested for validity). Validity addresses two issues which are: 1) the level of accuracy of the data collection technique or method that is used to conduct a study in measuring that which it is intended to measure. 2) Do the actual research findings really conform to what they claim to be and if so to what extend? The researcher established whether the research instrument was appropriate by using the principles from two types of validity; face and content validity, as follows:

a) **Face validity** – calls for relevancy of the research instrument to the participants in the study. According to Saunders et al. (2005:309), face validity verifies whether the questionnaire appears to make sense. A pilot study was carried out whereby 10 questionnaires were distributed to the Shift Line Controllers (Junior Managers) and they were asked to make sense of the questionnaire and ask as many questions as possible so that they are clear. During the pilot study, the respondents were asked to comment frankly on the relevance, balance and adequacy of the research instrument in relation to the research objectives;

b) **Content validity** – which is similar to face validity except that the researcher must seek the opinion of experts in the field on the adequacy of his/her research instrument. This was done through consultation with the Six Sigma Expert at DZPL.

Reliability was tested using the Cronbach Alpha test and the results showed that the test was reliable as is presented in table 4.0 in chapter four.

3.12 Limitations

The researcher administered the research instrument to most (i.e 87.5% of the respondents) of his subordinates and colleagues as well as superiors. The ethical issues to deal with participants’ rights were observed. Since most were subordinates, it was most likely that they could find it difficult to exercise their rights, i.e., the right to decline to take part and the right to withdraw from participation. This was circumvented through use of
self-administered questionnaires and reassurance of anonymity – the questionnaire was collected through a collection box.

Secondly, the novelty of the investigative topic (Lean Six Sigma) in Zimbabwe restricted the researcher from getting practical examples within the country. This was exacerbated by the unfavourable economic climate in the country which prohibited the researcher from travelling to neighbouring countries such as South African to have first-hand experience of Lean Six Sigma System. A thorough review of current and relevant literature was done to get a broader understanding of the topic.

Lastly, the objectives that are set by Lean Six Sigma System are too ambitious and therefore, it was most likely that top management would view them as unachievable and thus resulting in lack of commitment at that level. To those at lower levels of management, implementing this intense and rigorous system would mean increased accountability and thus resulting in resistance to change. The researcher designed the semi-structured interviews and the research instrument using appropriate guidelines besides equipping himself with convincing knowledge of the subject matter.

3.13 Ethical Considerations

To ensure that the research does not violate ethical considerations, the researcher used an introductory letter in which he clarified that the information sought was strictly for academic purposes. The introductory letter was stamped by the University and had the student registration number to confirm studentship, the contact details of the Graduate School of Management were also added to the letter so that the respondents could check with the University if they feel uncomfortable so that they are totally satisfied before giving out the information. The letter also specified that they would no attempt to use the information for publication in the media or leak it to the organisation’s competitors, social media or any other platform that has nothing to do with the academic research. The questionnaire did not require the respondents to give their names, this was done to protect the respondents’ identity in line with ethical considerations of the research.
3.14 Chapter Summary

This chapter started by stating the research objectives in order to enforce focus of the whole study. The various research designs were explained and the research design adopted for this study was explained and the reasons it was chosen were articulated. The research philosophical paradigms were explained and the different research approaches were noted with the approach chosen for this study explained. A look at the various research strategies was the next issue on the chapter and the strategy used for this chapter was explained. The chapter then looked at the data collection instruments used in the study, how the population was chosen and the sampling technique adopted in the study. Data analysis techniques were looked at. The concept of reliability and validity was also explained and the limitations that the researcher faced were also explained in this chapter. Finally, it was explained how the research managed to deal with ethical considerations. The next chapter will reveal the research findings, analysis of the findings and the discussion to go with the findings.
CHAPTER FOUR: RESEARCH FINDINGS, ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter presents the findings of the research and the discussions that are born from such findings. This chapter starts by computing the response rate from the study followed by a computation of the demographics of the respondents in terms of their positions, experience and knowledge of LSS. The findings from the study based on all the four objectives is then discussed based on descriptive statistics carried out. This chapter forms the foundation for research conclusions and recommendations of the study. There is deliberate attempt to link the discussions to the objectives and literature review.

4.2 Response Rate

A total of 40 questionnaires were sent to Management and staff of Dairibord Zimbabwe Private Limited. Thirty-five questionnaires were successfully completed by both staff and management. Some of the respondents returned their questionnaires late and the researcher had already completed the analysis so those questionnaires were not considered in the data analysis. The questionnaires returned and correctly completed represents a response rate of 87.5%. The response rate and sample size are large enough to warrant validity and reliability of the research findings. The responses were > 30 hence this qualifies to be a large sample.

4.3 Demographics of Respondents

The demographics of respondents in terms of their positions in the company, experience and knowledge of Lean Six Sigma were noted.
4.3.1 Position of Respondents in the Organisation

Figure 4.1 below shows the positions of respondents at Dairibord Zimbabwe Private Limited who participated in this survey.

![Pie Chart showing the positions of respondents in the organisation.](image)

**Figure 4.1: Position of Respondents in the Organisation**

The figure above shows that the majority of the respondents, 62.9% that participated in the survey are junior managers and 22.9% are middle managers and 8.6% were senior managers. Minority staff and management of DZPL represented by 5.7% indicated their positions in the organisation as senior managers. Since the majority of the respondents are managerial, this gives the research a positive dimension as they have the feasibility of integrating the Lean Six Sigma system as a complimentary system to the ISO 22000:2005 Food Safety management system in order to improve the production efficiencies in the manufacture of ice cream sticks at Dairibord Zimbabwe Private Limited. It is from the management that such initiatives are driven so the fact that most respondents were managerial is a good indicator.
4.3.2 Duration serving DZPL

The times that the respondents spent working at Dairibord Zimbabwe Private Limited who participated in this survey are presented below.

![Pie chart showing duration serving DZPL](image)

**Figure 4.2: Duration serving DZPL**

Figure 4.2 above shows that 37.1% research participants have spent six to ten years serving Dairibord Zimbabwe Private Limited and one to five years. On the other hand 20% respondents argued that they have spent above ten years working at DZPL and 5.7% said they have served DZPL for less than a year. This shows that the participants have considerable experience working for DZPL to give valid responses for the research.

4.3.3 Awareness of Lean Six Sigma

The research sought to determine extent to which DZPL staff (and management) is aware of Lean Six Sigma. The findings from the research are presented in the figure below.
The majority of the respondents 57.1% indicated that to a lesser extent they are aware of Six Sigma and 28.6% respondents indicated to a moderate extent they are aware of Six Sigma. Moreover 11.4% of the staff and management of DZPL were not sure if they are aware of Lean Six Sigma and 2.9% argued that to a greater extent they are aware of Lean Six Sigma. The findings lead to the implication that to a lesser extent staff and management of DZPL are aware of Lean Six Sigma. Low awareness of DZPL staff to Six Sigma is contrary to findings by Minter (2009:35) who observes that Six Sigma projects may be the single most important way a company can improve its competitive position. The strength of Six Sigma rests in that the quality management processes are manned by thoroughly trained internal professionals. On the other hand Huq, (2006:277) states that according to the competency based perspective (CBP), a company first needs to have the assets, skills, and resources to launch the Lean Six Sigma program, and second, it needs to have the expertise to integrate these assets to orchestrate a cohesive implementation of this program. In order to achieve this cohesive implementation, a well-structured organizational structure is to be put in place.

4.4 Reliability Tests

This section provides an analysis of the reliability of the data which was collected and captured for analysis.
Reliability Statistics

Table 4.1: The Cronbach Alpha test results

<table>
<thead>
<tr>
<th>Cronbach’s Alpha</th>
<th>N of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.934</td>
<td>66</td>
</tr>
</tbody>
</table>

The Cronbach Alpha value from table 4.1 above is 0.934 which is high enough to warrant validity of the data set being used for this analysis.

4.5 Benefits of applying Lean Six Sigma to the Ice Cream Sticks production Line

There are several benefits that can be derived from implementing Lean Six Sigma in the ice cream production line, the research finding below elaborate.

4.5.1 Benefits derived from the implementation of Lean Six Sigma (LSS)

Lean Six Sigma (LSS) is argued to bring some benefits. As a result the research investigated the benefits that can be derived from the implementation of LSS according to the view of the research participants.

4.5.1.1 LSS and Costs management

The figure below gives a graphical view of the responses that were given in the research on the benefit in terms of costs management that LSS has brought to DZPL.
According to 68.6% of the respondents they were not sure if LSS gives the benefit of improved reduction of production costs to DZPL while 2.9% agreed and 28.6% strongly agreed. On the other hand 68.6% respondents agreed that a benefit brought about by the implementation of LSS at Ice Cream sticks is improvement in yields for mix consumed in production and 28.6% strongly agreed. Findings also show 8.6% of staff and management of DZPL were not sure if the implementation of LSS improves yields for the mix that is consumed during Ice Cream Sticks production. However 57.1% of the respondents agreed that LSS improves yields for the mix that is consumed during Ice Cream Sticks production and 34.3% strongly agreed. On the other hand 2.9% respondents disagreed to the fact that LSS leads to improved total costs for each process at DZPL, 8.6% were not sure while 68.6% respondents agreed that LSS improve total costs for each process and 20% strongly agreed.

The research findings and analysis above lead to the implication that benefits that can be derived from the implementation of LSS at DZP at the ice cream sticks production line resulting in better yield for mix as well as for wrappers (packaging) that is used in production. This will lead to an improvement in total costs incurred during production hence making the company more competitive. This supports the argument that Lean Six Sigma fairly improves reduction of production costs. The study findings are further enhanced by Van Iwaarden, Van Der Wiele, Dale, Williams and Bertsch, (2008) who state that the goal of Six Sigma is value.
creation through quality improvement. Furthermore in line with the study findings, Thompson et al. (2005) and Jarman, (2005) buttress the same point by stating that the goal of Six Sigma is to increase profits by eliminating the variability, defects and waste that undermine customer loyalty and trust. The financial benefits of implementing Lean Six Sigma on other companies Benefits of LSS are further outlined by Bruce and Howes (2006) who state that Honeywell (former Allied Signal) reduced costs by 1.4 billion from 1992 through 1996 and reduced new product introduction time by 16%.

4.5.1.2 LSS and Profitability

The research investigated if LSS increases profitability, customer penetration rate and quality of ice cream sticks across the value chain. The views of the survey participants are presented in the figure below.

![Chart showing the views of survey participants](image)

**Figure 4.5: LSS and Profitability**

The figure above shows that 28.6% respondents strongly agreed and 62.9% agreed while 5.7% were neutral and 2.9% disagreed to the fact that LSS increases profitability. Also the study findings reveal that 11.4% of the staff and management of DZPL strongly agreed and 60% agreed that LSS will improve customer penetration rate. However 25.7% were not sure if LSS will improve customer penetration rate and 2.9%
disagreed to the fact that LSS will improve customer penetration rate. Moreover 22.9% staff and management of DZPL strongly agreed and 71.4% majority agreed that benefits that Lean Six Sigma will bring to the organisation is an improvement in the quality of ice creams across the value chain while 5.7% were not sure.

This shows that at DZPL, increase in profitability, improvement in customer penetration rate and improvement in quality of ice cream sticks across the value chain may be derived from the implementation of Lean Six Sigma. It is estimated that one could expect a minimum return on investment of three or four times the costs of implementing Lean Six Sigma (LSS) in around one year and a half (Bruce & Howes, 2006). The whole idea of adopting and implementing the Lean Six Sigma system is to try and gain a competitive edge over our competitors in this very tough economic environment. The competitive edge will then result is smarter and more efficient production processes and at the same time guaranteed quality. This results in increased customer loyalty which translates in to increased revenue and ultimately high profitability. Moreover Bruce and Howes (2006) state that the financial benefits (profitability) that LSS brings to companies is evidenced by Mount Carmel Health System which had a financial return of $2.4 million after the first year of implementing Six Sigma; saved $35, 8 million by early 2004 after investing only $600,000 in Six Sigma training and consulting. The majority of the respondents see the potential profitability that comes with LSS, this is a good indicator as well.

4.5.1.3 LSS and benefits to Production Losses

The research investigated the production benefits that maybe derived from the implementation of LSS at Ice Cream sticks production at DZPL. The findings from the staff and management of DZPL staff are presented in the figure below.
Figure 4.6: LSS and Production

The findings above reveal that 71.4% staff and management of DZPL agree that LSS will reduce production losses and 22.9% strongly agreed. However 5.7% of the respondents were not sure if LSS will reduce production losses. Moreover 51.4% respondents agreed that LSS will improve production efficiencies and also 34.3% strongly agreed. On the other hand 8.6% of the staff and management of DZPL were not sure if implementation of LSS at DZPL will reduce production losses and 5.7% disagreed.

The findings demonstrates that DZPL can achieve a reduction in production related losses and an increase in production efficiencies by adopting the LSS methodology. In light of the research findings Paiva, (2013) argues that even though the LSS system is still new in the agribusiness, it reduces production losses and increases quality. To augment the research findings, Moore, (2007) argues that the Just in Time (JIT) delivery and the elimination of waste are critical in Lean. Tesco, an international grocery supply company, adopted a toolset of JIT called “Kanban which assisted them to maintain low inventory levels and increased efficiency resulting in less financial losses. These are the benefits that maybe derived from the implementation of LSS at Ice Cream sticks production at DZPL.

4.5.2 Benefits in implementing LSS in ice cream sticks production

Research participants were asked by the researcher in their own view what the benefits of implementing LSS in ice cream sticks production are and the responses are presented in the table and figure below.
4.5.2.1 Production improvements

The table below summarises the production improvements that can be realised as a result of Lean Six Sigma

Table 4.2: Production improvements that can be achieved through LSS

<table>
<thead>
<tr>
<th>LSS implementation production improvements</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>limited scrap</td>
<td>17.1%</td>
<td>68.6%</td>
<td>8.6%</td>
<td>5.7%</td>
<td></td>
</tr>
<tr>
<td>no excessive cycle times and delays</td>
<td>20%</td>
<td>48.6%</td>
<td>31.4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>maximise the use of employees and output</td>
<td>14.3%</td>
<td>48.6%</td>
<td>22.9%</td>
<td>11.4%</td>
<td></td>
</tr>
<tr>
<td>get rid of bad production scheduling</td>
<td>22.9%</td>
<td>40%</td>
<td>31.4%</td>
<td>5.7%</td>
<td></td>
</tr>
<tr>
<td>remove inefficiencies within the value chain</td>
<td>25.7%</td>
<td>48.6%</td>
<td>14.3%</td>
<td>2.9%</td>
<td>8.6%</td>
</tr>
</tbody>
</table>

Table 4.2 above shows that 68.6% of the respondents agreed and 17.1% strongly agreed that implementing LSS in ice cream sticks production will achieve limited scrap, 8.6% were neutral and 5.7% disagreed. Also 20% respondents strongly agreed and 48.6% agreed that implementing LSS in ice cream sticks production will achieve no excessive cycle times and delays and 31.4% were not sure. Research findings also indicated that 14.3% respondents strongly agreed and 48.6% agreed while 22.9% were neutral to the fact that implementing LSS in ice cream sticks production will maximise the use of employees and output per employee. More so 22.9% of staff and management of DZPL strongly agreed and 40% agreed that implementing LSS in ice cream sticks production will get rid of bad production scheduling and 31.4% disagreed and 5.7% disagreed on the same fact. The study also found out that 25.7% respondents strongly agreed and 48.6% agreed that implementing LSS in ice cream sticks production will remove inefficiencies within the value chain, on the contrary 2.9% disagreed and 8.6% strongly disagreed.

The analysis above leads to the research implication that adopting the LSS in ice cream sticks production at DZPL will achieve the following: limited scrap, no excessive cycle times and delays, maximum use of employees and output per employee, riding the company of bad production scheduling and removal of inefficiencies within the value chain. In line with the study findings Subramaniam, (2007) emphasises the aim of Lean being creation of simple, value adding and efficient processes that will ultimately result in high productivity, high flexibility, and low inventory costs. Six Sigma on the other hand according to Economia.
Seria Management Volume 14, Issue 2, (2011) targets the following types of waste materialized in costs; rework; scrap; excessive cycle times and delays; unsatisfied customers with the goods and/or services provided; cost of opportunities lost due to lack of resources to take advantage of and poor quality. This is in route with the research findings. On the other hand Brue and Howes (2006) are of the view that LSS solves the production problems of inefficiencies; product complexity; bad scheduling; unreliable deliveries and poor communications.

4.5.2.2 Customer care

The figure below gives the customer care benefits of implementing LSS in ice cream sticks production.

![Customer care benefits of implementing LSS in ice cream sticks production](image)

**Figure 4.7: Customer care**

Majority staff and management of DZPL (60%) agreed that is no unsatisfied customers and 11.4% strongly agreed to the same fact. On the other hand 22.9% respondents were neutral and 5.7% disagreed to the fact that customer care benefits of implementing LSS in ice cream sticks production is no unsatisfied customers. According to 17.1% respondents they strongly agreed and 40% agreed that implementing LSS in ice cream
sticks production will achieve the elimination of unreliable deliveries, 20% were neutral and 22.9% disagreed. Results also show that 14.3% staff and management of DZPL strongly agree and 45.7% agreed that customer care benefit that can be achieved in implementing LSS in ice cream sticks production is communication improvement and 22.9% were neutral while 17.1% disagreed. Moreover study findings also reveal that 5.7% staff and management of DZPL strongly agreed and 65.7% agreed that benefit that can be achieved in implementing LSS in ice cream sticks production is that quality of products will be good. However 25.7% of the respondents were not sure and 2.9% disagreed to the fact that implementing LSS in ice cream sticks production will achieve good quality.

The results show that implementing LSS in production has an impact on customer care. The benefits of LSS to customers include: reduced unsatisfied customers, elimination of unreliable deliveries and improvements in quality of goods among others. The literature that supports this finding comes from a book called Lean Six Sigma, combining Six Sigma quality with Lean speed. In the book, it is argued that integration of Lean and Six Sigma will bring down costs, improve quality, and improve process speed and customer satisfaction. Furthermore the value of the customer in LSS is outlined by Ho and Chuang, (2006:167) who argue that in an age of thin profit margin, corporations are diligently looking for ways to differentiate themselves from the competitors, to beat the competition, to expand market share, to create quality differences, and even to achieve zero quality defects. On the other hand owing to these changes, Tiwari et al., (2008) argue that the focus has now been shifted from selling the product or services to capturing the voice of the customer most satisfactorily.

4.5.3 The extent to which the Lean Six Sigma system can help solve operating challenges at DZPL

The study sought to find out the extent to which the application of Lean Six Sigma can help solve operating challenges at DZPL. The views of the research participants are analysed and presented below.

4.5.3.1 Solving production processes challenges

There are several challenges that are encountered in the production processes and the study wished to seek employees’ opinions on how good LSS will be to solve such challenges.
Table 4.3: Solving production processes challenges

<table>
<thead>
<tr>
<th>Solving production processes challenges</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>inadequate process control</td>
<td>17.1%</td>
<td>45.7%</td>
<td>31.4%</td>
<td>5.7%</td>
</tr>
<tr>
<td>poor quality of products</td>
<td>11.4%</td>
<td>57.1%</td>
<td>22.9%</td>
<td>8.6%</td>
</tr>
<tr>
<td>high wastage rate in production</td>
<td>20%</td>
<td>42.9%</td>
<td>28.6%</td>
<td>8.6%</td>
</tr>
<tr>
<td>High utility costs</td>
<td>28.6%</td>
<td>34.3%</td>
<td>17.2%</td>
<td>20%</td>
</tr>
<tr>
<td>Inefficient utilization of human capital</td>
<td>20%</td>
<td>65.7%</td>
<td>8.6%</td>
<td>5.7%</td>
</tr>
<tr>
<td>Unclear expectations by employees on what is expected from them</td>
<td>14.3%</td>
<td>37.1%</td>
<td>34.3%</td>
<td>14.3%</td>
</tr>
</tbody>
</table>

The table above shows that 17.1% of the staff and management of DZPL strongly agree and 45.7% agree that the application of Lean Six Sigma can help to solve the challenge of inadequate process control while 31.4% were neutral and 5.7% disagreed. Findings also show that 57.1% staff and management of DZPL agreed and 11.4% strongly agreed that implementation of LSS at DZPL will help solve the challenge of poor quality of products, 22.9% respondents were not sure and 8.6% disagreed. Moreover 20% respondents strongly agreed and 42.9% agreed that high wastage rate in production will be reduced at DZPL through the application of LSS. According to 28.6% survey respondents they strongly agreed and 34.3% agreed that the challenge of high utility costs at DZPL will be reduced through the application of LSS. However 17.2% and 20% were not sure and disagreed respectively to the fact that the challenge of high utility costs at DZPL will be reduced through the application of LSS. According to 20% of the respondents they strongly agreed and 65.7% agreed that inefficient utilization of human capital is a challenge that can be solved through the application of Lean Six Sigma at DZPL, on the contrary 5.7% disagreed and 8.6% were neutral. Furthermore 14.3% respondents strongly agreed and 37.1% agreed that an unclear expectation by employees on what is expected from them is a challenge that can be solved by the implementation of LSS at DZPL. On the other hand 34.3% were neutral and 14.3% disagreed to the fact that an unclear expectation by employees on what is expected from them is a challenge that can be solved by the implementation of LSS at DZPL.
The operating challenges that can be solved at DZPL by the implementation of LSS are implied from the research findings and analysis above as inadequate process control, poor quality of products, high wastage rate in production, high utility costs, inefficient utilization of human capital and to a lesser extent the problem of unclear expectations by employees on what is expected from them. In line with the study findings Minter (2009:35) observes that Six Sigma projects may be the single most important way a company can improve its competitive position by solving production process challenges. The strength of Six Sigma rests in that the quality management processes are manned by thoroughly trained internal professionals. However, it should be noted that the adoption of Lean Six Sigma organizational structure calls for a significant investment in training and development of internal human resources. This is an investment that the organisation must be willing to make and if the organisation hesitates to fork out money for the training but still tries to implement the Lean Six Sigma system, the result will likely be a failure of the whole project. On the other hand Jacobsen, (2008:4) argues that when proven quality methodologies such as Total Quality Management (TQM), ISO 9000, Six Sigma, or Lean aren’t successful, it’s typically not for reasons inherent in the particular methodology; more likely it is due to unrealistic expectations and failures in planning and executing the chosen methodology.

4.6 Knowledge and expertise to apply Lean Six Sigma

The level of knowledge and expertise on Lean Six Sigma was also under scrutiny as this is vital for successful implementation.

4.6.1 Management capability and readiness

The research further investigated the extent of the managements’ knowledge and expertise to apply Lean Six Sigma. The findings from the survey participants are presented below.
An investigation into strategies for transforming Dairibord Zimbabwe Pvt Ltd (DZPL) ice cream sticks production section into a Lean Six Sigma profitable enterprise after a partial initial trial.

Figure 4.8: Ability of management to convince people and fully integrate LSS to existing systems

The majority of the survey respondents 60% agreed and 8.6% strongly agreed that management at DZPL will be capable of integrating Lean Manufacturing and Six Sigma as a process efficiency improvement tool. On the other hand 2.9% disagreed, 8.6% strongly disagreed and 20% were not sure to the research fact. Moreover the research found out that 20% of the respondents strongly disagreed and 5.7% disagreed to the fact that management is capable of convincing and managing people effectively while 28.6% were neutral. On the other hand 42.9% majority respondents agreed and 2.9% strongly agreed that management is capable of convincing and managing people effectively.

This analysis above shows that management at DZPL will be capable of integrating Lean Manufacturing and Six Sigma as a process efficiency improvement tool. Also it is implied that management is not fully capable of convincing and managing people effectively. Contrary to the research findings Parkinson (2006:72) observes that Lean Six Sigma can conflict with innovation because it tries to eliminate different ways of doing things in favour of the "best" way. He goes on to state that when Lean Six Sigma starts to be used as a universal solution for every possible challenge, it stops being a useful tool and becomes a religion; hence kills the innovative initiatives. On the other hand according to Dumitrescu and Dumitrache, (2011), it takes culture
change across the whole organisation starting with top management to integrate the LSS system into existing systems. This takes commitment of funds, energy and time in order to avoid failure of the project

4.6.2 Staff and management knowledge

The staff and management must possess adequate knowledge on the method of LSS, this was tested in the study with the results tabulated below.

Table 4.4: Staff and management knowledge

<table>
<thead>
<tr>
<th>Staff and management knowledge</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff and management possess adequate LSS knowledge and skill about the respective process</td>
<td>2.9%</td>
<td>34.3%</td>
<td>8.6%</td>
<td>42.9%</td>
<td>11.4%</td>
</tr>
<tr>
<td>Staff and management possess in-depth knowledge of all the tools and techniques of LSS</td>
<td>5.7%</td>
<td>20%</td>
<td>11.5%</td>
<td>42.9%</td>
<td>20%</td>
</tr>
<tr>
<td>Staff and management possess knowledge in design of experiments and the capability to convince and manage people</td>
<td>2.9%</td>
<td>37.1%</td>
<td>20%</td>
<td>22.9%</td>
<td>17.1%</td>
</tr>
</tbody>
</table>

The table above shows that 2.9% staff and management of DZPL strongly agree that possess adequate LSS knowledge and skill about the respective process and 34.3% agreed also. More so 8.6% were neutral and 42.9% majority disagreed while 11.4% strongly disagreed to the fact that staff and management of DZPL possess adequate LSS knowledge and skill about the respective process. Also the table shows that 5.7% respondents strongly agreed that staff and management possess in-depth knowledge of all the tools and techniques of LSS and 20% agreed. Majority respondents 42.9% disagreed to the research fact and 20% strongly disagreed. According to 2.9% respondents strongly disagreed and 37.1% disagreed to the fact that staff and management possess knowledge in design of experiments and the capability to convince and manage
people while 20% were not sure. On the other hand 22.9% respondents disagreed and 17.1% strongly disagreed to the fact that staff and management possess adequate knowledge to successfully implement LSS.

The findings above lead to the implication that Staff and management do not possess adequate LSS knowledge and skill about the respective process. There is a knowledge gap at DZPL when it comes to LSS. Also staff and management do not fully possess in-depth knowledge of all the tools and techniques of LSS, moreover it is implied that staff and management of DZPL fairly possess knowledge in design of experiments and the capability to convince and manage people.

In addition to the research findings Parkinson (2006) reiterates the need for knowledge and skills if LSS is to be successfully implemented. The growing demand for implementation of Lean Six Sigma is said to also require a growing number of consultants. However all consultants might not have the above-mentioned qualities. The same applies for Lean manufacturing, there is need for expertise. Moreover more recently according to Dumitrescu and Dumitrache, (2011) The fact that Lean Six Sigma combines Six Sigma and Lean to come up with Lean Six Sigma means that the master black belts in Six Sigma need to have knowledge in Lean as well and the Lean experts need to be equipped in Six Sigma in terms of knowledge, the integration of the two types of expertise of lack of it thereof is a critical factor in the success of Lean Six Sigma as a process efficiency improvement tool.

### 4.7 Applicability of Lean Six Sigma in the Food Industry

The study also sought to assess if the LSS methodology can be applied in the food industry, most of the success stories as highlighted in table 2.1 are not in the food industry.

#### 4.7.1 The extent to which implementation of LSS in the Ice cream Sticks production line will help DZPL

The research sought to determine the extent to which the implementation of Lean Six Sigma in the Ice cream Sticks production line will help DZPL. The findings are presented in the figure below and table on the views of staff and management on the subject matter under research.
4.7.1.1 Lean Six Sigma and Production activities

In the production department, the implementation of LSS is supposed to assist in various ways as is seen in the results below

![Figure 4.9: Direct benefit of LSS to Production](image)

Figure 4.9 above shows that 5.7% respondents strongly disagreed that the implementation of Lean Six Sigma in the Ice cream Sticks production line will help DZPL eliminate non value adding activities and 17.1% disagreed while 28.6% were neutral. On the other hand 25.7% agreed and 22.9% strongly agreed that LSS implementation will help DZPL to eliminate non value adding activities such as waiting for cold room space instead of producing. This shows that LSS implementation will fairly help DZPL to eliminate non value adding activities such as waiting for cold room space instead of producing.

Also 5.7% respondents strongly agreed that implementation of Lean Six Sigma in the Ice cream Sticks production line will help DZPL in not being idle between operations such as changeover times between different products, 40% also agreed. The analysis of the results leads to the implication that implementation of Lean Six Sigma in the Ice cream Sticks production line will help DZPL to eliminate or minimise idle time which is a cost.

Furthermore 22.9% staff and management of DZPL strongly agreed and 34.3% agreed while 28.6% were neutral to the fact that the implementation of Lean Six Sigma in the Ice cream Sticks production line will help DZPL to avoid excess inventory that leads to overstocking hence tying up working capital and 14.3% disagreed. The findings imply that implementation of Lean Six Sigma in the Ice cream Sticks production line
will help DZPL in excess inventory management that leads to overstocking that tie up working capital. According to 31.4% majority staff and management of DZPL strongly agreed and 20% agreed while 40% majority respondents were neutral and 8.6% disagreed to the fact that implementation of Lean Six Sigma in the Ice cream Sticks production line will help DZPL producing more than necessary or earlier than needed. Also it is implied from the findings of the staff and management at DZPL that implementation of Lean Six Sigma in the Ice cream Sticks production line will help DZPL to avoid producing more than necessary or earlier than needed. With reverence to the research findings, Kovach and Cho (2011) successful stories of Lean Six Sigma implementation are common in the general manufacturing industry worldwide especially in the developed countries. Unfortunately, the implementation of Lean Six Sigma in the food industry is still limited. However, the Lean Six Sigma case studies have shown that it is possible to implement the Lean Six Sigma system in the food industry for continuous quality improvement.

Whilst the adoption and implementation of Lean Six Sigma brings about financial and other benefits to the organisation, Brandt, (2007:32) states that it is worth noting that, it’s not all plain sailing, there are a number of challenges that come with this system. Companies that are implementing Lean Six Sigma methods are often able to track quality, measure and analyse data, and reduce defects

4.7.1.2 Impact of LSS on Employees

Lean six sigma will have an effect on employees, whether negative or positive, this was tested in the study as is below.

Table 4.5: Impact of LSS on Employees

<table>
<thead>
<tr>
<th>Employees</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unnecessary, and, dangerous moving of workers or inappropriate relocation</td>
<td>8.6%</td>
<td>54.3%</td>
<td>14.3%</td>
<td>17.1%</td>
<td>2.9%</td>
</tr>
<tr>
<td>Not using the full potential of employees</td>
<td>11.4%</td>
<td>42.9%</td>
<td>25.8%</td>
<td>20%</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.5 above shows that 54.3% respondents agreed and 8.6% strongly agreed that implementation of Lean Six Sigma in the Ice cream Sticks production line will help DZPL in the area of unnecessary, awkward,
dangerous moving of workers or inappropriate relocation of the organisation, 14.3% were neutral while 14.3%
disagreed and 2.9% strongly disagreed. The research findings also reveal that 11.4% study participants
strongly agreed and 42.9% agreed that implementation of Lean Six Sigma in the Ice cream Sticks production
line will help DZPL in the area of not using the full potential of employees. On the contrary 20% disagreed
and 25.8% were neutral to the same fact. This shows that implementation of Lean Six Sigma in the Ice cream
Sticks production line will help DZPL to avoid unnecessary, awkward, dangerous moving of workers or
inappropriate relocation of the organisation and also not using the full potential of employees. Lean and Six
Sigma complement each other. Lean accelerates Six Sigma, delivering greater results than what would
typically be achieved by Lean or Six Sigma individually. In sustenance to the study findings, Brue and Howes
(2006) state that implementation of LSS reduces unnecessary, awkward, dangerous moving of workers or
inappropriate relocation of the organization by focusing on efficiency of motions and most convenient
workplace.

4.7.1.3 Critical areas of focus for LSS to be successfully adopted

The study sought to determine the critical areas for LSS to be successfully adopted. The views of the staff and
management of DZPL on the subject matter are presented in the figure below.

![Figure 4.10: Critical areas for LSS to be successfully adopted](image)

An investigation into strategies for transforming Dairibord Zimbabwe Pvt Ltd (DZPL) ice cream sticks production section into a Lean Six Sigma profitable enterprise after a partial initial trial.
According to 57.1% respondents they agreed and 11.4% strongly agreed while 14.3% strongly disagreed and 11.4% disagreed to the fact that there is culture of training and development at DZPL which will help to support the implementation of LSS. Moreover 17.1% respondents strongly agreed and 37.1% agreed that there are adequate skills for the successful adoption and implementation of LSS, on the contrary 31.4% disagreed and 8.6% strongly disagreed. Also 34.3% agreed, 17.1% strongly agreed and 28.6% were neutral to the assertion that there are adequate assets and resources to adopt LSS at DZPL while 17.1% disagreed and 2.9% strongly disagreed. Basing on the views of the research participants and analysis the research implies that the critical areas for LSS to be successfully adopted at DZPL are culture of training and development, adequate resources and adequate skills. Considine (2006:63) observes that the reason many organisations fail to leverage the full potential benefits of Lean Six Sigma is because leaders fail to appreciate the enormous cultural challenges its practices demand leaders must be top-down advocates and role models. This view is supported by Cutler, (2007) who insists that using LSS to achieve quality and continuous improvement is critical in the food industry than other industries.

4.7.1.4 Challenges to the application of LSS

The study investigated the challenges to the application of LSS at DZPL. The responses from the survey participants on the challenges to the application of LSS are analysed below.

![Figure 4.11: Challenges to the application of LSS](image)

Figure 4.11: Challenges to the application of LSS
The figure above shows that 2.9% respondents strongly agreed, 40% agreed and 14.3% were neutral to the fact that a challenge to the application of LSS at DZPL is lack of buy in from shop floor workers, 14.3% were neutral and 34.3% disagreed with 8.6% survey participants strongly disagreeing. Research findings above show that 11.4% respondents strongly agree, 40% agree, 25.8% were neutral to the fact that lack of buy in from senior management is a challenge to the application of LSS. Moreover 8.6% respondents strongly agreed and 54.3% agreed that high variable material costs is a challenge to the application of LSS at DZPL and 17.2% neutral were neutral with 17.1% disagreed and 2.9% strongly disagreed. Furthermore 2.9% strongly agree, 57.1% agree and 20% were neutral to the fact that the application of LSS will be challenged by regulatory requirements while 14.3% disagreed and 5.7% strongly disagreed. This shows that the challenges to the application of LSS at DZPL may stem from lack of buy in from shop floor workers, lack of buy in from senior management, high variable material costs and regulatory requirements.

To add to the study findings on challenges to LSS, Froelich and Del Angel (2008:32) observe that high profile Six Sigma failures like Home Depot and 3M show that companies cannot focus on implementing Six Sigma in isolation – these examples prove the need for human involvement in corporate change. On the same note, Del Angel and Pritchard (2008:41) state that Lean Six Sigma is a set of process tools that should only be part of a more holistic process improvement strategy and for any of these tools to be used effectively, employee behaviour change must be an integral part of the program. However, Parkinson (2006:72) observes that Lean Six Sigma can conflict with innovation because it tries to eliminate different ways of doing things in favour of the best way. He goes on to state that when Lean Six Sigma starts to be used as a universal solution for every possible challenge, it stops being a useful tool and becomes a religion; hence kills the innovative initiatives.

4.8 Strategies to ensure success of Lean Six Sigma in the Ice Cream Sticks production

The factors that can help in implementing of LSS at DZPL Ice Cream sticks production area are presented in the figure below.
Figure 4.12: Factors that can help in implementing LSS at DZPL Ice Cream sticks production area

The figure above shows that 60% respondents strongly agreed and 34.3% agreed that continuous training of staff members and culture change to suit the needs of LSS can help in implementing LSS at DZPL Ice Cream sticks production area. Also the analysis above shows that 51.4% of the survey participants strongly agree and 42.9% agree that control skills from staff can help in implementing LSS at DZPL Ice Cream sticks production area. Majority respondents as indicated by 65.7% strongly agreed and 28.6% agree while 2.9% strongly disagree to the fact that good project management can help in implementing LSS at DZPL Ice Cream sticks production area. Furthermore 62.9% respondents strongly agreed and 31.4% agreed that organisational commitment and management involvement are factors that can help in implementing LSS at DZPL Ice Cream sticks production area.

The findings therefore lead to the implication that the factors that can help in implementing LSS at DZPL Ice Cream sticks production area are continuous training of staff members, culture change to suit the needs of LSS, control skills from staff, good project management, organisational commitment and management involvement. Paiva, (2013) supports the findings when he identifies, organizational commitment, project...
management, culture change and management involvement as key factors that influence LSS in terms of success.

4.9 The assessment of the trial implementation of Lean Six Sigma

The trial implementation of the Lean Six Sigma was done and the results are as follows

A data collation table for the responses is as below.

Table 4.6 Data collation table for the assessment of the initial trial of LSS

<table>
<thead>
<tr>
<th>Questions</th>
<th>Sample Size</th>
<th>Response Rate</th>
<th>Strongly agree(1)</th>
<th>Agree (2)</th>
<th>Neutral (3)</th>
<th>Disagree (4)</th>
<th>Strongly Disagree (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packaging material yields have improved?</td>
<td>40</td>
<td>87.5%</td>
<td>17</td>
<td>14</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Semi-finished material yields have improved</td>
<td>40</td>
<td>87.5%</td>
<td>15</td>
<td>17</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Are now more motivated</td>
<td>40</td>
<td>87.5%</td>
<td>4</td>
<td>14</td>
<td>5</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Yields were ≤95% before LSS trial</td>
<td>40</td>
<td>87.5%</td>
<td>21</td>
<td>13</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Yields were &gt; 95% after the LSS trial</td>
<td>40</td>
<td>87.5%</td>
<td>21</td>
<td>14</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>78</strong></td>
<td><strong>77</strong></td>
<td><strong>30</strong></td>
<td><strong>7</strong></td>
<td><strong>8</strong></td>
<td></td>
</tr>
</tbody>
</table>
The data collation table above indicates the distribution of the responses on a five point Likert scale.

**Figure 4.13: The graphical representation of the responses on assessing the LSS trial.**

In this analysis, the responses that indicated strongly agree and agree on the Likert scale are grouped together, they both indicate one agreeing to the assertion on the question. 88.5% of the respondents agreed and strongly agreed that the packaging material yields in the ice cream section improved when the initial trial was done. 91.4% of the respondents agreed and strongly agreed that the yields of the semi-finished product also improved when the trial run was made. However, only 51% of the respondents claimed to have been motivated by the LSS trial. 97% of the respondents agreed and strongly agreed that the yields were below 95% before the initial trial of the LSS method. There was a unanimous agreement that the yields improved when the trial implementation was done.

The empirical evidence presented above show that the LSS method is an effective tool that can be used to improve process efficiency during production. The data was then used to test the research hypothesis as is shown below.
9 Hypothesis Testing

The data that was collected underwent through a number of tests including the hypothesis testing in an effort to draw conclusions especially on the partial implementation of Lean Six Sigma. The data was tested for validity and reliability first.

Validity Testing

Table 4.6 Reliability tests

Case Processing Summary

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>31</td>
<td>77.5</td>
</tr>
<tr>
<td>Excluded</td>
<td>9</td>
<td>22.5</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>100.0</td>
</tr>
</tbody>
</table>

a. List wise deletion based on all variables in the procedure.

Since most of the cases were valid (77.5%), the data was valid and useful for the purpose of the study.

Reliability Statistics

Table 4.7 Cronbach Alpha test

<table>
<thead>
<tr>
<th>Cronbach's Alpha</th>
<th>N of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>.934</td>
<td>66</td>
</tr>
</tbody>
</table>

The table above shows that the reliability the data set has high reliability to warrant validity of the research findings. In other words, the data is reliable.

4.9.1 Test of Normality

The tests of Normality or normality tests were carried out in order to identify if the data collected was parametric or not, the table below presents the results.
Tests of Normality

Table 4.8 Test for Normality

<table>
<thead>
<tr>
<th></th>
<th>Kolmogorov-Smirnov</th>
<th>Shapiro-Wilk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Statistic</td>
<td>df</td>
</tr>
<tr>
<td>Packaging</td>
<td>.242</td>
<td>40</td>
</tr>
<tr>
<td>Yields</td>
<td>.243</td>
<td>40</td>
</tr>
<tr>
<td>Motivation</td>
<td>.217</td>
<td>40</td>
</tr>
<tr>
<td>Yields Before</td>
<td>.341</td>
<td>40</td>
</tr>
<tr>
<td>Yields After</td>
<td>.326</td>
<td>40</td>
</tr>
<tr>
<td>Improvement</td>
<td>.150</td>
<td>40</td>
</tr>
</tbody>
</table>

a. Lilliefors Significance Correction

The analysis above shows that all the Kolmogorov Smirnov values are less than 0.05 which implies that the data set deviates from a normal distribution and hence it is non parametric.

4.9.2 Test of Hypothesis

H₀: Yields significantly improve after the trial implementation of LSS

H₁: Yields did not improve after the implementation of LSS

A hypothesis testing procedure was carried out in line with the proposed Null and alternative hypothesis as is highlighted in Chapter one.
Test Statistics

Table 4.9: The Chi square statistic results

<table>
<thead>
<tr>
<th></th>
<th>Yields Before</th>
<th>Yields After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-Square</td>
<td>17.450&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9.650&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>df</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Asymp. Sig.</td>
<td>.000</td>
<td>.008</td>
</tr>
</tbody>
</table>

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 13.3.

The Chi square test above shows that there is significance difference between yields of Ice Cream after LSS was implemented. It can therefore be concluded that the implementation of LSS improve performance.

4.9.3 Regression analysis
The regression analysis was carried out specifically in line with objective number 5 which sought to assess the success of the LSS after a brief trial run. The model of the objective was that: Implementation of LSS will result in improvement of the production efficiencies as measured by material yields.

Model Summary
Table 4.10: A summary of the regression analysis

<table>
<thead>
<tr>
<th>Mode</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.312&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.097</td>
<td>.074</td>
<td>.68231</td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), Improvement
The r square value is high enough to warrant significance of the model which is 74%. This means that it approximates 74% of the data set in the model. The model suggests that 74% of the improvement in yields is attributed to LSS, this means that there are other factors that can cause an improvement in yields that are not necessarily LSS.

4.9.4 ANOVA

Table 4.11: The ANOVA Table for the data analysed

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>1.909</td>
<td>1</td>
<td>1.909</td>
<td>4.101</td>
<td>.050</td>
</tr>
<tr>
<td>Residual</td>
<td>17.691</td>
<td>38</td>
<td>.466</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>19.600</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Dependent Variable: Yields after Trial Implementation
b. Predictors: (Constant), Improvement of yields.

However, using the ANOVA the model seems not significant since the p value 0.05 is less than the significance value from the table of 0.50. This makes the model not significant meaning to say the improvements as a result of LSS did not significantly contribute to the improvements after its implementation.

Coefficients

Table 4.12: The model

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improvement</td>
<td>.659</td>
<td>.477</td>
<td>1.383</td>
<td>.175</td>
</tr>
<tr>
<td>(Constant)</td>
<td>.449</td>
<td>.222</td>
<td>.312</td>
<td>2.025</td>
</tr>
</tbody>
</table>

a. Dependent Variable: Yields After partial implementation

4.10 Chapter Summary and Conclusion

This chapter summarised the findings from the study and linked the findings to literature that supports or opposes such findings. Statistical measures such as graphs and tables as well as inferential statistics were made use of. The Cronbach Alpha test was also recorded as a measure of validity. The chapter presented findings...
and discussions on the feasibility of integrating the Lean Six Sigma system as a complimentary system to the ISO 22000:2005 Food Safety management system in order to improve the production efficiencies in the manufacture of ice cream sticks at Dairibord Zimbabwe Pvt Ltd. The next chapter will present the research conclusions and recommendations based on the research findings.
CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the research conclusions and the recommendations. The conclusions were drawn from the research findings as well as recommendations. Other sections in this chapter are the validation of the hypothesis and an area of further study.

5.2 Conclusions drawn from the study

The following conclusions were drawn from the research:

5.2.1 Objective One: To identify the potential benefits that DZPL could derive from implementing Lean Six Sigma on the ice cream sticks section.

Based on the findings from chapter four, the researcher makes the conclusion that several benefits can be derived from the implementation of LSS at DZPL in the ice cream sticks production section. These are: improvement in yields for mix consumed in production, improvement in yields for wrappers (packaging) used in production and improvement total costs for each variant of the ice cream stick, that is the moulded and the extruded ice cream sticks. It is also concluded in this research that Lean Six Sigma results in a reduction of production costs at DZPL. This is very important in this difficult economy where cost containment is everything that matters for business continuity in a deflationary economic environment.

The researcher also concludes that an increase in profitability, improvement in customer penetration rate and improvement in quality of ice cream sticks across the value chain may be derived from the implementation of Lean Six Sigma at DZPL. Further benefits derivable from the LSS include the achievement of limited scrap, removal of excessive cycle times and delays, maximum use of employees and output per employee, getting rid of bad production scheduling and removal of inefficiencies within the value chain.

The researcher also concludes that the LSS system will improve customer care through the reduction of unsatisfied customers, elimination of unreliable deliveries and improvements in quality.
The operating challenges that can be solved at DZPL by the implementation of LSS are concluded from the research findings and analysis as: reduction of inadequate process controls, poor quality of products, high wastage rate in production, high utility costs, inefficient utilization of human capital and to a lesser extent the problem of unclear expectations by employees on what is expected from them.

5.2.2 Objective two: To establish the feasibility of the adoption of the Lean Six Sigma at the ice cream section at DZPL in terms of knowledge and expertise.

The researcher makes the conclusion that, the staff and management at DZPL does not possess adequate knowledge, skill and expertise when it comes to Lean Six Sigma. Whilst the management is capable of managing people effectively, they can only spear head a new system like LSS if they have the adequate knowledge of the system. The researcher also concludes that staff and management at DZPL does not possess adequate knowledge in design of experiments, a key factor in LSS. It is clear that the zeal and the ability to manage and convince people is there within the management at DZPL but what lacks is the actual acquired knowledge of LSS. Since the ability to manage and convince people is present within the DZP, it will be quite easy for the expert to instil the LSS knowledge hence the implementation will be possible. The lack of adequate knowledge may lead to wrong implementation if the LSS system is to be fully adopted without further training and this may discourage people, both the management and the non-management staff. The LSS system may then suffer from a still birth if it is to be jumped into without proper knowledge and expertise having been acquired.

The researcher makes a final conclusion that DZPL lacks adequate knowledge and expertise of LSS to fully embrace and implement the system.

5.2.3 Objective three: To determine the applicability of Lean Six Sigma in the food manufacturing industry in Zimbabwe to improve production efficiencies.

The researcher makes the conclusion that the LSS system is applicable in the food industry and at DZPL since it cuts down on costly activities such as idle time, over production and overstocking. The issue of avoiding over stocking is critical for the food industry particularly DZPL since it helps to avoid perishable food from
An investigation into strategies for transforming Dairibord Zimbabwe Pvt Ltd (DZPL) ice cream sticks production section into a Lean Six Sigma profitable enterprise after a partial initial trial.

going bad before the sale by date. The researcher, however noted that lack of buy in from employees and management could hamper the applicability of the LSS system at DZPL.

The critical areas of focus that will ensure that the LSS system is successfully adopted at DZPL are concluded in this study as: culture of training and development, provision of adequate resources, adequate skills for the successful adoption and implementation of LSS.

The researcher makes the final conclusion that the LSS system is very applicable to DZPL and to the food industry, there is no unsolvable hindrance to its applicability in the food industry and at DZPL. As long the necessary preliminaries are adhered to, the LSS system is very applicable to DZPL.

5.2.4 Objective Four: To identify strategies that can be deployed in order to successfully implement the Lean Six Sigma system in the ice cream sticks production section.

The researcher makes the conclusion that there are several factors that can contribute to the successful implementation of LSS at DZPL, in the Ice Cream sticks production area. These are concluded as; continuous training of staff members, culture change to suit the needs of LSS, instilling process control skills in staff, good project management, organisational commitment and management involvement.

The researcher makes the final conclusion that the key strategy to the adoption and implementation of LSS at DZPL is training coupled with culture change. The LSS system requires a completely new culture dynamic and a lot of management involvement. It has been noted in chapter two that a lot of Lean Six Sigma projects fail because of lack of support from management and that also relates to culture change. It is therefore imperative that the culture change be embraced and the first step towards the culture change is the investment in training and development.

5.2.5 Objective Five: To assess if the trial run of Lean Six Sigma resulted in better production efficiencies.

The researcher makes the conclusion that the trial run of LSS resulted in better production efficiencies, the material usage yields improved from below 95% to above 95%. The argument is that there could be other factors other than the trial LSS implementation that resulted in the improvement but according to the research, the LSS system will result in better efficiencies as is seen by the results of the trial run. The hypothesis testing carried out in chapter four clearly showed that there was an improvement in packaging and raw material yields after the trial run of LSS.
5.3 Validation of research hypotheses

The researcher makes the conclusion that the hypothesis that was being tested proved that the Lean Six Sigma system plays an important role in business growth and sustenance. Of the five research objectives that were being explored in this study, four of them were in the positive for DZPL. The only objective that had a negative outcome is the one to do with lack of knowledge and expertise. The LSS system has been shown through this research to bring a lot of benefits to DZPL, it has been validated that it is applicable in the food industry and at DZPL, it requires certain strategies, key among them training and culture change to be successful and it improve yields in production.

5.4 Recommendations

The study recommends DZPL to first have their assets, skills, and resources assessed for viability and compatibility in order to launch the Lean Six Sigma program. Secondly, DZPL needs to invest in acquiring the expertise needed to integrate these assets and LSS in order to orchestrate a cohesive implementation of this program, this entails a massive training program.

DZPL is recommended through this research to adopt and implement the Lean Six Sigma strategy in order to ensure consistent and cost effective production to fully benefit from Lean manufacturing and Six Sigma. Through the findings and analysis in this research it is recommended that DZPL should adopt an easy integration of LSS initiative into the management approach that implies a cultural change at all levels of DZPL, with a special stress on the top management level. They must commit their time, energy and the resources of the company to promote the initiative. One reason Six Sigma implementation failed in many companies was due to the lack of commitment from management.

5.5 Areas of further study

An area of further study is recommended to investigate the challenges in managing change towards new methods that help to improve production efficiencies, one such method is Overall Equipment Effectiveness (OEE). Further studies can look at how to integrate OEE with Lean Six Sigma.
REFERENCES


**Websites**

[www.fda.gov/Food/GuidanceComplianceRegulatoryInformation](http://www.fda.gov/Food/GuidanceComplianceRegulatoryInformation)


http://GoLeanSixSigma.com
### SECTION A: GENERAL QUESTIONS

1. **Position at DZPL**
   - a) Senior Manager [ ]
   - b) Middle Manager [ ]
   - c) Junior Manager [ ]
   - d) Non Managerial [ ]
   - e) Other (specify) ___________________________________________________________________

2. **Duration serving DZPL**
   - a) Less than a year [ ]
   - b) One to five years [ ]
   - c) Six to ten years [ ]
   - d) Above ten years [ ]

3. **To what extent is DZPL staff (and management) aware of Lean Six Sigma?**
   - a) Lesser extent [ ]
   - b) Moderate [ ]
   - c) Not sure [ ]
   - d) Greater extent [ ]
SECTION B: BENEFITS OF APPLYING LEAN SIX SIGMA (LSS) to the Ice Cream sticks production Line

In this section please use the following key:

1=strongly agree  2=Agree  3=Neutral  4=Disagree  5=strongly disagree

Put a circle on the answer that best suits your response

4. Lean Six Sigma (LSS) is argued to bring some benefits to organisations. Do you think the following benefits may be derived from the implementation of LSS at Ice Cream sticks production Line at DZPL?

a. Improve Yields for wrappers (packaging) used in production
   1  2  3  4  5

b. Improve yields for the mix that is consumed during Ice Cream Sticks production
   1  2  3  4  5

c. Improve reduction of production costs
   1  2  3  4  5

d. Increase in profitability
   1  2  3  4  5

e. LSS will improve customer satisfaction index
   1  2  3  4  5

f. LSS will improve Customer penetration rate
   1  2  3  4  5

g. LSS will improve employee satisfaction and motivation
   1  2  3  4  5

h. LSS will improve production efficiencies
   1  2  3  4  5

i. LSS will reduce production losses
   1  2  3  4  5

j. LSS will improve quality of ice cream sticks across the value chain
   1  2  3  4  5

k. LSS will improve total cost for each process, i.e. Molded and extruded ice cream sticks
   1  2  3  4  5
5. In your own view do you think by implementing LSS in ice cream sticks production, we will achieve the following benefits:

a. Reduced or zero Rework;
   1  2  3  4  5

b. Limited Scrap;
   1  2  3  4  5

c. There are no excessive cycle times and delays;
   1  2  3  4  5

d. There are no unsatisfied customers with the products provided;
   1  2  3  4  5

e. There are no opportunities lost
   1  2  3  4  5

f. The quality of products will be good
   1  2  3  4  5

g. Remove inefficiencies within value chain
   1  2  3  4  5

h. Get rid of bad production scheduling
   1  2  3  4  5

i. Eliminate unreliable deliveries caused by unreliable production runs
   1  2  3  4  5

j. Improve communication
   1  2  3  4  5

k. Maximize the use of employees and output per employee
   1  2  3  4  5

l. Maximize the process flows more efficiently
   1  2  3  4  5

Do you think the application of Lean Six Sigma can help to solve the following challenges at DZPL?

a. Inadequate process control
   1  2  3  4  5

b. Poor quality of products
   1  2  3  4  5
c. High wastage rate in production
1 2 3 4 5
d. Poor process and product design
1 2 3 4 5
e. High utility costs (Coal, water and Electricity)
1 2 3 4 5
f. Poor raw and packaging material yields
1 2 3 4 5
g. Inefficient utilization of human capital especially in production
1 2 3 4 5
h. Unclear expectations by employees on what is expected from them
1 2 3 4 5
i. High unit cost of production
1 2 3 4 5

SECTION C: KNOWLEDGE AND EXPERTISE TO APPLY LEAN SIX SIGMA

a. Staff and management (especially in production) possess adequate LSS knowledge and skill about the respective processes
1 2 3 4 5
b. Staff and management possess in-depth knowledge of all the tools and techniques of LSS
1 2 3 4 5
c. Staff and management possess knowledge in descriptive and inferential statistics
1 2 3 4 5
d. Staff and management possess knowledge in design of experiments and the capability to convince and manage people.
1 2 3 4 5
e. Management at DZPL is capable of convincing and managing people effectively.
1 2 3 4 5
f. Management at DZPL will be capable of Integrating Lean Manufacturing and Six Sigma as a process efficiency improvement tool.
1 2 3 4 5
SECTION D: APPLICABILITY OF LEAN SIX SIGMA

a. To what extent do you agree that the implementation of Lean Six Sigma in the Ice Cream Sticks production Line will help in eliminating problems in the following areas?

b. Producing more than necessary or earlier than needed

| 1 | 2 | 3 | 4 | 5 |

c. Excess inventory leading to overstocking that ties up working capital

| 1 | 2 | 3 | 4 | 5 |

d. Non-value adding activities such as waiting for cold room space instead of producing

| 1 | 2 | 3 | 4 | 5 |

e. Being idle between operations, e.g. running out of fruit ice mix then having to wait for milk ice mix to age

| 1 | 2 | 3 | 4 | 5 |

f. Causing damage and waste of time by moving products/processes

| 1 | 2 | 3 | 4 | 5 |

g. Unnecessary, awkward, dangerous moving of workers or inappropriate relocation of the organization

| 1 | 2 | 3 | 4 | 5 |

h. Not using the full potential of employees

| 1 | 2 | 3 | 4 | 5 |

For the LSS to be successfully adopted, the following areas are critical, do you agree to the assertions below?

a. There are adequate assets and resources to adopt LSS.

| 1 | 2 | 3 | 4 | 5 |

b. Management and staff are able to see the LSS in the same way and hence adopt it (There is constancy of purpose)

| 1 | 2 | 3 | 4 | 5 |

c. Management will be patient to get results using LSS

| 1 | 2 | 3 | 4 | 5 |

d. There are adequate skills for successful adoption and implementation of LSS.

| 1 | 2 | 3 | 4 | 5 |

e. There is adequate expertise the organization for LSS

| 1 | 2 | 3 | 4 | 5 |

f. There is a culture of training and development at DZPL which will help to support the implementation of LSS.

| 1 | 2 | 3 | 4 | 5 |
The application of LSS will be challenged by

g. Lack of buy in from shop floor employees
   1  2  3  4  5

h. Lack of buy in from senior management
   1  2  3  4  5

i. High variable material costs
   1  2  3  4  5

j. Regulatory requirements
   1  2  3  4  5

SECTION E: STRATEGIES UNDERTAKEN TO ENSURE LEAN SIX SIGMA SUCCEDS IN THE ICE CREAM STICKS AREA

Do you think the following can help in implementing LSS at DZPL Ice Cream sticks production area?

a. Management involvement
   1  2  3  4  5

b. Organizational commitment,
   1  2  3  4  5

c. Good Project management
   1  2  3  4  5

d. Control skills from staff
   1  2  3  4  5

e. Cultural change to suit the needs of LSS
   1  2  3  4  5

f. Continuous training of staff members
   1  2  3  4  5

g. The involvement of all stakeholders
   1  2  3  4  5

h. Commitment of time, energy and the resources by management of the company to promote the LSS initiative
   1  2  3  4  5

i. Involvement of stakeholders like external partners and suppliers
   1  2  3  4  5

j. Hiring multi-skilled employees
   1  2  3  4  5

k. Integrating LSS with the current management systems
   1  2  3  4  5
SECTION F: TESTING THE INITIAL TRIAL IMPLEMENTATION OF LSS

a. Since partial implementation of LSS in July 2015, packaging material yields have improved?
   1 2 3 4 5

b. Since partial implementation of LSS in July 2015, semi-finished material yields have improved?
   1 2 3 4 5

c. Are you now more motivated since the partial implementation of LSS?
   1 2 3 4 5

d. Before the partial implementation of LSS, yields on ice cream sticks were below 95%
   1 2 3 4 5

e. After the partial introduction of LSS, the yields are now more than 95%
   1 2 3 4 5

End of Questionnaire

Thank you for your time and effort
APPENDIX 2: INTRODUCTORY LETTER

UNIVERSITY OF ZIMBABWE

MASTERS IN BUSINESS ADMINISTRATION

GRADUATE SCHOOL OF MANAGEMENT

Reference: Academic research letter for N C Chidzambwa (R0101466)

I am a bona fide Mater of Business Administration (MBA) at the Graduate School of Management (University of Zimbabwe). I am carrying out research in partial fulfilment of the MBA Degree program requirement.

May you kindly assist me with the information that I require for the purposes of this research. Please note that the information will strictly be used for academic purposes and will not be disclosed to third parties. The Graduate School of Management upholds very high standards of confidentiality and ethics in doing research.

For further information or clarification, you are free to contact the Graduate School of Management on (04) 45316/18 or email the Director Dr N Kaseke on nykaseke@gmail.com

Thank you for your co-operation.

Regards

Nyasha C Chidzambwa