

ASSESSING THE IMPLEMENTATION OF A LEAN SIX SIGMA IMPROVEMENT PROGRAMME: A CASE STUDY OF THE RAIL ENGINEERING ORGANISATION IN GAUTENG PROVINCE

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ABSTRACT

Globalisation has opened up international markets for South African companies, but has also introduced competition in the domestic market. As a result, South African organisations are forced to attain global efficiency levels if they are to compete on the world market as well as maintain their domestic market share. Organisations have to come with creative methods that can enhance their competitiveness, one of them being the Lean Six Sigma.

Lean Six Sigma is an improvement strategy that focuses on process improvement, waste and variation reduction as a means towards performance improvement. The methodology has a reputation of success, however a number of organisations believe that the methodology is not relevant to their specific competitive needs. Lean Six Sigma is seen as another continuous improvement tool applicable to first world country organisations which will fade away with time.

Introduction

This study assesses the implementation of lean six sigma at the rail engineering company in Gauteng.

Literature Review

Introduction

This section aims to review the literature covering the views of Lean Six Sigma. The section focuses on the impact of the LSS implementation on the performance of the organization, then the benefits that are associated with a successful implementation of LSS, followed by the challenges that have been experienced by the organizations that attempted implementing this improvement strategy and finally the success factors for effectively implementing LSS.

Lean and Six Sigma were regarded as separate and distinct quality improvement programs in the mid to late 1990s. Lean production was first practiced at Toyota Motor Manufacturing under the leadership of Taiichi Ohno. In fact, for many practitioners, Lean production and the Toyota Production System are synonymous. Though lean was founded in Japan, it has been implemented by many major US organizations, including Danaher Corporation and Harley-Davidson, (Arnheiter and Maleyeff, 2005:5). The focus of Lean is on reducing the wasteful use of resources and applying a holistic approach when dealing with employees, suppliers, and customers (Maleyeff, Arnheiter, and Venkateswaran, 2012:543). Six Sigma originated at Motorola Corporation in the 1980s and subsequently adopted by many US companies, including GE and Allied Signal. Six Sigma focuses on variation reduction so that the incidents of defects and other errors are minimized.

Presently there is a high degree of integration, which began in earnest in the early part of the new millennium. While consultants and practitioners have continued to directly influence the evolution of the integrated form, academics are researching the common holistic model. Practice has observed a trend of adapting Lean Six Sigma universally. Given this, some authors optimistically claim that the integration of Six-Sigma and Lean systems represents an evolution of the Six Sigma methodology and Lean Six Sigma is becoming a new continuous improvement approach in industry (Mayeleff et al., 2012:543).

Manville, Greatbanks, Krishnasamy and Parker (2012: 10-11) suggest that Lean management is primarily concerned with reducing waste or non-value added activities within a business process. As such Lean seeks to make the process as efficient as possible through identifying sources of waste, and reducing and eliminating waste until only the added value elements of the process remain. Six Sigma is primarily a tool focusing on reducing process variation. Manville et al, (2012:10-11) further indicate that Six Sigma concentrates on reducing variability of output with an aim of reducing variability to levels below 3.4 defects per million opportunities (DPMO). Where a Six Sigma process is operating centrally within the accepted tolerance band, defect opportunities will be significantly less than 3.4 DPMO. Whilst both approaches have a different focus, both place great emphasis on the customer. Lean approaches ensure smooth and uninterrupted product flow through the organization to produce only what is required by the customer. Six Sigma focuses on “critical to quality” processes or operations and drives down cost through reduced variability and improved yield management. Six Sigma relies on the selection of appropriate projects which are strategically relevant to both the organization and the customer. Through this, process factors critical to quality as determined by the customer, become the focus of improvement.

Edward and Maleyeff (2005:6-7) support the same view that the key issue driving the development of Six Sigma was the need for quality improvement when manufacturing complex products having a large number of components, often resulted in a correspondingly high probability of defective final products. The driving force behind the development of Lean Management was the elimination of waste, especially in Japan, a country with few natural resources.

Both Six Sigma and Lean Management have evolved into comprehensive management systems. In each case, their effective implementation involves cultural changes in organizations, new approaches to production and to servicing customers, and a high degree of training and education of employees, from upper management to the shop floor. As such, both systems have come to encompass common features, such as an emphasis on customer satisfaction, high quality, and comprehensive employee training and empowerment. With disparate roots but similar goals, Six Sigma and Lean Management are both effective on their own. However, some organizations that have embraced either Six Sigma or Lean Management might find that they eventually reach a point of diminishing returns. That is, after re-engineering their operating and supporting systems for improvement by solving major problems and resolving key inefficiencies, further improvements are not easily generated. These organizations have begun to look elsewhere for sources of competitive advantage.

Organizational performance is multifaceted, according to Richard, Devinney, Yip and Johnson (2009:3) organizational performance encompasses three specific areas of firm outcomes: (1) financial performance (profits, return on assets, return on investment, etc.); (2) market performance (sales, market share, etc.); and (3) shareholder return (total shareholder return, economic value added, etc.).

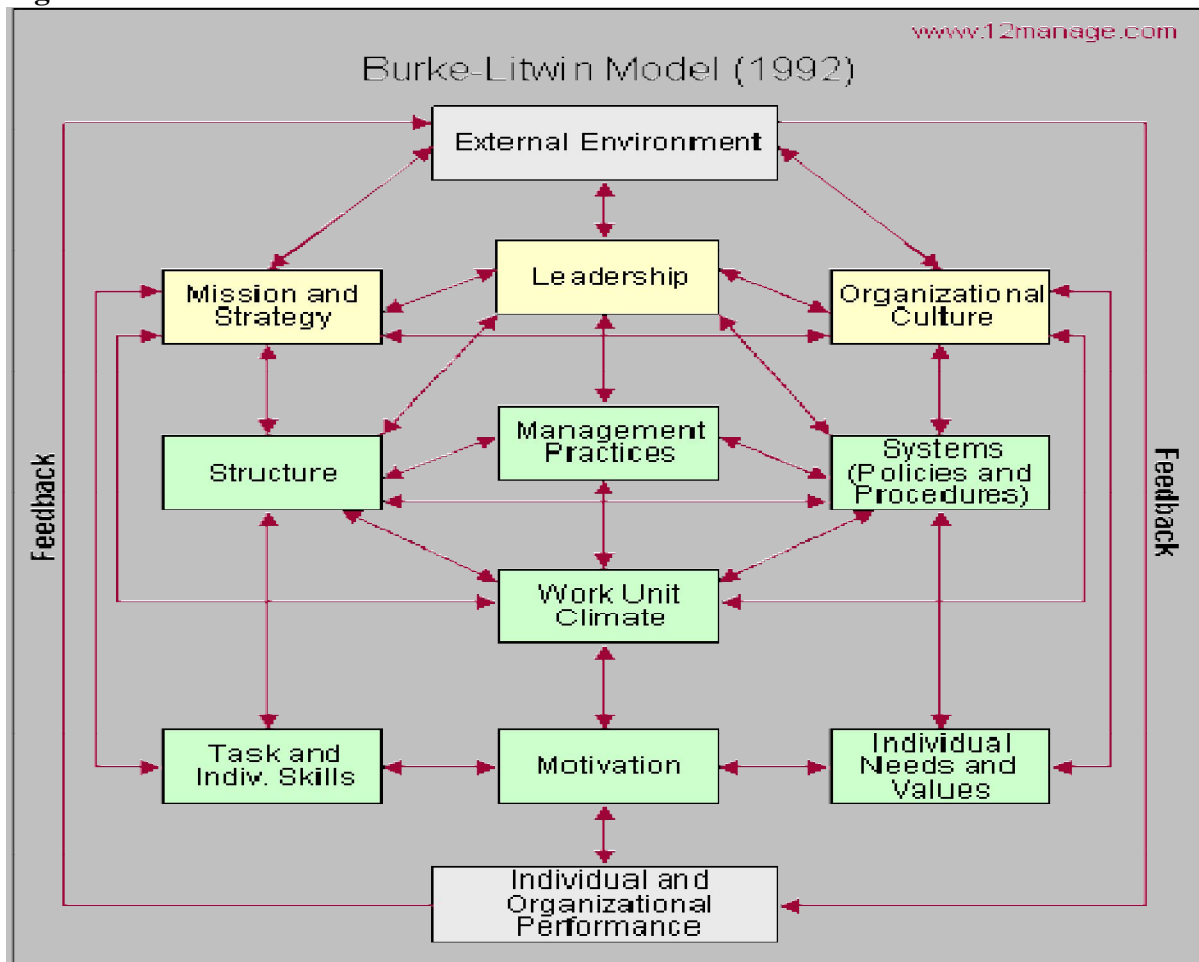
Scott (2003:11) elaborates by mentioning that traditional notions of organizational performance were focused on productivity, profit, growth, and stability under a rational system. The emerging notions of organizational performance focus on quality, durability, and customer satisfaction. Both traditional and emerging notions of organizational performance are influenced by external environments which require quality in processes and finished products.

Lean Six Sigma methodology and tools are a way to eliminate customer Critical to Quality (CTQ) issues and dramatically improve cost, quality and responsiveness (George, 2002:31). Measurements include increased Return on Invested Capital (ROIC), reduced manufacturing lead time, reduced inventory, reduced manufacturing overhead and quality cost, increased gross profit margins, increased operating margins, and higher quality levels. A value proposition for Lean Six Sigma describes current and future percent revenue, including a percent cost reduction for revenue, direct costs, cost of goods sold, gross profit, operating profit, marketing, and other general accounting values

Six sigma as an organizational change agent and motivational tool: It is a philosophy that benefits everyone from the customers to the shareholders and even the suppliers and employees six sigma is a means of saving both the company and the customer not only money but also all the problems that come along with poor quality, focused methodology that drives out waste, raises levels of quality, and improves the financial performance of organizations to breakthrough levels While the major benefit of six sigma may be its impact on the bottom line, there are many other benefits such as increased customer satisfaction, higher understanding of problem solving, increased teamwork, and increased employee morale. (Nakhai, and Neves, 2009:673)

The Burke-Litwin model of Organizational Performance and Change (Sharma 2006:63) serves as the theoretical framework and delineates 12 attribute independent variables which are external environment, leadership, mission and strategy, organization culture, structure, management practices, systems, work unit climate, motivation, task requirements and individual skills, individual needs and values, and individual and organizational performance.

Figure 2.1: The Burke-Litwin Model



Source: Adapted from (Sharma 2006:63)

1.1 Benefits Associated with Implementing Lean Six Sigma

Byrne, Lubowe, and Blitz (2007:6) suggest that LSS if focused not just on efficiency but also on growth, can serve as a foundation for innovation throughout an organization. Simply put, such a lean Six Sigma program is not just about doing things better, it is a way of doing better things. Used effectively it can enhance innovations in products, services, markets and even a company's underlying business model, as well as improve operations. Guided by this method, Caterpillar developed a strategic vision that outlined a roadmap for change based on fact-based analysis. Caterpillar's on-going initiative also led to product innovations, such as its phenomenally successful low-emissions diesel engine, and to redesigned processes, including a streamlined

supply chain. By 2005, revenues had grown by 80 percent. The leading companies using lean Six Sigma that we examined were intentionally pursuing this much larger innovation agenda. They aimed beyond operational improvement to innovation throughout the enterprise. Lean Six Sigma, enabled them to produce breakthrough innovations that caused profound improvements in their business performance. But perhaps more importantly, they obliterated their CEOs' biggest innovation obstacle by creating an organizational climate in which innovation has become expected

According to Laureani and Antony (2010:689) the benefits of Lean Six Sigma in the industrial world (both manufacturing and service) include:

- Ensuring services/products conform to what the customer needs (voice of the customer (VOC));
- Removing non-value adding activities (waste);
- Reducing the incidence of defective products/transactions;
- Shortening cycle time; and
- Delivering the correct product/service at the right time in the right place.

In a case study about applying Lean Six Sigma in a small engineering company, Thomas, Barton, and Chuke-Okafor, (2009:125) found that the company made the following savings from implementing this strategy:

- Reject rate reduction on the pilot line of 55 per cent indicating a potential saving over the year of £29,000.
- Cost of rejects before Lean Six Sigma ¼ £69,000, cost of rejects after Lean Six Sigma ¼ £36,000.
- Cell Operational Equipment Efficiency (OEE) increased from 34 to 55 per cent. A 31 per cent increase in parts per hour from the production system.
- Throughput before Lean Six Sigma ¼ 15 parts per hour (pph), throughput after Lean Six Sigma ¼ 22 pph. Equating to 2,800 additional parts per annum.
- Energy usage reduction of 12 per cent per annum. From 23,000 to 21,500 KWh.
- In conjunction with the OEE performance increase, the TPM program reduced equipment downtime to 2 per cent from 5 per cent. Based upon nominal operating hours of 2,000 per annum. Hours downtime before Lean Six Sigma ¼ 100 hours ¼ 5 per cent. Hours downtime after Lean Six Sigma ¼ 40 hours ¼ 2 per cent.
- The project proved to be highly successful primarily through the substantial improvement made in foam production but also through the cost benefit ratio achieved (outlay of £4,800 compared to the total savings made of over £40,000 in the first three months of implementation).

Kwak and Anbari (2006:3) investigated various literatures for benefits and savings of implementing Lean Six Sigma and summarized them in Table 2.1.

Table 2.1: Reported Benefits and Savings from Six-Sigma in the Manufacturing Sector

Company/ Project	Metric	Benefit
Motorola (1992)	In process defect levels	150 times reduction
Raytheon/ aircraft integration systems	Depot maintenance inspection time	Reduced 88% as measured in days

GE/ Railcar leasing business	Turnaround time at repair shops	62% reduction
Allied Signal plant in South Carolina	Capacity, cycle time, inventory, on time delivery	Up 50%, down 50%, down 50%, increased to near 100%
Allied Signal IQ brake pads	Concept to shipment cycle time	Reduced from 18 months to 8 months
Hughes missiles system group	Quality/ productivity	Improved 1000%, improved 500%
GE	Financial	\$ 2 billion in 1999
Motorola (1999)	Financial	\$15 billion over 11 years
Dow rail delivery project	Financial	Savings of \$2.45 million in capital expenditures
DuPont/ Yerkes plant, NY (2000)	Financial	Savings of more than \$25 million
Telefonica de espana (2001)	Financial	Savings and increases in revenue 30 million euro in the first 10 months
Texas instruments	Financial	\$600 million
Johnson and Johnson	Financial	\$500 million
Honeywell	Financial	\$1.2 billion

Source: (Kwak and Anbari, 2006: 4)

Stiles and Associate says they enjoy the following according to the article by Teresko (2007:41):

- Customer service levels of 95% to 99%;
- Customer retention of 90% or more;
- Lead times of one-quarter to one-half the industry average;
- Productivity/throughput improvement: 15-plus % per year;
- Sales growth: three to five times the industry average;
- Earnings growth: two to four times the industry average.

Desai, Antony and Patel (2012:427) state that Six Sigma is a systematic, highly disciplined, customer-centric and profit-driven organisation-wide strategic business improvement initiative that is based on a rigorous process focused and data-driven methodology. It drives customer satisfaction and bottom-line results by systematically reducing variation in processes and thereby promoting a competitive advantage. It is a customer oriented approach for process and/or product improvement. It is a company-wide initiative to improve both top line and bottom line through sustained customer satisfaction. The entire movement is driven by the voice of the external customer and concentrates on what is really important for the customer.

According to Thomas, Barton, and Chuke-Okafor (2009:114) the “lean” concept has often successfully allowed companies to deliver bottom-line savings in production through improved process efficiency. Lean is aimed at reducing waste and adding value to production systems so that systems performance is significantly improved and a company “does more with less”. A typical example is applying Total Productive Maintenance (TPM) techniques to poorly maintained machinery. This provides for value-added inputs by way of ensuring machinery

remains in productive operation for longer periods of time and this in turn improves equipment efficiency and shortens production lead times.

According to Thomas et al. (2009: 127) the softer benefits of Lean Six Sigma is the development of a culture towards continuous improvement. The application of the Lean Six Sigma approach allows the company to develop advanced statistical techniques and to become generally more “technical” in their approach to problem solving.

1.2 Challenges Associated With Implementing Lean Six Sigma

Henderson and Larco (2000:233) state that Lean Six Sigma implementation requires a change in the mind-set of employees and strong leadership, and then they identify obstacles to the Lean Enterprise as:

- Top management lack strategic understanding of Lean Enterprise
- Lack of specific Lean Enterprise skills, knowledge
- Culture, ego, and organizational inertia
- Management reluctance to empower people
- Fear of change, loss of organizational power
- “Not invented here” syndrome
- Internal systems and hurdles, specifically—
 - MRPII systems
 - Inflexible accounting methods
 - Severely disjointed plant operations

Despite the virtues of Lean Six Sigma system, implementation challenges are surmountable. To highlight a vital one, Lean Six Sigma changes how people work but not necessarily the way they think. Most people, including so-called blue collar workers will find their jobs more challenging as Lean Six Sigma spreads. They are more likely to become productive but at the same time they may find their work more stressful because a key objective of Lean Six Sigma is to push responsibility far down the organizational ladder (Agus and Hajinoor, 2012:96).

1.2.1 The management systems required to monitor the improvement program:

- little leadership from top management including deployment plans – strategy, goals, etc.;
- poor or infrequent management reviews;
- poor support from finance, IT, HR, maintenance, and QC Lab.;
- Lack of appropriate recognition and reward.

1.2.2

1.2.3 Top management must get involved

Without the full support and involvement of top management the improvement effort is likely to wither on the vine. That does not mean mere cheerleading or statements of support through E-mail, newsletters, and the like. It means creating a real sense of urgency about the need to improve and doing things that increase the likelihood of success: removing obstacles, allocating financial and human resources to the effort, regularly reviewing its progress, and ensuring recognition and rewards for participants. In comprehensive, high-level improvement programs designed to radically change the organization’s way of working, senior leaders should directly oversee implementation.

1.2.4 Need to focus on improvement, not on training

Many companies shy away from large-scale improvement programs because they do not want to make large investments in training employees in unfamiliar improvement methods. Further, there is often a perceived long lag time between the end of training and the emergence of concrete results from subsequent improvement projects. There is, however, an elegant solution to the problem: as is the practice in most Lean Six Sigma deployments; managers must combine training with real improvement projects, not academic exercises (Snee, 2010: 21). Project-based training offers a number of advantages. First, it produces immediate financial and business results that pay for the training right away. Second, participants take real-world projects far more seriously than empty exercises and devote their best energies to the effort. Third, by linking training projects to business priorities, training is transformed into improvement..

1.2.5 Use of top talent to conduct improvement initiatives

If improvement is truly important to the organization's success, the effort will be entrusted to the most talented people. In fact improvement and changing how work gets done is too difficult a problem to be left to anyone but the most capable people. Assigning top talent to improvement initiatives also sends the unmistakable message to everyone in the organization that leadership regards it as an important priority, (Snee. 2010: 21).

1.2.6 Building the supporting infrastructure

Faced with the imperative to improve continuously, it is short sighted to regard improvement initiatives as ad hoc undertakings in need of no permanent infrastructure to support and execute them efficiently and repeatedly. The requisite infrastructure includes four elements:

- (1) A structured approach to problem solving. This could be, for example, Lean Six Sigma's DMAIC.
- (2) Proven analytical techniques. To better understand, trouble-shoot, and improve manufacturing and non-manufacturing processes alike, the analytical techniques should be both qualitative and quantitative (i.e. VSM, DoE, interviewing, etc.).
- (3) Personnel skilled in improvement. These are the leaders through whom projects are realized. As they become increasingly skilled in leading improvement and training colleagues, they form a permanent cadre of improvement experts who can be relied upon to deliver superior improvement efficiently and expertly.
- (4) Management systems. The company should create an overall improvement system that guides and integrates all types of organizational improvement and creates the supporting management systems required to sustain it. It is not necessary to create new management systems but to integrate improvement management systems with existing management systems. (Snee. 2010: 22).

Losonci and Demeter (2013:230) state that lean principles should not be limited to manufacturing operations, companies also have to apply them in the service and supporting functions. And manufacturing can facilitate this learning process by the tremendous knowledge it has accumulated.

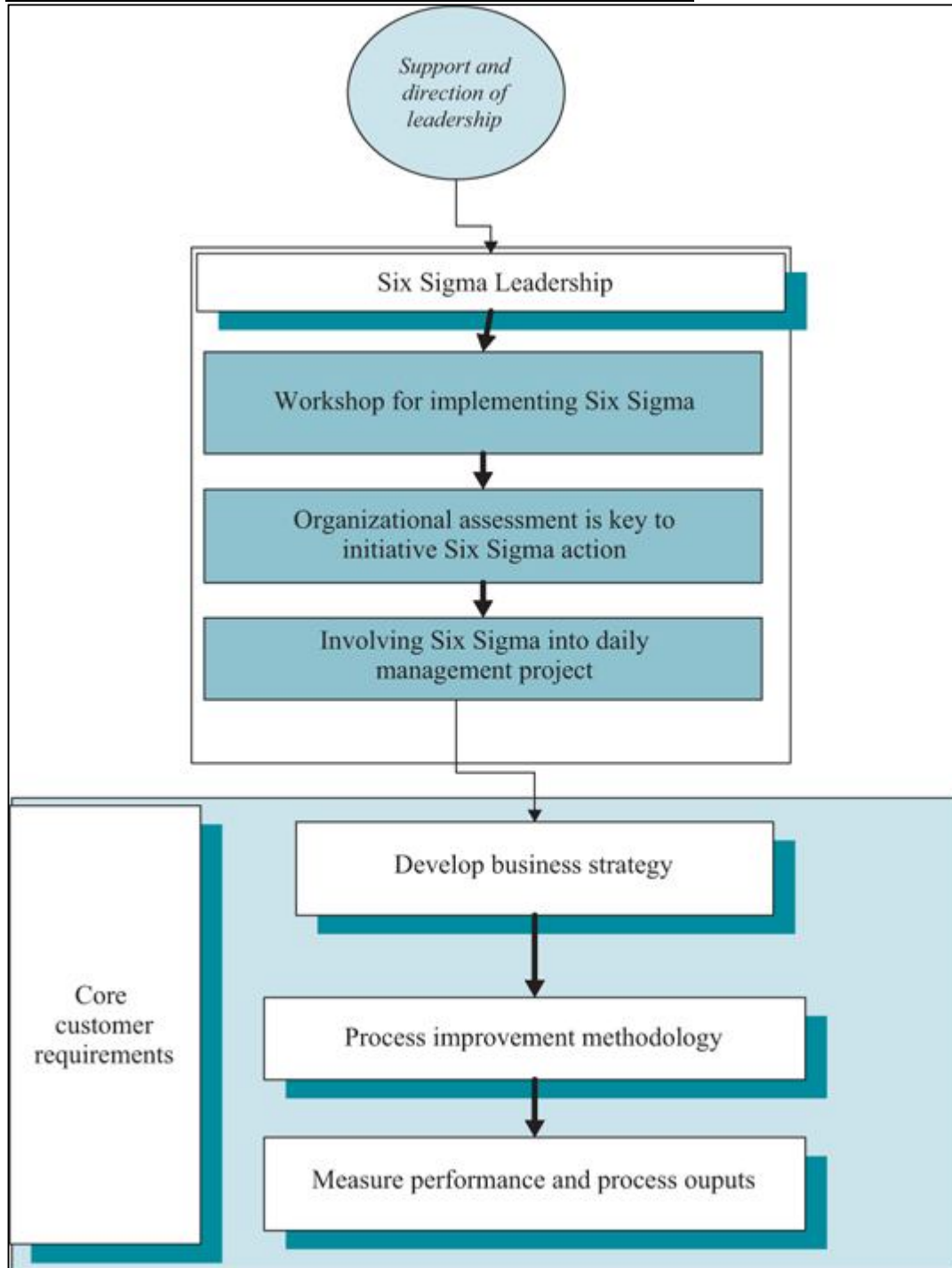
Snee (2010:23) cites over emphasis of the financial savings criteria as one of the challenges in implementing Lean Six Sigma. This criterion sometimes limits the selection to mainly cost reduction projects thereby losing the opportunity to select higher impact projects, such as product

quality improvement projects. In addition, this focus gives Six Sigma a poor image as simply a cost-cutting program. This selection criteria should be based on opportunities, not based on problems and should not over-emphasize financial savings

Cheng (2013:24) stated that the most important factors for successful Six Sigma implementation are management involvement and participation, linking Six Sigma to customers and to the business strategy of the organizations. From this perspective the decision rights to initiate a project are allocated to senior managers, and Six Sigma can thus help them to carry out appropriate strategies by selecting strategically related projects. The potential of Six Sigma to help companies formulate and deploy a business strategy and bring about broad transformational change means that it can be seen as a high order leadership approach, philosophy, and methodology for change. Accordingly, Six Sigma cannot be treated as a stand-alone activity. As with any quality management program, the success of Six Sigma initiatives depends on top-management involvement to change organizational culture and old habits that have become entrenched.

Figure 2.2 demonstrates how to link Six Sigma activities to the business strategy model developed in this work, in order to meet key customer requirements. This model indicates that both leadership support and the linking of Six Sigma to business strategy are required to achieve a competitive advantage. The top management must develop their leadership, actively initiate business strategies actively and organize a Six-Sigma steering committee. Moreover, the management team must develop a philosophy, mission positioning and vision sharing for all employees in order to change organizational concepts and enable them to learn new skills. Employees who are willing to change and learn new skills occupy the key positions in the leadership process. The Six Sigma steering committee must audit and validate status the firm's total quality assurance system. Alternative strategies must be generated and proposed by diagnosing and assessing the core business processes, and then developing the Six Sigma strategic goals and implementing the related action plans.

Figure 2.2: Linking Six Sigma to Business Strategy Model



Source: Cheng (2013:24)

Cheng (2013:26) further states that the Six Sigma leadership stage includes workshop activities, organizational assessment and daily management. The aim of these workshops is to build an

organizational consensus to combine Six Sigma activities into daily management projects via SWOT analysis. AIDC's first step in designing workshops is to ensure that they will reinforce its related business strategy.

RESEARCH METHODOLOGY

1.3 Introduction

The aim of this research was to investigate the value and significance of the Lean Six Sigma improvement program implementation as a method for obtaining and sustaining the competitiveness of REO.

1.4 Target Population and Sampling Strategy

The target population for this study was the employees of the Railway Engineering Organization in the Gauteng Region, of which the total workforce is 1350 employees ranging from the shop floor level to top management level. The population is the study object and consists of individuals, groups, organizations, human products and events to which they are exposed.

A research problem therefore relates to a specific population and the population encompasses the total collection of all units of analysis about which the researcher wishes to make special conclusions (Welman et al. 2005:52).

1.4.1 The Research Sample

In order for the results to be generalizable, the sample must be representative. By representative it is meant that the sample has the exact properties in the exact same proportions as the population from which it was drawn, but in smaller numbers (Welman et al. 2005: 55).

Welman et al. (2005:56) distinguish between probability samples and non-probability samples. Their respective types are listed in Table 3.1

Table 3.1: Distinction between probability and non-probability samples

Probability Samples	Non-Probability Samples
Simple Random Samples	Accidental Samples
Stratified Random Samples	Quota Samples
Systematic Samples	Purposive Samples
Cluster Samples	Snowball Samples
	Self-Selection Samples
	Convenience Samples

Source: (Welman et al. 2005:56)

The sampling strategy that was used in this research was non-probability sampling using purposive sampling. Welman et al. (2005:69) describe this as the very important type of non-probability sampling. Researchers rely on their experience, ingenuity and or previous research findings to deliberately obtain units of analysis in such a manner that the sample they obtain may be regarded as being representative of the relevant population.

Identifying a sufficient sample size is important. Larger sample sizes are desirable as they are more representative of the population. Sample size is inversely proportional to sampling error and a large sample is desirable.

An ad hoc method was used to select a sample size for this study. Collis and Hussey (2003:61-155) describe this method a non-statistical approach that is adequate for non-probability sampling methods.

1.5 Limitations of the Research

Due to the quantitative nature of the study, there was little or no opportunity to probe for more detail. The study's scope was within the Railway Engineering Organization in Gauteng only, other branches were excluded. The study was very dependent on the respondents experience, knowledge and expertise in the field of Lean and/or Six-sigma. The sample size selected is governed by the limited time by which the study had to be completed. The study was dependent on the response rates

Results, Discussion and Interpretation of Findings

Introduction

The previous chapter contained the specific details of how the research was conducted, from the type of methodology used to the type of measurement instrument to be used and finally the methods that were applied to analyse the data.

The purpose of this chapter is to present the empirical findings of this research and discuss the findings in relation to the theoretical perspectives. Firstly, the response rate pertaining to this research will be presented, followed by the identification of the descriptive statistics regarding the biographical information of the respondents. The assessment of the reliability of the measuring instruments is next established through the use of Cronbach's Alpha coefficient. Thereafter the results of the benefits of Lean Six Sigma implementation, the challenges faced by the organization as well as the impact on the organizational performance will be presented and discussed using the descriptive statistics and the last part analysed using the Correlation analysis method. The data was analysed using the XLSTAT Version 2013.4.08 and IBM SPSS Statistics version 22.

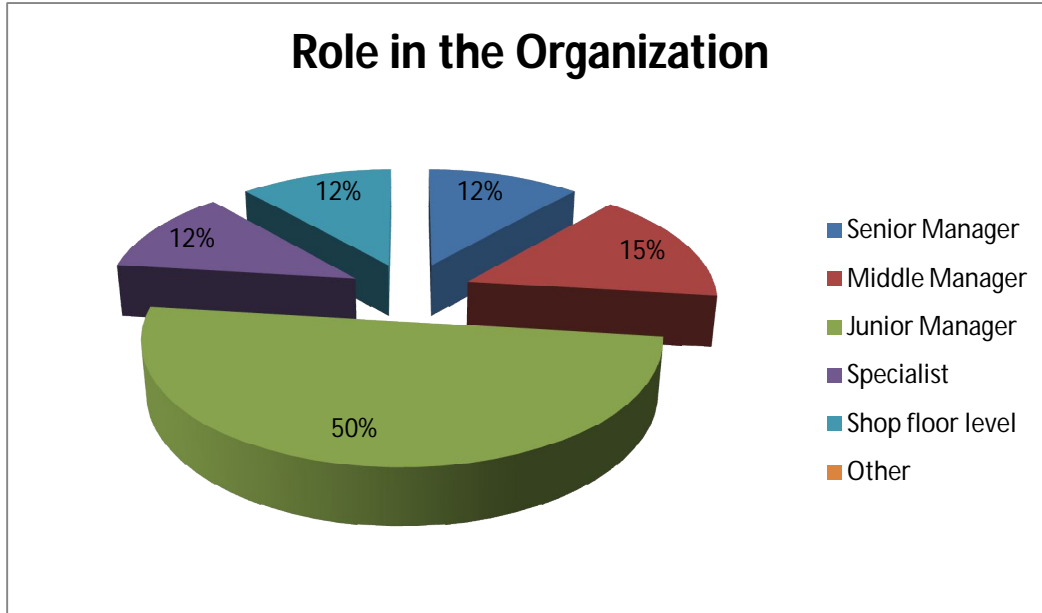
1.6 Section A: Demographic variables of the survey

This section of the questionnaire presents the information relating to the respondents/ participants themselves in terms of their role in the organization, the level of involvement with Lean Six Sigma and the amount of time each respondent has been exposed to Lean Six Sigma.

This section was analysed statistically using frequency tables, simple graphs were constructed in order to graphically represent the data contained in the frequency table.

1.6.1 Role of Respondents in the Organization

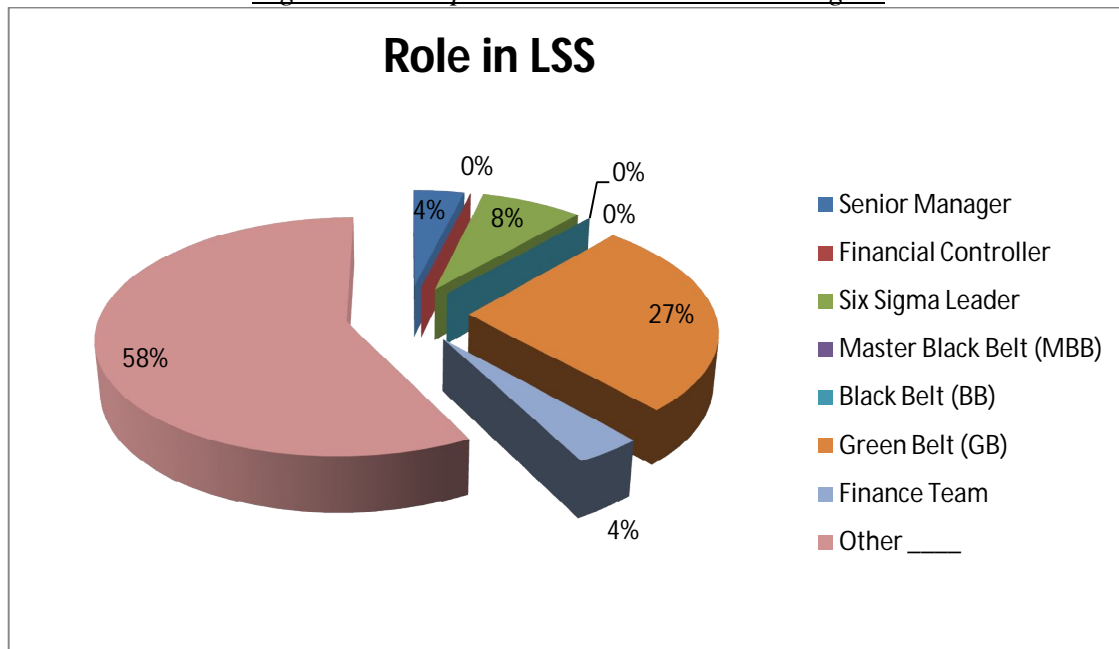
Figure 4.1: Respondent's role in the Organization



In terms of the job levels of the participants, the Junior Managers (which consists of Supervisors, Technicians, Foremen and Senior Inspectors) make up a bulk of the respondents at 50%, followed by Middle Managers at 15% and the Senior Managers, Specialists and shop floor personnel contributing equally at 12%. This ensures that diverse responses are achieved.

1.6.2 Role of the Respondent in the company's Lean Six Sigma program

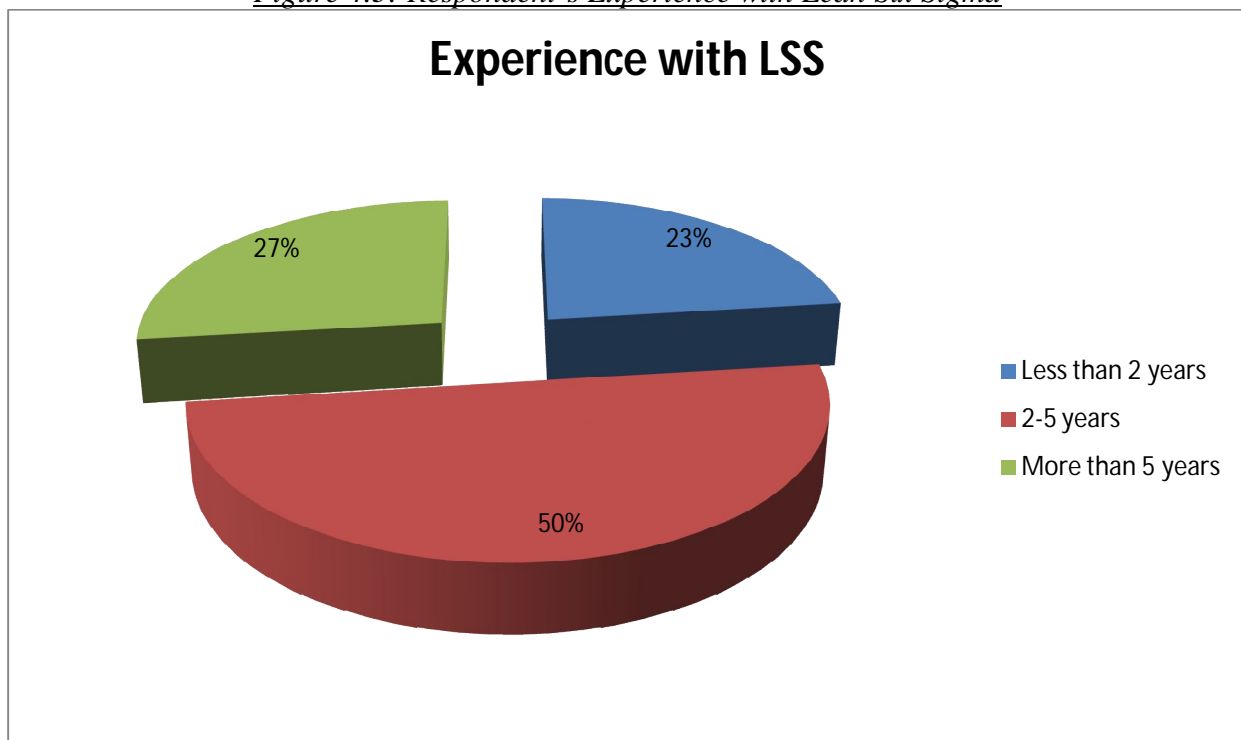
Figure 4.2: Respondent's Role in Lean Six Sigma



In terms of the level of Lean Six Sigma involvement the largest part of the respondents is made up of the 'other' category, at 58%. This category of respondents are neither trained LSS specialists nor middle/ senior Managers, but are a group of shop Junior Managers like Technicians, QA Officers, QC Controllers and Supervisors and Foremen who play an important role in LSS. The green belt holders form the second highest number of respondents at 27%, and the remaining percentage is made up of Six Sigma Leaders at 8% and Senior Managers and the Finance Team equally at 4%.

1.6.3 Respondents years of experience with Lean Six Sigma

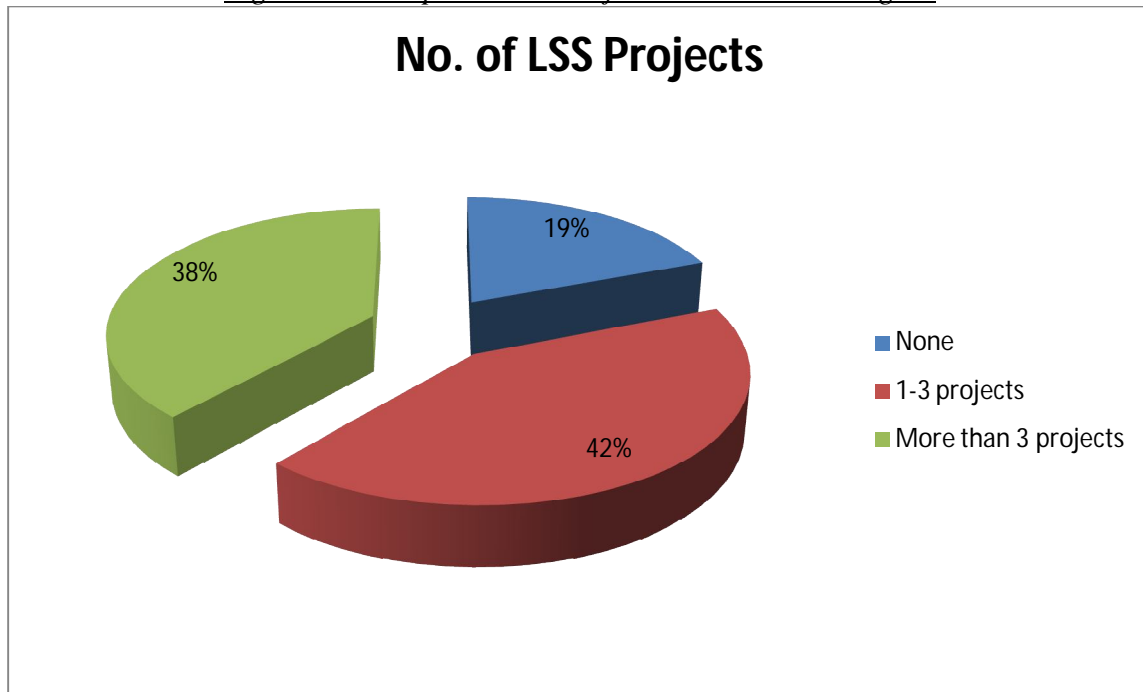
Figure 4.3: Respondent's Experience with Lean Six Sigma



50% of the respondents have been involved with Lean Six Sigma for two to five years, 27% for more than five years and the remaining 23% for less than two years. This indicates that most respondents have had a fairly reasonable level of exposure to Lean Six Sigma.

1.6.4 Number of projects handled by the Respondent so far

Figure 4.4: Respondent’s Projects with Lean Six Sigma



42% of the respondents have been part of one to three Lean Six Sigma projects, 38% have participated in more than three projects and the remaining 19% have never been part of any Lean Six Sigma project. This indicates that the bulk of the respondents have got some detailed experience on Lean Six Sigma.

1.7 Measurement Reliability

The Cronbach’s coefficient alpha was used to test the internal consistency of the factors. The detailed results of the reliability analysis are presented in Appendix D.

The summarised reliability results are as follows:

Table 4.1: Reliability Results

	Section B1	Section B2	Section C	Section D	Section E
Valid cases (N)	26	26	26	26	26
Excluded (N)	0	0	0	0	0
Total (N)	26	26	26	26	26
Chronbach’s Alpha	0.901	0.816	0.880	0.932	0.950

The Cronbach's coefficient alpha was produced for the relationship factors. As seen in table 4.1, the coefficient of reliability for all questionnaire sections is high thus indicating a high level of reliability. Hence, the reliability analysis of the questionnaire continuous statements in Sections B to E indicates that the variables have adequate internal consistency and reliability.

1.8 Section B: Assessing the Relationship between Lean Six Sigma and Organizational Performance

1.8.1 Leadership: Top Management promotes LSS in words and action

Figure 4.5: Responses to Leadership

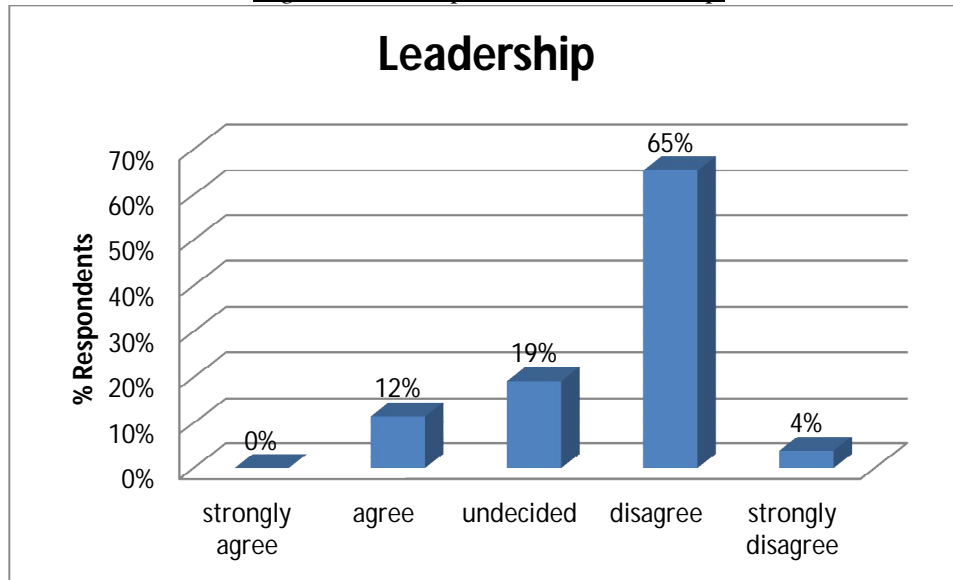


Figure 4.5 indicates that 12% of the respondents agree with the statement. 19% of the respondents are undecided, while 65% and 4% disagree and strongly disagree with the above statement, respectively. The analysis also shows that cumulatively, 69% of the respondents positively disagreed with the above statement as indicated in the descriptive statistics Appendix E. The mode for this question was 4 as shown in Appendix E, which illustrates that the most respondents disagreed with the above statement.

1.8.2 Employee Involvement: All employees are involved and have formed cross-functional teams for problem solving and continuous improvement

Figure 4.6: Responses to Employee involvement

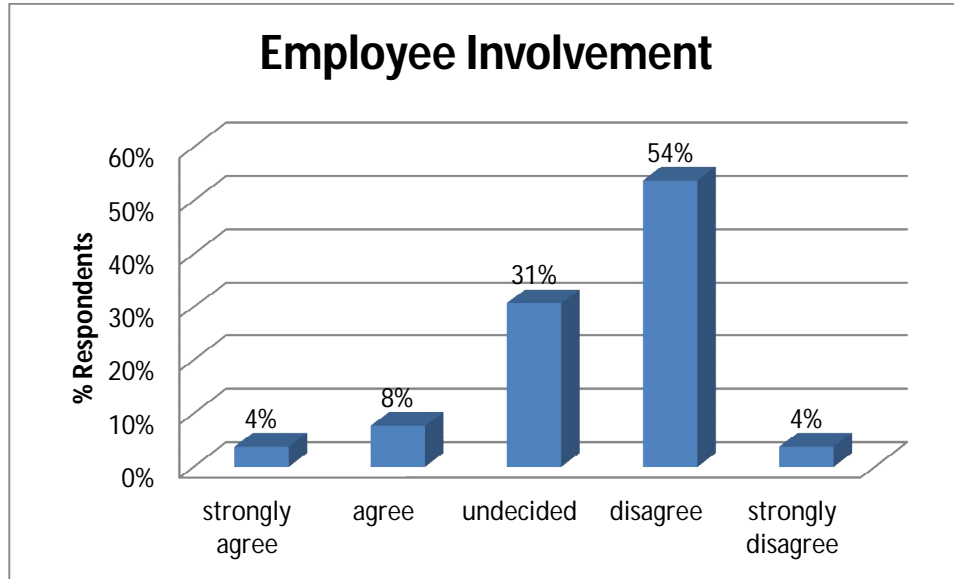


Figure 4.6 indicates that 4% and 8% of the respondents strongly agreed and agreed with the statement, respectively. 31% of the respondents are undecided, while 54% and 4% disagree and strongly disagree with the above statement, respectively. The analysis also shows that cumulatively, 58% of the respondents positively disagreed with the above statement as indicated in the descriptive statistics Appendix E. The mode for this question was 4 as shown in Appendix E, which illustrates that the most respondents disagreed with the above statement.

1.8.3 LSS Systems: Production and maintenance LSS systems have been implemented to a full extent, e.g. Kaizen, Total Production Maintenance, DMAIC

Figure 4.7: Responses to LSS Systems

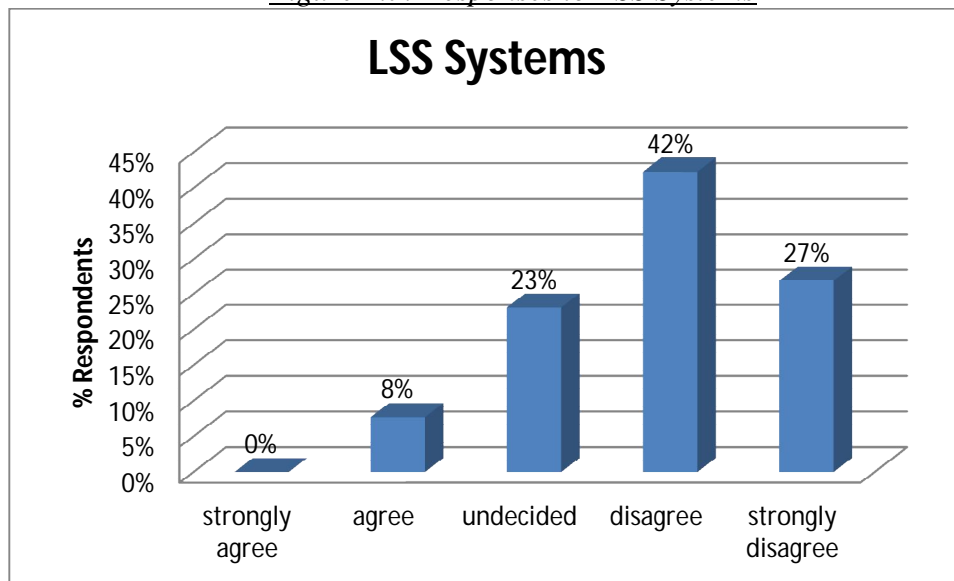


Figure 4.7 indicates that 8% of the respondents strongly agreed with the statement. 23% of the respondents were undecided, while 42% and 27% disagree and strongly disagree with the above statement, respectively. The analysis also shows that cumulatively, 69% of the respondents positively disagreed with the above statement as indicate in the descriptive statistics Appendix E. The mode for this question was 4 as shown in Appendix E, which illustrates that the most respondents disagreed with the above statement.

4.4.4 LSS Tools: LSS tools have been implemented to a full extent, e.g. Just In Time, Value Stream Mapping, Statistical Process Control

Figure 4.8: Responses to LSS Tools

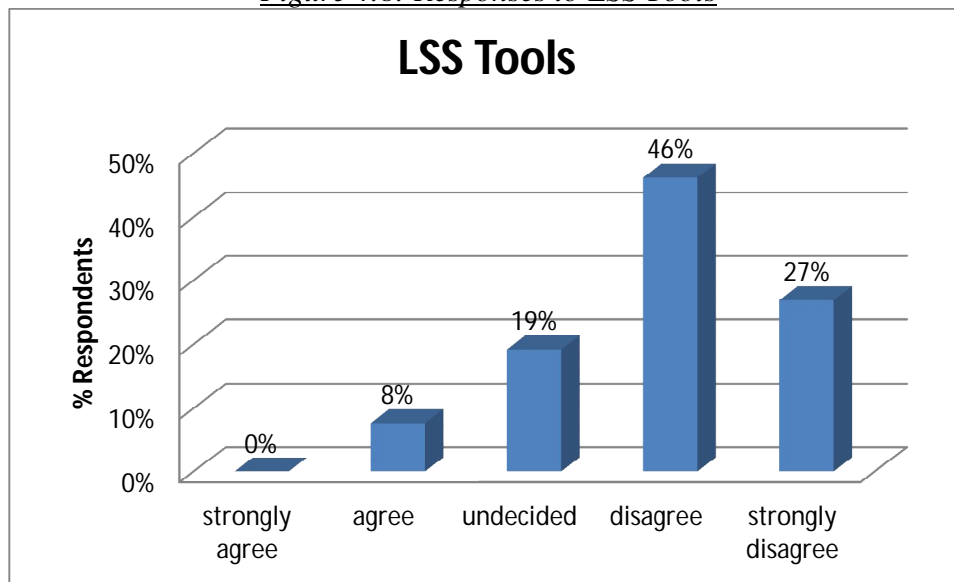


Figure 4.8 indicates that 8% of the respondents strongly agreed with the statement. 19% of the respondents were undecided, while 46% and 27% disagree and strongly disagree with the above statement, respectively. The analysis also shows that cumulatively, 73% of the respondents positively disagreed with the above statement as indicate in the descriptive statistics Appendix E. The mode for this question was 4 as shown in Appendix E, which illustrates that the most respondents disagreed with the above statement.

4.4.5 Continuous Improvement: Internal and external metrics are collected and used to continually improve to a great extent

Figure 4.9: Responses to Continuous Improvement

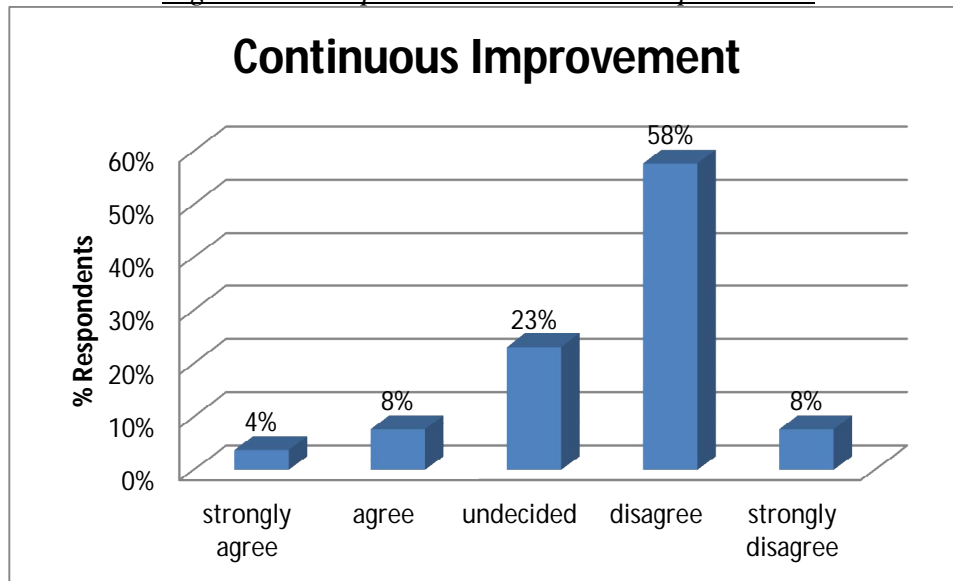


Figure 4.9 indicates that 4% and 8% of the respondents strongly agreed and agreed with the statement, respectively. 23% of the respondents are undecided, while 58% and 8% disagree and strongly disagree with the above statement, respectively. The analysis also shows that cumulatively, 66% of the respondents positively disagreed with the above statement as indicated in the descriptive statistics Appendix E. The mode for this question was 4 as shown in Appendix E, which illustrates that the most respondents disagreed with the above statement.

From the above charts, it is evident that the respondents mostly disagree with the evidence of the implementation of the independent variables placing the leanness of the organization at a basic level.

4.4.6 Success with LSS: Which of the following best describe your organizations success with LSS implementation?

Figure 4.10: Responses to Success with LSS

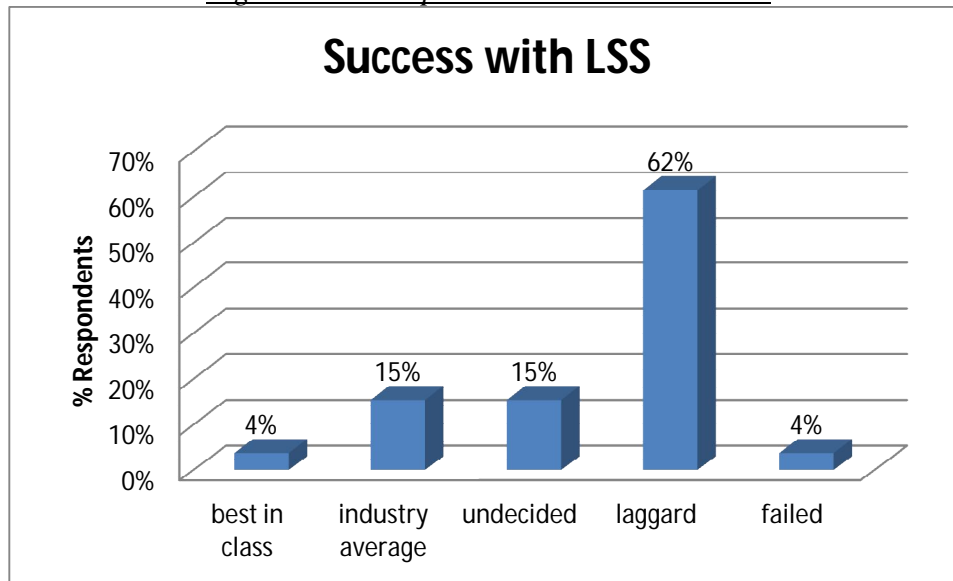


Figure 4.10 indicates that 4% and 15% of the respondents strongly agreed and agreed with the statement, respectively. 15% of the respondents are undecided, while 62% and 4% disagree and strongly disagree with the above statement, respectively. The analysis also shows that cumulatively, 66% of the respondents positively disagreed with the above statement as indicate in the descriptive statistics Appendix E. The mode for this question was 4 as shown in Appendix E, which illustrates that the most respondents disagreed with the above statement.

To support the statement in 4.4.6 that suggests that the organizations leanness is at a basic level, the respondents have placed the organization at a laggard level with regards to LSS implementation – where the company is still learning from its mistake in as far as LSS is concerned. This level is superseded by being ‘the best in class’.

4.4.7 Costs: Costs have been reduced to a great extent, e.g. manufacturing costs, cost of poor quality

Figure 4.11: Responses to Costs

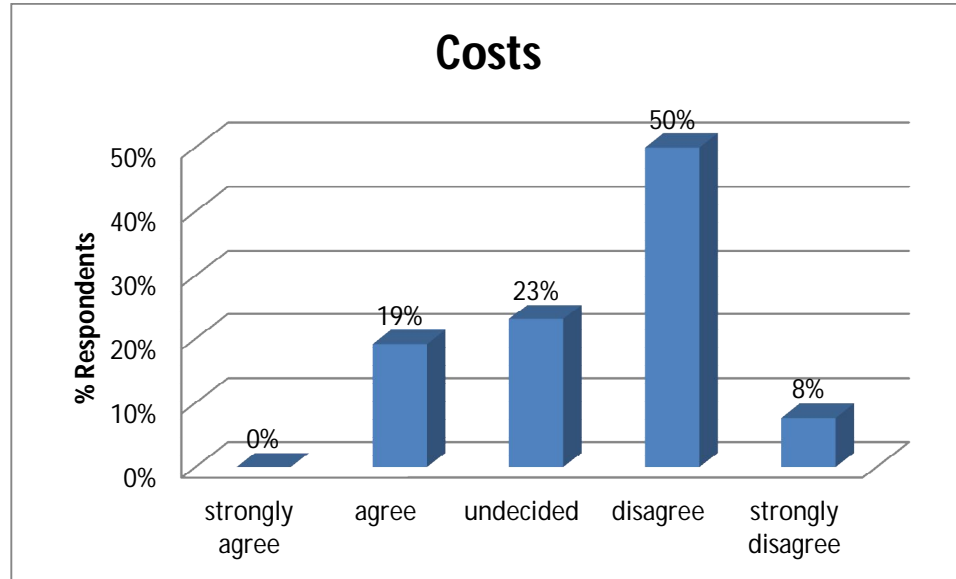


Figure 4.11 indicates that 19% of the respondents agreed with the statement. 23% of the respondents were undecided, while 50% and 8% disagree and strongly disagree with the above statement, respectively. The analysis also shows that cumulatively, 58% of the respondents positively disagreed with the above statement as indicate in the descriptive statistics Appendix E. The mode for this question was 4 as shown in Appendix E, which illustrates that the most respondents disagreed with the above statement.

4.4.8 Sales: Sales have increased

Figure 4.12: Responses to Sales

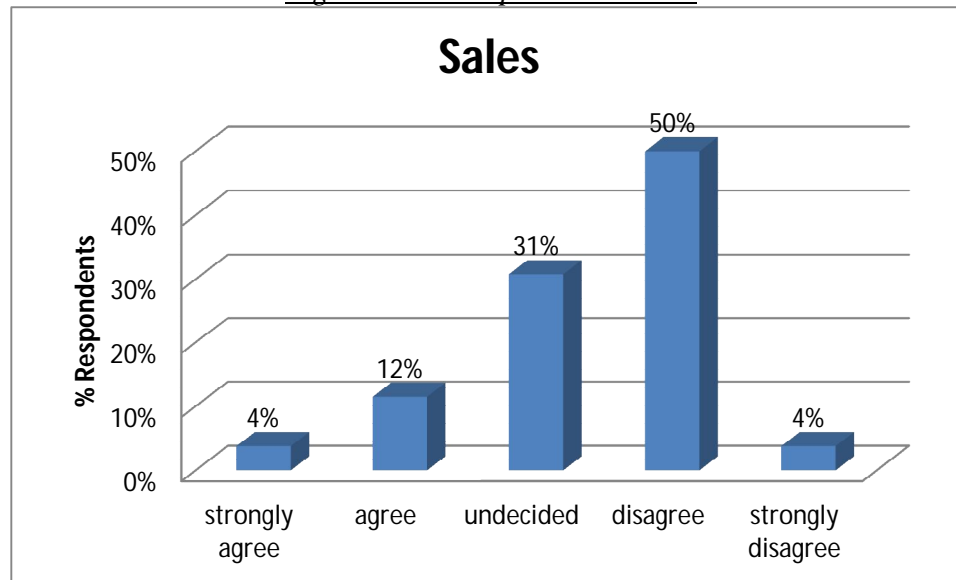


Figure 4.12 indicates that 4% and 12% of the respondents strongly agreed and agreed with the statement, respectively. 31% of the respondents are undecided, while 50% and 4% disagree and strongly disagree with the above statement, respectively. The analysis also shows that cumulatively, 54% of the respondents positively disagreed with the above statement as indicate

in the descriptive statistics Appendix E. The mode for this question was 4 as shown in Appendix E, which illustrates that the most respondents disagreed with the above statement.

4.4.9 Organizational Culture: Culture has improved

Figure 4.13: Responses to Organizational Culture

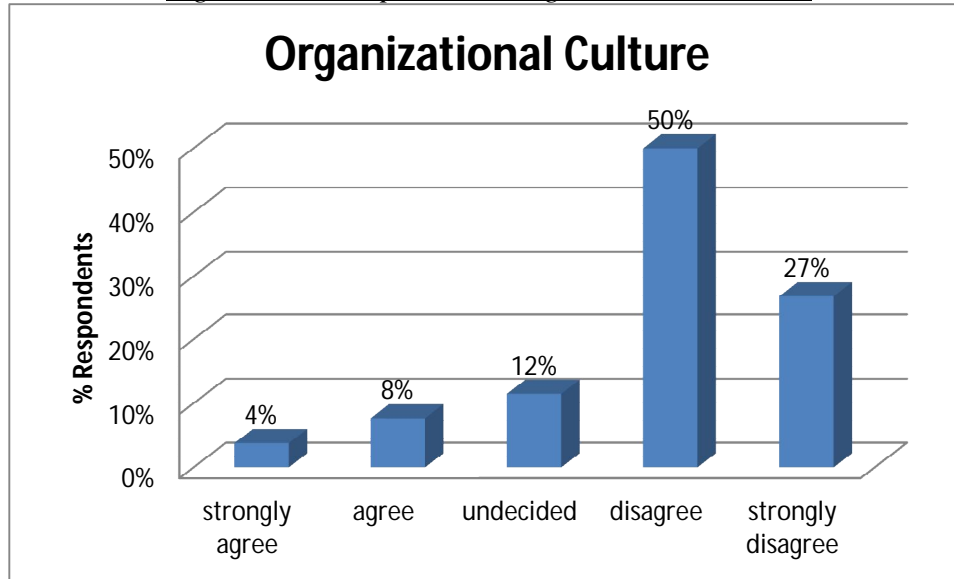


Figure 4.13 indicates that 4% and 8% of the respondents strongly agreed and agreed with the statement, respectively. 12% of the respondents are undecided, while 50% and 27% disagree and strongly disagree with the above statement, respectively. The analysis also shows that cumulatively, 77% of the respondents positively disagreed with the above statement as indicated in the descriptive statistics Appendix E. The mode for this question was 4 as shown in Appendix E, which illustrates that the most respondents disagreed with the above statement.

Employee Motivation: Motivation has improved

Figure 4.14: Responses to Employee Motivation

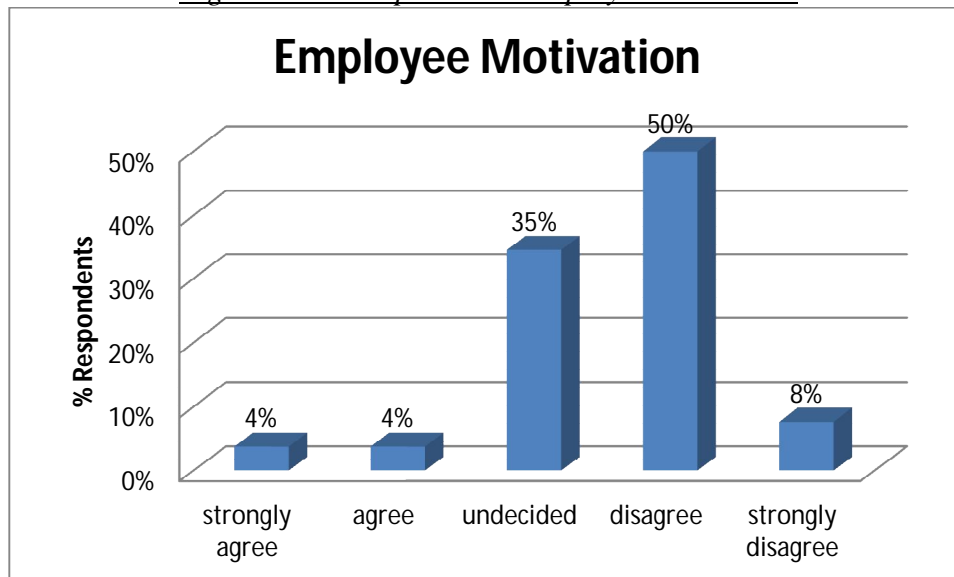


Figure 4.14 indicates that 4% and 4% of the respondents strongly agreed and agreed with the statement, respectively. 35% of the respondents are undecided, while 50% and 8% disagree and strongly disagree with the above statement, respectively. The analysis also shows that cumulatively, 58% of the respondents positively disagreed with the above statement as indicate in the descriptive statistics Appendix E. The mode for this question was 4 as shown in Appendix E, which illustrates that the most respondents disagreed with the above statement.

4.4.10 Quality Performance: We provide high quality products and services to our customers

Figure 4.15: Responses to Quality Performance

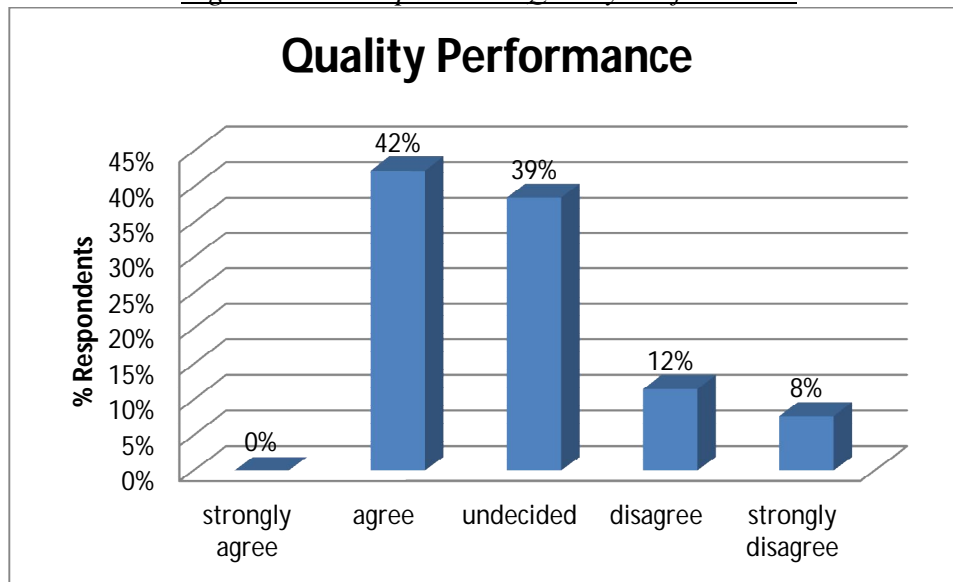


Figure 4.15 indicates that 42% of the respondents agreed with the statement. 39% of the respondents were undecided, while 12% and 8% disagree and strongly disagree with the above statement, respectively. The analysis also shows that cumulatively, 42% of the respondents positively agreed with the above statement as indicate in the descriptive statistics Appendix E. The mode for this question was 2 as shown in Appendix E, which illustrates that the most respondents agreed with the above statement.

From the above responses it can be seen that a larger percentage of the respondents disagreed about the organization achieving very significant levels of success.

4.4.11 Correlation Analysis of the Relationship between LSS Implementation and Organizational Performance

One of the objectives of this research was to investigate the relative changes in the organizational performance that can be attributed to the implementation of Lean Six Sigma. The null hypothesis was that there is no statistically significant relationship between the implementation of the Lean Six Sigma improvement program and organizational performance. Given this, the study examined the impact of the implementations of Lean Six Sigma practices on performance outcomes. The relationship was assessed using Pearson’s correlation coefficient (r). This was done in order to indicate the strength and direction of this linear relationship. The strength of the linear relationship’s significance is indicated by the p-value and a negative relationship is indicated by a – sign in front of the correlation coefficient. Table 16 provides the Pearson’s

correlation coefficients between the questions in Section B. Note that all significant linear relationships are indicated by * or **. In terms of the Pearson's correlation coefficient, relationships are regarded as being significant when they are closer to 1, i.e. a relationship closer to 1 either positive or negative indicates a very strong relationship, whereas the closer to zero indicates a very weak relationship.

The data set for this analysis is a set of questions from Section B. The first part of the data set (B1.1 to B1.6) in the Section B questionnaire represents the implementation level or leanness indicator as well as the opinion the respondents about how far the company has gone in terms of LSS implementation as compared to the companies in the same industry. The second part of the data set in Section B (B2.1 to B2.5) represents the level of performance that has been achieved by the REO organization.

Section B part 1, the Leanness indicators represent the independent variables, and Section B, part 2 are the dependent variables.

A matrix of correlations was computed to identify any correlation existing between the explanatory variables (LSS Implementation) and dependent variables (performance).

Table 4.2: Correlation Analysis Results

	B1.1	B1.2	B1.3	B1.4	B1.5	B1.6
N	26	26	26	26	26	26
B2.1 Pearson Correlation	.565**	.538**	.554**	.542**	.396*	.721**
Sig. (1-tailed)	.001	.002	.002	.002	.023	.000
N	26	26	26	26	26	26
B2.2 Pearson Correlation	.583**	.487**	.645**	.638**	.505**	.723**
Sig. (1-tailed)	.001	.006	.000	.000	.004	.000
N	26	26	26	26	26	26
B2.3 Pearson Correlation	.764**	.648**	.752**	.729**	.633**	.629**
Sig. (1-tailed)	.000	.000	.000	.000	.000	.000
N	26	26	26	26	26	26
B2.4 Pearson Correlation	.642**	.842**	.544**	.474**	.306	.419*
Sig. (1-tailed)	.000	.000	.002	.007	.064	.016
N	26	26	26	26	26	26
B2.5 Pearson Correlation	.486**	.445*	.501**	.470**	.254	.495**
Sig. (1-tailed)	.006	.011	.005	.008	.105	.005
N	26	26	26	26	26	26

** . Correlation is significant at the 0.01 level (1-tailed).

* . Correlation is significant at the 0.05 level (1-tailed).

From table 4.2 it can be seen that the relationships between the dependent and independent variables are in the range of 0.4xx to 0.8xx, with the mode at 0.5xx at a significant level of 0.01 and 0.3xx to 0.4xx at a level of significance of 0.05. This means that mostly moderate, positive linear relationships exist between the dependent and independent variables.

The levels for the correlations between the individual correlations are below 0.05 level of significance. That indicates that the null hypothesis is rejected, leaving the conclusion that there is a statistically significant relationship between the independent and the dependent variables.

Therefore there is a positive relationship between LSS implementation and the organizational performance at the REO.

The explanatory variables may be also correlated among themselves. The output in table 4.3 provides Pearson correlations between independent variables and associated significance tests. Most of the relationships are strongly positive linear relationships with the exception of B1.5 (continuous improvement variable), which has weak positive relationships with the other variables.

Table 4.3: Correlation between the Independent Variables

		B1.1	B1.2	B1.3	B1.4	B1.5	B1.6
B1.1	Pearson Correlation	1					
	Sig. (1-tailed)						
	N	26					
B1.2	Pearson Correlation	.719**	1				
	Sig. (1-tailed)	.000					
	N	26	26				
B1.3	Pearson Correlation	.693**	.685**	1			
	Sig. (1-tailed)	.000	.000				
	N	26	26	26			
B1.4	Pearson Correlation	.670**	.675**	.927**	1		
	Sig. (1-tailed)	.000	.000	.000			
	N	26	26	26	26		
B1.5	Pearson Correlation	.576**	.314	.426*	.456**	1	
	Sig. (1-tailed)	.001	.059	.015	.010		
	N	26	26	26	26	26	
B1.6	Pearson Correlation	.708**	.563**	.575**	.565**	.612**	1
	Sig. (1-tailed)	.000	.001	.001	.001	.000	
	N	26	26	26	26	26	26

Table 4.4 presents the correlations between dependent variables. The relationships are mostly weak but positive

Table 4.4: Correlations between the Dependent Variables

		B2.1	B2.2	B2.3	B2.4	B2.5
B2.1	Pearson Correlation	1				
	Sig. (1-tailed)					
	N	26				
B2.2	Pearson Correlation	.905**	1			
	Sig. (1-tailed)	.000				
	N	26	26			
B2.3	Pearson Correlation	.487**	.524**	1		
	Sig. (1-tailed)	.006	.003			
	N	26	26	26		
B2.4	Pearson Correlation	.285	.291	.569**	1	
	Sig. (1-tailed)	.079	.075	.001		
	N	26	26	26	26	
B2.5	Pearson Correlation	.471**	.508**	.400*	.259	1
	Sig. (1-tailed)	.008	.004	.022	.100	
	N	26	26	26	26	26

4.4.12 Discussion and interpretation of the responses to the relationship section

Management and leadership support is strongly positively correlated with the organizational culture and the employee motivation; moderately positively correlated with the reduction of the manufacturing costs and sales increase; and finally it has a weak positive correlation with quality performance of the organization.

The strong correlation between management and leadership support is in line with the statement by Cheng (2013:24) that if once top management takes a drives the LSS implementation strategy, the culture improves from a passive culture to that which is pro-active and open. Once the employees observe management taking the initiative, their level of involvement also increases dramatically.

The relationship between the reduction of manufacturing costs, sales and quality is also positive though not strong, that can be explained by Losonci and Demeter (2013:218-219) when they cite that Researchers are reaching conflicting conclusions when it comes to the impact of LSS (of which management and leadership support is a part of) and business performance (which includes the reduction in costs and sales), some are saying there is a strong positive impact some are not necessarily agreeing.

The weak correlation between management support and quality can be explained by the fact that the LSS quality standard is very stringent and tough, and quite a lot of organizations find it very challenging to reach the 0.3% defective rate prescribed by LSS according to Nakhai and Neves (2009:670)

Employee involvement is strongly positively correlated with employee motivation and culture; moderately positively correlated with the reduction of costs and increased sales; and weakly correlated to the quality performance of the organization. It is interesting to note that the correlation between employee involvement and quality is at a lower level of significance, $\alpha=0.05$ as opposed to the other relationship at $\alpha=0.01$.

If employees start helping one another and working as a team towards a common goal of reducing waste, (Dahlgaard, 2006:279), that will improve the culture and improve the morale and motivation. This explains the strong positive relationship between employee involvement and motivation and culture.

LSS systems are strongly positively correlated to culture and increased sales; moderately correlated with decreased costs, employee motivation and quality performance of the organization. Note that this is the only dependent variable that has a better correlation with the quality performance of the organization.

LSS tools are strongly positively correlated with the culture and increased sales; moderately correlated with the costs and has a weak correlation with employee motivation and quality performance.

LSS systems and tools, if implemented well enough will positively affect the sales and the costs (business performance) as cited by several Researchers (Losonci & Demeter, 2013:218-219; Hilton and Sohal, 2012:59 and Moyano-Fuentes and Sacrista'n-Dí'az, 2011:562). This is however, dependent on the maturity of the LSS implementation (Hilton and Sohal, 2012:59).

It is interesting to note a strong relationship between the quality performance of the organization and LSS systems, this suggests that if LSS is viewed as a system, as a philosophy, a way of life instead of just another passing improvement fad – it will enable the organization to achieve the stringent and challenging Six-Sigma level of quality.

And finally, continuous improvement has a strong to moderate positive correlation with the culture and sales; a weak relationship with costs; and no relationship with employee motivation and quality performance.

The lack of impact of continuous improvement to employee motivation can be explained by Agus and Hajinoor (2012:96) when they state that when the LSS improvement is implemented successfully and the organization is at a stage when it is continually improving, some employees might find that their jobs are becoming more and more challenging and they are getting more and more responsibilities. They are more likely to find their work stressful and that will not necessarily improve their motivation.

The level at which the organization is with regards to LSS implementation as compared to similar industries strongly and positively affects the costs, sales and culture; and moderately affects motivation and quality performance of the organization.

All of these positive relationships suggest that the null hypothesis is rejected, and therefore proves the existence of the statistically significant positive linear relationship between the LSS implementation and the resulting performance of the organization.

Therefore, implementing LSS successfully will increase or enhance the variables of organizational performance (costs, sales, employee motivation, culture and quality performance). The level of enhancement will vary

4.5 Section C: Assessing the Benefits of Implementing Lean Six Sigma

The results of the benefits associated with having implemented the Lean Six Sigma improvement strategy at the REO are presented in this section.

4.5.1 Implementing LSS in our organization has resulted in new innovative products and services

Figure 4.16: Distribution of responses for the Benefits question 1

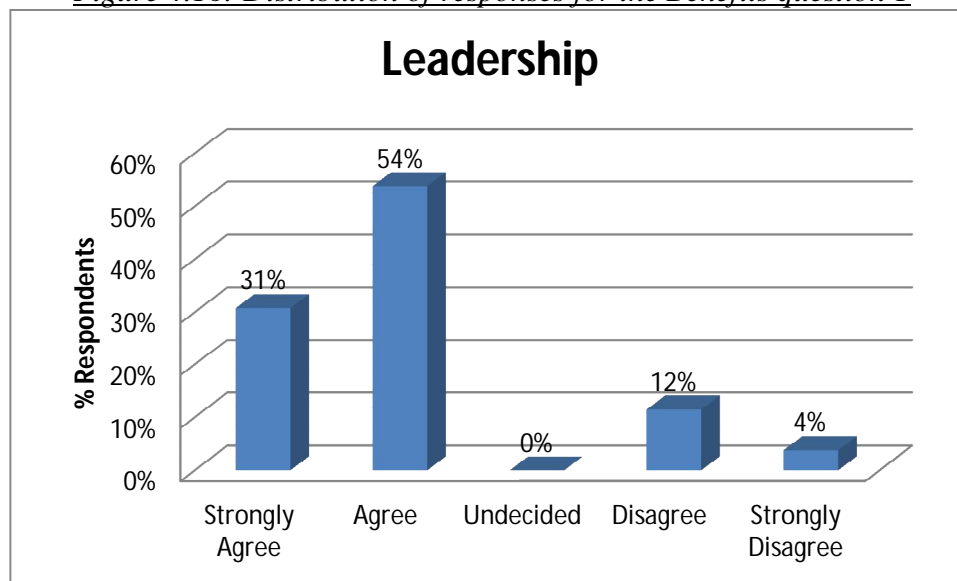


Figure 4.16 indicates that 31% and 54% of the respondents strongly agree and agree with the statement, respectively. Only 12% and 4% of the respondents disagree and strongly disagree with the above statement, respectively. The analysis also shows that cumulatively, 85% of the

respondents positively agreed with the above statement as indicate in the descriptive statistics Appendix E. The mode for this question was 2 as shown in Appendix E, which illustrates that the most respondents agreed with the above statement.

Quite a large percentage of people agree with this benefit that has been realised as a result of having implemented this improvement strategy, there is however 16% of the respondents that are not sharing the same view who have not experienced the new products and services.

4.5.2 Implementing LSS has resulted in reduced defects rates, process variability and cost of poor quality

Figure 4.17: Distribution of responses for the Benefits question 2

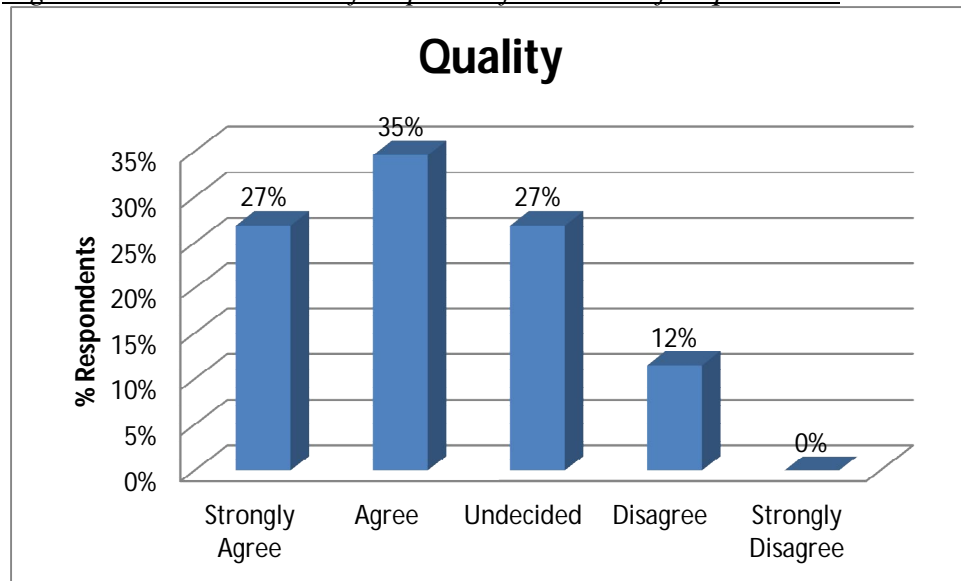
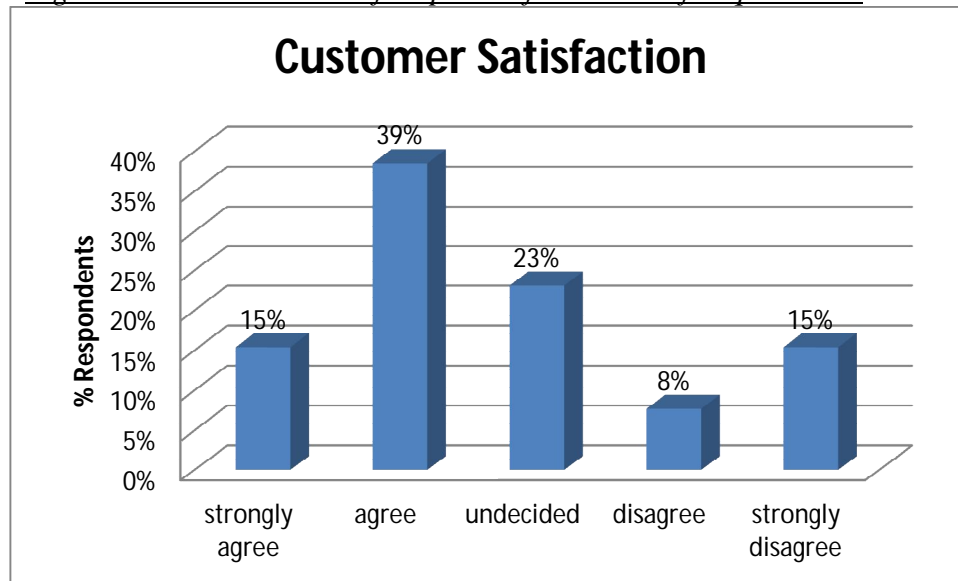


Figure 4.17 indicates that 27% and 35% of the respondents strongly agree and agree respectively, while 27% are undecided. Only 12% of the respondents disagree with the above statement. Cumulatively, 62% of the respondents positively agreed with the above statement as indicate in Appendix E. The mode for this question was 2 as shown in Appendix E, which illustrates that the most respondents agreed with the above statement.

It is interesting to see that though most of the respondents positively agree with this benefit, the percentage is lower than the first question. This indicates that a larger number of respondents are (38%) are not quite convinced that the improvement program has affected the quality of the products and processes in a way that has been described by the literature.

4.5.3 Customer satisfaction has greatly improved since the implementation of LSS

Figure 4.18: Distribution of responses for the Benefits question 3

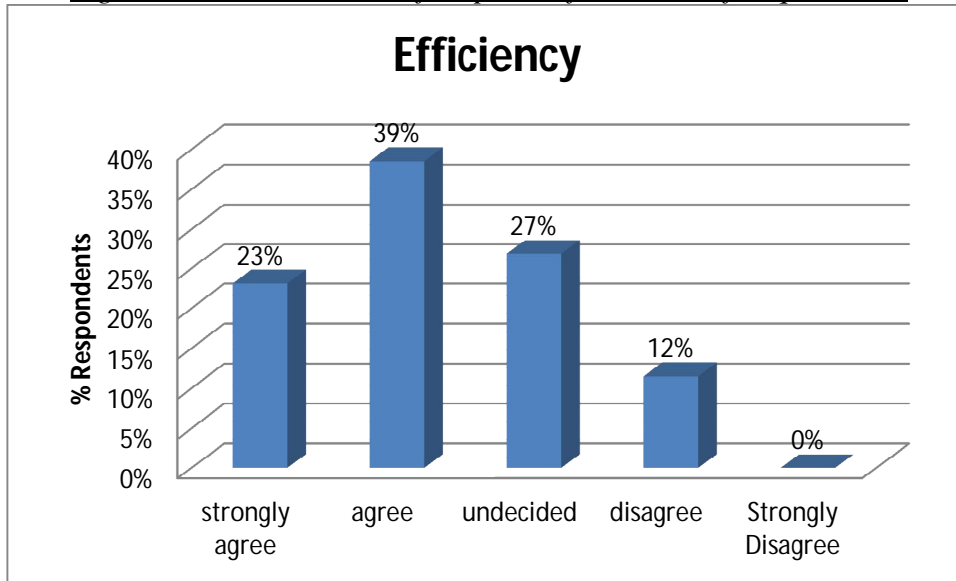


15% and 39% of the respondents strongly agree and agree respectively, while 23% are undecided. Only 8% and 15% of the respondents disagree and strongly disagree with the above statement. Cumulatively, 53% of the respondents positively agreed with the above statement as indicate in Appendix E. The mode for this question was 2 as shown in appendix E, which illustrates that the most respondents agreed with the above statement

In this question, though the respondents that positively agree with the benefit are still in the majority, the percentage is even lower than the previous questions, almost marginal. Even though only 23% of them positively disagree this shows that almost half of the respondents have not seen the positive effect of this improvement initiative on customer satisfaction.

4.5.4 Implementing LSS has resulted in improved equipment efficiency, low set up times and low lead times

Figure 4.19: Distribution of responses for the Benefits question 4

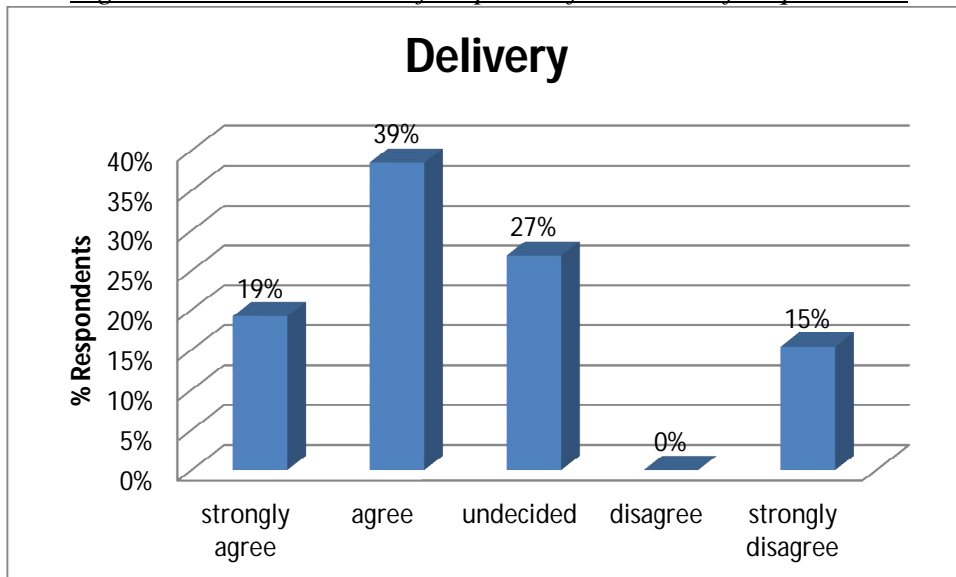


23% and 39% of the respondents strongly agree and agree respectively, while 27% are undecided. Only 12% of the respondents disagreed with the above statement. Cumulatively, 62% of the respondents positively agreed with the above statement as indicate in appendix E. The mode for this question was 2 as shown in appendix E, which illustrates that the most respondents agreed with the above statement.

It's very interesting to note that again in this instance it is not a significant percentage of respondents that positively agree with the benefit of improved efficiencies, set-up times and decreased lead times as a result of implementing Lean Six Sigma.

4.5.5 Implementing LSS has resulted in improved on time delivery

Figure 4.20: Distribution of responses for the Benefits question 5



19% and 39% of the respondents strongly agree and agree respectively, while 27% are undecided. Only 15% of the respondents strongly disagreed with the above statement. Cumulatively, 58% of the respondents positively agreed with the above statement as indicate in appendix E. The mode for this question was 2 as shown in appendix E, which illustrates that the most respondents agreed with the above statement

As with the above questions the trend is that the percentages of respondents that agree is not very significant.

4.5.6 Discussion and interpretation of the responses to the benefits section

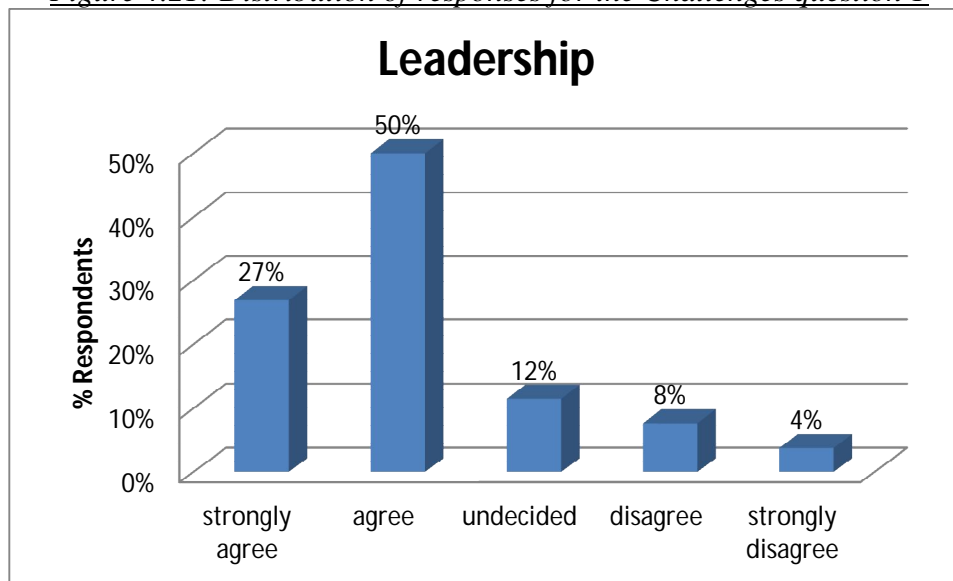
Literature review suggest that implementing LSS successfully offers benefits to organizations in the areas of quality improvement, innovation, customer satisfaction, improved reject rates, improved operational efficiencies, improved delivery times (Byrne, Lubowe, and Blitz, 2007:6; Thomas et al. 2009:125; Snee 2010:11-12, etc.).

The respondents at the REO have expressed that the organization has not seen the benefits of implementing LSS to the same level that literature promises, though it has been five years since the strategy was implemented. This is supported by the fact that the respondents that positively agree with the benefits statements are in the 50-60 percentiles. This raises questions and suggests that more needs to be done. The next section looks at the challenges and critical success factors which will improve the benefits for the REO.

4.6 Section D: Assessment of the Challenges of Implementing LSS

4.6.1 The organization was faced with the challenge to keep top management focused after initial stages of the program

Figure 4.21: Distribution of responses for the Challenges question 1

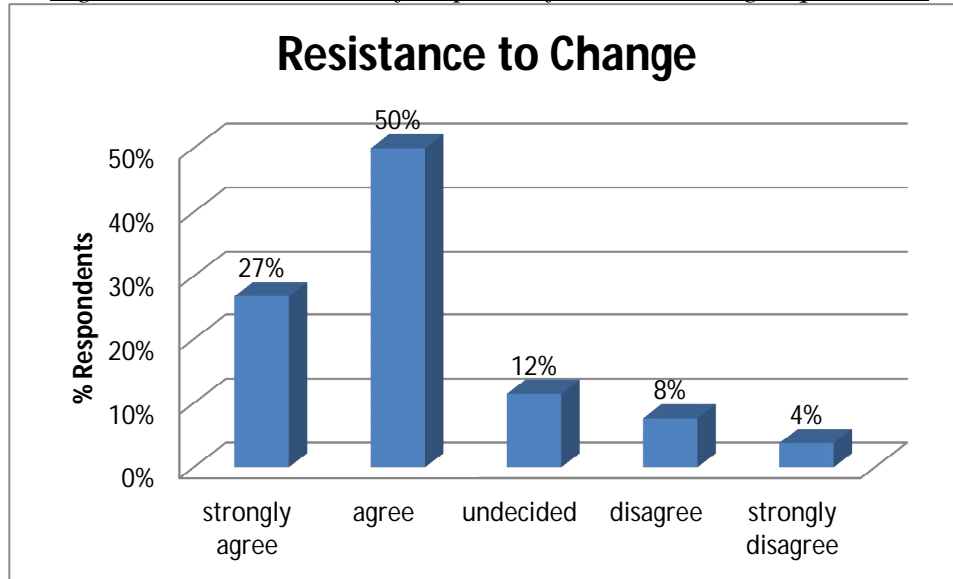


27% and 50% of the respondents strongly agree and agree respectively with the above statement, while 12% are undecided. 8% of the respondents disagreed with the above statement and 4% strongly disagreed. Cumulatively, 77% of the respondents positively agreed with the above statement as indicate in appendix E. The mode for this question was 2 as shown in appendix E, which illustrates that the most respondents agreed with the above statement.

Most of the respondents agree that management commitment after the introduction of the improvement program faltered/ dwindled/ lost momentum.

4.6.2 The organization was faced with the challenge of resistance from knowledge workers and middle management

Figure 4.22: Distribution of responses for the Challenges question 2

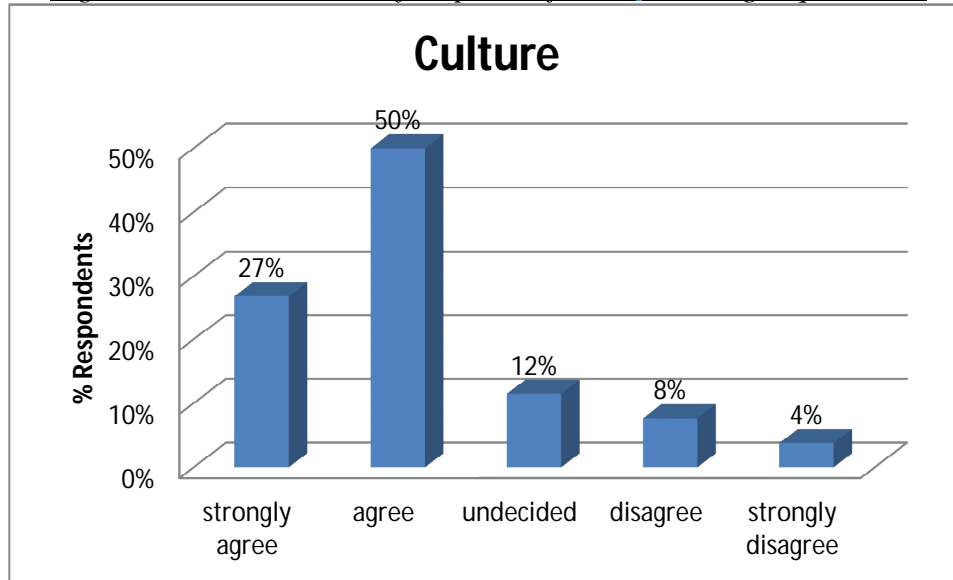


27% and 50% of the respondents strongly agree and agree respectively with the above statement, while 12% are undecided. 8% of the respondents disagreed with the above statement and 4% strongly disagreed. Cumulatively, 77% of the respondents positively agreed with the above statement as indicate in appendix E. The mode for this question was 2 as shown in appendix E, which illustrates that the most respondents agreed with the above statement.

Most of the respondents agree that the organization was faced with resistance and that posed a challenge to LSS implementation.

4.6.3 The organization was faced with the challenge of embracing the LSS culture

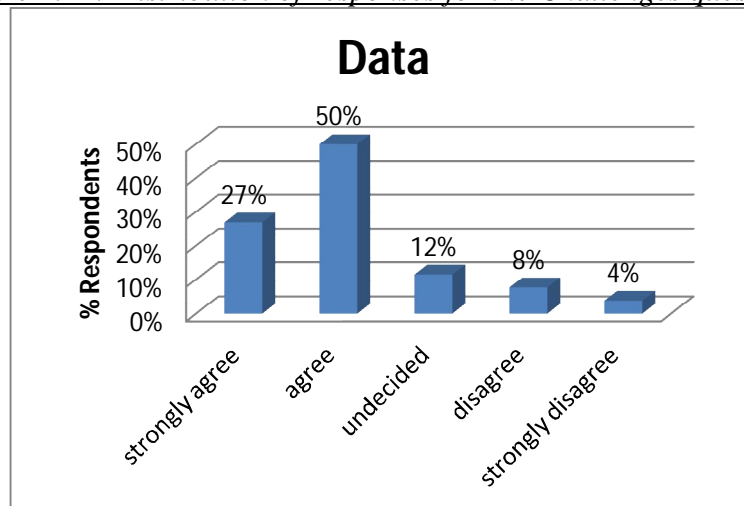
Figure 4.23: Distribution of responses for the Challenges question 3



27% and 50% of the respondents strongly agree and agree respectively with the above statement, while 12% are undecided. 8% of the respondents disagreed with the above statement and 4% strongly disagreed. Cumulatively, 77% of the respondents positively agreed with the above statement as indicate in appendix E. The mode for this question was 2 as shown in appendix E, which illustrates that the most respondents agreed with the above statement. Most of the respondents agree that the culture at the REO was conducive for a successful implementation of LSS.

4.6.4 The organization was faced with the inability to collect sufficient data that is to make efficient use of SPC

Figure 4.24: Distribution of responses for the Challenges question 4

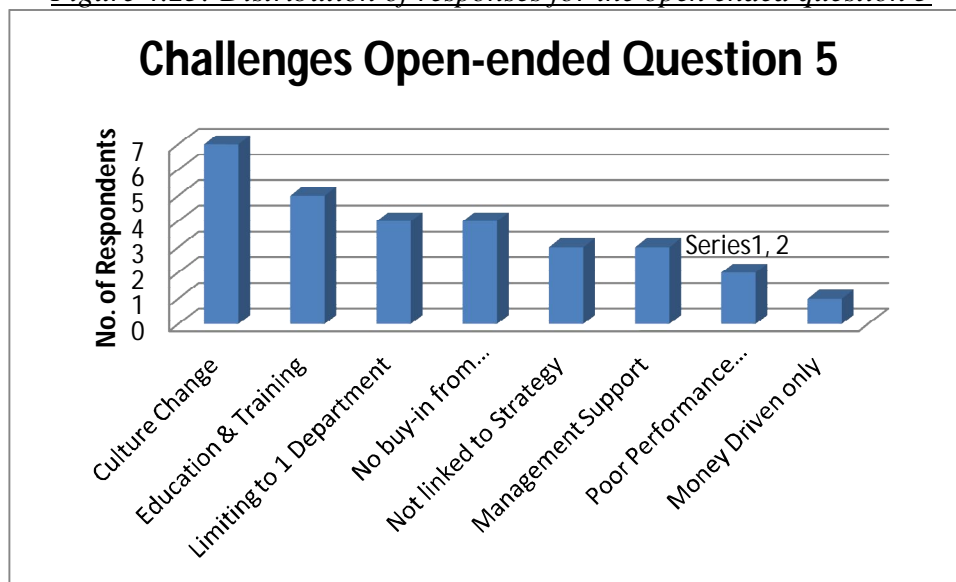


27% and 50% of the respondents strongly agree and agree respectively with the above statement, while 12% are undecided. 8% of the respondents disagreed with the above statement and 4% strongly disagreed. Cumulatively, 77% of the respondents positively agreed with the above statement as indicate in appendix E. The mode for this question was 2 as shown in appendix E, which illustrates that the most respondents agreed with the above statement. Most of the respondents agree that data management was a challenge.

4.6.5 The open ended question – other challenges faced by the organization

Question 5 explored the additional reasons why the respondents thought the implementation was a challenge; it was an open ended question therefore the respondents had the opportunity to give their thoughts without being limited to specific answers. The results were coded into categories for data analysis. Respondents cited cultural change; education and training; performance management as some of the challenges in implementing LSS as depicted in figure 25

Figure 4.25: Distribution of responses for the open ended question 5



The Pareto analysis of the responses to the open ended questions indicates that the culture of resistance to change was the biggest challenge that hindered the effective implementation, followed by the inadequate training and education of the employees to enable them to effectively implement LSS and the least of the responses suggested the lack of incentives and using financial gains as the only criteria to choose LSS projects as the challenges.

4.6.6 Discussion and interpretation of the responses to the challenges section

The close ended questions indicated that the organization was equally challenged by factors relating to leadership and management support; resistance from knowledge workers; a poor LSS culture and the inefficient data collecting and data management process.

The following themes emerged from the open ended question about what the respondents thought were the challenges facing the implementation.

Culture change: Seven respondents re-iterated the resistance to change as the major challenge that made this implementation very difficult.

Education and Training: Five respondents pointed the lack of awareness and training on the concept of LSS as barriers that made implementation difficult. The champions were trained but the rest of the organization that were the recipients of the system were not trained and made aware enough to support and complement the champions during the implementation process. This in turn made the people resistant to the change that was being implemented.

Limiting the change to one department: Four respondents felt that limiting the implementation to one department was also a challenge because the processes from ordering a product to after delivery to the customer are interlinked and improving one aspect of the process (i.e. production) without improving the other aspects of the process creates a lag that renders the whole improvement ineffective. This is supported by Losonci and Demeter (2013:230) where they state that lean principles should not be limited to manufacturing operations.

No buy in from employees: Four other respondents mentioned the lack of involvement by other employees as a challenge. Only the champions were given attention, and therefore the process was viewed as one that belongs to the champions and other people as a result did not actively participate.

Lack of management support: Three respondents listed the lack of support from top management as another challenge. As pointed out in the question 1, top management was actively involved in the initial stage of introducing the concept but once the message had gone across, they were not committed enough during the actual implementation process to see it reaching the envisaged benefits swiftly.

The change was not linked to strategy: Three respondents mentioned involving too many departments at the same time and setting too many conflicting targets at the same time was also a challenge. The objectives were not set with the common goal in mind, the goal that ultimately puts the customer at the forefront instead they were set with each department trying to achieve their goals at the forefront. As a result the different departments were pulling in different directions and this resulted in the implementation being a challenge.

Poor performance management: Two respondents pointed out the lack or inadequacy of rewards and incentives, which demotivated those involved and hampered the implementation.

Money driven only: Another respondent pointed out that the company only focused on the monetary gains as the only driving factor to measure the success of the implementation and that was a challenge.

The challenges are in line with what other organizations have experienced according to the literature review. Top management support is seen cited by a few Researchers as one of the biggest challenges (Snee, 2010: 20; Scherrer-Rathje 2008: 81; Henderson and Larco, 2000:233, etc.). This involves the lack of strategic understanding of LSS by management, senior management taking a hands-off approach to LSS implementation, or in the case of REO offering very little support once the initial stages of deployment had been completed.

Another important one that has been cited is the employee resistance to change, which was also prevalent in the REO. Snee (2010:18) states that this could be due to lack of understanding of the LSS strategy, or thinking that the new strategy could endanger their jobs.

4.7 Section E: Assessment of the Critical Success Factors (CSF) of Implementing LSS

4.7.1 Leadership: Leadership at all levels must drive, live and demonstrate behaviours supportive of LSS

Figure 4.26: Distribution of responses for the CSF question 1

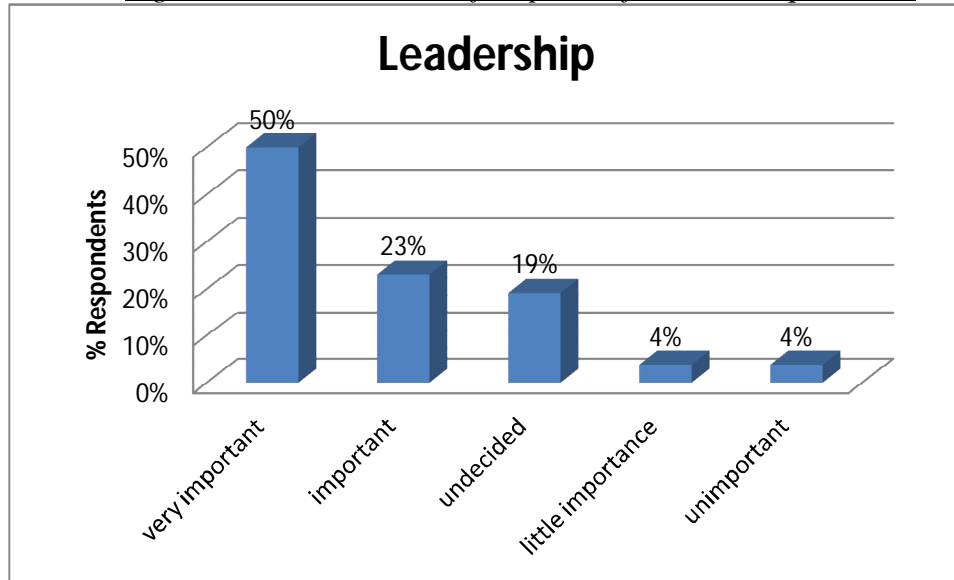


Figure 4.26 indicates that cumulatively, 73% of the respondents positively agree with the importance of the role played by leadership as critical to a successful LSS implementation. 19% of them are undecided, while 8% cumulatively agree that leadership role is not an important factor in successfully implementing LSS. The mode for this question is 1 as shown in Appendix E, which illustrates that the most respondents say that Leadership is very important for success.

4.7.2 Linking LSS to customers: LSS begins and ends with the customer in mind

Figure 4.27: Distribution of responses for the CSF question 2

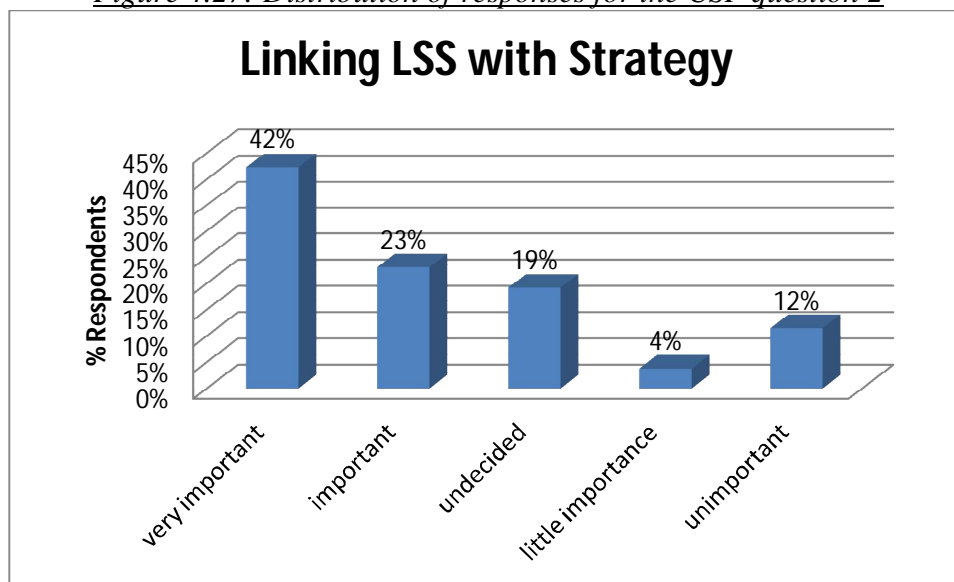


Figure 4.27 indicates that cumulatively, 65% of the respondents positively agree with the importance of linking LSS goals with the organizational strategy a success factor for effective LSS implementation. 19% of them are undecided, while 16% cumulatively agree that this is not an important factor in successfully implementing LSS. The mode for this question is 1 as shown in Appendix E, which illustrates that the most respondents say that linking the LSS goals to strategy is a very important critical success factor.

4.7.3 Linking LSS to Strategy: There must be a clear link between the organizational goals, key objectives and LSS outcomes

Figure 4.28: Distribution of responses for the CSF question 3

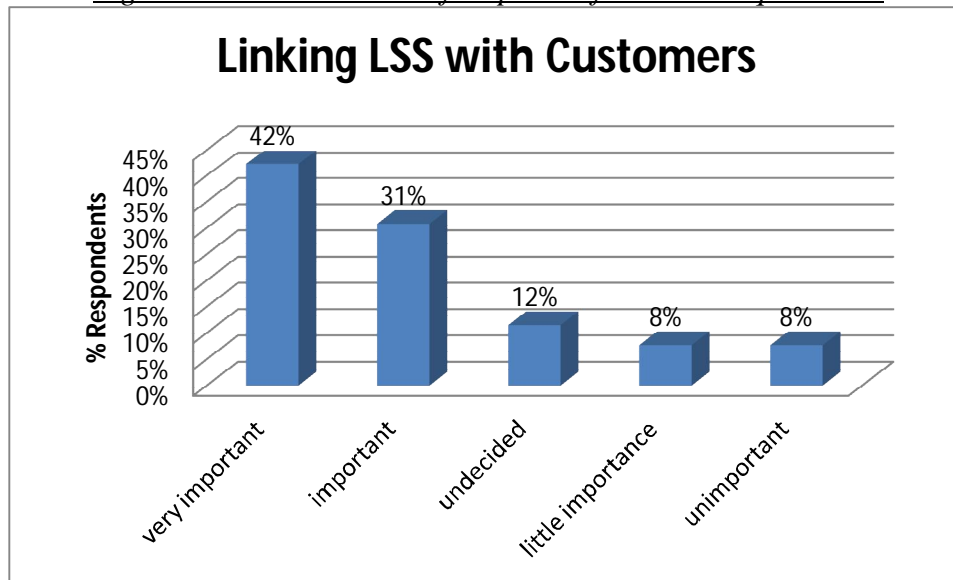


Figure 4.28 indicates that cumulatively, 72% of the respondents positively agree with the importance of putting customers at the centre stage of LSS implementation a success factor. 12% of them are undecided, while 16% cumulatively agree that this is not an important factor in successfully implementing LSS. The mode for this question is 1 as shown in Appendix E, which illustrates that the most respondents say that linking the LSS with the customer is a very important critical success factor.

4.7.4 Training: Ultimately it is the knowledge, skills, involvement and commitment of employees that will make the difference to LSS success

Figure 4.29: Distribution of responses for the CSF question 4

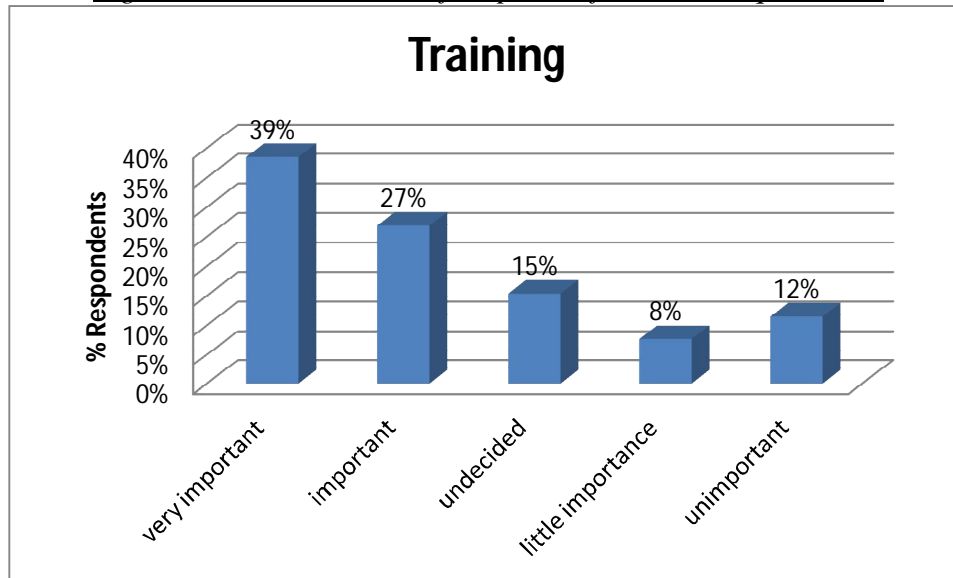


Figure 4.29 indicates that cumulatively, 66% of the respondents positively agree with the importance of training as a critical success factor for LSS implementation. 15% of them are undecided, while 20% cumulatively agree that this is not an important factor in successfully implementing LSS. The mode for this question is 1 as shown in Appendix E, which illustrates that the most respondents say that linking the LSS with the customer is a very important critical success factor.

4.7.5 Culture: The organization must integrate the soft issue such as culture, mind-set and behaviours with the hard issues such as systems, structure, process and tools of LSS

Figure 4.30: Distribution of responses for the CSF question 5

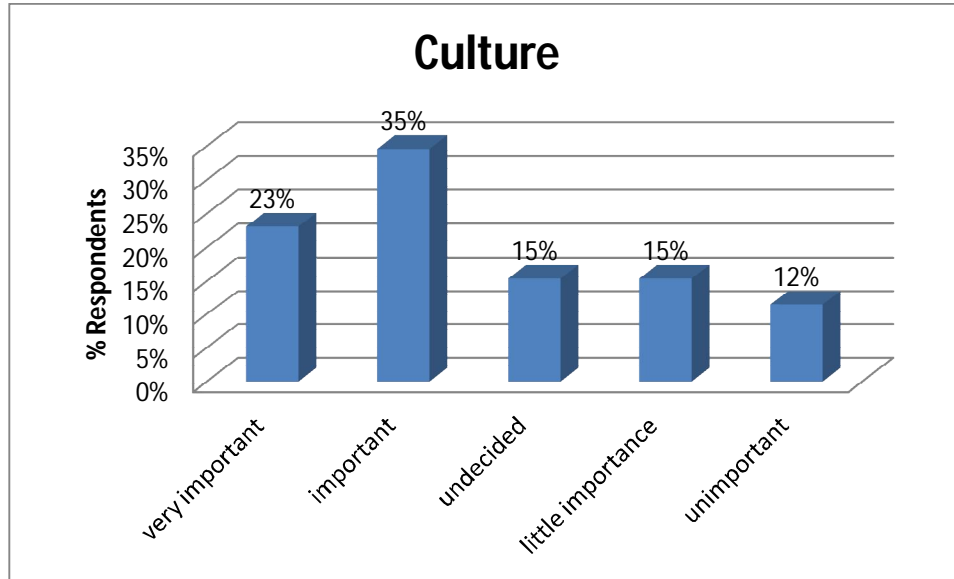


Figure 4.30 indicates that cumulatively, 58% of the respondents positively agree with the importance of a conducive LSS culture as a critical success factor for LSS implementation. 15% of them are undecided, while 27% cumulatively agree that this is not an important factor in successfully implementing LSS. The mode for this question is 2 as shown in Appendix E, which illustrates that the most respondents say that culture is an important critical success factor.

4.7.6 Discussion and interpretation of the responses to the CSF section

Table 4.5: Pareto on CSF

Question	% Very important + Important
Leadership	73%
Linking LSS to customer	72%
Training	66%
Linking LSS to strategy	65%
Culture	58%

Figure 4.31: Pareto Analysis on the CSF

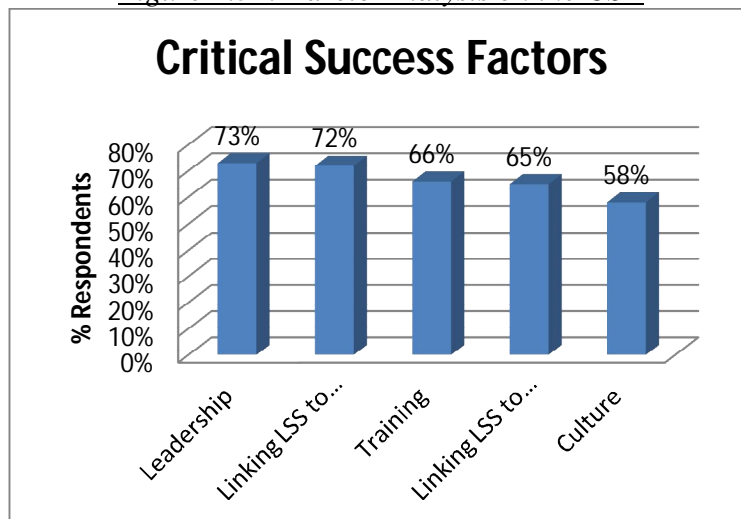


Figure 4.31 indicates that leadership has been chosen by the responses as the most critical success factor for an impactful LSS implementation, followed by linking LSS to customers, then training, then linking LSS to customers and finally culture.

This is closely supported by Manville (2012:14) who lists the six critical success factors to be

- Senior management commitment, support and enthusiasm
- Linking Lean Six Sigma to business strategy
- Linking Lean Six Sigma to the customer
- Project selection and prioritization
- Training, education and understanding the tools and techniques

Antony and Banuelas (2002: 24) state that top management commitment to Six Sigma had the highest rating in the pilot study which was done in the UK. The results from the respondents clearly indicate that at the REO, Top management support is also the highest. From the results the researcher can conclude that the importance of top management commitment is the same regardless of the location.

Antony and Banuelas (2002: 25) state that training is a critical factor in the successful implementing of Six Sigma projects. He further explained that explaining to employees the how's and the whys of Six Sigma in the early stages improves employees comfort level in project involvement.

The results above indicate that culture change is viewed as important for the success of Six Sigma. Six-Sigma is considered a breakthrough management strategy because it involves adjustments to the firm's value and culture and it also involves substantial change in the organisational structure and strategy. According to the respondents culture change is important. Employees believe that culture change will result in the long term support to Six Sigma resulting in high yield of return in Six Sigma.

According to Antony and Banuelas (2002:23) Six Sigma should begin and end with the customers. Projects must begin with determining customer requirements and this will close the gap between the customer and the organisation. The success of Six Sigma projects closes the gap between customer expectation and the actual performance.

As expected, the research supports the findings of literature that for LSS to be successful it should be implemented as one of the organizations strategic drivers. Any strategic issue obviously requires the commitment of the executive leadership.

Conclusions and Recommendations

2.1 Introduction

In Chapter 4 the results of the study were presented, analysed and discussed. Chapter 5 reiterates the analysis with the purpose of solving the objective of the study. The main problem and sub-problems are briefly discussed. The findings of the empirical and literature studies were presented. Conclusions based on the findings and recommendations are made regarding challenges and success of implementing LSS at the REO.

In this chapter, the researcher concludes the study with a discussion of the research findings, and draws conclusions and recommendations.

2.2 Findings from the study

It was submitted that the effectiveness of LSS as a business management improvement strategy is beyond question, and that LSS has become a competitive necessity for many organizations. It was also stated that although many organizations attempt to go LSS, few succeed, in other words LSS in most cases, never achieves what it could or should have achieved. The generally accepted LSS success rate recorded in literature is between 10% and 30%. (Bhasin and Burcher, 2005:56) Given that apparent low success rate, the objective of this study was uncovering the reasons behind the lack of success through identifying the challenges and the critical success factors for the effective and fruitful implementation in the REO. The results of this study shows that the organization has not been very successful, only 4% of the respondents see the company as the best in class and 15% as an average, in other words there is a very big room for success. This supports the reasons or justification to conduct this study.

2.2.1 Findings from literature review

2.2.1.1 Impact of LSS on Organizational Performance

The literature reviewed revealed that the successful implementation of LSS can positively improve the performance aspects of the organization in the areas of reducing costs, reducing inventories and poor quality, improving the sales, improving the organizational culture, increasing employee teamwork thus positively affecting the employee morale and motivation.

2.2.1.2 Benefits of LSS Implementation

As stated in the literature review, the benefits of LSS range from reduction in operational costs to improving customer relations to improving the innovation capability of the organization, improving productivity and quality performance of the organization to some extent.

2.2.1.3 Challenges of LSS Implementation

Past research shows that implementing LSS is never an easy road and there are common challenges experienced by most manufacturing companies, as covered in chapter 3 namely: leadership and management support; resistance from knowledge workers; a poor LSS culture and the inefficient data collecting and data management process, lack of specific Lean Enterprise skills, knowledge, management reluctance to empower people, Fear of change, loss of organizational power and internal systems and hurdles.

2.2.1.4 CSF for the Effective LSS Implementation

The important CSF was pointed out by literature and they are:

- Senior management commitment, support and enthusiasm
- Linking Lean Six Sigma to business strategy
- Linking Lean Six Sigma to the customer
- Project selection and prioritization
- Training, education and understanding the tools and techniques

2.2.2 Findings from the primary research

2.2.2.1 Impact of LSS on Organizational Performance

The correlation analysis in chapter 4 identified a number of practices that largely affect organizational performance and the analysis indicated that the change in culture is the most positively influenced by LSS implementation. Bhasin and Burcher (2005:64) state that it is

essential for the right culture to exist amongst the organizations employees in order for the business to enjoy the full benefits of LSS. Before the costs can be reduced or sales increased the culture and the way of doing things in an organization has to be changed. Bhasin and Burcher (2005:64) insist that Lean must be viewed as a philosophy, they are adamant that it must be viewed more as a philosophy than a process.

LSS also positively affects and impacts on the cost savings that are generated by the organization from reducing waste and other LSS efforts, the resultant reduction in costs will have a positive effect on the number of sales as well. And if the culture is right the employee motivation will also increase. What seems to be weakly affected though is the quality performance of the organization. This could be an indication that the level of quality conformance of the products and services was not a problem but rather the availability of the actual products or a variety. In this case the improvement that can be brought about by implementing LSS will not necessarily improve the quality of the product, but improve the variety of the product offering as well as make more units available in a short space of time. It can also be the measurement for quality being the Six Sigma quality (3.4 DPMO), which is very difficult to attain.

2.2.2.2 Benefits of LSS Implementation

Though the benefits were there, they were not effected to all the employees or departments in the REO as a significant percentage did not positively agree on their presence. The benefits could not be fully realised because of the challenges that the organization was experiencing.

2.2.2.3 Challenges of LSS Implementation

The conclusion drawn from the responses proved that the REO faced challenges similar to other manufacturing industries when implementing LSS. According to the analysis, the organisation experienced challenges and this is one of the reasons why the organisation did not achieve the desired level of benefits of LSS. These challenges could be prevented by identifying them and putting in place a contingency plan in order to prevent setbacks.

2.2.2.4 CSF for the Effective LSS Implementation

In chapter 4 the researcher discussed the findings of the survey. Data analysis was conducted on specific questions from the survey. From the results, it can be deduced that the following 5 potential critical success factors are in fact the necessary for LSS implementations at REO, with the top one being the most critical and the last one at the bottom of the priority list:

- There must be Senior management commitment, support and enthusiasm for effective implementation of LSS
- LSS must be linked to the customer for effective implementation
- There must be adequate training, education and understanding the tools and techniques for effective implementation of LSS
- LSS must be linked to business strategy for effective implementation
- Culture must be conducive for an effective implementation of LSS

2.2.3 Conclusions

The responses are in line with the literature review, especially on the impact of LSS on performance as well as the challenges and critical success factors.

2.3 Recommendations

Lean Six Sigma can be seen as top-down approach. When top management decides to implement LSS, it needs to develop an explicit strategy to change the leadership approach of the firm. The fundamentals aspects of this new leadership include challenging the existing processes, inspiring a shared vision, and enabling others to act. In short, managers must support and direct the LSS actions, by serving as communicators of the LSS vision and its focus on quality, as well as being drivers of organizational change, the providers of integrated resource, and the facilitators of knowledge sharing

Workshop activities as a facilitator for linking LSS to business strategy. There may be some obstacles to implementing LSS systems within an organization, and these are often related to people, and it is therefore important to choose the right staff and motivate them to undertake changes in the right way. REO builds an organizational consensus via workshop activities, and these can help to create new behaviours and emphasize how strategic initiatives can help the firm meet its business objectives. REO can thus smoothly implement LSS based on a common language within the organization.

Integrate LSS activities with daily management activities. Implementing the LSS is not just about using the DMAIC methodology, but also about improving the bottom line. REO applies the actions in seven stages to achieve this, by setting priorities with regard to problems, and using scientific approaches, such as FEMA or causes and effects, in order to develop an action plan. REO also engages all the business process owners in the LSS a project using the DMAIC approach, along with daily management activities to solve the main problems that arise in the firm, so that the employees also learn to apply the kaizen spirit to LSS. Implement LSS based on business goals. The purpose of implementing LSS is to improve organizational performance. REO's goals in this respect include on time delivery and inventory reduction, as well as increasing quality and productivity and reducing costs.

2.4 Conclusion

Generally it can be concluded that the findings of this study confirm the theories reported in recent literature

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