

**UNIVERSITY OF KWAZULU-NATAL**

**“A Critical Evaluation of the application of Six Sigma as a Business Transformation  
Methodology at Lonmin South African Operations.”**

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**A dissertation submitted in partial fulfillment of the requirements for the degree of  
Master of Business Administration**

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Faculty of Management Studies**

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**Year of submission: 2010**

## **DECLARATION**

I , Raymond Naidoo declare that

- (i) The research reported in this dissertation/thesis, except where otherwise indicated, is my original research.
- (ii) This dissertation/thesis has not been submitted for any degree or examination at any other university.
- (iii) This dissertation/thesis does not contain other persons' data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons.
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## **ACKNOWLEDGEMENTS**

I wish to express my sincere appreciation and gratitude to the following individuals, without whose assistance, this study would not have been possible:

- Professor Anesh Maniraj Singh my dissertation supervisor for his guidance and support.
- Lonmin Platinum for allowing me to conduct the research on the organisation
- Lonmin colleagues for helping me conduct this study
- Everyone I have interacted with during my studies at GSB UKZN.
- My family and friends, for their understanding and support.
- My wife Roseanne Naidoo, daughter Shivarina Naidoo and son Rearden Raymond Naidoo for their motivational inspiration, patience and support during my MBA study.

## **ABSTRACT**

One of the major challenges for organisations operating in today's global business environment is to improve productivity, reduce costs and enhance customer service. Six Sigma methodology has become a popular approach in a number of organisations as a business improvement tool.

This research presented Six Sigma as a business transformation methodology within Lonmin operations. The purpose of this research was to identify the primary factors in the Six Sigma framework, and to evaluate the relationship between these factors in the framework and their contribution towards transformation in terms of business improvement. This research critically evaluated the application of Six Sigma within Lonmin in the South African context.

Quantitative data was obtained from questionnaires distributed to the different Six Sigma role players within Lonmin. A probability sample was used; sixty five (65) Six Sigma candidates were drawn from Lonmin with a Six Sigma population size of one hundred and twenty (120) employees listed in the Six Sigma database. Data was collected using an e-mail based questionnaire developed by the researcher.

The main contributions of this study showed that communication and organisational culture were the most important factors to transform business performance when Six Sigma was integrated with business principles. The study revealed that project selection was a vital element in the process that determined the value towards business improvement. Six Sigma must be supplemented by other programmes (Theory of Constraints, Design For Six Sigma) in order to be more effective in attaining business performance.

This research will benefit management to evaluate and structure an aligned methodology for transformation. Employees will be motivated to attain greater knowledge and skill. Research will prove beneficial to organisations that need to transform their organisation.

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# **CHAPTER ONE:**

## **Overview and Introduction to the Study**

---

### **1.1 Introduction**

Increasing competitive pressure from global markets and technology developments had resulted in continual demand for business improvement philosophies and methodologies in operations management to address these challenges (McAdam & Hazlett, 2005).

According to many business development and quality improvement experts, Six Sigma was the most popular management methodology in history. More and more companies have turned towards Six Sigma certification to remain competitive and improve their overall quality [Online]. Available WWW: [www.isixsigma.com](http://www.isixsigma.com) (Accessed 1 July 2010).

### **1.2 Motivation for the Study**

In today's marketplace, Chief Executive Officer's (CEO) are faced with increased globalisation, constant technological advances and other competitive pressures that accelerate the pace of change. The resulting opportunities and threats have placed innovation on top of CEO's priority list [Online]. Available WWW: [www.ibm.com](http://www.ibm.com) (Accessed 1 July 2010).

Research showed that the right operations strategy can transform organisation for business improvement. In the business world, Six Sigma was defined as a business strategy used to improve business profitability, to improve the effectiveness and efficiency of all operations to meet or exceed customer's needs and expectations [Online]. Available WWW: [www.isixsigma.com](http://www.isixsigma.com) (Accessed 1 July 2010).

The results of this research would be of interest to individuals and practitioners who are keen in adopting Six Sigma. The research will help them to:

- Understand the Six Sigma methodology
- Successfully implement Six Sigma in areas that will add most business performance value

- Maximise return on investment by effectively integrating people, processes and knowledge as outlined by Six Sigma methodology
- Identify potential pitfalls of Six Sigma implementation

This study will provide senior management with fundamental strategic programme implementation considerations to transform organisations.

The results of this research will be of value to organisations who want to derive a competitive advantage. Leading companies (General Electric, AlliedSignal, Motorola and Caterpillar) have successfully implemented Six Sigma in their operational strategies [Online]. Available WWW: [www.isixsigma.com](http://www.isixsigma.com) (Accessed 1 July 2010).

In order to continue to grow and develop shareholder value, organisations need to ensure that they identify new opportunities, create new customer promises and deliver flawlessly to keep them ahead of the competition (Jugulum and Samuel, 2008).

### 1.3 Focus of the Study

Transformation as a visionary strategy was integrated into the organisation to develop the organisation's capabilities. Therefore, transformation was a phenomenon beyond simple innovation adoption, or scanning the environment for new knowledge or practice assets. Adopting an innovative programme capable of generating fundamental organisation wide change in practices was necessary condition of transformation [Online]. Available WWW: [www.inderscience.com](http://www.inderscience.com) (Accessed 1 July 2010).

In addition to cutting costs and improving quality, successful continuous improvement initiatives ultimately changed the culture of an organisation. The culture change focused on the motivation and desire of the organisation's members to continually improve business processes and policies. This fundamental change in operating and managing processes required the stimulus of a structured method or program of continuous improvement [Online]. Available WWW: [www.isixsigma.com](http://www.isixsigma.com) (Accessed 1 July 2010).

#### 1.4 Problem Statement

Although most organisations want to improve quality and reduce costs, the deployment and implementation of continuous improvement methodologies is commonly viewed as a daunting journey. Many organisations fail to properly structure and/or support continuous improvement initiatives, which ultimately lead them to failure [Online]. Available WWW: [www.isixsigma.com](http://www.isixsigma.com) (Accessed 1 July 2010).

Lonmin's position as the lowest cost producer was under threat. Lonmin's CEO had implemented Six Sigma as a business improvement transformation tool to transform the organisation to achieve status as the lowest cost Platinum producer. The end result of this transformation was erosion of shareholder value and threat to Lonmin sustainability. Six Sigma was one of the chosen programmes to ameliorate these effects and help transform the company to achieve its strategy to grow the value of its Platinum business [Online]. Available WWW: [www.lonmin.com](http://www.lonmin.com) (Accessed 1 July 2010).

#### 1.5 Research Questions

The purpose of this study was to investigate the role of Six Sigma in transforming Lonmin operations to attain business improvement. In order to achieve this purpose, the research aimed to answer the following fundamental question:

*Is Six Sigma a transformational tool to drive business improvement?*

#### 1.6 Objectives

The research question is broken down to the following research objectives:

It was noted that culture adaptation was key to attain any success. It was argued that for an organisation to realise the value of implementing quality practices, it must have a culture that is capable of fully supporting their implementation (Sousa-Poza, Nystrom, and Wiebe, 2001). Organisational culture was recognised as one major factor or challenge to the Six Sigma implementation (Antony and Banuelas, 2002; Coronado and Antony, 2002; Kwak and Anbari, 2004).

*Objective 1: To determine the impact of Six Sigma on culture transformation*

Culture adaptation in this study focused on Change Management, Knowledge Management and Sustainability. Objective 1 was subdivided into three sub objectives as follows:

- *Objective 1a: To determine the impact of Six Sigma as Change Management at Lonmin*
- *Objective 1b: To determine the value of Six Sigma Knowledge Management at Lonmin*
- *Objective 1c: To determine the Sustainability of Six Sigma programme at Lonmin*

The underlying measure of any implementation is to attain value and return on investment. Quality management is a philosophy and process to improve performance across the organisation (Prycraft, Singh, and Phihlela, 2005).

*Objective 2: To determine impact of Six Sigma on business improvement.*

Business performance in this study focused on Six Sigma Benefits, performance and Political, Environment/ Economy, Social, Technology (PEST) evaluation and Performance. Objective 2 was subdivided into three sub objectives as follows:

- *Objective 2a: To determine the benefits of Six Sigma programme at Lonmin*
- *Objective 2b: To determine the Six Sigma Performance at Lonmin*
- *Objective 2c: To determine the PEST analysis impact on Lonmin's transformation programme*

### 1.7 Limitations of the Study

Sample size was one of the limitations, due to the size of the organisation, accessibility of employees; the miners and operators were excluded from the research. The research only focused on the Six Sigma Role players.

Education and knowledge was another limitation, the level of education and knowledge of the Six Sigma was important for the study, only employees that were involved with the programme were included.

Medium of communication was another limitation, due to the dispersed operations sites and availability of respondents, this research totally relied on electronic communications (e-mail) and only employees configured on the email system. The feedback response rate was slow due to the completion of the survey and commitment in terms of submission of the survey. The result was a good response rate; of the one hundred and twenty (120) individuals who received the survey via e-mail only sixty five (65) responded, equating to fifty four percent (54%) of the population. Delay in responses from respondents resulted in re-requesting and finally acknowledging non participation. Time was another limitation due to the resignation of the researcher from Lonmin.

## 1.8 Structure of the Research

### Chapter One

Chapter one of the study introduces the research and the various chapters contained in this thesis and their content.

### Chapter Two

Chapter two of the study details the extensive literature review undertaken to explain Six Sigma. Various theories and models of Six Sigma are discussed in detail and related to the Lonmin. A number of textbooks, journals, websites and other sources of information have been consulted in order to present a comprehensive literature survey of the established models and theories.

### Chapter Three

Chapter three details the research methodology that was employed to ascertain the impact of Six Sigma at Lonmin on the performance of the business. The chapter discusses the various approaches adopted by the researcher to get the required information and responses from employees.

### Chapter Four

Chapter four of the study presents the results of the research. Quantitative techniques were used to assess both employee responses and performance at Lonmin.

## Chapter Five

Chapter five discusses the findings and links it to other similar studies in the field.

## Chapter Six

Chapter six presents the conclusions and recommendations of the study. The recommendations that are made are based on the analysis and findings from Chapter five.

### 1.9 Conclusion

The motivation of this study was to determine the capability of Six Sigma as a transformation programme to improve business performance. CEO's have the power to implement programmes; the value of the application was in the organisation culture adaptation for success. Sample size, education and Six Sigma knowledge, communication medium and time were limitations of this study.

The role of Six Sigma as a transformation programme entailed organisational culture adaptation in the constructs of change management, knowledge management and sustainability. The role of Six Sigma as a business improvement tool entailed the constructs of Six Sigma benefits, performance and PEST analysis.

The results of this research will help individuals and practitioners by providing information on the deliverables of Six Sigma towards business improvement. It will also help organisations to invest in Six Sigma as a competitive tool.



## **CHAPTER TWO**

### **Literature Review**

---

#### **2.1 Introduction**

Six Sigma is more popular than ever as an operational quality improvement technique for cutting costs, improving processes, and reducing business cycle times. Six Sigma can also be employed as a powerful leadership philosophy and methodology (Smith & Blakeslee, 2002). Snee (1999) defines Six Sigma as a Strategic Business Improvement approach that seeks to increase both customer satisfaction and an organisation's financial health.

Macro-environment framework entails strategic tools for formulating business strategies, marketing planning, business and product development and how the business responds to these external influences.

This chapter will deal with Six Sigma as a strategic tool for developing and accelerating corporate strategy and for spurring organisational change. This chapter discusses the major issues regarding Six Sigma deployment towards Business Performance.

An objective of this study is to identify the strategic deployment of Six Sigma in attaining business performance at Lonmin Platinum South Africa operations. The literature review indicates that various researchers adopted different Six Sigma indicators for measuring business performance. The focus of the transformational plan is on the Six Sigma programme and how the programme needs to transform in the macro environment to meet the business objectives.

#### **2.2 Origin of Six Sigma**

Since the early 1990s, globalisation has driven businesses towards more rapid change as competition became „border-less’. In an attempt to manage this change, organisations have pursued formalised change programmes such as: total quality management (TQM);

continuous improvement methodologies such as Kaizen; business process re-engineering (BPR); and more recently, Six Sigma quality initiatives (Hammer and Goding, 2001).

Six Sigma was initially pioneered as a quality manufacturing strategy in Motorola and General Electric, but has since evolved into a Business Process Change (BPC) initiative used by organisations across a wide range of industries. As a BPC initiative, Six Sigma targeted business processes to achieve significant improvements in performance (Kettinger and Grover, 1995).

Six Sigma relied on tried and true methods that have been around for decades, incorporating elements from the work of many quality leaders such as Dr. W. Edwards Deming (1986), Dr. Joseph M. Juran (Juran and Gryna, 1993), Philip B. Crosby (1979), Dr. Armand V. Feigenbaum (1991), and Kaoru Ishikawa (1985) who contributed their propositions that are the foundations for understanding the concept of Six Sigma.

### 2.3 The Quality Leaders

Quality experts have shaped modern quality practices. The following subsections present the main principles and practices proposed by these quality leaders. The theoretical essence of the Deming approach to Six Sigma concerns the creation of an organisational system that fosters cooperation and learning for facilitating the implementation of process management practices (Deming, 1986). Deming (1986) stressed the responsibilities of top management to take the lead in changing processes and systems. Process Improvement methodology Plan-Do-Check-Act (PDCA) Cycle (Figure 2.1) was developed to implement this statistical approach (Deming 1986).

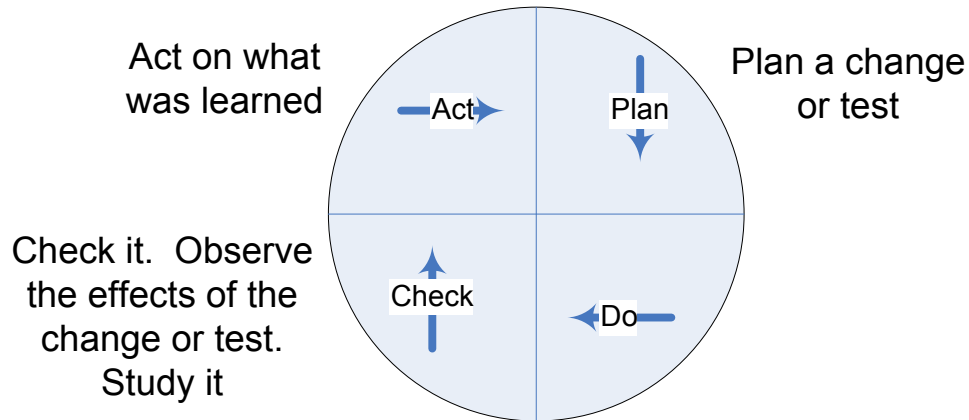


Figure 2.1 Deming's PDCA Cycle (Adapted from Deming, W.E. (1986), *Out of Crisis*, Massachusetts Institute of Technology, Center for Advanced Engineering Study, Cambridge, MA.)

Deming (1986) defined the PDCA approach as a cyclic process for planning and testing improvement activities prior to full-scale implementation and/or formalising the improvement. Deming (1986) stressed an end to reliance on inspection to achieve quality in his "14 Points"; the need to institute training on the job, and to drive out fear, and the removal of all barriers that rob people of pride of workmanship. Deming (1986) emphasised the importance of organisational culture and employee attitudes in creating a successful organisation.

Six Sigma was the system of activities directed at achieving delighted customers, empowered employees, higher revenues, and lower costs (Juran and Gryna, 1993). Juran's approach emphasised on team (Quality Circles (QC) and self-managing teams) and project work, which can promote quality improvement, improve communication (Juran and Gryna, 1993). Juran (1993) emphasised the importance of top management commitment and empowerment, participation, recognition and rewards for success. Juran (1993) considered quality management as three basic processes known as Juran Trilogy (Figure 2.2) which comprises of quality control, quality improvement, and quality planning.

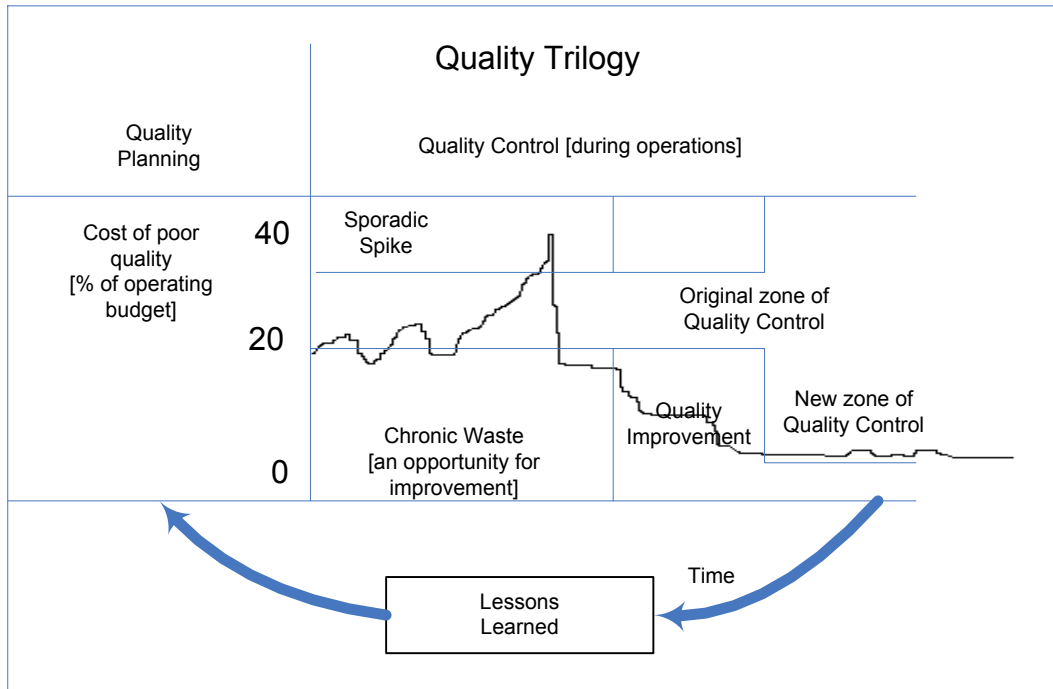


Figure 2.2 Quality Trilogy (Adapted from J.M. Juran, *Juran on Planning for Quality*, The Free Press, New York.)

The purpose of quality planning was to provide operators with the ability to produce goods and services that can meet customers' needs. Quality control was used to prevent things from getting worse. Quality improvement encompassed improvement of fitness-for-use and error reduction, seeks a new level of performance that was superior to any previous level, and was attained by applying breakthrough thinking.

Juran (1993) defined four broad categories of quality costs namely, Internal failure costs, External failure costs, Appraisal costs and Prevention costs) which was used to evaluate the organisation's costs related to quality a move towards Cost of Poor Quality (COPQ). Juran (1993) emphasised the importance of "identifying the customer" and that meeting their needs is the paramount challenge for every worker.

Crosby (1979) identified a number of important principles and practices for a successful quality improvement program, which included, management participation, management

responsibility for quality, employee recognition, education, reduction of the cost of quality (prevention costs, appraisal costs, and failure costs), emphasised on prevention rather than after-the-event inspection, doing things right the first time, and zero defects. Understanding, commitment, and communication were all essential.

Feigenbaum (1991) defined Six Sigma as an effective system for integrating the quality development, quality-maintenance, and quality-improvement efforts of the various groups in an organisation so as to enable marketing, engineering, production, and service at the most economical levels which allow for full customer satisfaction. He claimed that it permitted what might be called total quality management to cover the full scope of the product and service “life cycle” from product conception through production and customer service. Feigenbaum (1991) emphasised that efforts should be made towards the prevention of poor quality rather than detecting it after the event.

Feigenbaum (1991) considered top management commitment, employee participation, supplier quality management, information system, evaluation, communication, use of quality costs, and use of statistical technology to be an essential component of Six Sigma. He argued that employees should be rewarded for their quality improvement suggestions. He stated that effective employee training and education should focus on the following three main aspects: quality attitudes, quality knowledge, and quality skills. Feigenbaum’s (1991) concept of total quality control required as the first step that management acknowledge that quality was too important to leave to a handful of experts, that everyone in an organisation must be involved in the process.

Ishikawa (1985) argued that Six Sigma extends beyond the product and encompasses after-sales service, the quality of management, the quality of individuals and the organisation itself. He claimed that the success of an organisation is highly dependent on treating quality improvement as a never-ending quest. A commitment to continuous improvement can ensure that people will never stop learning. Ishikawa (1985) advocated employee participation as the key to the successful implementation of Six Sigma.

The BPC Management Model suggested by Kettinger et al. (1995) considered environmental conditions and the organisation's ability to manage change, as important components for successful implementation.

#### 2.4 Six Sigma Business Framework Performance Model

To date, no uniform models have existed, therefore, the constructs of Six Sigma Business Framework Performance Model, Supplier-Input-Process-Output-Customer (SIPOC) depicted in Figure 2.3 has to first be defined so that this research could be conducted.

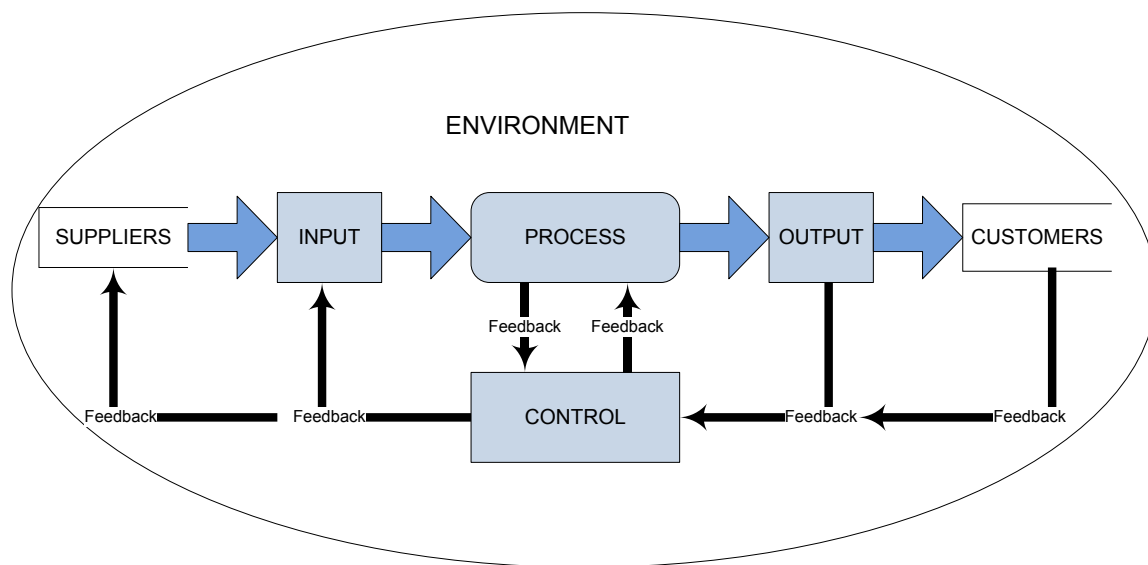


Figure 2.3 SIPOC Process (Adapted from William J. Stevenson, *Operations Management*, McGraw Hill, seventh edition 2002.)

Figure 2.3 defines the model in terms of supplier, inputs (Resources, Systems, and Infrastructure), process (Six Sigma tool and Business Principles), outputs (change culture, business improvement and learning organisation) feedback and customers. A SIPOC model provided a map of the process that needed to be assessed and thus assisted project leaders in defining the problem at stake (Webb, 2006).

Kettinger et al. (1995) defined BPC as an organisational initiative aimed at significantly improving performance of business processes through changes in the relationship between management, information, technology, organisational structure and people. In

order to evaluate the success of a BPC initiative, Kettinger et al. (1995) put forward a theoretical model of BPC Management (Figure 2.4).

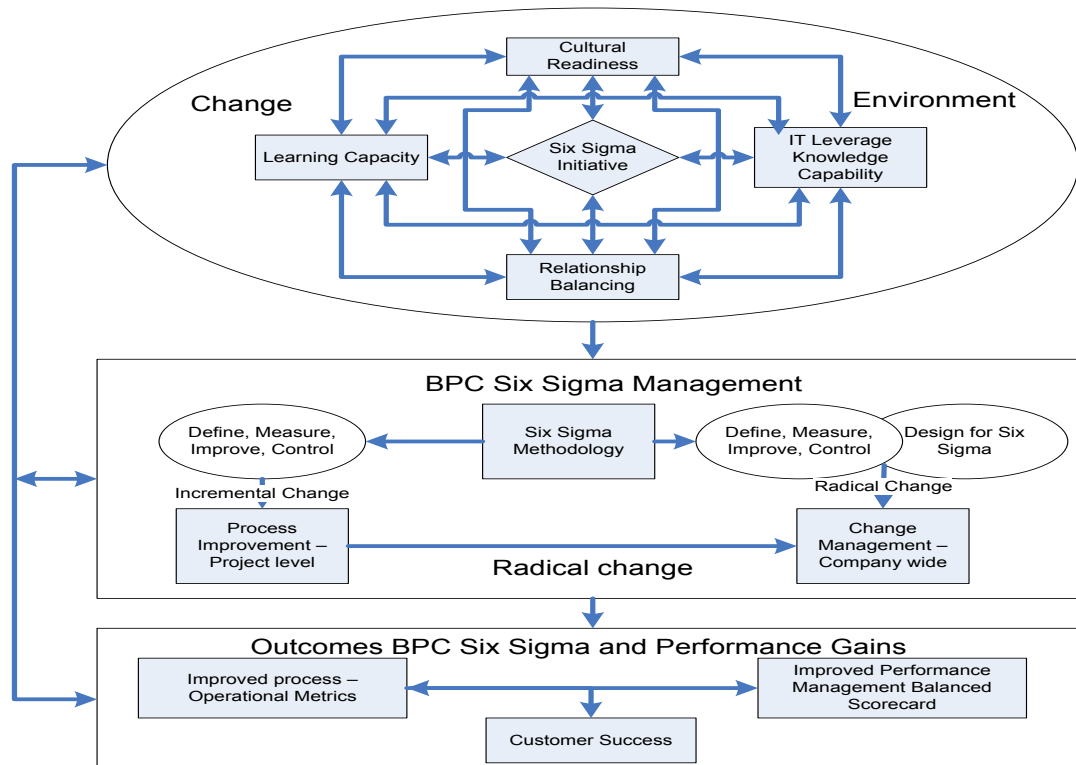


Figure 2.4 Business Process Change Management Model (*Adapter from Kettinger, W.J. and Grover, V. (1995) 'Toward a theory of business process change management', Journal of Management Information Systems*)

The BPC Management model is separated into three sections:

- Change environment
- BPC management
- Outcomes of BPC and performance gains.

The BPC management model (Kettinger et al. 1995), suggested that any BPC requires a strategic initiative (company vision) whereby the vision of change is defined and communicated by the top management. Subsequently, cultural readiness, learning capacity, Information Technology (IT) leveragability and knowledge-sharing capability and balanced network relationships issues facilitate the implementation of prescribed

process management and change management practices, which are components identified within the BPC management section. Process and change management practiced together with the change management environment contribute to improved business processes and helped in securing improved work quality, ultimately leading to improved customer satisfaction and organisational performance gains (Kettinger et al. 1995).

Breyfogle (2003) described Six Sigma as a methodology for pursuing continuous improvement in customer satisfaction and also organisational profit. This definition makes it clear that Six Sigma focuses on business processes and performance change.

## 2.5 Six Sigma Methodology

The word „sigma’ when applied to business processes measures the deviation between the outcome of the process and expected customer satisfaction. The outcome of these processes was measured using Defects per Million Opportunities (DPMO) (Caulcutt, 2001). An important feature of Six Sigma is its well-defined methodologies, Define-Measure-Analyse-Improve-Control (DMAIC) and Define for Six Sigma (DFSS), which addresses change at project and/or corporate level (Gupta, 2004). Stamatis (2000) described DMAIC as a reactive model that focused on identifying the „current problem and fixing the problem’ and was often employed on incremental process improvement initiatives at project level. In contrast, DFSS used a proactive approach to „prevent problems from occurring’ (Stamatis, 2000). Both methodologies were used at corporate level that focused on critical preparation issues such as establishing key business performance measurements and readying the organisation for SS implementation (Gupta, 2004).

DMAIC is a controlled, disciplined, step-wise model that can be used for both business improvement and for creating a well thought-out business strategy (Lucas, 2002). The DMAIC roadmap illustrated in Figure 2.5 provides a framework to incorporate many of the strategic and decision-making tools and models into a structured process and will support any company on the road to success.



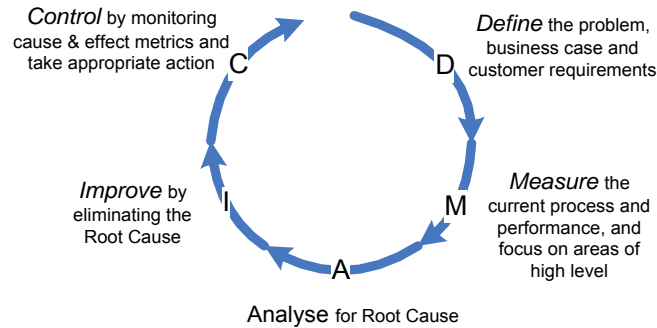


Figure 2.5 DMAIC Process (Adapted from Pyzdek, T. (2001) *The Six Sigma Handbook: A Complete Guide for Greenbelts, Blackbelts and Managers at all Levels* (New York: McGraw-Hill)).

**Define:** This phase which defines the problem identifies the customer, the parameters of interest i.e., the Critical to Quality (CTQ) factors. This process entails a series of steps involved in transforming inputs to outputs and all other factors affecting the transformation namely people, tools, etc. The process to be improved is defined by developing a SIPOC.

**Measure:** This phase involves specifying the measure of the process in terms of DPMO (which gives the sigma rating of the present process). In this phase Failure Mode and Effect Analysis (FMEA) is done and high Risk-Priority-Number (RPN) causes are identified. Histogram is made for variable data and DPMO, long-term and short-term sigma ratings are calculated using descriptive statistical measures.

**Analyse:** In the analyse phase, the data collected and the process map developed in the previous phases are analysed to determine the root causes of defects, identify opportunities for improvement, find gaps between current and target performance, identify root causes of defects and sources for variation. The process is analysed to remove non-value added activities, if any.

**Improve:** In the improve phase, the target process (i.e. the process under consideration) is improved by designing creative solutions to problems taking into account the result of the analysis performed in the previous phase. Innovative solutions are found to improve performance and implementations of pilot solutions are planned.

**Control:** This phase involves controlling improvements on the new process suggested in the improve phase. It requires documenting and monitoring the improvements planned so that the process does not revert to the “old process”, and institutionalises the suggested improvements.

In business today every organisation has a goal to improve their quality and or service for their customer satisfaction. Six Sigma involves changing major business value streams that cut across organisational barriers. It is the means by which the organisation's strategic goals are to be achieved (Pyzdek ,2004).

#### 2.5.1 Goals of Six Sigma

The goal of Six Sigma was to help people and processes aim high in aspiring to deliver defect-free products and services. Six Sigma provided a goal that applies to both product and service activities which sets attainable, short term goals while striving for long-range business objectives (Pande and Holpp, 2002).

At the strategic level, or transformational level, the goal of Six Sigma was to align an organisation keenly to its marketplace and deliver real improvements to the bottom line (Smith & Blakeslee, 2002).

At the operational level Six Sigma moved business product or service attributes fully within the zone of customer specifications and dramatically reduced process variation, the caused defects that negatively affected customers (Smith & Blakeslee, 2002).

According to Pyzdek (2004) by adopting the Six Sigma philosophy organisations will:

- become more competitive
- establish a new culture which will enable growth and longevity
- provide a working environment in which everyone can succeed
- reduce stress, waste and friction
- build teams, partnerships and co-operation

Pande and Holpp (2002) define the Six Sigma value-improvement process was based on:

- establishment of measures of value;
- business objectives and targets against which improvement is assessed;
- processes (the how) and functions (the why).

Improvements in these areas usually represent dramatic cost savings to business, as well as opportunities to retain customers, capture new markets and build a reputation for top performing products and services. Six Sigma involved measuring and analysing an organisation's business processes, Six Sigma was not merely a quality initiative but a business initiative (Pande and Holpp, 2002).

Top management should make a choice for what purpose it wishes to employ Six Sigma, which results they aim to achieve, and integrate Six Sigma in this wider vision. Stamatis (2000) argued that Six Sigma had "little to offer that isn't already available through other approaches."

#### 2.5.2 Six Sigma Implementation Approaches

The three approaches of Six Sigma implementation defined by Pyzdek (2004) were as follows:

##### 2.5.2.1 Business Transformation

Management defined the need for an organisation to break away from old habits and to transform itself. With a vision, and drive to launch Six Sigma as a full-scale change initiative, business transformation, was the right approach. Communication was intensive and widespread. Teams chartered along the business transformation path were change agents to key processes areas and with recommendations for change.

##### 2.5.2.2 Strategic Improvement

A strategic-improvement effort can be limited to one or two critical business needs, with teams and training aimed at addressing major opportunities or weaknesses.

The strategic-improvement approach was all-encompassing as the all-out corporate-wide effort, but was not as extensive or ambitious as the most aggressive efforts. A number of organisations that have started with the more limited strategic focus have later expanded Six Sigma into a full-scale corporate change initiative.

#### 2.5.2.3 Problem Solving

The problem-solving approach was best for organisations that tapped into the benefits of Six Sigma methods without creating major change ripples within the organisation. This approach targeted nagging and persistent problems. People trained in Six Sigma toolset lead to better problem analysis and solutions, based on facts and real understanding of causes and needs. The benefit of this approach was the focus on meaningful issues and addressing their root causes.

Organisations experienced success with Six Sigma had created an infrastructure to support strategy. For Six Sigma to become a successful business strategy, it needs to have executive management support and an effective organisational structure. Six Sigma needs to become a business process management system. A very powerful feature of Six Sigma is the creation of an infrastructure to ensure that performance activities have their necessary resources (Pyzdek, 2004).

#### 2.5.3 Six Sigma Structure

It is believed that by focusing on a top-down deployment approach, the leadership vision can be realised through „a set of linked strategies’ (Pyzdek, 2004). Managers’ consistent involvement in Six Sigma activities enables the restructuring of business processes and facilitates changing employees’ attitudes towards continuous improvement through the unstable transformation period (Hendricks and Kelbhaugh, 1998).

The employees were classified into the levels of leadership, champions and sponsors, master black belt (MBB), black belt (BB) and green belt (GB), based on their knowledge and experience regarding quality management within the organisation to address its metrics and structure (Slater, 2002) as illustrated in Figure 2.6.

Leadership

Champions and Sponsors

Master Black Belts

Green Belts

Black Belts

\$1,000,000/BB/yr

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The promising practices learned from the successful management of Six Sigma projects could have important applications in managing traditional projects and wider applications in managing organisational change. Table 2.1 describes the roles of the Six Sigma team and the application at Lonmin.

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<b>Champions and Sponsors</b> Trained business leaders promoting and leading the Six Sigma deployment in significant or critical areas of business.	<ul style="list-style-type: none"> <li>• Six Sigma targets were incorporated within the balanced scorecards of all Vice Presidents (VP's) and Senior Managers</li> <li>• Top senior managers within the group were Greenbelt trained and certified.</li> <li>• Process Owners, own the projects. They should be GB certified and responsible for sustaining processes and benefits.</li> </ul>
<b>Master Black Belt (MBB)</b> Trained quality leaders responsible for Six Sigma strategy, training, mentoring, deployment and results	<ul style="list-style-type: none"> <li>• MBB's were full time roles within the organisation.</li> <li>• BB certified and a 12 month training program for MBB.</li> <li>• Responsible for training and mentoring BB's and GB's.</li> </ul>
<b>Black Belt (BB)</b> Fully trained experts leading improvement teams across the business	<ul style="list-style-type: none"> <li>• BB's were full time on the programme for at least 24 months, which comprises of 5 months of training and completion of 3 projects to be certified.</li> <li>• BB reported to the MBB and mentored GBs.</li> <li>• This was an area for senior management development with the selection of candidates from the talent pool and high performers.</li> </ul>
<b>Green Belt (GB)</b> Individuals trained in Six Sigma supporting Six Sigma projects	<ul style="list-style-type: none"> <li>• GB's to spend 20-30% of time on projects. GB's were trained for 2 weeks and to complete 2 projects to be certified.</li> <li>• All managers (including senior managers and VP's) must be GB certified</li> </ul>
<b>Team Members</b> Individuals supporting specific projects in their areas.	<ul style="list-style-type: none"> <li>• Benefits Capture Manager was full time on the programme and GB certified. Responsible for creating benefits models, tracking and verifying benefits.</li> </ul>

Table 2.1 Roles of Six Sigma Change Agents at Lonmin

#### 2.5.4 Themes of Six Sigma

According to Six Sigma experts (Pande and Holpp, 2002) there are six themes of Six Sigma which are illustrated in Table 2.2

Theme	Summary
Theme One: Genuine focus on the Customer	<ul style="list-style-type: none"><li>• accurate understanding of customer needs and the ability and commitment to meet those needs.</li><li>• strong communication with customers.</li><li>• begin with the customer and customer focus becomes the top priority.</li><li>• improvements are defined by their impact on customer satisfaction and value.</li></ul>
Theme Two: Data and Fact Driven Management	<ul style="list-style-type: none"><li>• extensive data and information to detect and solve problems (Breyfogle, 2003).</li><li>• „management by fact” concept with relentless focus on data</li><li>• clarifying what measures are key to gauging business performance and then gathering data and analysing key variables.</li><li>• problems to be effectively defined, analysed, and resolved-permanently.</li><li>• support data-driven decisions and solutions.</li></ul>
Theme Three: Processes are where the action is	<ul style="list-style-type: none"><li>• focus on key processes and how to improve them.</li><li>• positions the process as the key vehicle of success. Mastering processes is a way to build competitive advantage in delivering value customers.</li><li>• what is changing and why it is changing</li><li>• objectives are met and changes are replicated consistently throughout the organisation.</li><li>• policies, processes and procedures clearly and effectively communicated</li></ul>
Theme Four: Proactive	<ul style="list-style-type: none"><li>• tools and practices that replace reactive habits with a dynamic, responsive, proactive style of management.</li></ul>

Management	<ul style="list-style-type: none"> <li>• pro-active management focusing on problem prevention, continuous improvement and constant striving for perfection</li> <li>• organisational changes, with the right changes to happen in both evolutionary and revolutionary ways.</li> <li>• focus on the right information to the right people at the right time in the right form to make good business decisions and take effective action.</li> <li>• effective communication is essential for successful change management.</li> </ul>
Theme Five: Boundary less Collaboration	<ul style="list-style-type: none"> <li>• collaboration within organisations and with vendors and customers</li> <li>• working towards a common cause by providing value to customers.</li> <li>• cross organisational as well as geographic boundaries.</li> <li>• work together across departmental, geographical and organisational boundaries.</li> <li>• translation effectiveness and cost improvements with well-structured communication.</li> </ul>
Theme Six: Drive for Perfection; Tolerate Failure	<ul style="list-style-type: none"> <li>• accept-and manage-occasional setbacks.</li> <li>• “drive for perfection, but tolerate failure,”</li> <li>• communicate clearly what happened that led to the failure, why it happened and what the organisation can learn from the experience to help ensure that the next project is a success.</li> </ul>

Table 2.2 Themes of Six Sigma (Adapted from Pande, P., Holpp, L. (2002), What is Six Sigma, McGraw-Hill Companies, New York)

Critics had created myths about Six Sigma. One of the main criticisms of the Six Sigma method was that it offered nothing new and simply provided repackaged traditional principles and techniques related to quality (Catherwood 2002).



### 2.5.5 Myths of Six Sigma

(Marsh, 2000) highlighted that in the last few decades there had been many programmes that had purported to be the answer to industry's process management problems, these programmes were also considered a passing fad by many. These programmes included Zero Defects, Management by Objectives (MBO), Quality Circles (QC) and Total Quality Management (TQM).

The research addresses some of the myths and realities relating to Six Sigma business strategy (Snee, 1999). Some of the more common myths are described as follows:

Myths of Six Sigma
<b><i>Six Sigma is all about statistics:</i></b> The statistical term “sigma” gives the impression of Six Sigma being a statistics and measurement programme. Six Sigma uses statistics solely as a tool for collecting, analysing and interpreting data.
<b><i>Six Sigma is more about changing the mindset of people, making a shift from the traditional approach to problem solving,</i></b> i.e. fire fighting, to the proactive approach, i.e. getting to the root cause of the problem and devising solutions to eliminate it. The Six Sigma drive for defect reduction, process improvement and customer satisfaction is based on “statistical thinking” paradigm- a philosophy of action and learning based on process, variation and data.
<b><i>Six Sigma ignores the customer in search of bottom-line benefits:</i></b> This statement is not myth, but rather misinterpretation. Projects worthy of Six Sigma investment should <ul style="list-style-type: none"><li>• be of primary concern to the customer, and</li><li>• have the potential for significantly improving the bottom line.</li></ul> In today's competitive environment, there is no surer way of going out of business than to ignore the customer in a blind search for profits.
<b><i>Six Sigma creates a parallel organisation:</i></b> an objective of Six Sigma is to eliminate every ounce of organisational waste that can be found and then reinvest a small percentage of those savings to continue priming the pump for improvements. With the large amount of downsizing that has taken place throughout the world during the past decade, there is no room or inclination to waste money through the duplication of

functions. Many functions are understaffed as it is. Six Sigma is about nurturing any function that adds significant value to the customer while adding significant revenue to the bottom line.
<b><i>Six Sigma is not cost-effective:</i></b> If Six Sigma is implemented wisely, organisations can obtain a very high rate of return on their investment within the first year.
<b><i>Six Sigma is the same as any other quality program:</i></b> Does Six Sigma offer anything new when compared to other quality initiatives of the past? Organisations that have previously made improvements through the use of TQM or Crosby's Zero Defects or QC (Walters, 2005) are now embracing Six Sigma within their working culture; one can only assume that the other programmes were not addressing all of their needs.
<b><i>In the quest to for business excellence Six Sigma should be viewed more as a business strategy than a quality programme.</i></b> While many organisations have embraced numerous quality improvement programmes, most failed to deliver the measurable bottom results. (Pyzdek, 2001) pointed out that Six Sigma is "an entirely new way to manage an organisation."
<b><i>Deploying Six Sigma requires strong infrastructure and massive training:</i></b> It is true that Six Sigma requires some investment at the outset for training the most talented people in an organisation and converting them into the so called „change-agents'. However, it is already a proven fact that the benefits obtained from Six Sigma implementation outweigh the investment costs. An organisation can start with Six Sigma deployment by identifying a manageable number of critical projects that are topping priority for the organisation and can be successfully completed within a few months (2-5 months). This will involve fewer resources and can help to win commitment from top management and engender faith in the philosophy.

Table 2.3 Myths of Six Sigma (Adapted from J Antony; MMSMAG, Pieter de Villiers, July 2007)

Starbird (2002) argued that the Six Sigma process is part of a management system to achieve business excellence in the organisations and presented keys to Six Sigma success.

### 2.5.6 Six Sigma Critical Success Factors

Leading practitioners and researchers of Six Sigma have arrived at the following CSFs for the successful deployment of a Six Sigma program. A summary of CSFs identified in the literature is presented in Table 2.4.

Proponent	Critical Success Factor
Byrne, 2003, Caulcutt,2001 Coronado and Antony,2002	Management involvement and commitment
Coronado and Antony,2002	Understanding of Six Sigma methodology, tool, and techniques
Coronado and Antony,2002	Linking Six Sigma to business strategy
Coronado and Antony,2002	Linking Six Sigma to customers
Coronado and Antony,2002	Project prioritisation, selection reviews and tracking
Coronado and Antony,2002	Organisation infrastructure IT infrastructure
Carnell,2004	Cultural change - Organisation culture
Crom, 2000	Cross-cultural model
Coronado and Antony,2002	Project management skills, Cross functional teams
Coronado and Antony,2002	Project management skills, Cross functional teams
Coronado and Antony,2002	Linking Six Sigma to suppliers
Coronado and Antony,2002	Training
Wyper and Harrison 2000	Linking Six Sigma to human resources
Coronado and Antony,2002	Communication

Table 2.4 Six Sigma Critical Success Factors

Benefits and savings of implementing the project-driven Six Sigma method have been widely reported.

#### 2.5.6.1 Six Sigma Implementation Successes

Table 2.5 summarises the organisations, projects, benefits, improvements, and savings achieved by implementing the Six Sigma method in the manufacturing sector, based on

extensive investigation of literature on Six Sigma (Weiner 2004, De Feo and Bar-El 2002, Buss and Ivey 2001, and McClusky 2000).

Organisation/Project	Metric/Measures	Benefit/Savings
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/Laminates plant in South Carolina	Capacity Cycle time Inventory On-time delivery	Up 50% Down 50% Down 50% Increased to near 100%
Allied Signal/Bendix IQ brake pads	Concept-to-shipment cycle time	Reduced from 18 months to 8 months
Hughes Aircraft's Missiles Systems Group/Wave soldering operations	Quality Productivity	Improved 1000% Improved 500%
General Electric	Financial	\$2 billion in 1999
Motorola (1999)	Financial	\$15 billion over 11 years
Dow Chemical/Rail delivery project	Financial	Savings of \$2.45 million in capital expenditures
DuPont/Yerkes Plant in New York (2000)	Financial	Savings of more than \$2 million
Telefonica de Espana (2001)	Financial	Savings and increases in revenue 30 million euro in the first 10 months
Texas Instruments	Financial	Savings of \$ 600 million
Johnson & Johnson	Financial	Savings of \$ 500 million
Honeywell	Financial	Savings of \$1.2 billion

Table 2.5 Reported Benefits and Savings from Six Sigma in the Manufacturing Sector

Organisations without a complete understanding of real obstacles of Six Sigma projects or a comprehensive change management plan will no doubt fail.

#### 2.5.6.2 Six Sigma Implementation Failures

Organisations must realise that Six Sigma is not the universal answer to all business issues, and that it may not be the most important management strategy requiring a sense of urgency of understanding and implementation.

Breyfogle, (2003) outlines the top 10 reasons why Six Sigma Initiatives fail:

1. Selected Six Sigma projects are not connected to the corporation's goal
2. The corporation is deploying Six Sigma for the wrong reasons
3. Six Sigma project goals are not aligned with the Champion's goal
4. A bottom-up rather than top down project selection methodology
5. No clear financial benefits
6. The corporation does not have clear processes to support customers
7. Poor or wrong metrics
8. Project has ineffective charter
9. Solution is obvious
10. Focusing on output measures

Awards have been established to generate awareness and interests in quality and performance. They provide a useful audit framework against which organisations can evaluate their implementation practices, seek improvement opportunities, and the end results.

#### 2.5.7 Global Six Sigma Awards

There are several Quality Awards worldwide, such as the Deming Prize (1996) in Japan, the European Quality Award (1994) in Europe, the Malcolm Baldrige National Quality Award (1999) in the United States of America.

Six Sigma contributed to the success of Motorola winning the first Malcolm Baldrige National Quality Award in 1989. "The result was a culture of quality that permeated throughout Motorola and led to a period of unprecedented growth and sales. The crowning achievement was being recognised with the Malcolm Baldrige National Quality Award" (Wiggenhorn 1999).

In today's economic environment, organisations need to maximise their productivity, accountability, and impact. It is important to closely monitor and manage company performance against strategy. This is to ensure the company follows the path that leadership wants to take. The adage from Dr. Genichi Taguchi, "if you can't measure it, you can't improve it," applies to business strategy just as much as business improvement (Taguchi, 1985).

Talwar (1993) suggested using a balanced scorecard to assess the results of BPR and contended that Six Sigma initiatives should start with senior executives creating a balanced scorecard of strategic goals, metrics and initiatives to identify the improvement points that will have the most effect on an organisation's bottom line.

#### 2.5.8 Balanced Scorecard

Six Sigma organisations that adopt traditional backward looking accounting-based Performance Management Systems (PMS) that focus on operations functions, failed to align project metrics to the Six Sigma business scorecard. To address this discrepancy, the balanced scorecard approach is often recommended for the optimal results highlighted by Gupta (2004).

Six Sigma accommodates Kaplan and Norton's (1996) balanced scorecard model where performance is linked to goals from four perspectives. The financial perspective is captured in operational budget and capital budget. The customer perspective is embodied in the quality, timing and cost of output. The internal business perspective is represented in the departmental measures and how they relate to the organisation's strategic focus. The innovation and learning perspective is embraced in the focus on processes and activities and ways of improving them. Gupta (2004) added that a properly executed Six

Sigma business scorecard, besides encouraging leaders to uphold profitability, should promote intellectual participation from employees and demand high level of performance from the management team illustrated by Figure 2.7 balanced scorecard process.

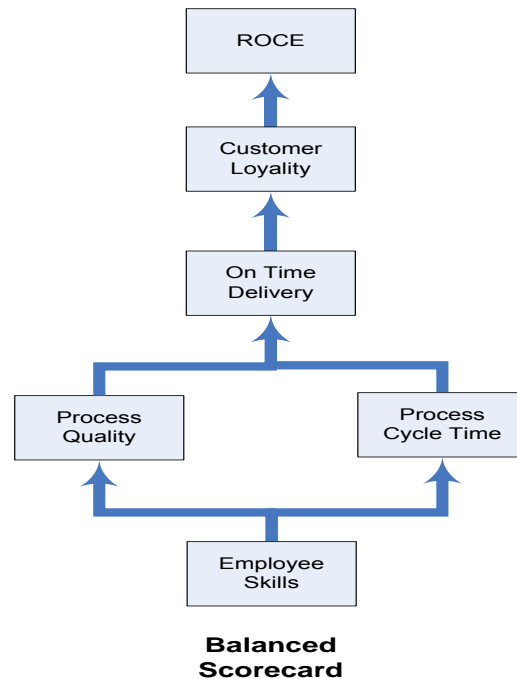


Figure 2.7 Balanced Scorecard Process

Adapted from Kaplan, R.S. and Norton, D.P. (1996) *The Balanced Scorecard: Translating Strategy into Action*, Harvard Business School Press, Boston, MA.

Employee skills were the base of Kaplan's business model (Kaplan and Norton 1996). Improved quality and reduce cycle times (improve processes) were achieved and results achieved. This created customer loyalty which in turn generated profits for the organisation (Return on Capital Employed). Kaplan and Norton (1996), suggested using measures of employee skills, process quality, process cycle time, and on-time performance to monitor business performance in addition to the usual financial measures (which lag performance). Six Sigma was a well established approach to improve business process performance and to deliver measurable or benefits to organisations (Pande an Holpp, 2002).

## 2.6 Six Sigma Business Performance

Six Sigma was a comprehensive and flexible system for achieving, sustaining and maximising business success. The power of Six Sigma to create a culture of continuous improvement lied in the combination of changing the way work gets done by changing processes, plus educating people in new ways of understanding processes and solving problems.

### 2.6.1 Six Sigma as a Culture Transformation

Organisational culture is viewed as the pattern of values, beliefs, and assumptions shared by members in an organisation, which are perceived by the organisation as the valid, correct way to perceive and solve problems (Sigler and Pearson, 2000). These shared values, beliefs, and assumptions in the organisation bind its employees together and become the manner or strategies through which the organisation achieves its goals (Marcoulides and Heck, 1993). Values and beliefs underlying an organisation's culture are able to shape its philosophy and policies of managing business, which in turn influence the performance of the organisation (Waldman, 1993).

The Six Sigma workforce management practice is to use the entire capacity of workers and to encourage employee commitment to organisational continuous improvement efforts (Flynn, Schroeder, and Sakakibara, 1995). Workforce management emphasises the organisational and people side of quality management and uses a variety of techniques to facilitate changes, such as employee participation in decisions, employee recognition, teamwork, and the use of effective communications to create an awareness of organisational goals (Kaynak, 2003). Considering the different features of the quality practices, it is very possible that cultural characteristics that support a certain type of quality practice differ from those cultural characteristics that support other types of quality practices. Organisations need to manage not only change, but to develop the type of organisation and leaders which can operate successfully in a future of continuous change (Kaplan and Norton, 1996).



The differences between a traditional and a Six Sigma culture can be characterised as shown in the Table 2.6

Aspects of Culture	Traditional	Six Sigma
Work orientation	Departmental, functional and/or task	Process flow and customer-output related
Who defines what needs improving	Senior managers and department managers	Senior and department managers plus bottom-up suggestions from project leaders and team members
Leadership for improvement	Functional managers or designated project leaders	Champions and improvement specialist (Belts)
Who has skills to develop and implement solutions	Specialists (e.g., engineers) and managers	Specialists plus project leaders, team members and managers
Improvement methods/tools used	The most familiar ones	Common, state-of-the-art approach and tools
Degree of operator involvement	Ad hoc	Widespread through Yellow Belt training
Project management discipline related to improvement	Variable	Gate reviews at each step of DMAIC
How performance is measured	Actual versus budget	Impact on Xs (causal measures) that affect Ys (outcomes)

Table 2.6 Differences Between Traditional and Six Sigma Cultures (*Adapted from [www.isixsigma.com](http://www.isixsigma.com) (Accessed 1 July 2010).*)

Six Sigma business strategies involve the measurement of how well business processes meet their objectives and offers solutions to make needed improvements.

### 2.6.2 Six Sigma as a Business Improvement

The application of the techniques to all functions results in a very high level of quality at reduced costs with a reduction in cycle time, resulting in improved profitability and a competitive advantage (Breyfogle, 2003).

Six Sigma projects help to avoid competitive disadvantage and to gain strategic benefits. The quality of a product or service is measured in terms of the satisfaction that the customer (both internal & external) derives from using it.

The quality of a process depends on its ability to consistently deliver products or services within customer-specified limits. While it is possible for an organisation to deliver a good quality product using an inefficient process, the organisation does so at a very high cost. This cost is defined as the cost of poor quality and expressed in terms of percentage of revenue or sales as shown in Table 2.7

Sigma Level	Cost of Poor Quality	Defects per million opportunities	Comment
6	<10%	3.4	World Class Benchmark
5	10-15%	233	
4	15-20%	6,210	Industry average
3	20-30%	66,807	
2	30-40%	308,537	Non-competitive
1	>40%	500,000	

Table 2.7 Cost of Poor Quality for the Industry (*Adapted from Hendricks, C.A. & Kelbaugh, R. 1998. Implementing Six Sigma at GE. The Journal of Quality and Participation*)

Intellectual capital theories that discussed intangibles such as knowledge and creativity in terms of competitive advantage had provided an important strategic and philosophical support for learning organisation theories (Senge 1990).

### 2.6.3 Six Sigma as a Learning Organisation

Jensen (1998) defines specific knowledge as knowledge that is difficult and costly to transfer. Knowledge necessary for decision making is not only dispersed, important parts of it are available only as tacit knowledge, for example in the form of unspoken „know-how’.

Organisations that go further and use the Six Sigma programme to build knowledge creation and utilisation competencies in the organisation used these competences to leverage the organisation’s competitive strategy. The competencies that an organisation built using Six Sigma were complex and tacit in nature and for these reasons hard to imitate: competitors cannot buy them on the market, but have to build them, which will take years. Thus, the competencies an organisation built using Six Sigma in them were sources of sustainable competitive advantage (Teece, D.J., Pisano, G. & Shuen, A., 1997).

Skill acquisition, management of intangible assets, learning Six Sigma and Competitive Advantage became fundamental strategic issues. Organisation’s skills, competencies and capabilities were valuable for a customer, unique and difficult to replicate, this was a source of sustainable profitability. The continual effort of Six Sigma projects to understand processes and systems, model them by transfer functions, and define crucial measurements, resulted in a better general understanding of how production and service processes worked. These competencies enabled a superior coordination and integration of processes, learning, and reconfiguration and transfiguration, which, Teece et al. (1997) argued, were sources of competitive advantage. Reconfiguration and transfiguration relate to an organisation’s resilience, the ability to dynamically reinvent business models and strategies as circumstances change.

In order to sustain in a more and more turbulent world, an organisation’s resilience becomes all-important. Organisations should continually morph their strategy, conform it to emerging opportunities and incipient trends (Teece et al., 1997).

#### 2.6.4 Feedback Process, Sustainability, control

In order to achieve long-term success, an organisation must innovate while simultaneously keeping employees productive. Six Sigma tools and structure helps organisation balance the drive for productivity with the need to innovate. To ensure the long-term prosperity and sustainability of the Six Sigma method, organisations need to analyse and accept the strengths and weaknesses of the approach and to properly utilise Six Sigma concepts and tools (Pyzdek, 2004).

#### 2.7 Future of the Six Sigma Method

Researchers and practitioners were also trying to integrate Six Sigma with other existing and innovative management practices to make the Six Sigma method even more attractive to different organisations that might have not started or fully implemented the Six Sigma method. Integrating and comparing principles and characteristics of Six Sigma with TQM (Hammer and Goding 2001), Human Resource Functions (Wyper and Harrison 2000), Lean Production (Antony et al. 2003), ISO 9000 (Catherwood 2002), ISO 9001 (Dalglish 2003), and the Capability Maturity Model (Murugappan and Keeni 2003) are all part of the quality community effort to maximise the positive effects of the Six Sigma method. Harry (1997) specified that he did not see the Six Sigma method as having fallen short of its promises, but saw “mistakes” within the industry of Six Sigma itself, within the quality profession.

#### 2.8 Conclusion

The literature review began with a framework of adapting a new system within the organisational economic conditions. This review focused on the deliverables of Six Sigma implementation with the constraints of the inputs, business principles and economic conditions.

Research on the origin of Six Sigma in context of the quality leaders had unveiled the dimensions of Six Sigma’s methodology and goals. This detailed the strategic approaches and requirements to deploy Six Sigma as a transformational tool. An analysis of the myths, obstacles, challenges and benefits were evaluated to position the success of Six Sigma.

Evaluation of the business principles was conducted from an economic framework standpoint. The review quantified the combination of Six Sigma and economic framework to deliver results towards transformation (organisational culture, knowledge and business improvement).

There was evidence in the literature review that encapsulated the analysis of Six Sigma as a transformation tool in the economic conditions. This gives rise for an empirical study of the adaptation of Six Sigma as a transformational tool at Lonmin in the South African economy context.

Chapter three discusses the research methodology of the research topic. The application of the research methodology that encapsulates the research design, data collection method, sampling technique and ethical considerations are detailed.

## **CHAPTER THREE**

### **Research Methodology**

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#### **3.1 Introduction**

The way in which research is conducted may be conceived of in terms of the research philosophy subscribed to, the research strategy employed and to the research instruments utilised in the pursuit of a goal, and the quest for the solution of a problem. The researcher has outlined the research question in chapter one. This chapter outlines the research objectives, research philosophy, research methodologies and research instruments adopted in the pursuit of the goals of this study.

#### **3.2 Statement of the Research Problem**

Six Sigma was the flavour of the year topic. Organisations implemented it from a strategic point to address business improvement which is evident in first world countries. This research aimed to evaluate the Six Sigma application in a third world country in the context of a South African organisation.

Lonmin plc is a platinum group metals (PGM) mining and refining company, and third largest producer of platinum in the world. Lonmin Platinum mines are located in South Africa, with three in the Marikana area, which is approximately 50 kilometres northwest of Pretoria, and one in the Limpopo province. The Smelter and Base Metals Refinery operations are also located at Marikana, whilst the final step in the value chain, namely, Precious Metals Refinery plant, is located at Brakpan, east of Johannesburg. Lonmin has also been the lowest cost producer of platinum, a position which had been eroding since 2001. Lonmin employs about 30 000 people, including contractors.

To ensure sustainability of the programme, Lonmin management set a target of three years to successfully implement Six Sigma within the organisation. Hence, this research is aimed at determining the value of Six Sigma implementation at Lonmin.

### 3.3 Aim and Objectives of the Study

The aim of this research was to analyse and assess the impact of Six Sigma as a transformation tool driving Business Improvement at Lonmin Platinum and to make recommendations to facilitate future change initiatives.

The impact of introducing and implementing Six Sigma at Lonmin Platinum was evaluated with respect to financial performance and employee attitude.

The specific objectives of the study were:

- To determine the impact of Six Sigma on culture transformation
  - To determine the impact of Six Sigma as Change Management at Lonmin
  - To determine the value of Six Sigma Knowledge Management at Lonmin
  - To determine the Sustainability of Six Sigma programme at Lonmin
- To determine impact of Six Sigma on business improvement.
  - To determine the benefits of Six Sigma programme at Lonmin
  - To determine the PEST analysis impact on Lonmin
  - To determine the Six Sigma Performance at Lonmin

The researcher has evaluated the transformation, compared and contrasted it to the theory and provided recommendations for improvement, where necessary, which would benefit the organisation in the future.

### 3.4 Research Strategies

For conducting empirical research, there were two methods of data collection; Qualitative and Quantitative. The qualitative method permitted researchers to study selected issues in depth and detail. The quantitative method, on the other hand required the use of standardised instruments so that the varying perspectives and experiences of people can fit a limited number of predetermined response categories, to which numbers are assigned (Patton, 1990). Based on the two research objectives proposed in this study, the research

strategies of a literature review and a questionnaire survey were adopted in this research, and characterised as quantitative research.

### 3.5 Sampling

A sample is a relatively small subgroup or small subset of the population (Hair, Babin, Money & Samouel 2005). Sekaran (1999) cited that some, but not all elements of a population would form a sample. Sekaran (1999) defined sampling as the process of selecting a sufficient number of elements from a population so that by studying the sample, and understanding the properties or the characteristics of the sample subjects, it would be possible to generalise the properties or characteristics to the population elements.

There are two major types of sampling designs: probability and non-probability sampling. In probability sampling, the researcher can specify in advance that each segment of the population will be represented in the sample (Leedy & Ormrod 2005). Non-probability sampling is arbitrary (non-random) and subjective where the inclusion and exclusion of an element is left to the discretion of the researcher (Hair, Money, Samouel & Page 2007).

Even though there were a variety of methods according to which a non-probability sample can be taken, there were three general methods identified in the literature convenience, purposive and snowball sampling (Collis & Hussey 2003, pp. 158-159; Blumberg, Cooper & Schindler 2005; Hair *et al.* 2005; Leedy & Ormrod 2005).

Purposive or judgemental sampling enabled the researcher to use judgement in selecting cases that will provide the best approach in meeting the objectives. Sekaran (1992) states that judgemental sampling is when participants are selected on the basis of their expert knowledge in the subject matter being investigated. This type of sampling is usually used when the sample is small (Saunders and Lewis, et al, 2003). The nature of this design is such that the researcher purposefully selects respondents who have the required experience to answer the research questions (Creswell, 1994). Furthermore, the objective



is to select experts who are representative of the population, and who are expected to give normal perceptions and perspectives (Leedy & Ormrod, 2001). No attempt will be made to select respondents randomly (Creswell, 1994) but the researcher will endeavour to be objective in the selection of the respondents (Walker, 1985).

The sampling technique selected for this study was a purposive non-probability sample where the sample units were based on personal judgment and not where the sample unit had a known, non-zero probability of selection *i.e.* probability sample. A non-probability sampling approach was practical and economical (Sekaran 1999). A disadvantage of this method was that the sample cannot claim to be representative which limits the the research results (Hair *et al.* 2005).

Having chosen the purposive sampling technique for this study the next part of the research design was to specify the sample size.

### 3.6 Sample Size

Surveys are useful and powerful in finding answers to research questions, but can do more harm than good if not correctly targeted (Sekaran 1999). Sekaran (1999) added that if data is not collected from the people or objects that can provide the correct answers to solve the problem, the survey will be in vain. Only rarely can a researcher look at everything that has potential relevance for the research problem (Leedy & Ormrod 2005). Blumberg, Cooper and Schindler (2005) listed the following regarding the size of a sample needed, sample must be large or it is not representative, sample should bear some proportional relationship to the size of the population from which it is drawn.

In addition Fisher (2004) stated that the size of a sample depends in part on the size of the margin of error one is prepared to accept and the size of the population from which one is going to take the sample. Jankowicz (2005) suggested that statistical theory can be used to compute the sample size. Hair *et al.* (2005) argued that irrespective of how the sample size is determined it is essential that it should be a sufficient size and quality to yield results that are seen to be credible in terms of their accuracy and consistency. In terms of

accuracy and consistency it would be desirable to collect data from all members of the population under investigation. However, contacting the entire population generally would be costly and time consuming (Hair *et al.* 2007).

The population for this study included all employees of Lonmin that were directly involved in Six Sigma projects, management staff, Six Sigma consultants, Six Sigma personnel such as Black Belts, Green Belts and Process Owners, the population size was one hundred and twenty (120) as drawn from the Lonmin Six Sigma database. The size of the sample was sixty five (65) respondents across the organisation. The sample was drawn from Management, Process Owners, six sigma personnel such as Black Belts and Green Belts, consultants who were actively participating in the implementation of Six Sigma at Lonmin Platinum. With ninety five percent (95%) confidence level, ten percent (10%) error, fifty percent (50%) distribution and a population size of one hundred and twenty (120), the recommended sample size was fifty four (54).

### 3.7 Data Collection Approach

Data can be collected in a variety of ways, in different settings, and from different sources (Sekaran 1999). Data collection methods include questionnaires, standardised tests, observational forms, laboratory notes and instrument calibration logs (Blumberg, Cooper & Schindler 2005). The type and amount of data collected depends upon the nature of the study together with its research objectives (Hair *et al.* 2005). Qualitative data can be collected through the use of focus groups, personal interviews, or by observing behaviour or events (Hair *et al.* 2007). Quantitative data on the other hand involves gathering numerical data using structured questionnaires or observation guides to collect primary data from individuals (Hair *et al.* 2007). Collis and Hussey (2003) concluded that one of the main advantages of a quantitative approach to data collection is the relative ease and speed with which the research can be conducted.

These various methods of data collection methods available could be used for this study. However, in this study, an e-mailed electronic questionnaire had been used to obtain the data relevant to the study's objectives and research questions, the reasons being that it

was cheap, it can be self-administered, and there was very low probability of data errors (Bhaskaran 2008). The disadvantages of electronic questionnaire as per Bhaskaran (2008) are that not all your customers might have access to the e-mail and employees may be wary of divulging information online. These disadvantages did not apply in this study since the identified population were configured on the Lonmin email system and had access to computers.

### 3.8 Data Collection Instruments

Bryman and Bell (2007) defines a research method as a technique for collecting data. Sekaran (1999) emphasised that interviewing, administering questionnaires, and observing people and phenomena are the three main data collection methods in a survey research. A questionnaire is a pre-formulated written set of questions to which respondents record their answers, usually within rather closely defined alternatives (Sekaran 1999). According to Collis and Hussey (2003) the aim of a questionnaire is to find out what a selected group of participants do, think and feel about a particular subject or topic. The data collection method can influence the accuracy and reliability of survey data and it is therefore very important to select the correct method (Hair *et al.* 2005).

The research approach for this study can be epitomised as a quantitative survey. Quantitative research was used to answer questions about relationships among measured variables with the purpose of explaining, predicting, and controlling phenomena (Leedy & Ormrod 2005, p. 94). The electronic questionnaire method fit this study where the researcher gathered data from a large sample and administered. The respondents were computer literate and had access to an online computer with access to e-mail. The questionnaire method had been chosen as a research tool and described in the next section. The respondents nominated were contacted by e-mail to inform them of the purpose of the study, subjects to be covered and the research process, including the expected duration to complete the questionnaire. Importantly, respondents were guaranteed that their identities would remain confidential.

### 3.9 The Questionnaire as a Research Tool

Collis and Hussey (2003) define a questionnaire as a list of carefully structured questions, chosen after considerable testing, with a view to eliciting reliable responses from a chosen sample. Jankowicz (2005) defined the data gathering questionnaire method as a fully structured technique – the content, layout, question sequence and answer format have been determined in advance, in such a way that there is little that the respondent can say or do which would deviate from this set pattern. Electronic questionnaires can be administered by email or are web-hosted on the internet or on companies' intranets (Hair *et al.* 2005).

In conducting a questionnaire-based study, there are a number of interrelated activities that must be considered. These include: the general design of the questionnaire, validation of the questionnaire by pre-testing, and the method by which the questionnaire is administered (Hair *et al.* 2005). Questionnaires are handed out to the target population to evaluate attitudes, knowledge as well as behaviour. They enable the researcher to gather information from a large number of people, rapidly, over extended coverage, and is one of the lowest cost methods (Blumberg, Cooper & Schindler 2005). However, there are problems experienced with questionnaires as a method for data collection. Questionnaires must be simple as they are self administered and there are no interviewer interventions available (Blumberg, Cooper & Schindler 2005).

For this study, an electronic questionnaire method was effective as it had a wider access and better coverage (global access), was inexpensive, and produced high quality of data (Hair *et al.* 2005). Moreover, there was a wider range of advantages of using electronic questionnaires in this study. Such advantages were: responses can be quantified, easily summarised and the returned questionnaire was easy to analyse. Questionnaires can provide a large volume of data and information, to be tabulated using any computerised spreadsheet, while confidentiality of respondents is maintained (Blumberg, Cooper & Schindler 2005, p. 249). Contrary to the latter, there were also some disadvantages associated with using questionnaires, for example, low response rate (Sekaran 1999), can be difficult to interpret (Leedy & Ormrod 2005) and cannot be long or complex (Collis &

Hussey 2003). The design of the questionnaire followed the recommendations of Hair *et al.* (2005) on how to achieve high response rates and high quality responses and will be detailed in the next section.

### 3.10 Questionnaire Design

To achieve high response rate and high quality responses, particular attention was paid to the length of the questionnaire as well as the manner in which the questions were structured, and coded (Hair *et al.* 2005). Moreover, to ensure maximum confidentiality and anonymity of the questionnaire, no social or demographic data were included in the questionnaire.

The questionnaire for this study was based on the literature review (Chapter 2). The questionnaire consisted of the following 3 sections as per the logical flow of the literature review in chapters two:

- Section 1: Operations related (2 questions)
- Section 2: Six Sigma Transformation and Performance (21 questions)
- Section 3: Six Sigma Organisation Benefit (11 questions)

Each section in the questionnaire was supplied with a brief explanation, which also included the number of questions in the section. Together with the questionnaire, a covering letter was sent out, explaining the purpose of the questionnaire. There were several considerations that needed to be taken note of. The covering letter and a sample questionnaire can be viewed in Appendix 1 and Appendix 2 respectively.

The questionnaire was designed such that respondents could complete and respond electronically. Comments columns were included in the questionnaire, the aim was for the respondents to express or justify their decision. Because the researcher only wanted accurate information from the respondents, it stood to reason that the respondents knew exactly what was being asked of them. With this in mind technical terms were avoided. Thus, in the questionnaire, only known and generally accepted technical words and terms were used. The questions were formulated with the intention that the words used were

simple, clear and concise (Hair *et al.* 2007). Likewise the questions were brief and clear instructions were given in each section.

The questionnaires were designed in such a way that the individual questions were ordered and grouped into three sections. The form of these questions and the order in which they appeared in the questionnaire is very important (Hair *et al.* 2005). The order was important as earlier responses may affect subsequent responses. Accordingly, questions that were related to the same aspect were grouped under the same section so that respondents did not have to continually switch their focus.

Questionnaires only contained closed questions. Section 1 consisted of two operations questions. A five point Likert scale was used for Section 2 and section 3 questions where respondents had to select from five alternative responses. Section 2 Likert scale against a 5 point bi-polar scale from 1 „Strongly Disagree’ to 5 „Strongly Agree’ with an uncertain central point. Section 3 likert scale was anchored to 1 (Small Benefit) and 5 (Huge Benefit). A likert Scale is the most frequently used type of scale (Blumberg, Cooper & Schindler 2005). According to Leedy and Ormrod (2005), a rating scale is more useful when a behaviour, attitude, or other phenomenon of interest needs to be evaluated on a continuum. An advantage of this method is that a number of different statements can be provided in a list which does not take up much space, is simple for the respondent to complete and simple for the researcher to code and analyse (Collis & Hussey 2003).

The research questionnaires were sent to the Six Sigma Senior Manager for quality and construct checks. He has added one additional question to the survey (question no. 34: Increase in teamwork).

Informed consent is the principle that participants are not coerced, persuaded or induced into research against their free will but their participation should be on a voluntary basis and on a full understanding of the repercussions of participation. Informed refers to disclosure to the participants of all pertinent aspects of what will happen; and also that they are in a position to comprehend the information. Consent refers to the participant

being capable of making a logical decision about whether to participate, and that their approval should be voluntary rather than the result of intimidation or undue influence (Green and Thorogood, 2004).

Henning, van Rensburg and Smit (2004) concur that participants must provide informed consent to participate, i.e. the participants must be fully informed about the research in which the interview will be utilised. The participants are to know that their privacy and sensitivity will be safeguarded and what will happen to the data after recording. In the letter of consent provided by the researcher, the participant provides consent to these and other ethical factors.

Increasingly, ethics committees are compelling researchers to provide written evidence of informed consent (Green and Thorogood, 2004).

In this research, informed consent forms were e-mailed together with the questionnaire to each participant, certain individuals had completed them electronically, while others printed and signed the consent letters. Majority has not completed the consent letters, copies of the response e-mails are used as acceptance of consent.

Gatekeepers refer to those who are in command of the researcher's access to the fieldwork site or to other participants, either formally, such as managers whose authority is required to gain access, e.g. to a medical facility; or informally, e.g. to assist in recruitment of hard to reach groups (Green and Thorogood, 2004). Green and Thorogood (2004) further explain that although gatekeepers are a critical route for gaining entry to various settings, they are also influential on the participants and are frequently chosen for their persuasiveness or support for the research. A potential drawback of gatekeepers is due to immense pressure to participate and also restricting to those who are invited to participate. Although the use of gatekeepers to aid and legitimate access is necessary in numerous studies, the researchers should however, strive to ensure that participants are justly voluntary and that the sentiments of individuals or groups are not silenced by dependence on gatekeepers for contacts (Green and Thorogood, 2004). The researcher

had gained written permission from Lonmin's External Affairs committee to conduct the research on Lonmin (Appendix 3).

It is important that the measuring instruments (questionnaires) described in this chapter should be reliable and valid. The reliability of a particular measure specifies the stability and consistency with which the research instrument is quantifying the concept and assists in determining the integrity of a measure (Sekaran, 1992).

### 3.11 Questionnaire Pretesting, Reliability and Validation

No questionnaire should be administered before the researcher has evaluated the likely accuracy and consistency of the responses. According to Hair *et al.* (2007) the accuracy and consistency of the responses can be achieved by pretesting the questionnaire using a small sample of the respondents with characteristics similar to the target population. The sample size in a pre-test would likely be between four to no more than thirty (Hair *et al.* 2005).

The draft questionnaire was first pre-tested with the Six Sigma leadership to check its content validity and terminology and modified accordingly. The modified questionnaire was then pilot tested to check its suitability and appropriateness for the target population. Based on feedback from the pre-test, including the coding and analysis of the responses to individual questions, the questionnaire was refined by rephrasing some questions to exclude ambiguity. Moreover, the questionnaire was modified to group the questions into three sections for easy focus for the respondents. Such pretesting helped to rectify any inadequacies, in time, before administering the instrument orally or through a questionnaire to a large number of respondents, and thus reduce bias (Sekaran 1999).

Cooper and Schindler (2003) concur that within the framework of reliability, the concept of consistency emerges. A measure is reliable to the extent that it provides consistent results. Reliability is concerned with estimates of the extent to which a measurement is free of random or unstable error. Reliability is established by carrying out repeated tests



of phenomena and relationships between phenomena, by repeating the tests among different groups of individuals with the same results (Jensen, 2002).

Validity is defined as achieving confidence that what is being set out to be measured is actually measured and not something else. Different types of validity tests are utilised to determine the integrity of measures. These tests are content validity, criterion-related validity and construct validity (Sekaran, 1992).

The content validity of a measuring instrument is the degree to which it provides sufficient exposure of the questions directing the study. Criterion-related validity demonstrates the success of measures utilised for prediction or estimation.

Criterion measures must also be analysed in terms of relevance, freedom from bias, reliability and availability. In order to assess construct validity, both the theory and measuring instrument utilised are considered. A researcher may decide to measure or infer the presence of abstract characteristics for which no empirical validation appears possible, attitude scales, aptitude and personality tests form this category (Cooper and Schindler, 2003).

Saunders and Lewis, et al (2003) state that there are at least four stages that must emerge if validity and reliability is to exist. Face validity presents a basic level of judgement that a measured variable actually measures the phenomenon it represents (Jensen, 2002).

Reliability was tested by issuing a sample of the questionnaire during a Six Sigma training session. The results obtained were similar and it was therefore concluded that reliability was established.

### 3.12 Data Capturing Methods

For testing the two theoretical models hypothesised in this study, the measurement instruments should be reliable and valid. Thus, they should be evaluated for reliability and validity. In evaluating measurement instruments, reliability analysis, item analysis,

and factor analysis should be conducted in order to understand whether measurement instruments were reliable and valid. Minitab 15 was used in evaluation, as this is the tool prescribed for Six Sigma. To test the two theoretical models, structural equation modelling (LISREL) technique was used. LISREL can provide the appropriate and most efficient estimation technique for a series of separate multiple regression equations estimated simultaneously (Hair et al., 1992). There were two reasons for employing LISREL in this study. First, LISREL estimates a series of separate, but interdependent, multiple regression equations simultaneously by specifying the structural model used by the statistical program. LISREL is powerful in studying the relationships among independent and dependent variables, even when a dependent variable becomes an independent variable in other relationships. Second, the sample size was 65 in this study, which is proposed as the critical sample size for employing LISREL analysis.

### 3.13 Data Analysis Methods

After data has been collected and before it is analysed, the researcher must examine them to ensure their completeness and validity (Hair *et al.* 2007). Before the data analysis process, the collected data must be prepared. This was done using standard editing and coding procedures. Data analysis usually involves reducing accumulated data to a manageable amount, developing summaries, looking for patterns and applying statistical techniques (Blumberg, Cooper & Schindler 2005). This was done in accordance with the objectives of the study.

In this study, the data was analysed by means of exploratory data analysis. In exploratory data analysis, techniques were applied to data as part of a preliminary analysis or even a full analysis, if great statistical rigour is not required or the data does not justify it (Collis & Hussey 2003). Blumberg, Cooper & Schindler (2005) pointed out that exploratory data analysis is both a data analysis perspective and a set of techniques. The exploratory technique used in this study was frequencies and central tendencies. In addition to numerical summaries of role and service, exploratory data analysis uses visual displays to provide a complete and accurate impression of distributions and variable relationships (Blumberg, Cooper & Schindler 2005). This study tested the theories and concepts

presented in the literature review chapter and statistically determine the causal relationship between the various independent and dependent variables.

Data must be coded either before or after the data is collected but it is best to code them ahead of time (Hair *et al.* 2005). Coding of collected data means assigning a number to a particular response so the answer can be entered into a database.

Data was organised according to meaningful categories of responses. Simple tabulation, cross tabulation and summarising the appropriate details of the responses was utilised to analyse the data. The collected data was statistically analysed and presented in the next chapter using descriptive statistics and inferential statistics. The combination of these variables into the objectives simplified the analysis and understanding of the data.

Descriptive statistics was concerned with the presentation of the data using frequency and central tendency statistical techniques. In inferential statistics, T-Test and Pearson Chi-square methods will be used.

Questionnaires were filled by the respondents electronically on Microsoft Excel and some printed and completed manually. The questionnaires were coded electronically onto Microsoft Excel. Microsoft Excel provides some statistical and reporting tools to report the survey results. Thus the analysis of the data will initially use the tools available in Microsoft Excel for final presentation.

### 3.14 Conclusion

This chapter presented the research strategy adopted in this study: A literature review and questionnaire survey, thus characterised as a quantitative strategy. The processes and methods of conducting the research followed in conducting the study by detailing the research design, sample, and the data collection instrument. The participants were selected using the purposive sampling method, as the research required participants that were exposed to the Six Sigma programme. Purposive sampling was used to ensure that participants were selected because of their suitability and ability to provide rich

information in order to learn a great deal about issues of central importance for the study. The questionnaire was chosen as the preferred method of data collection. Chapter four will present the analysis of this research.

## CHAPTER FOUR

### Presentation of Results

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#### 4.1 Introduction

This chapter firstly describes the sample. Secondly, descriptive statistics were presented to give an initial indication and the use of elements of collaboration to determine the results of this study (using questionnaires, graphs and tables). The data had been analysed in relation to the problem statement and critical questions outlined in section three. The section presented the results in Microsoft Excel.

#### 4.2 Description of Sample

Two questions were used to determine the description of the sample population, with the role defined as MBB (Master Black Belt), BB (Black Belt), GB (Green Belt), PS (Project Sponsor), CA (Change Agent), O (Other) and their service period with Lonmin operations.

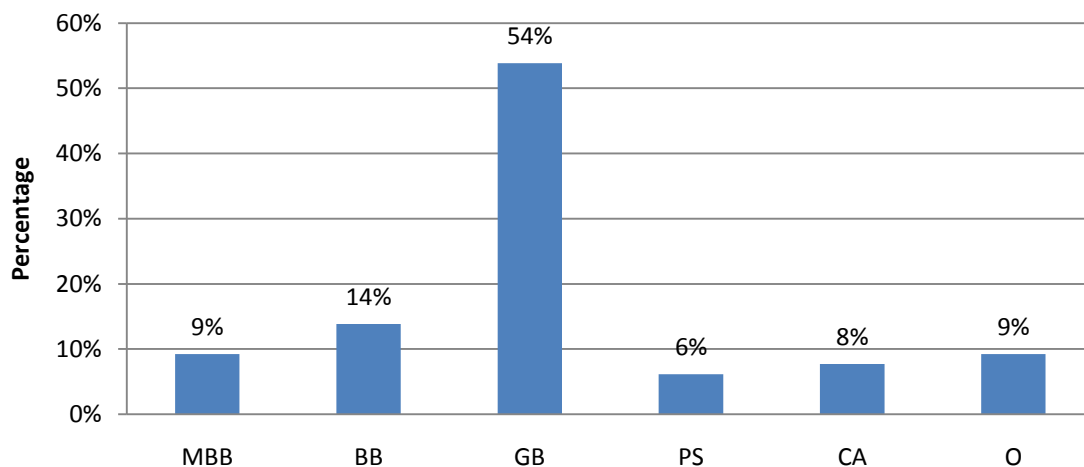


Figure 4.1: Your role within Lonmin operations

Fifty four percent (54%) of the participants were of the role category GB, fourteen percent (14%) of role category BB, nine percent (9%) of role category MBB and O, eight percent (8%) of role CA and six percent (6%) of role PS. Seventy seven (77%) of participants were within the role category of GB, BB and MBB.

There was more keen response from the Six Sigma role participants in comparison to other roles. This indicates that majority of the participants had enriched knowledge on Six Sigma.

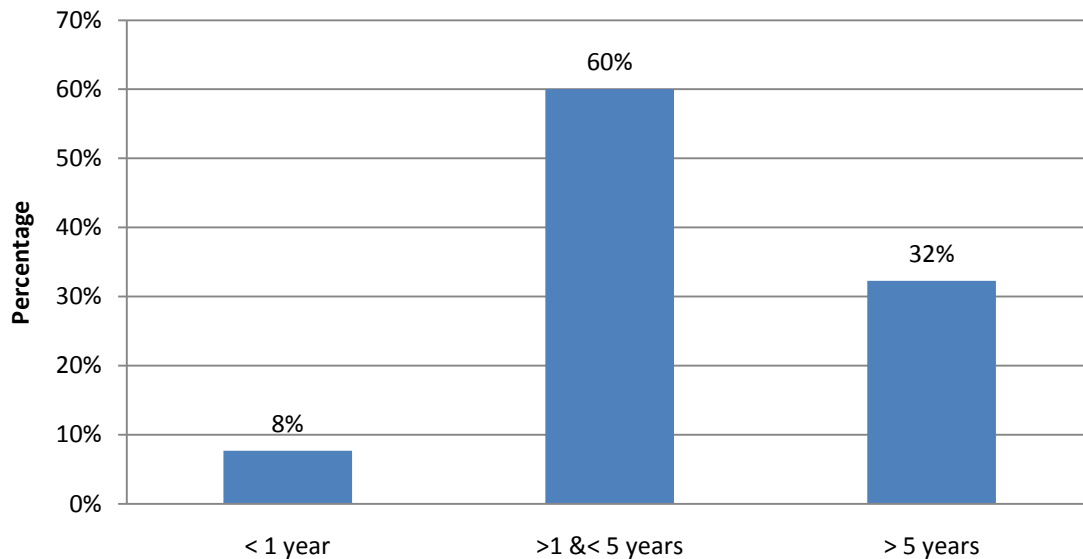


Figure 4.2: Your service with Lonmin operations

Sixty percent (60%) of the participants were within the service category >1 & < 5 years, thirty two percent (32%) within the service category > 5 years and eight percent (8%) within the service category <1 year. Ninety two (92%) of participants were within the service category of > 1 year, indicated a more keen response from older service period participants, thus indicated that participants were knowledgeable on Lonmin's operations.

### 4.3 Characteristics of Six Sigma as transformational programme

Twenty one questions were detailed to determine the characteristics of Six Sigma as a transformational programme within Lonmin.

#### 4.3.1 Six Sigma as Change Management at Lonmin

Six Sigma as a Change Management focused on Lonmin's transformational plan, communication plan, vision and strategy, alignment of the transformational plan and assigned dedicated people to the plan.

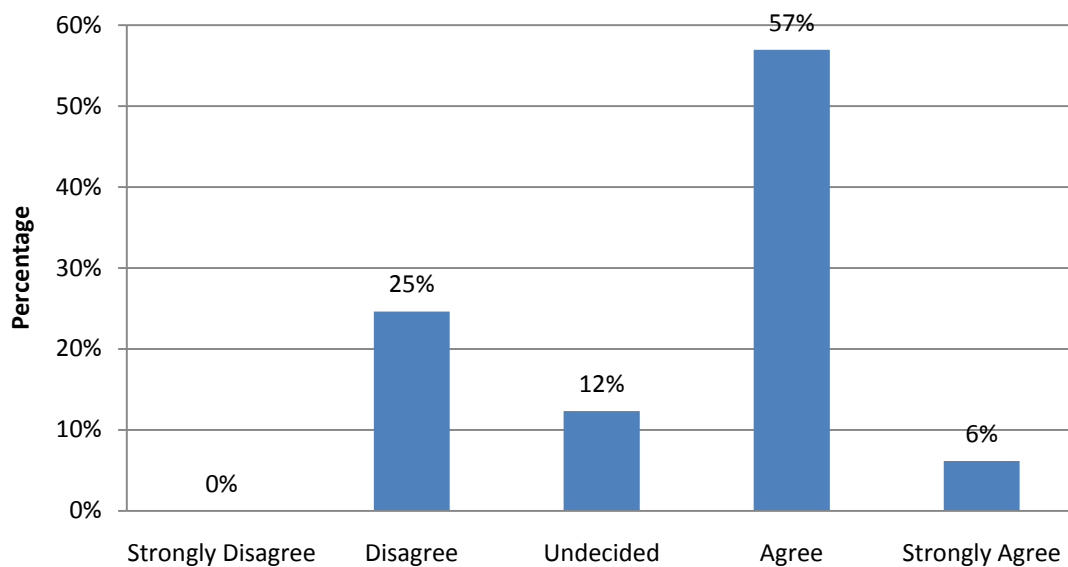


Figure 4.3: Lonmin's top management have a clear transformation plan

Fifty seven percent (57%) of the participants agreed that Lonmin had a clear transformation plan, twenty five percent (25%) disagreed, twelve percent (12%) were undecided and six percent (6%) strongly agreed.

A study by KIO Advisory Services has found that South African mining companies have shown a disturbingly low level of workforce transformation, eight years after signing the Mining Charter. (<http://miningweekly.com>)

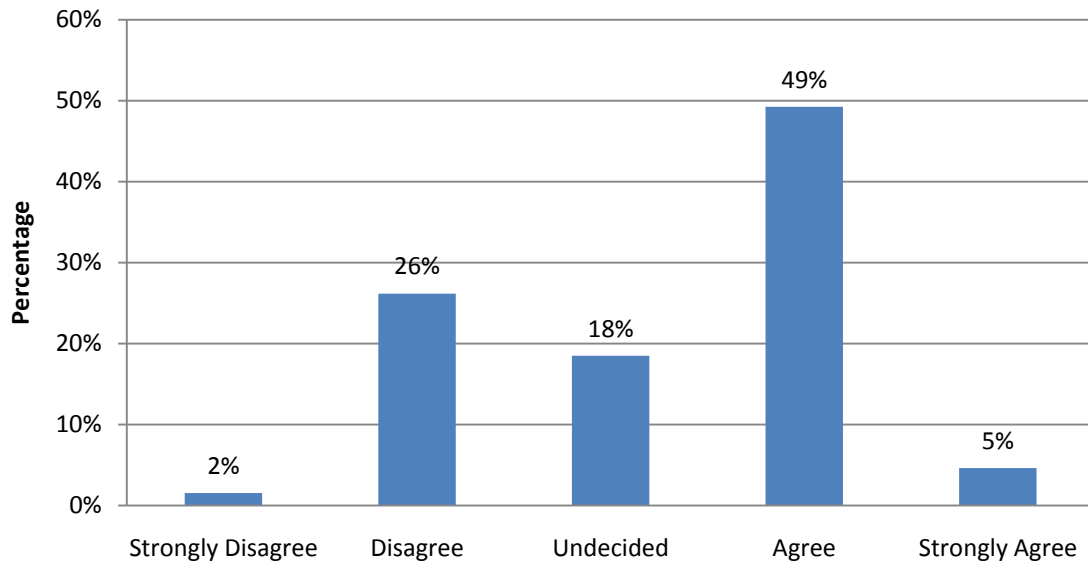


Figure 4.4: Lonmin's top management have communicated the transformation plan within the organisation

Forty nine percent (49%) of the participants agreed that Lonmin's top management had communicated the transformation plan within the organisation, twenty six percent (26%) disagreed, eighteen percent (18%) were undecided, five percent (5%) strongly agreed and two percent (2%) strongly disagreed.

A study posed on [www.isixsigma.com](http://www.isixsigma.com) (Accessed 1 July 2010) stated that over sixty percent (60%) of change initiatives failed due to the absence of organisational acceptance. Building Six Sigma acceptance began with the development of solid communication strategies. The following is a list of some commonly used communication tactics:

- Face to face meetings
- Chief Executive Office memo to employees
- Presentation at staff/management meetings
- Intranet posting updates
- Regular column in employee newsletter
- Phone hotline
- Email



- Milestone recognition event
- Suggestion and question box

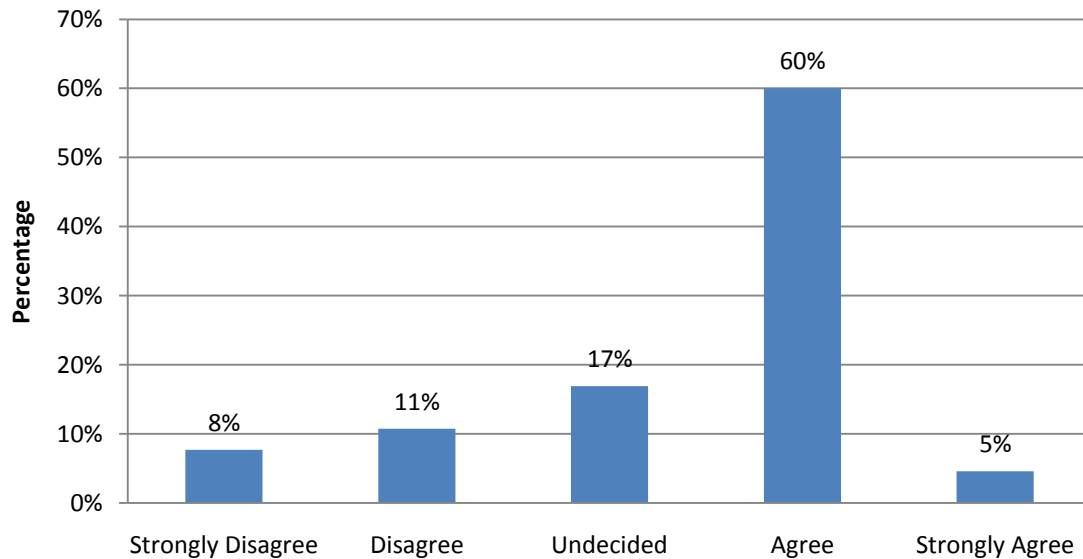


Figure 4.5: The Six Sigma team has a clear and visible vision and strategy that drives improvement

Sixty percent (60%) of the participants agreed that Six Sigma team had a clear and visible vision and strategy that drives improvement, seventeen percent (17%) were undecided, eleven percent (11%) disagreed, eight percent (8%) strongly disagreed and five percent (5%) strongly agreed.

Research showed that the right operations strategy can help companies make innovation a regular occurrence [Online]. Available WWW: ([www.ibm.com](http://www.ibm.com)) (Accessed 1 July 2010). Such a strategy focused on efficiency and also on growth can serve as a foundation for innovation throughout an organisation. Successful innovators had;

- An innovation vision based on factual customer and market
- Leadership commitment to perpetual innovation
- Alignment across the extended enterprise
- Organisational capabilities that made innovation habitual

CEO's ranked an "unsupportive culture and climate" as the biggest obstacle to innovation success. Their organisations lacked the processes, discipline and organisational mindset to foster meaningful innovation on a continuous basis.

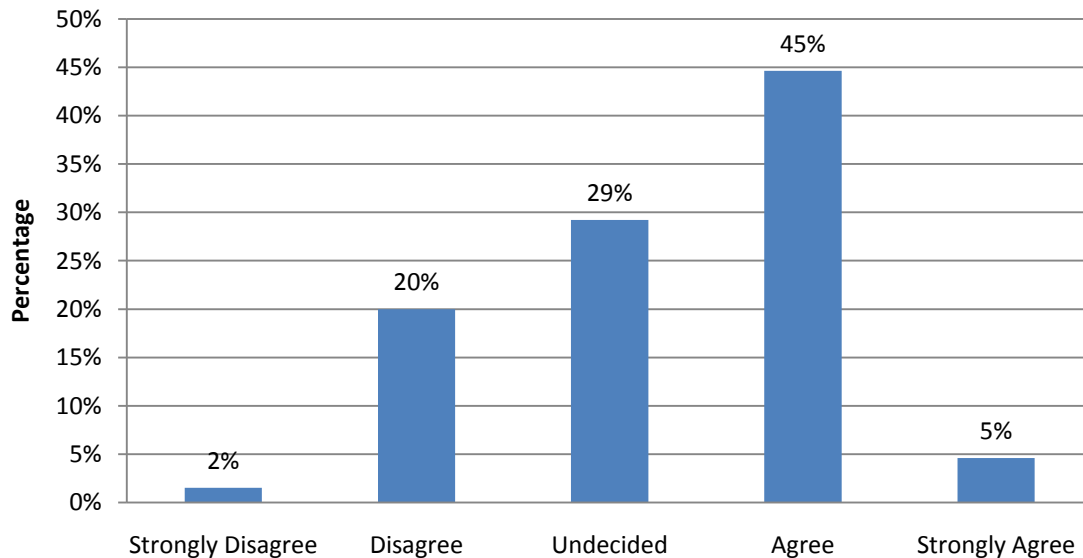


Figure 4.6: The Six Sigma programme is linked to Lonmin's transformational plan

Forty five percent (45%) of the participants agreed that Six Sigma programme was linked to Lonmin's transformational plan, twenty nine percent (29%) were undecided, twenty percent (20%) disagreed, five percent (5%) strongly agreed and two percent (2%) strongly disagreed.

Honeywell business leaders aligned the Six Sigma strategy with the business strategy; they have included Six Sigma in their management operating system, balanced scorecard and day to day language in order to illustrate for employees their commitment [Online]. Available WWW: [www.isixsigma.com](http://www.isixsigma.com) (Accessed 1 July 2010).

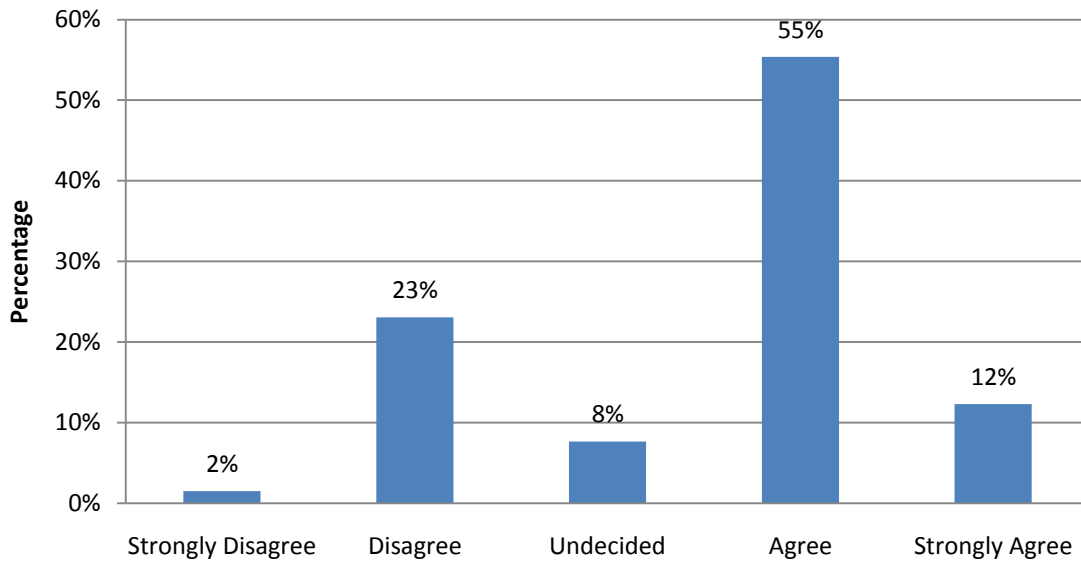


Figure 4.7: Lonmin has assigned dedicated people to transformation plan within the organisation

Fifty five percent (55%) of the participants agreed that Lonmin had assigned dedicated people to transformation initiative on a full time basis, twenty three percent (23%) disagreed, twelve percent (12%) strongly agreed, eight percent (8%) were undecided and two percent (2%) strongly disagree.

In big corporation with outstanding results, the Six Sigma formal structure played a key role, establishing rules and procedures that were certainly fostered by a culture to continuous improvement. Those factors promoted Six Sigma sustainability and the continuous push to insert projects in a knowledge database that slowly increased in scope and quality [Online]. Available WWW: [www.isixsigma.com](http://www.isixsigma.com) (Accessed 1 July 2010).

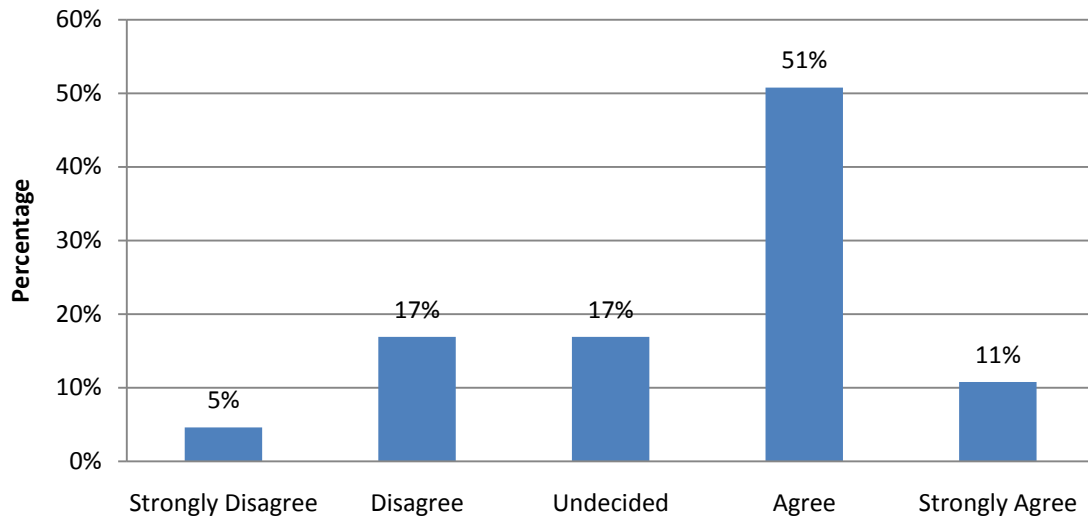


Figure 4.8: Six Sigma initiatives have integrated with other business improvement initiatives to maximise improvement

Fifty one percent (51%) of the participants agreed that Six Sigma initiatives had integrated with other business improvement initiatives to maximise improvement, seventeen percent (17%) disagreed and seventeen percent (17%) were undecided, eleven percent (11%) strongly agreed and five percent (5%) strongly disagreed.

A research conducted by PRTM had found that Six Sigma implementation objectives do not link to overall business objectives often because the high volume of projects makes this a challenge [Online]. Available WWW: [www.supplychain-forum.com](http://www.supplychain-forum.com) (Accessed 1 July 2010).

Those that do tend to see better results they rely on cross functional steering committees seventy one percent (71%) of the time, hold phase reviews versus status reviews fifty seven percent (57%) of the time, and rely more on benchmarking eighty six percent (86%) of the time.

#### 4.3.2 Six Sigma Knowledge Management at Lonmin

Six Sigma as Knowledge Management contribution at Lonmin focused on Six Sigma skills deployment, subject matter experts, desired skills and knowledge for the business.

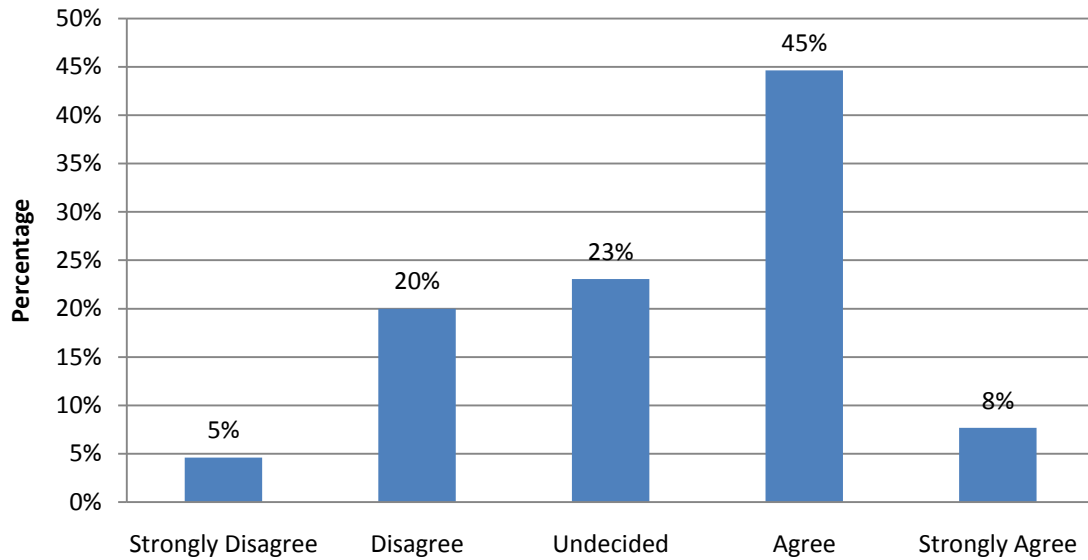


Figure 4.9: Six Sigma skills have been deployed effectively

Forty five percent (45%) of the participants agreed that Six Sigma skill had been deployed effectively, twenty three percent (23%) were undecided, twenty percent (20%) disagreed, eight percent (8%) strongly agreed and five percent (5%) strongly disagreed.

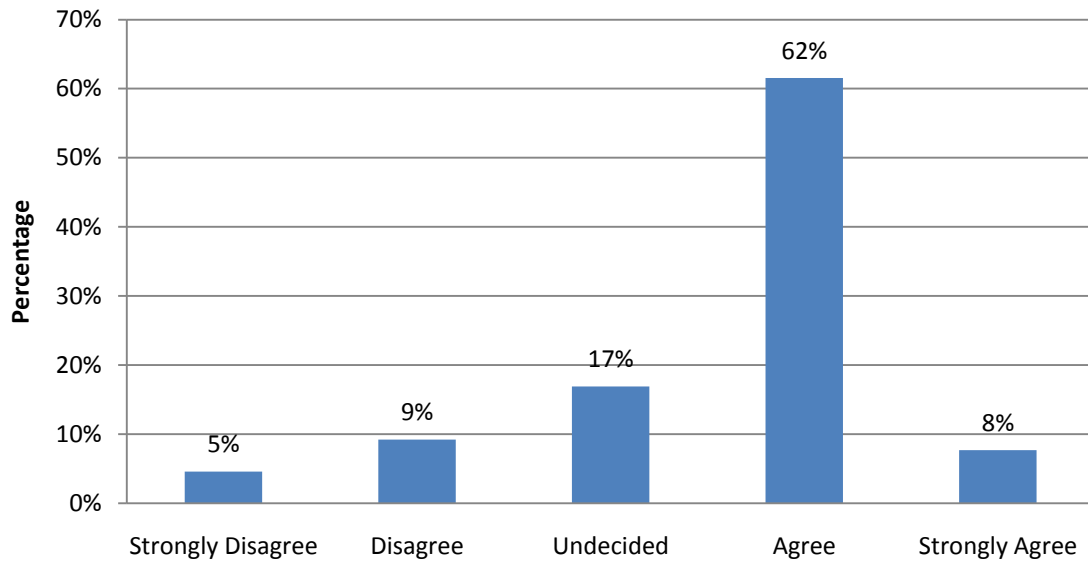


Figure 4.10: Six Sigma team were used as subject matter experts in Six Sigma tools and applications expertise

Sixty two percent (62%) of the participants agreed that Six Sigma team were used as subject matter experts in Six Sigma tools and applications, seventeen percent (17%) were undecided, nine percent (9%) disagreed, eight percent (8%) strongly agreed and five percent (5%) strongly disagreed.

A research conducted by PRTM had found that companies must select the right people from within their organisation to provide both subject matter expertise and the political clout need to get things done. Respondents agreed that a standard framework Six Sigma would benefit inter-company exchanges [Online]. Available WWW: [www.supplychain-forum.com](http://www.supplychain-forum.com) (Accessed 1 July 2010).

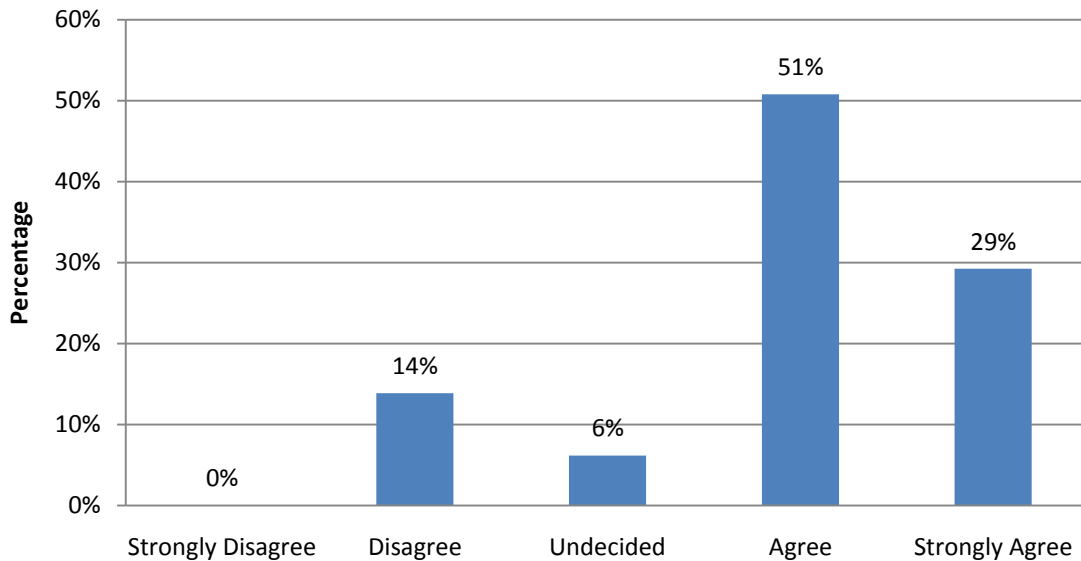


Figure 4.11: Six Sigma knowledge and skills are the desired requirements for business performance

Fifty one percent (51%) of the participants agreed that Six Sigma knowledge and skills were the desired requirements for business performance, twenty nine percent (29%) strongly agreed, fourteen percent (14%) disagreed and six percent (6%) were undecided.

The study on how Six Sigma practices can lead to organisational knowledge creation capability and how this capability can lead to the improvement of organisational performance showed that [Online]. Available WWW: [www.inderscience.com](http://www.inderscience.com) (Accessed 1 July 2010).

- 1) Six Sigma practices allow knowledge creation processes (socialisation, externalisation, combination and internalisation).
- 2) Knowledge created has positive impact on four different measures of organisation performance (customer, internal business performance, employee learning and growth and financial)
- 3) Process improvement through Six Sigma projects involves the creation of knowledge.

#### 4.3.3 Sustainability of Six Sigma Programme at Lonmin

The sustainability of Six Sigma Programme at Lonmin focused on Six Sigma as a long term business methodology, Six Sigma business integration and Six Sigma team visible leadership.

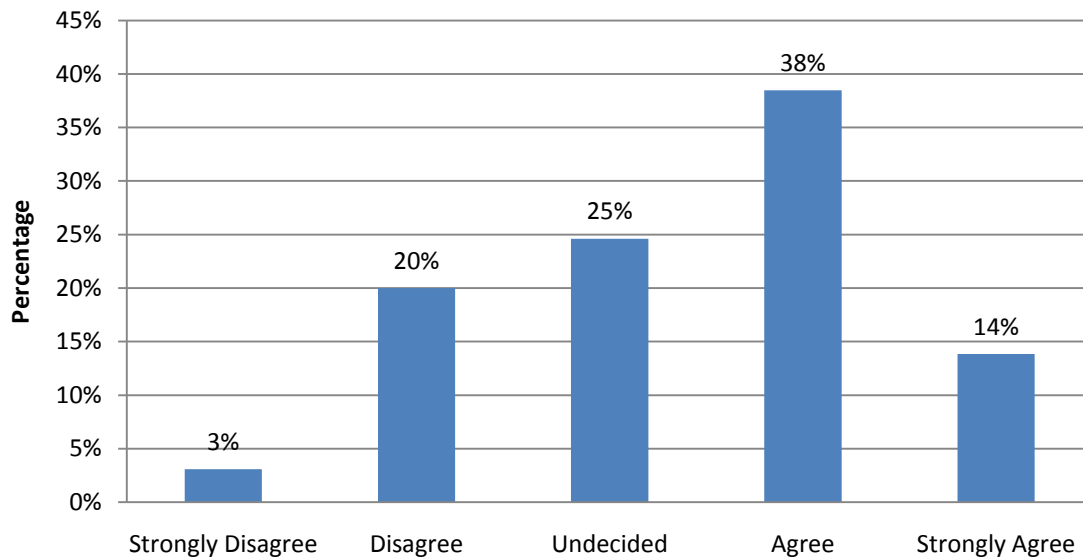


Figure 4.12: Six Sigma is Lonmin's long term business improvement methodology

Thirty eight percent (38%) of the participants agreed that Six Sigma was Lonmin's long term business improvement methodology, twenty five percent (25%) were undecided, twenty percent (20%) disagreed, fourteen percent (14%) strongly agreed and three percent (3%) strongly disagreed.

A study on paradigm shift suggested that every tool, methodology or framework had a limited life [Online]. Available WWW: [www.isixsigma.com](http://www.isixsigma.com) (Accessed 1 July 2010).

The strategy to sustain Six Sigma must address the following:

- Leadership commitment
- Managing Six Sigma
- Black Belt accountability
- Innovation



The combined the best components of Theory of Constraints (TOC), lean and Six Sigma to form “TLS” process improvement methodology delivered considerably higher cost savings to the company. Specifically its application in a contribution of 89% of the total savings reported. Six Sigma by itself reported 7% contribution to the company savings, followed by 4% from stand alone lean application.

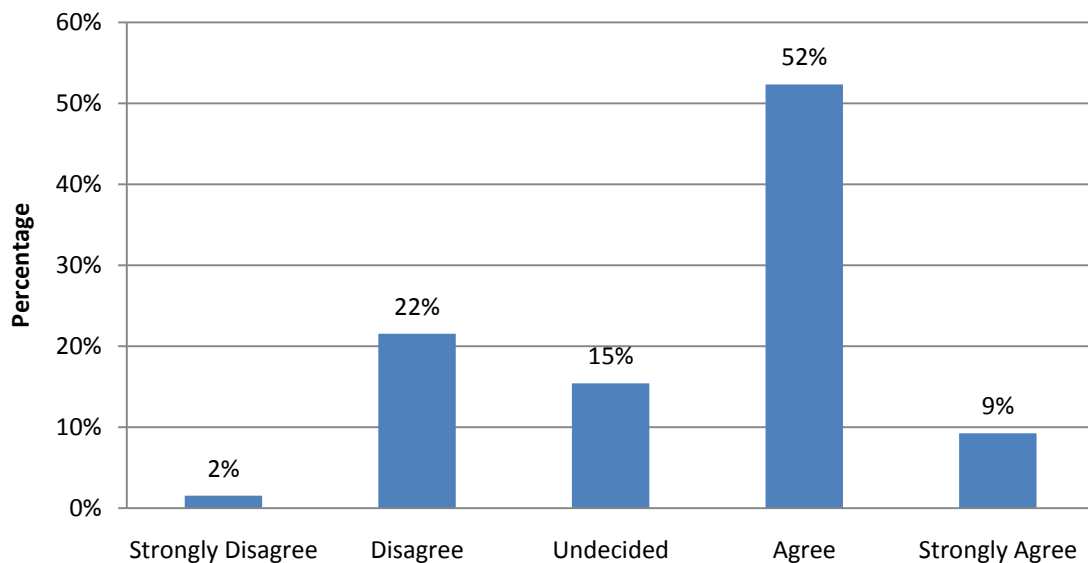


Figure 4.13: The Six Sigma approach has been integrated in the way you do business

Fifty two percent (52%) of the participants agreed that the Six Sigma approach had been integrated in the way Lonmin does business, twenty two percent (22%) disagreed, fifteen percent (15%) were undecided, nine percent (9%) strongly agreed and two percent (2%) strongly disagreed.

The Importance of Project Selection white paper [Online], Available WWW: [www.ssqi.com](http://www.ssqi.com) (Accessed 1 July 2010), analysis revealed that seventy five percent (75%) of the companies admitted they didn't have a project selection methodology that assured on-time completion. Forty-eight percent (48%) of the projects were initially “poorly designed”, and thirty five percent (35%) of the Black Belts surveyed stated that they started out their Six Sigma efforts by receiving project assignments that had “little chance” of success from the start. This white paper detailed key elements of the Project Selection Process as follows:

- Commitment of senior management to the process
- Project selection based on realistic, available metrics
- Voice of the Customer/Voice of the Business/Voice of the Process
- Clear linkage to organisational goals
- Specific, detailed project plans
- Properly selected and prepared implementers, with key organisational support and alignment.

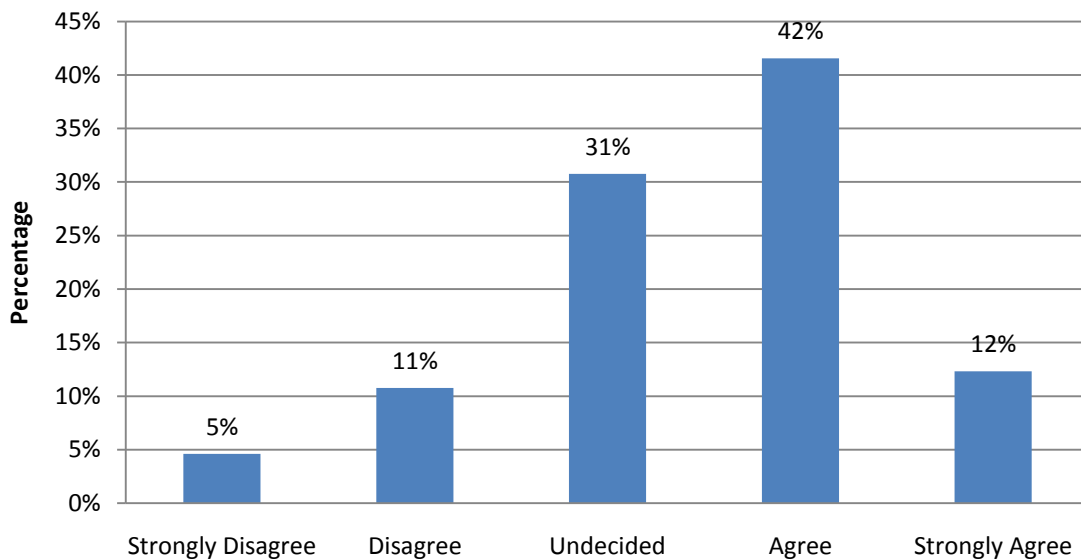


Figure 4.14: The Six Sigma team has showed visible leadership in terms of the Lonmin Charter

Forty two percent (42%) of the participants agreed that Six Sigma team had showed visible leadership in terms of the Lonmin Charter, thirty one percent (31%) were undecided, twelve percent (12%) strongly agreed, eleven percent (11%) disagreed and five percent (5%) strongly disagreed.

#### 4.3.4 Benefits of Six Sigma Programme at Lonmin

Eleven questions were used to determine the level of benefit to Lonmin by using Six Sigma as the transformation tool. The next table details the benefits relation of all categories identified.

Benefit Category	No Benefit	Small Benefit	Average Benefit	Big Benefit	Huge Benefit
Reduction in process variability	3%	31%	35%	26%	5%
Increase in profitability	6%	34%	32%	26%	2%
Reduction of operational costs	8%	37%	26%	25%	5%
Reduction in Cost of Poor Quality	5%	18%	34%	38%	5%
Increase in productivity	12%	32%	29%	20%	6%
Reduction in Cycle Time	8%	42%	28%	22%	2%
Reduction in Customer complaints	12%	18%	37%	28%	5%
Improved sales	18%	38%	23%	17%	3%
Improve decision making	5%	23%	25%	43%	5%
Reduced Inspection	9%	38%	34%	17%	2%
Increase in teamwork	5%	17%	32%	38%	8%
<b>Average</b>	<b>8%</b>	<b>30%</b>	<b>30%</b>	<b>27%</b>	<b>4%</b>

Table 4.1 – Six Sigma Benefits Matrix

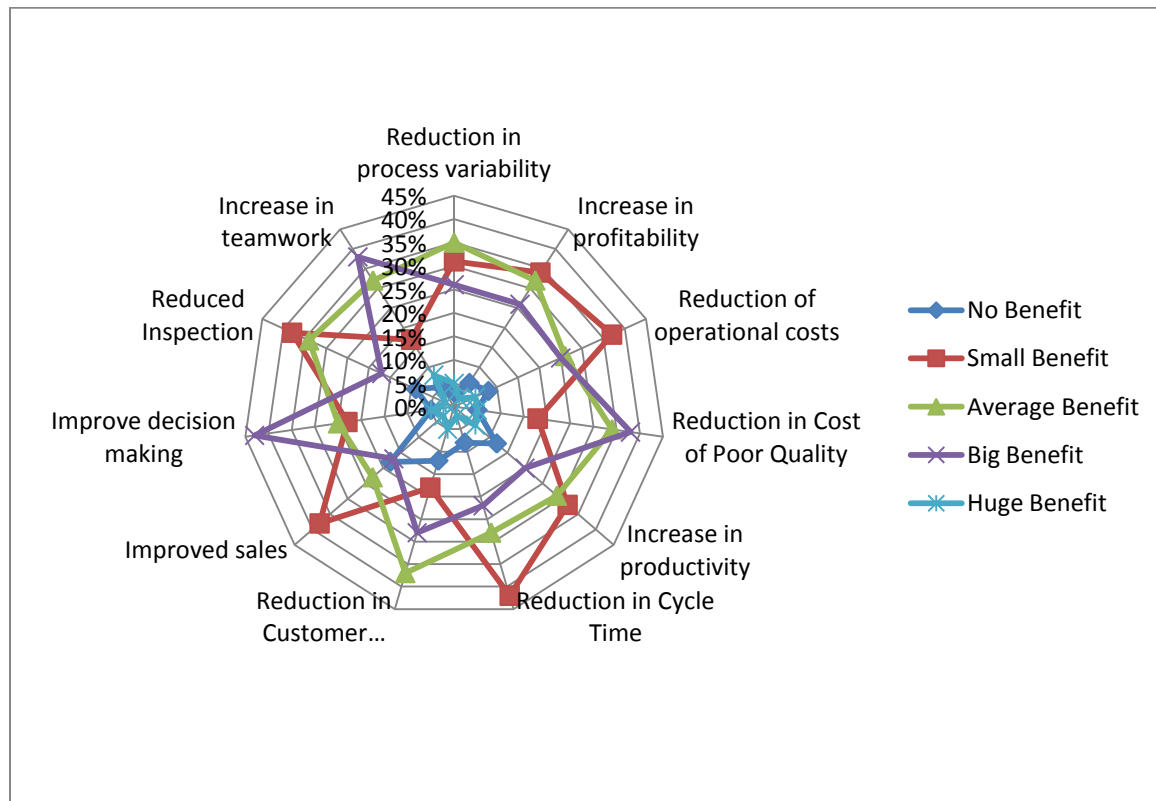


Figure 4.15: Six Sigma Benefits

Table 4.1 and Figure 4.15 indicates that the top three “big to huge” benefits were, improved decision making (43%), increase in team work (38%), and reduction in Cost of Poor Quality (38%). The top three “small to no benefit” were Improved Sales (56%), Reduction in Cycle Times (50%), and Reduced Inspections. The top average benefit was Reduction in Customer complaints.

Total Quality Management white paper presented Six Sigma Benefits realised when six sigma processes were applied in a systematic way [Online]. Available WWW: [www.isixsigma.com](http://www.isixsigma.com) (Accessed 1 July 2010).

- a. Decreased work in progress
- b. Improved capacity and output
- c. Improved customer satisfaction and process flow
- d. Improved inventory turns
- e. Increased productivity
- f. Reduced cycle times

#### 4.3.5 Six Sigma Performance at Lonmin

Six Sigma performances at Lonmin focused on the Six Sigma transformational impact, projects focus and its contribution to performance and project cycle times meeting business needs.

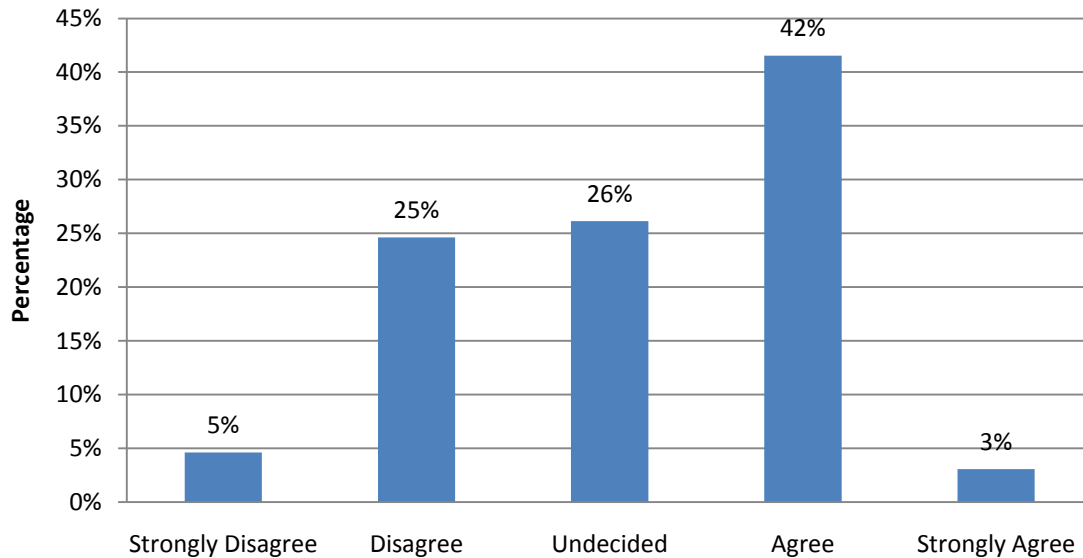


Figure 4.16: Six Sigma drives transformation

Forty two percent (42%) of the participants agreed that Six Sigma team were considered as Change Agents within the business and visibly drove the transformation of Lonmin, twenty six percent (26%) were undecided, twenty five percent (25%) disagreed, five percent (5%) strongly disagreed and three (3%) strongly agreed.

A research published on [Online], Available WWW: [www.isixsigma.com](http://www.isixsigma.com) (Accessed 1 July 2010), stated that companies that treat their Six Sigma efforts as both the impetus and mechanism for culture change were twice more successfully deployed than those that had no link between Six Sigma and culture.

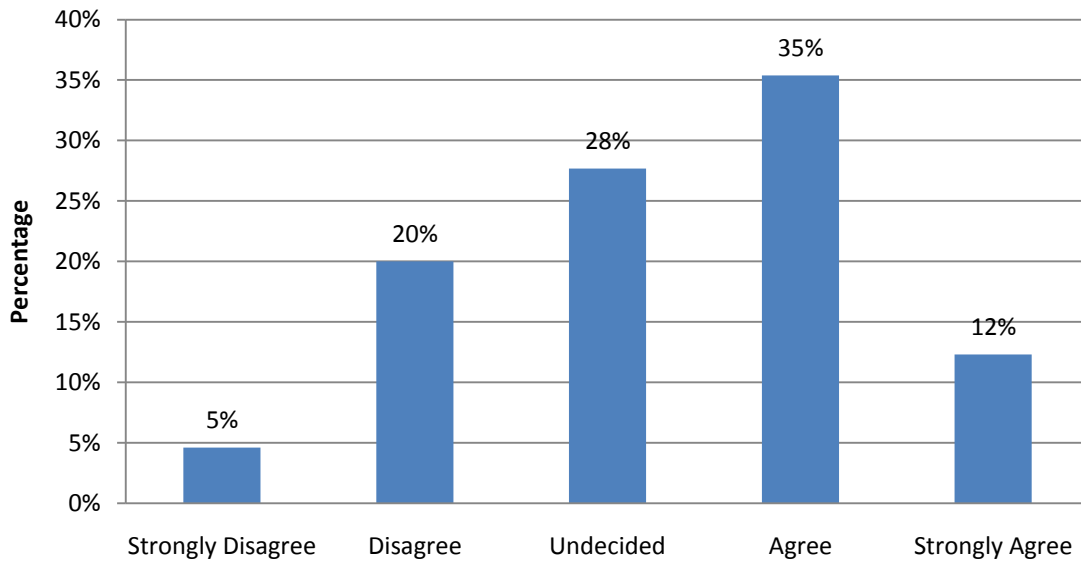


Figure 4.17: Six Sigma projects have the right focus and will contribute to the transformation of Lonmin and facilitate the achievement of its goals

Thirty five percent (35%) of the participants agreed that Six Sigma projects had the right focus and will contribute to the transformation of Lonmin and facilitate the achievement of its goals, twenty eight percent (28%) were undecided, twenty percent (20%) disagreed, twelve percent (12%) strongly agreed and five percent (5%) strongly disagreed.

The Bain & Company management survey revealed that eighty percent (80%) of their Six Sigma efforts are failing to drive the anticipated value and seventy four percent (74%) are not getting the expected competitive edge because they haven't achieved their savings [Online]. Available WWW: [www.bain.com](http://www.bain.com) (Accessed 1 July 2010).

Their findings resulting in this failure were:

- 1) Mobilising large and costly squads of black belts in some cases actually slowed down performance
- 2) Managers are unsure how to best deploy Six Sigma experts and too often black belts treat all problems, big and small with the same approach, resulting in less effective solutions.
- 3) Managers fail to prioritize the improvements that will make the biggest difference.

Brain & Company identified companies that are yielding biggest gains from Six Sigma by deploying an upfront diagnostic X-ray to help them identify the most critical opportunities that consisted of:

- 1) Enterprise Value Stream Mapping
- 2) Benchmarking
- 3) Prioritising

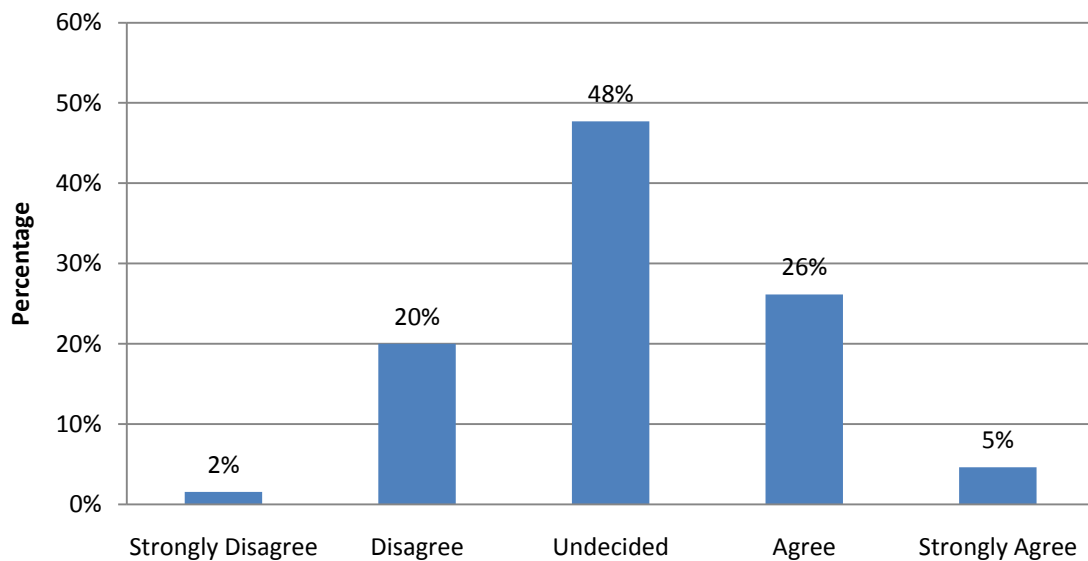


Figure 4.18: Cycle times of Six Sigma projects has improved and are meeting business needs

Forty eight percent (48%) of the participants were undecided that cycle time of Six Sigma projects improvement had improved and met business needs, twenty six percent (26%) agreed, twenty percent (20%) disagreed, five percent (5%) strongly agreed and two (2%) strongly disagreed.

Recent Trends in Six Sigma with paper [Online], Available WWW: [www.qualitypublishing.com](http://www.qualitypublishing.com) (Accessed 1 July 2010), identified reasons for emphasis on Cycle Time reduction:

- Late Shipment result in penalties
- Excessive Cycle Times lead to downtime for downstream processes

- Cycle Time reduction improves capacity, reducing the need for increased labour, equipment or facility costs

Black belts are trained in tools for cycle time reduction which are Process Mapping, Lean Thinking and Theory of Constraints.

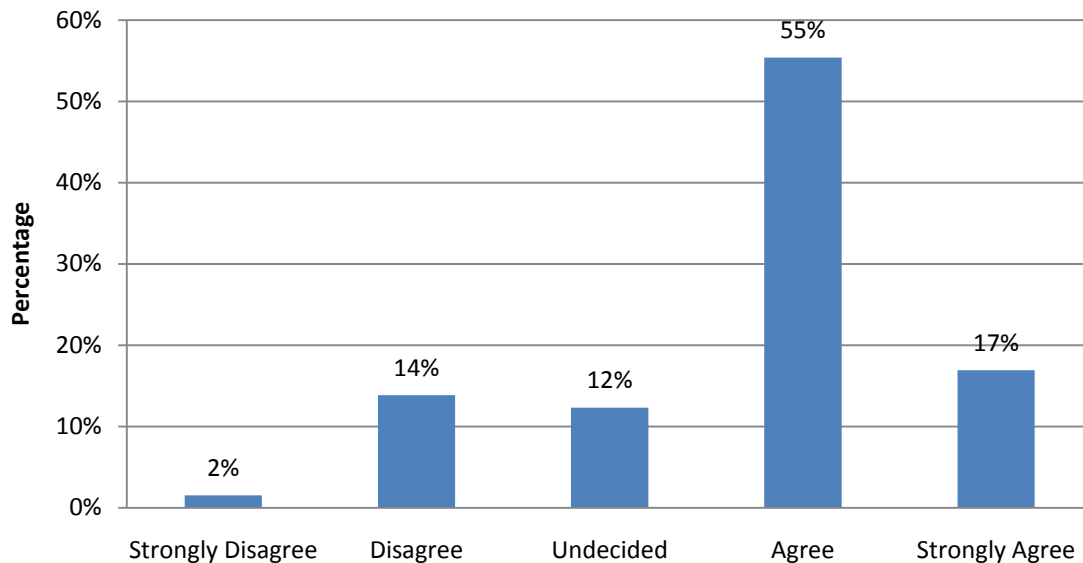


Figure 4.19: Six Sigma process has a positive impact on the business performance

Fifty five percent (55%) of the participants agreed that Six Sigma process had a positive impact on the business performance, seventeen percent (17%) strongly agreed, fourteen percent (14%) disagreed, twelve percent (12%) were undecided and two percent (2%) strongly disagreed.



#### 4.3.6 PEST Evaluation on Lonmin's Transformation Programmes

PEST evaluation on Lonmin's transformation programme focused on political impact, economic impact, environment impact, social impact and technological impact on the transformation programme.

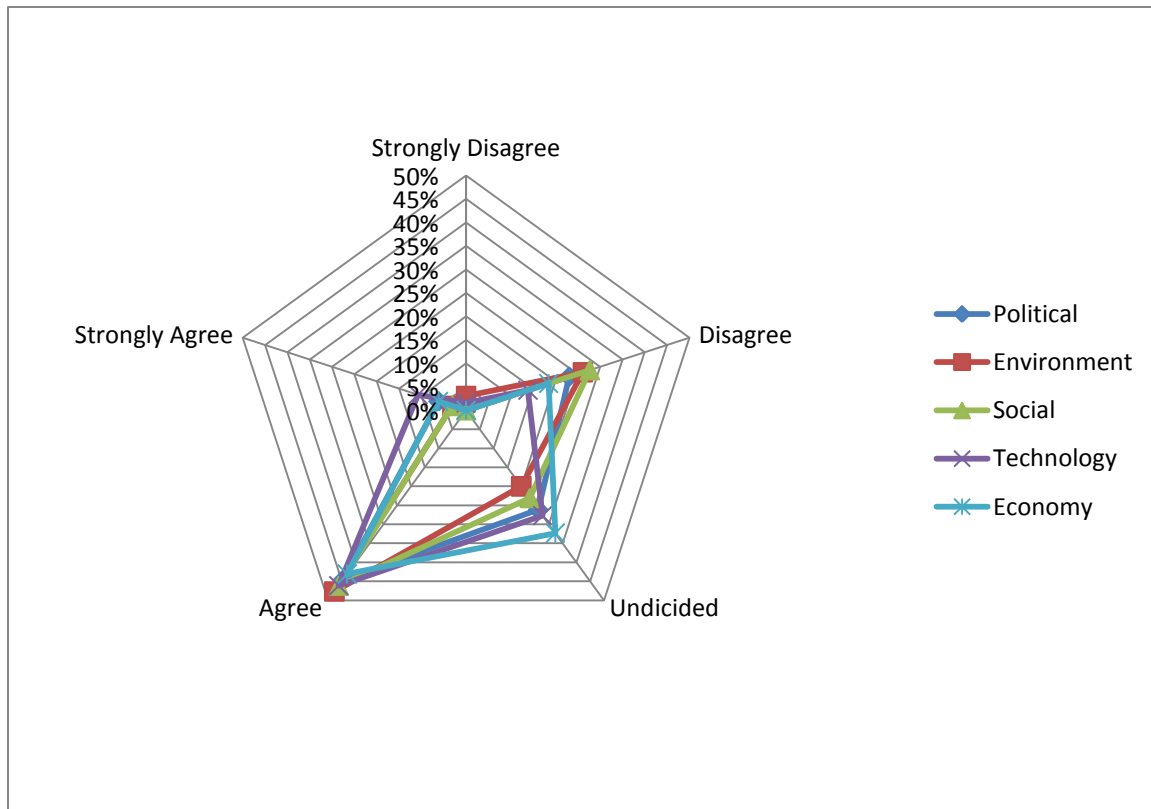


Figure 4.20: PEST evaluation impact on the success of the transformation process

Forty nine percent (49%) of the participants agreed that political aspects had an impact on the success of the transformation process, twenty three percent (23%) disagreed, twenty percent (20%) were undecided and eight percent (8%) strongly agreed.

The KIO Advisory Service report suggested three weaknesses to be addressed by the Presidential BEE Advisory Council and industry stakeholders [Online]. Available WWW: <http://miningweekly.com> (Accessed 1 July 2010):

- a) White woman in management that distorts the true picture of transformation in the industry.

- b) Develop a rigorous BEE measure system to reduce the possibility of different interpretation.
  - c) The targets in the Mining Charter and Department of Mineral Resources (DMR) are too low, Dispensing with Historically Disadvantaged South Africans (HDSA) targets in the Mining Charter. The HDSA targets should be discontinued because there is significant overrepresentation they should be redrafted and aligned with the BEE targets.
- 2) Forty three percent (43%) of the participants agreed that economic aspects had an impact on the success of the transformation process, thirty two percent (32%) were undecided, eighteen percent (18%) disagreed and six percent (6%) strongly agreed.

Fifty one percent (51%) of the participants agreed that environmental aspects had an impact on the success of the transformation, twenty five percent (25%) disagreed, seventeen percent (17%) were undecided, five percent (5%) strongly agreed and three percent (3%) strongly disagreed.

Forty six percent (46%) of the participants agreed that social aspects had an impact on the transformation process, twenty eight percent (28%) disagreed, twenty three percent (23%) were undecided and three percent (3%) strongly agreed.

In a study done by The Bench Marks Foundation on the Corporate Social Responsibility programmes of the platinum mining companies in the North West, inadequacies in respect of health, labour, transformation, environmental effects as well as safety are severely criticised [Online]. Available WWW: [www.fataltransactions.org](http://www.fataltransactions.org) (Accessed 1 July 2010).

This study recommended ways in which the mines, the community and the government can work together in order to address some of the issues identified:

- a) Reed and grass production and harvesting
- b) Pomegranate juice and vegetable juices production
- c) Transparency in reporting on dewatering and pumping of underground water
- d) Living out allowance given to workers

Forty six percent (46%) of the participants agreed that Technology aspects impacted on the success of the transformation process, twenty eight percent (28%) were undecided, fourteen percent (14%) disagreed, eleven percent (11%) strongly agreed and two percent (2%) strongly disagreed.

PricewaterhouseCoopers (PwC) stated that currently platinum is being substituted for palladium, gold and silver as nanotechnology research is increasing, which will mean far less demand for precious metals if successfully mass produced [Online]. Available WWW: [www.miningweekly.com](http://www.miningweekly.com) (Accessed 1 July 2010).

Information Technology and Six Sigma Implementation white paper found that the advent of personal computing technologies coupled with the advancement of networking systems and Internet infrastructure as well as the sophisticated software tools have contributed to the success of implementation a Six Sigma quality control system.

#### 4.4 Inferential Statistics

To determine the relevance between the data collected, the cross-tabulations below will be utilised to distinguish the relevance.

Service period within role	Role					
	MBB	BB	GB	PS	CA	O
Service Period <1 year % within role	0%	0%	5%	2%	0%	2%
Service Period >1 & <5 years % within role	3%	8%	32%	5%	6%	6%
Service Period > 5 years % within role	6%	6%	17%	0%	2%	2%

Table 4.2 – Cross tabulation Role and Service period

Table 4.2 indicates that seventy seven percent (77%) of the respondents were within the Six Sigma role and ninety two percent (92%) were more than one year service with Lonmin. This indicated that respondents are knowledgeable of Six Sigma and Lonmin operations.

The next four tables accessed the transformation process sensitivity of the respondents by role and service period to determine the implementation, uniformity and continuity of the transformation plan.

<b>Role</b>	<b>Service</b>	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Undecided</b>	<b>Agree</b>	<b>Strongly Agree</b>
MBB	<1	0%	0%	0%	0%	0%
	>1<5	0%	3.1%	0%	0%	0%
	>5	0%	0%	0%	6.3%	0%
BB	<1	0%	0%	0%	0%	0%
	>1<5	0%	3.1%	0%	4.7%	0%
	>5	0%	1.6%	0%	4.7%	0%
GB	<1	0%	0%	3.1%	1.6%	0%
	>1<5	0%	4.7%	0%	26.6%	1.6%
	>5	0%	4.7%	3.1%	9.4%	0%
PS	<1	0%	0%	1.6%	0%	0%
	>1<5	0%	0%	0%	3.1%	1.6%
	>5	0%	0%	0%	0%	0%
CA	<1	0%	0%	0%	0%	0%
	>1<5	0%	3.1%	1.6%	1.6%	0%
	>5	0%	0%	1.6%	0%	0%
O	<1	0%	0%	0%	0%	1.6%
	>1<5	0%	3.1%	1.6%	0%	0%
	>5	0%	1.6%	0%	0%	0%

Table 4.3 – Cross tabulation – Role & Service Sensitivity to Transformation Plan

Table 4.3 analysis rounded to the nearest decimal indicated that fifty eight percent (58%) agreed and five percent (5%) strongly agreed that Lonmin had a transformation plan. Evidence given by the responses of seventy eight percent (78%) was within a Six Sigma role and ninety two percent (92%) of the responses greater than one year service with the organisation. Thirteen percent (13%) were undecided and twenty five percent (25%) disagreed that Lonmin had a transformation plan. This constituted by the responses of twenty two percent (22%) was not in Six Sigma role and eight percent (8%) were below one year of employment.

<b>Role</b>	<b>Service</b>	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Undecided</b>	<b>Agree</b>	<b>Strongly Agree</b>
MBB	<1	0%	0%	0%	0%	0%
	>1<5	0%	1.5%	1.5%	0%	0%
	>5	0%	1.5%	1.5%	3.1%	0%
BB	<1	0%	0%	0%	0%	0%
	>1<5	0%	1.5%	3.1%	3.1%	0%
	>5	0%	3.1%	0%	3.1%	0%
GB	<1	0%	0%	4.6%	0%	0%
	>1<5	0%	6.2%	1.5%	24.6%	0%
	>5	0%	6.2%	0%	10.8%	0%
PS	<1	0%	0%	1.5%	0%	0%
	>1<5	0%	0%	0%	3.1%	1.5%
	>5	0%	0%	0%	0%	0%
CA	<1	0%	0%	0%	0%	0%
	>1<5	0%	4.6%	0%	1.5%	0%
	>5	0%	0%	1.5%	0%	0%
O	<1	0%	0%	0%	0%	1.5%
	>1<5	1.5%	1.5%	1.5%	0%	1.5%
	>5	0%	0%	1.5%	0%	0%

Table 4.4 – Cross tabulation – Role & Service Sensitivity to Communication Process

Table 4.4 analysis rounded to the nearest decimal indicated that forty nine percent (49%) agreed and five percent (5%) strongly agreed that Lonmin had communicated the transformation process. Evidence given by the responses of seventy seven percent (77%) was within Six Sigma role and ninety two percent (92%) of the responses were more than one year service with the organisation. Eighteen percent (18%) were undecided, twenty six percent (26%) disagreed and two percent (2%) strongly disagreed that Lonmin communicated the transformation process. This constituted by the responses of twenty three percent (23%) was not in the Six Sigma role and eight percent (8%) were below one year of service to the organisation.

Role	Service	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
MBB	<1	0%	0%	0%	0%	0%
	>1<5	0%	3.1%	0%	0%	0%
	>5	0%	0%	0%	6.2%	0%
BB	<1	0%	0%	0%	0%	0%
	>1<5	0%	1.5%	0%	3.1%	3.1%
	>5	0%	3.1%	0%	3.1%	0%
GB	<1	0%	0%	1.5%	1.5%	1.5%
	>1<5	0%	3.1%	1.5%	24.6%	3.1%
	>5	0%	6.2%	1.5%	7.7%	1.5%
PS	<1	0%	0%	0%	0%	1.5%
	>1<5	0%	0%	0%	4.6%	0%
	>5	0%	0%	0%	0%	0%
CA	<1	0%	0%	0%	0%	0%
	>1<5	0%	3.1%	1.5%	1.5%	0%
	>5	0%	1.5%	0%	0%	0%
O	<1	0%	0%	0%	1.5%	0%
	>1<5	0%	1.5%	1.5%	1.5%	1.5%
	>5	1.5%	0%	0%	0%	0%

Table 4.5 – Cross tabulation – Role & Service Sensitivity to Transformation People

Table 4.5 analysis rounded to the nearest decimal indicated that fifty five percent (55%) agreed and twelve percent (12%) strongly agreed that Lonmin had assigned people for the transformation process. Evidence given by the responses of seventy seven percent (77%) was within Six Sigma role and ninety two percent (92%) of the responses were more than one year service with the organisation. Eight percent (8%) were undecided, twenty three percent (23%) disagreed and two percent (2%) strongly disagreed that Lonmin had assigned people for transformation process. This constituted by the responses of twenty three percent (23%) was not in Six Sigma role and eight percent (8%) were below one year of service to the organisation.

Role	Service	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
MBB	<1	0%	0%	0%	0%	0%
	>1<5	0%	1.5%	0%	1.5%	0%
	>5	0%	0%	1.5%	3.1%	1.5%
BB	<1	0%	0%	0%	0%	0%
	>1<5	1.5%	1.5%	3.1%	1.5%	0%
	>5	0%	3.1%	0%	3.1%	0%
GB	<1	0%	0%	4.6%	0%	0%
	>1<5	0%	4.6%	10.8%	16.9%	0%
	>5	0%	4.6%	4.6%	7.7%	0%
PS	<1	0%	0%	0%	0%	1.5%
	>1<5	0%	0%	1.5%	3.1%	0%
	>5	0%	0%	0%	0%	0%
CA	<1	0%	0%	0%	0%	0%
	>1<5	0%	1.5%	3.1%	1.5%	0%
	>5	0%	0%	0%	0%	1.5%
O	<1	0%	0%	0%	1.5%	0%
	>1<5	0%	3.1%	0%	3.1%	0%
	>5	0%	0%	0%	1.5%	0%

Table 4.6 – Cross tabulation – Role & Service Sensitivity to Six Sigma Strategy Alignment

Table 4.6 analysis rounded to the nearest decimal indicated that forty five percent (45%) agreed and five percent (5%) strongly agreed that Six Sigma programme was aligned to Lonmin's strategy. Evidence given by the responses that seventy seven percent (77%) was within Six Sigma role and ninety two percent (92%) of the responses were more than one year of service with the organisation. Twenty nine percent (29%) were undecided, twenty percent (20%) disagreed and two percent (2%) strongly disagreed of assigned people for transformation process. This constituted by the responses of twenty three percent (23%) was not in Six Sigma role and eight percent (8%) were below one year of service to the organisation.



#### 4.5 Conclusion

This chapter provided the data to determine the application of Six Sigma to establish its transformation process and performance towards the organisation. Sample descriptive analysis was defined by the role played within Six Sigma and service period with Lonmin. Basic and Inferential Statistics was done on the results for the objectives defined and presented with Microsoft Excel.

Research and studies were presented for the objectives to support the results and identify gaps to be used for discussion.

In chapter five the results from this chapter will be used to discuss the research objectives defined.

## CHAPTER FIVE

### Discussion

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#### 5.1 Introduction

This chapter discusses the results from chapter 4 for each of the objective that is set out in chapter 3, in light of the literature that is described in chapter 2. This chapter aims to answer the research problem described in chapter 1.

#### 5.2 Sample Study

The responded fifty four percent (54%) of the population was evaluated as a good sample size; this was acknowledged to have the same result of the total population. Chapter 4, Section 4.4 analysis on the respondents on Six Sigma role and service at Lonmin indicated that respondents were knowledgeable on Six Sigma and Lonmin operations.

#### 5.3 Objective one: To determine the impact of Six Sigma on culture transformation

The first objective of this study was to determine the impact of Six Sigma on culture transformation. It has been argued that for an organisation to realise the value of implementing Six Sigma, it must have a culture that is capable of fully supporting their implementation (Sousa-Poza, Nystrom, and Wiebe, 2001). This objective was broken down to three sub objectives:

##### *Objective 1a: To determine the impact of Six Sigma as Change Management at Lonmin*

The results were presented in Chapter 4, Section 4.3.1 on Six Sigma as a Change Management. The results positively indicated that management had a transformation plan; they communicated the transformation plan, had implemented a Six Sigma vision and mission, assigned transformation people and integrated Six Sigma with other business improvement initiatives. The results also indicated that Six Sigma was not totally aligned to Lonmin's strategy.

*Objective 1a postulated that Six Sigma was positively associated with change management at Lonmin.*

*Objective 1b: To determine the value of Six Sigma Knowledge Management at Lonmin*

The results were presented in Chapter 4, Section 4.3.2 on Six Sigma as Knowledge Management at Lonmin. The results positively indicated Six Sigma skills were deployed effectively and entirely, Six Sigma team members were subject experts and Six Sigma that knowledge and skill were vital for business improvement

The results showed that there was no vast value of Six Sigma knowledge to the Organisation, although great amount of the respondents were undecided. This indicated that the Six Sigma programme was not tailored for transferring skills and knowledge and to take leading roles within the Organisation.

*Objective 1b postulated that Six Sigma was positively associated with knowledge management at Lonmin.*

*Objective 1c: To determine the Sustainability of Six Sigma programme at Lonmin.*

The results were presented in Chapter 4, Section 4.3.3 on sustainability of Six Sigma at Lonmin. The results positively indicated that Six Sigma was Lonmin's long term business improvement tool, Six Sigma was the way Lonmin does business and Six Sigma team members were showing visible leadership.

The results showed that it was favourable for Six Sigma to be sustained within the Organisation, effort must be made to capitalise on involving, educating and transforming the undecided respondents to strengthen the sustainability of Six Sigma.

*Objective 1c postulated that Six Sigma was positively associated with sustainability at Lonmin.*

The results from the cross tabular tables Chapter 4 Section 4.4 indicated that new employees were not been given orientation on the transformation plan, transformation people were not introduced and not exposed to the entire organisation, there was no clarity on the how Six Sigma was linked to Lonmin's strategy and there was no continuity of communicating the transformation plan throughout the organisation.

The survey [Online], Available WWW: [www.sixsigmacompamies.com](http://www.sixsigmacompamies.com) (Accessed 1 July 2010), showed that Six Sigma-trained employees used their change management skills far more often than generally perceived. "Though only thirty-two percent of respondents said they would label their Black Belts as 'change agents,' almost twice that figure said they would personally use change management skills frequently or all the time."

The study [Online], Available WWW: [www.isixsigma.com](http://www.isixsigma.com) (Accessed 1 July 2010), identified communication was extremely important for success. Multiple communication strategies and two way communication media were used frequently to attain success.

Objective one postulates that Six Sigma had a positive impact on culture transformation at Lonmin.

#### 5.4 Objective 2: To determine impact of Six Sigma on business improvement

The second objective of this study was to determine the impact of Six Sigma on business improvement. This objective was broken down to three sub objectives:

##### *Objective 2a: To determine the benefits of Six Sigma programme at Lonmin*

The results were presented in Chapter 4, Section 4.3.4 on benefits of Six Sigma programme at Lonmin. The results positively indicated that improved decision making, team work and reduction in Cost of Poor Quality were huge benefits. Improved Sales, reduction in cycle times and reduced inspection were small benefits.

Analysis indicated that Six Sigma played a positive role in human behavioural aspects whilst did not contribute intensively on the financial aspects. Research showed that performance management systems linked to goals will contribute positively in those areas (Kaplan and Norton, 1996).

*Objective 2a postulated that Six Sigma positively benefited Lonmin.*

*Objective 2b: To determine the Six Sigma Performance at Lonmin*

The results were presented in Chapter 4, Section 4.3.5 on Six Sigma performance at Lonmin. The results positively indicated that Six Sigma had the right focus and positively contributed towards transformation and business performance. The results also negatively indicated that cycle time of Six Sigma projects had improved and met business needs and Six Sigma team was change agents that drove transformation.

Analysis indicated that cycle time was not a good measure of projects to evaluate business improvements and the Six Sigma team was not effective and visible in driving transformation. Six Sigma was not applied with uniformity towards its contribution of transformation.

*Objective 2b postulated that Six Sigma positively contributed to the performance at Lonmin.*

*Objective 2c: To determine the PEST analysis impact on Lonmin*

The results were presented in Chapter 4, Section 4.3.6 on PEST analysis impact on Lonmin. The results positively indicated that political, environmental and technology aspects had an influential role on transformation. The result negatively indicated social and economy aspects had an influential role on transformation.

*Objective 2c postulated that political, environment and technology had a positive impact on Lonmin and social and economy had a negative impact on Lonmin.*

A study [Online], Available WWW: [www.isixsigma.com](http://www.isixsigma.com) (Accessed 1 July 2010), that aligned Six Sigma with its business strategy and used performance management tools (Balanced Scorecard) gained employee commitment improved results.

A study [Online], Available WWW: [www.ssqi.com](http://www.ssqi.com) (Accessed 1 July 2010), revealed that project selection was the key element for the success of the organisation. PRMT research detailed that assigning the right people to the right projects at the right time delivered positive results.

Objective 2 postulates that Six Sigma had a positive impact on business improvement at Lonmin.

## 5.5 Conclusion

From the results it was found that majority of the respondents were within the Six Sigma role and had more than a year service with Lonmin, thus giving this research richness in Six Sigma knowledge and Lonmin business experience exposure.

The research report found that Six Sigma had a positive influence on both culture transformation and business improvement. The evidence supported this claim that Six Sigma positively influenced culture transformation was change management, knowledge management and sustainability. The evidence supported the claim that Six Sigma positively influenced business improvement was Six Sigma transformation strengths as a business integration and improvement tool in leadership, subject matter experts, teamwork, skill and knowledge. High benefits to Lonmin were decision making, reduced cost of poor quality and teamwork. The Six Sigma programme delivered average benefit and was more a quality tool than a business tool.

In contrast evidence was also found that Six Sigma had a low negatively influenced on both change transformation and business improvement. The evidence to support this claim that Six Sigma transformation weaknesses were in cycle times of projects and transformation agents' visibility. Low benefits included reduced operating costs, profitability and improved sales.

The results showed that Six Sigma programme had been successfully implemented but did not maintain uniformity and continuity of the transformation plan.

Chapter Six details recommendations to strengthen the positive influences and mitigate the negative influences of six sigma transformation. This chapter highlights future research proposals to improve on the field of Six Sigma methodology application.

## CHAPTER SIX

### Conclusions and Recommendations

---

#### 6.1 Introduction

This chapter outlines the highlights of the research, how the research problem was resolved with recommendations and proposed areas for further research. Based on the detailed analysis and interpretation of the data performed, the researcher was satisfied that the above research problems were sufficiently addressed.

#### 6.2 Attainment of Research Objectives

The implementation of Six Sigma at Lonmin was undertaken as a business culture performance transformation tool to transform the organisation to attain its lowest cost platinum producer position.

The analysis of results of the survey questionnaire showed how Six Sigma was associated on the objectives:

- *Objective one postulates that Six Sigma had a positive impact on culture transformation at Lonmin.*
- *Objective two postulates that Six Sigma had a positive impact on business improvement at Lonmin.*

Initiating transformation of any magnitude across an organisation requires meaningful dialogue with executive management, mid-level managers, employees and other stakeholders. The leadership team must communicate early and often, clearly conveying the vision, strategies and benefits for all concerned. Since Six Sigma involves changing human behaviour, it is critical to include a carefully constructed communication plan that identifies and addresses human concerns. It was found from the literature and survey that strong leadership, management commitment, communication, education and training were critical in introducing and driving any culture change initiative such as Six Sigma.

Six Sigma is a business initiative, not a quality initiative. Six Sigma is an umbrella term for a philosophy and way of running a business that improves quality and productivity and increases profits. It was found that Six Sigma organisations realise a significant improvement in the performance of operational metrics and strategic metrics.

The research report found that Six Sigma was a transformation tool that drove business improvement at Lonmin. The evidence supported this claim was based on the outcome of the above objectives association to the research question. The result showed that the implementation of Six Sigma had a positive impact on culture transformation and business improvement at Lonmin. Six Sigma was a transformational tool for business improvement at Lonmin.

### 6.3 Recommendations

The Six Sigma programme has been noted to deliver business performance success, management must introduce regular induction and communication programme on Six Sigma transformation process with its milestones progress and targets. Six Sigma starts at the top of an organisation and requires constant attention by senior managers who are responsible for establishing the Six Sigma culture. In addition, senior management must enable the creation of an infrastructure to support Six Sigma improvement projects by:

- Engaging in dialogue with business leaders on Business excellence achievements, plans and goals.
- Engaging in dialogue with all other levels of the business regarding the reasons for Business excellence, what it is and what it is made up of.
- Listening to the business by spending time with business stakeholders and where necessary, creating forums.
- Engaging in dialogue specifically with unions and related staff with regards to all aspects of Business excellence.
- Developing communication with and between other established forums in the business.



- Making more use of communication tools, such as Platinum Conversations, Intranet, etc, in order to educate stakeholders on all areas of Business excellence. This will be part of Business excellence communication strategy.

Six Sigma transformation process begins with people. A top-down and bottom-up approach is recommended to drive a performance culture. The Six Sigma roadmap enables leaders to positively drive and communicate the transformation. Employees must be brought into the fold and empowered through training and knowledge transfer to deliver results.

A Project Selection Committee is to be set up to review and provide approval based on the alignment to the organisations strategic goals and attainment of projects. Rath and Strong (2002) stated that the biggest challenge in improving projects is the ability of people to implement tasks and align them with business requirements. Managers must be the architects of an organisation culture and climate conducive to continual business improvement. The following courses of action that should be considered to impact an organisational culture in order to align it with improvement programs are:

- Process thinking linked to customer requirement should be the key driver of all business operations
- Improvement work must be a key performance requirement for employees at all levels in the organisation
- Performance appraisals/review should specifically measure the „improvement performance’ of all employees
- Skills and knowledge regarding improvement and business problem solving must be a key learning requirement for all employees who wish to progress up the corporate ladder
- Managers must lead in respect of improvement activity by actively planning for improvement and implementing improvement projects
- The success of improvement projects must be celebrated and those who brought about the improvement must be recognised and rewarded publicly

The Six Sigma team must be encompassed with other teams and be part of their processes, to create visibility, enhance leadership as subject matter experts. The Six Sigma methodology must be compulsory for any project approval and process deviation analysis. Projects knowledge to be transferred by presenting to key stakeholders and the reports are to be saved on a database. Team leaders must implement interactive workshops and conduct coaching sessions to enhance knowledge transfer by:

- Six Sigma technologies to be fully owned by MBB's
- MBB's and BB's to be rotated to new business areas in order for them to develop experience in new areas, as to improve their leadership and team building skills.
- MBB's and BB's have to take on much more of a role as change agents and breakthrough leaders.
- MBB's to each take on a coach for their own development. They should also take on at least one person whom they will coach.
- BB's to also take on a coach to assist them.

Aligning organisational culture with the need to improve transformation was the challenge for Lonmin. Organisational culture, communication and project selection were considered to be vital and to be part of the planning process for improvement initiatives.

#### 6.4 Future Research

This research was limited to the Six Sigma Programme within Lonmin Operations, future research proposals should analyse Six Sigma applications in the South African Platinum Mining Industry. No attempt was made to investigate Six Sigma implementation programmes at other mining organisations. This presents an area for further study, as it will perhaps be interesting to establish the experience of other South African companies that are already implementing Six Sigma.

## 6.5 Conclusion

The sample size was a good reflection of the population, thus the results was accepted to be a reference of the entire population. The respondents had a rich knowledge on Six Sigma and Lonmin operations.

Objective one postulates that Six Sigma had a positive impact on culture transformation at Lonmin and objective two postulates that Six Sigma had a positive impact on business Improvement at Lonmin. This has answered the researcher question; Six Sigma was a transformation tool for business improvement at Lonmin.

Recommendations were made in the areas of communication for commitment, project selection for business alignment, additional supporting programmes for sustainability, performance management system attaining results and motivation, knowledge and coaching to dive benefits to the organisation.

The researched identified an area for future research to be conducted with other mining industries in a South African context that have implemented transformational programmes for business improvement.

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## Appendix 1: Letter of Introduction

### UNIVERSITY OF KWAZULU-NATAL GRADUATE SCHOOL OF BUSINESS

Dear Respondent,

#### **MBA Research Project**

**Researcher:** Raymond Naidoo (0832940317)

**Supervisor:** Prof. Anesh Maniraj Singh (031-2607564)

**Research Office:** Ms P Ximba 031-2603587

I, Raymond Naidoo a MBA student at the Graduate School of Business at the University of Kwazulu Natal hereby invite you to participate in a research project entitled “A Critical Evaluation of the application of Six Sigma as a Business Transformation Methodology at Lonmin South African Operations.” The aim of this study is to establish the impact of Six Sigma Methodology as a business transformation tool within Lonmin in South Africa as a third world country.

Through your participation I hope to understand the value of Six Sigma programme. The results of the survey are intended to successfully contribute to management of Six Sigma within the South African operations.

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

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

The survey should take you about 20 minutes to complete. I hope you will take the time to complete this survey.

Sincerely

Investigator's signature \_\_\_\_\_ Date \_\_\_\_\_

## Appendix 2: Survey Questionnaire

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### UNIVERSITY OF KWAZULU-NATAL GRADUATE SCHOOL OF BUSINESS

#### MBA Research Project

**Researcher:** Raymond Naidoo (0832940317)

**Supervisor:** Prof. Anesh Maniraj Singh (031-2607564)

**Research Office:** Ms P Ximba 031-2603587

“A Critical Evaluation of the application of Six Sigma as a Business Transformation Methodology at Lonmin South African Operations.”

The purpose of this survey is to solicit information from Lonmin regarding Six Sigma programme. The information and ratings you provide us will go a long way in helping us identify the impact and value of the implementation of Six Sigma as a transformational programme. The questionnaire should only take 20 minutes to complete. In this questionnaire, you are asked to indicate what is true for you, so there are no “right” or “wrong” answers to any question. Work as rapidly as you can. If you wish to make a comment please write it directly on the booklet itself. Make sure not to skip any questions. Thank you for participating!

1. Please tick your role within Lonmin operations

- ☐ Master Black Belt
- ☒ Black Belt
- ☐ Green Belt
- ☐ Project Sponsor
- ☐ Change Agent
- ☐ Other

2. Please tick your service period with Lonmin operations

- ☐ less than one year (< 1 year)
- ☒ more than one year but less than five years (>1 & < 5 years)
- ☐ more that five years ( > 5 years)

Questions 3 to 23, please tick the response to each factor using the following scale: Strongly Disagree, Disagree, Neither Agree nor Disagree, Agree or Strongly Agree.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
3) Lonmin's top management have a clear transformation plan	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Comments</u>					

4) Lonmin's top management have communicated the transformation plan within the organisation	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Comments</u>					
5) Lonmin has assigned dedicated people to transformation initiatives on a full time basis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<u>Comments</u>					
6) The Six Sigma team has a clear and visible vision and strategy that drives improvement	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Comments</u>					
7) The Six Sigma programme is linked to Lonmin's transformation plan	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Comments</u>					
8) Six Sigma initiatives work have integrated with other business improvement initiatives to maximise improvement	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
<u>Comments</u>					
9) Six Sigma skills have been deployed effectively	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Comments</u>					
10) Six Sigma team were used as subject matter experts in Six Sigma tools and applications	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<u>Comments</u>					
11) The Six Sigma approach has been integrated in the way you do business	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Comments</u>					

12) Six Sigma projects have the right focus and will contribute to the transformation of Lonmin and facilitate the achievement of its goals	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Comments</u>					
13) The cycle time of Six sigma projects has improved and are meeting business needs	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Comments</u>					
14) The Six Sigma team are considered Change Agents within the business and visibly drive the transformation of Lonmin	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Comments</u>					
15) The Six Sigma team has showing visible leadership in terms of the Lonmin Charter	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Comments</u>					
16) Six Sigma process has a positive impact on the Business performance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<u>Comments</u>					
17) Six Sigma knowledge and skills are the desired requirements for business performance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
<u>Comments</u>					
18) Six Sigma is Lonmin's long-term business improvement methodology	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Comments</u>					
19) Technology aspects (Information Systems, Communication Systems) had an impact on the success of the transformation process	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>

<u>Comments</u>					
20) Economy aspects (exchange rate, inflation rate) had an impact on the success of the transformation process	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<u>Comments</u>					
21) Social aspects (Greater Lonmin Community) had an impact on the success of the transformation process	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<u>Comments</u>					
22) Political aspects (Department of Minerals and Energy, Department Of Labour) have an impact on the success of the transformation process	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<u>Comments</u>					
23) Environment aspects (ISO 14000) have an impact on the success of the transformation process	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Comments</u>					

Questions 24 to 34, please tick the response to each factor that Six Sigma programme has brought Lonmin since implementation using the following scale of no benefit, small benefit, big benefit and major benefit.

Benefits of Six Sigma at Lonmin	No Benefit	Small Benefit	Average Benefit	Big Benefit	Huge Benefit
24) Reduction in process variability	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Comments</u>					
25) Increase in profitability	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Comments</u>					
26) Reduction of operational costs	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

<u>Comments</u>					
27) Reduction in Cost of Poor Quality	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<u>Comments</u>					
28) Increase in productivity	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Comments</u>					
29) Reduction in Cycle Time	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Comments</u>					
30) Reduction in Customer complaints	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Comments</u>					
31) Improved sales	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Comments</u>					
32) Improve decision making	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<u>Comments</u>					
33) Reduced Inspection	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Comments</u>					
34) Increase in teamwork	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<u>Comments</u>					

**End of the Questionnaire**

Thank you for taking the time to complete the questionnaire.

### Appendix 3: Approval to conduct research at Lonmin



**Lonmin Platinum**  
Middelkraal Farm  
Marikana 0284  
North West Province  
Republic of South Africa

Private Bag X508  
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Republic of South Africa

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**[www.lonmin.com](http://www.lonmin.com)**

28 November 2008

University of KwaZulu Natal  
Graduate School of Business  
Private Bag X54001  
Durban  
4000

Dear Sir

#### Approval to conduct research at Lonmin

This letter serves to confirm that Lonmin grants permission to Raymond Naidoo to conduct research on the topic: “A Critical Evaluation of the application of Six Sigma as a Business Transformation Methodology at Lonmin South African Operations” within the organisation.

Yours faithfully

Barnard Mokwena  
Vice President External Affairs (Lonmin)



## Appendix 4: Ethical clearance approval



10 March 2011

Mr. R Naidoo (203520270)  
Graduate School of Business

Dear Mr. Naidoo

**PROTOCOL REFERENCE NUMBER: HSS/0042/09M**  
**NEW PROJECT TITLE: "A Critical Evaluation of the application of Six Sigma as a Business Transformation Methodology at Lonmin South African Operations"**

**APPROVAL AND CHANGE OF DISSERTATION TITLE**

I wish to confirm that ethical clearance has been granted full approval for the above mentioned project:

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach/Methods must be reviewed and approved through an amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the school/department for a period of 5 years

Best wishes for the successful completion of your research protocol.

Yours faithfully

  
.....  
**PROFESSOR STEVEN COLLINGS (CHAIR)**  
**HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE**

cc. Supervisor – Prof. AM Singh  
cc. Mrs. C Haddon

Postal Address:  
Telephone:                      Facsimile:                      Email:                      Website: [www.ukzn.ac.za](http://www.ukzn.ac.za)  
Founding Campuses:      ■ Edgewood      ■ Howard College      ■ Medical School      ■ Pietermaritzburg      ■ Westville