AN APPROACH TO SIX SIGMA IMPLEMENTATION IN SOUTH AFRICAN ENTERPRISES

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DECLARATION

"I hereby declare that this research report submitted for the degree (Magister Technologiae: Quality) at the Cape Peninsula University of Technology, is my own original, unaided work and has not previously been submitted to any other institution of higher education. I further declare that all sources cited or quoted, are indicated or acknowledged by means of a comprehensive list of references".

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Date: 04/04/2011

DEDICATION:

This study is dedicated to the following people:

My mother, my brothers and sisters, and to my friends, who never stopped believing in me; my father who continues to inspire me with positive reflections; the Head of Department of Industrial and Systems Engineering for giving me this opportunity to broaden my knowledge, and finally to all unprivileged people around the world, because wherever we are, we can make a difference.

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ABSTRACT

To succeed in the global market, South African enterprises need an overall operational excellence which is a key requirement for any business to sustain competiveness and growth. To effectively respond to the constant flexibility of customer demands, many quality initiatives have been developed to assist business organisations in the quest for excellence. Quality management has evolved over the years from a simple product inspection, to a modern management system that requires the involvement of the entire workforce and other stakeholders to work closely, toward customer satisfaction. Currently, the most used quality concepts by organisations throughout the world are ISO 9001(2008); Total Quality Management; Just in Time; and Six Sigma. Among these quality initiatives, Six Sigma has emerged as the most powerful quality improvement strategy.

In South Africa (SA), business organisations have adopted several quality initiatives to cope with the challenges of globalisation. Six Sigma is one of the latest quality initiatives that many businesses in SA are using or considering as a mechanism to strengthen their product or service quality. This study explores a Six Sigma model for implementation in the context of the South African business environment.

As less than ten percent of organisations worldwide have recognised the tremendous effects of Six Sigma in boosting their productivity and financial profit, it becomes extremely important to understand the complexity and critical aspects behind Six Sigma implementation, that organisations in SA must recognise when implementing Six Sigma.

This study can assist many industries in SA, as well as those in other developing nations, who have not yet experienced Six Sigma implementation, to become aware of the complexity and critical elements of this quality approach.

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GLOSSARY OF TERMS

Black belt:	Trained individual with extensive experience in applying statistics in business process improvement and works full time on cost saving projects.
Breakthrough:	Significant improvement in quality performance or business results.
Champion:	Individual occupying strategic position in an organisation and who has a full understanding of Six Sigma deployment and is fully committed to its success.
Continuous improvement:	Never ending quest of enhancing business activities by involving everyone who can influence product or service quality.
Customer:	Any person or entity that uses or experiences the services of another one.
Defect:	An imperfection that contributes to process inefficiency, which eventually leads to customer complaints.
Improvement:	Moving from a lower quality level to quality excellence.
Key elements:	Factors which are critical to the success of Six Sigma implementation in an organisation in the sense that, if objectives associated with these factors are not achieved, the organisation will fail.

Master Black Belt: Experienced Black Belt who provides technical support to Black Belts, Green Belts, and Yellow Belts, including other project team members.

Processes: A set of steps to follow in order to transform raw materials (inputs) into output (goods or services).

Process variation: a statistical description of process outputs that exhibit unavoidable fluctuations.

Quality tools: A single devise having a clear function and used on its own, and by which a particular problem can be solved.

Quality techniques: A set of quality tools which require more thought, complexity, skills and training for effective use.

Sigma (σ): A symbol that comes from the Greek Alphabet and it is known as a standard deviation in statistic.

Six (6): Refers to the number of standard deviations from the target value to the specification limits, at each side of the normal distribution curve of a process, producing almost no products out of specification limits.

Six Sigma: A quality improvement philosophy that incorporates management strategies and statistical techniques in a well structured and disciplined fashion to optimise business activities.

Sigma level: A term used in Six Sigma language to identify the level of performance of a process or that of an organisation.

Six Sigma Methodology: A continuous improvement closed loop used to reduce process variability.

Yellow belt: An individual with a technical background who receives two to three weeks training on Six Sigma methodology and there after works on Six Sigma projects on a temporary basis.

ACRONYMS

BB:	Black Belt
DFSS:	Design For Six Sigma
DMAIC:	Define Measure Analyse Improve Control
DPMO:	Defect Per Million Opportunities
EMPEA:	Emerging Markets Private Equity Association
FDI:	Foreign Direct Investment
GB:	Green belts
MBB:	Master Black Belt
MBC:	Management By Commitment
MBO:	Management By Objectives
MBQA:	Malcolm Baldrige Quality Award
PDCA:	Plan Do Control Act
SA:	South Africa
SABC:	South African Broadcasting Corporation
SABS:	South African Bureau of Standard
SAQI:	South African Quality Institute
SAEF:	South African Excellence Foundation
SAEM:	South African Excellence Model
SS:	Six Sigma
SSA:	Sub-Sahara Africa
TQM:	Total Quality Management
UK:	United Kingdom
UNCTAD:	United Nation Conference on Trade and Development
USA:	United States of America
UNIDO:	United Nations and Industrial Development Organisation
WEFEROUM:	World Economic Forum
YB:	Yellow Belt
ZBB:	Zero Based Budgets

CHAPTER 1: THE SCOPE OF THE RESEARCH

1.1 INTRODUCTION AND MOTIVATION

This study explores a Six Sigma model for implementation in the context of the South African business environment. Six Sigma is a quality improvement philosophy that incorporates management strategies and statistical techniques in a well structured and disciplined fashion to optimise business activities. It focuses on variation reduction in all processes by involving top management and the operating force to achieve customer satisfaction and financial return. To effectively respond to the constant flexibility of customer demands, many quality initiatives have been developed to assist business organisations in the quest for excellence. Currently, the most used quality concepts by organisations throughout the world are ISO 9001(2008), Total Quality Management, Just in Time, and Six Sigma. Among these quality initiatives, Six Sigma has emerged as the most powerful quality improvement strategy that can be applied in every segment of business activities in the likes of manufacturing, service, large, medium or small organisations, and all the divisions of the value chain (Antony, 2009:274).

Six Sigma is strategically a business improvement mechanism used to optimise profitability, remove waste from processes and to meet or go beyond customer requirements and expectations (Antony & Banuelas, 2002:21). Eckes (2001:11) and Antony (2008:107), view Six Sigma as a concept that provides a statistical measurement of a product or service performance by identifying problems, establishing root causes, and solving them in a closed loop continuous improvement way, that results in a process generating only 3.4 Defects Per Million Opportunities (DPMO).

Six Sigma was pioneered at Motorola in the late 1980s as a mechanism to streamline organisation performance with emphasis on minimising quality cost by means of defect reduction. Breyfolgle (2003:5) and Senapati (2004:683), assert that during the same period, Motorola was awarded the Malcolm Baldrige National Quality Award (MBQA) in recognition of its achievement. There after many other organisations in America (General Electric, Raytheon, Allied Signal, Honeywell, Sony, Ford, and Caterpillar), adopted Six Sigma and consequently registered incredible results. The research of Antony (2009:274), suggests that companies across the world ranging from small business, private and public to large organisations have adopted this philosophy to substantially improve:

- Quality levels,
- Customer satisfaction,
- Market share,
- Employees moral,
- Organizational culture,
- People development, and
- Financial profit.

In South Africa (SA), the 1994 mass democratic election systematically changed the political, social, cultural, international, and economic outlook of the country. The business perception of SA improved significantly. The transition to democracy has allowed SA to return to the international arena, which consequently exposed its market to international challengers. This situation has forced local organisations to change business practices in order to cope with international demand, as well as to achieve an edge in the local market (Denton & Vloeberghts, 2002:85). To achieve operational and service excellence, SA organisations embarked on numerous quality improvement programmes such as: Total Quality Management, ISO 9001(2008), Quality Circle, Just in Time, and the SA excellence model. The Six Sigma philosophy was initiated in SA since the beginning of the 21st century by several multinational companies, with the support of their overseas headquarters.

The adoption of Six Sigma has recently surged in developing countries. Six Sigma plays a major part in the sustainability, profitability, and competitiveness of many organisations in developed countries. The study of Antony and Desai (2009:413), suggests that Six Sigma has been a subject of debate by many scholars, but few published papers underpin the utulisation of Six Sigma in developing countries. Many quality initiatives have not adequately succeeded in bringing about the desired quality improvement, sustainability, and profitability in many enterprises.

This was mainly caused by the lack of emphasis placed on the critical factors associated with the Six Sigma philosophy, as well as with the various quality methodologies used in SA enterprises. Given the complexity of Six Sigma, it becomes critical to examine the elements (resources, top management, employees' involvement, long term focus and culture change), indispensable to support the implementation of this quality paradigm in the context of SA enterprises.

1.2 BACKGROUND OF THE RESEARCH PROBLEM

Quality management has evolved over the years from a simple product inspection, to a modern management system that requires the involvement of the entire workforforce and other stakeholders to work closely toward customer satisfaction. While developed countries have monopolised the world market with higher quality products, developing countries have adopted export promotion as a development strategy, but their performances in the global market remain meager (Mersha, 2000:119). Many factors including the inability to meet defined quality standards as required by international customers have contributed to the inadequate performance of the enterprises from developing countries (Mersha, 2000:121, cited in Austing, 1990).

In SA, business organisations have adopted several quality initiatives to cope with the challenges of globalisation. Six Sigma is one of the quality initiatives that many businesses in SA are using or consider as a mechanism to strengthen their product or service quality. However, Coronado and Antony (2002:92), state that less than 10% of organisations worldwide have recognised the tremendous effects of Six Sigma in boosting their productivity and financial profit. These contrasting results explain the complexity and some critical aspects behind Six Sigma implementation that organisations in SA must recognise when implementing Six Sigma.

1.3 RESEARCH PROBLEM STATEMENT

Against the above background, the research problem statement for this dissertation reads as follows: “South African enterprises that implement Six Sigma, do not consider critical implementation issues associated with the concept, resulting in either inefficient implementation or a product that does not deliver on expectations”.

1.4 RESEARCH QUESTION

The research question forming the crux of this study reads as follows: “Can a structured single alternate process be developed for the implementation of Six Sigma to ensure successful implementation thereof in South African enterprises?”

1.4.1 INVESTIGATIVE (SUB-) QUESTIONS

The investigative questions to be researched in support of the research question read as follows:

- What are the potential benefits of implementing Six Sigma in SA enterprises?
- What are the key driving factors for the sustainability of Six Sigma in SA enterprises?
- What are the tools and techniques of Six Sigma prevailing in SA enterprises?
- To what extent are SA enterprises using the Six Sigma Methodology?

1.5 PRIMARY RRESEARCH OBJECTIVES

The following will serve as the main objectives of the study:

- To formulate a structured single process to aid the successful implementation of Six Sigma in SA industries.
- To explore the benefits of the implementation of the Six Sigma quality management system in SA enterprises.
- To identify the tools and techniques for the suitability of Six Sigma in SA industries.

- To determine factors that can influence the Six Sigma implementation in the context of SA business environment.

1.6 RESEARCH PROCESS

The research process provides insight into how the study will be conducted from formulating the research proposal to the final submission of the dissertation. Remenyi, Williams, Money and Swartz (2002:64-65), put propose that a research process consists of eight specific phases, common to all scientific based investigations. These phases are:

- Reviewing the literature;
- Formulating the research question;
- Establishing the methodology;
- Collecting evidence;
- Developing conclusion;
- Understanding the limitation of the research; and
- Producing management guidelines or recommendations.

This dissertation follows a process proposed by Collis and Hussey (2003:16), who define a research process as consisting of six fundamental stages:

- The research topic identification;
- Definition of the problem;
- Determining how the research is going to be conducted;
- Collecting the research data;
- Analyzing and interpreting the research data; and
- Writing up of the dissertation or thesis.

1.7 RESEARCH DESIGN AND METHODOLOGY

There are several types of research methodologies that can be used, which depend on the study and the goal to be achieved (Stuart and Wayne, 1996:3; Collis and

Hussey, 2003:10). These various types of research can be categorised with regard to:

- The 'purpose' of the research (exploratory, descriptive, and analytical, research).
- The 'logic' of the research (deductive or inductive research).
- The 'outcome' of the research (applied or basic research).
- The 'process' of the research (qualitative or quantitative).

This research study is theoretical in nature, using a positivist (quantitative) research paradigm as its basis. Babbie (2005:25) states that, "…recognizing the distinction between qualitative and quantitative research doesn't mean that you must identify your research activities with one to the exclusion of the other. A complete understanding of a topic often requires both techniques". This study is quantitative using a structured tool to generate numerical data as well as statistics to interpret, organise, and represent the collected data. Frequency tables and graphs will be used to analyse and interpret the findings.

A case study research method will serve as the research method. According to Yin (1994:1), this type of research can be used in various instances which include:

- Policy, political science, and public administration research;
- Community psychology and sociology research;
- Organization and management studies;
- City and regional planning research; and
- Research into social sciences and, the academic disciplines.

Collis and Hussey (2003:68-70), assert that case study research can be defined as exploratory research used in a field where there are no or very few existing theories to understand a phenomenon. The following are types of case studies that can be identified:

- Descriptive case studies;
- Experimental case studies;
- Exploratory case studies; and
- Illustrative case studies.

1.8 DATA COLLECTION DESIGN AND METHODOLOGY

Data collection is a means by which a researcher collects reliable information in order to meet the research objectives. For this research study, a questionnaire will serve as a data collection methodology. A questionnaire is a technique designed to obtain reliable responses by providing to respondents, a list of carefully structured questions chosen after considerable testing. Questionnaires form part of the wider definition of ‘survey research’. A ‘survey’ is defined by Remenyi *et al.* (2002:290), as: “…the collection of a large quantity of evidence usually numeric, or evidences that will be converted to numbers, normally by means of a questionnaire”.

Two approaches can be referred to in order to structure questions as follow:

- Closed ended questions and
- Opened ended questions.

Closed ended questions will be used in the questionnaire in this research study as this technique implies a quantitative research approach which allows respondents to quickly rate a list of well structured questions with predetermined answers. Furthermore, data will be collected from a random sample of 30 Six Sigma organisations across the Western Cape Province.

1.9 DATA VALIDITY AND RELIABILITY

Collis and Hussey (2003:186), argue that ‘validity’ is concerned with the extent to which the research findings accurately represent what is happening. Data must be a true reflection of what is being investigating. Three major types of validity can be identified, namely ‘content validity’, ‘criterion-related validity’ and ‘construct validity’ (Cooper and Schindler, 2006:318-320). Content validity refers to the content of the measuring instrument that offers sufficient coverage of the investigative (sub-) questions guiding the study. Criterion-related validity reflects the success of measures used for prediction or estimation. Construct validity refers to the theory and measuring instrument that should be taken into account in order to evaluate construct validity.

Reliability mainly focuses on the findings of the research (Collis and Hussey, 2003:186). If anyone repeats the research and gets the same outcomes, then the findings are said to be reliable. There are three common ways of determining the reliability of responses to questions in questionnaires, namely: 'test re-test method', 'split-halves method' (which will be applied in this study) and 'internal consistency method'.

1.10 ETHICS

In the context of research, according to Saunders, Lewis and Thornhile (2000:130), "…ethics refer to the appropriateness of your behavior in relation to the rights of those who become the subject of your work, or are affected by it". According to Leedy and Ormrod (2001:107-108), the majority of problems regarding ethics in research fall into one of the four categories:

- Protection from harm: in cases involving creating a small amount of psychological discomfort, participants should know about it ahead of time and any necessary debriefing or counselling should follow immediately after their contribution;
- Informed consent: All the participants should be told everything in advance about the nature of the study and be given the choice to participate or not. According to Leedy and Ormrod (2001:108), informed consent should be in a form covering the nature of the research as well as the instructions concerning participants' contribution in a research study and should include the following:
  - A brief description of the nature of the study;
  - A description of what participants will be involved in terms of activities and duration;
  - A statement indicating that participation is voluntary and can be terminated at any time without penalty;
  - A list of potential risks and possible discomfort that participants may encounter;
  - The guarantee that all responses will remain confidential and anonymous;
  - The researcher's name and information about how the researcher can be contacted;

  - An individual or office that participants can contact in case of any concern regarding the research study;
  - An offer to provide detailed information about the research study up to its completion.
- Right to privacy: The researcher should keep the nature and performance of any participant strictly confidential;
- Honesty with professional colleagues: Researchers must report the findings in a complete and honest fashion without misrepresenting what has been done or intentionally misleading others. Data should not be fabricated to support any conclusion.

1.11 RESEARCH ASSUMPTIONS

The following assumptions will be applied to this research study:

- Organisations in SA who implement Six Sigma are considering some critical elements of this approach to ensure success.
- All the relevant personnel in charge of Six Sigma in SA enterprises have received adequate Six Sigma training.

1.12 RESEARCH CONSTRAINTS

The research constraints pertaining to this study include the following:

- the study will be limited to industries using Six Sigma within the Western Cape Province; and
- the questionnaires will only be directed to personnel who have knowledge of Six Sigma.

1.13 SIGNIFICANCE OF THE PROPOSED RESEARCH

This research study will determine an alternative approach to Six Sigma implementation in the context of SA business environment. Given the complexity of Six Sigma, this research will provide some useful information to organisations in SA that are using or may consider the implementation of this approach. Furthermore, it is expected that this study will add to the existing published body of knowledge on the specific requirements of Six Sigma implementation in the context of the SA business environment.

1.14 CHAPTER AND CONTENT ANALYSIS

The following chapter and content analysis are applicable to this study:

- **Chapter One - Scope of the research:** In this chapter, a holistic perspective of the proposed research taking place in SA organisation using Six Sigma will be provided. The research problem will be explained, followed by the formulation of the research problem, the research question and investigative (sub) questions. The research process will be elaborated upon, followed by a description of the research design and data collection methodology. The research constraints will be listed and a high level overview provided of the chapter and content analysis of the dissertation. This chapter will conclude with a list of the primary research objectives.
- **Chapter Two - Holistic overview of the research environment:** In this chapter, a holistic perspective will be provided of organisations that have implemented Six Sigma in South Africa.
- **Chapter Three - Six Sigma A literature review:** This chapter will focus on the following:
  - Brief history of Six Sigma.
  - The definition of Six Sigma.
  - The difference between Six Sigma and other quality management concepts.
  - The Six Sigma methodology for process improvement.
  - The Six Sigma key personnel structure.
  - The key elements required for Six Sigma implementation.
- **Chapter Four -Data collection design and methodology:** This chapter will examine the tools and methods used for data gathering. Challenges faced during the data collection exercise will be elaborated upon. The survey environment will be explained and the target population, as well as the sample size will be defined. This chapter will conclude with a list of questions for the target population.

- **Chapter Five - Data analysis and interpretation of results:** In this chapter, the data gleaned from the survey will be analysed and interpreted.
- **Chapter Six - Conclusion and recommendations:** In this chapter, the study will be concluded. The research problem, research questions, investigative questions and main research objectives will be revisited. Recommendations will be made in order to mitigate the research problem.

1.15 CONCLUSION

In this chapter, an introduction and background of the proposed research was provided. The research process was explained and the research problem, research question and investigative questions, and research objectives formulated. The research design and methodology, which include the data collection design and methodology, was depicted. This chapter concluded with an overview of the dissertation structure, chapter and content analysis.

In the next chapter, a holistic perspective will be provided of organisations who have implemented Six Sigma in South Africa.

CHAPTER 2: OVERVIEW OF THE RESEARCH ENVIRONMENT

2.1 INTRODUCTION AND BACKGROUND

2.1.1 Brief overview of sub-Saharan Africa drawbacks

After Asia, Africa represents the second largest continent in the world. It occupies a total surface area of thirty million square kilometres (30 million km^2), with an estimate population of 888 million people (Bamikole, Rovani & Blottmitz, 2008:55). The Sahara desert occupies a quarter of the surface of Africa and its extreme climate contributes to low population density in certain regions. Bamikole, Rovani and Blottmitz (2008:55) estimated the Sub-Saharan Africa (SSA) population to be at 642 million in 1999 which represents 80% of the African population. Although having many natural resources, Africa is the poorest continent in the world due to factors such as:

- Corruption;
- Misappropriation of international aid;
- Degradation of environment;
- Lack of democracy;
- Poor economy management;
- Wars;
- Epidemic diseases such as Aids and Malaria;
- Low foreign investment; and
- Famine (Mersha, 2000:119).

Since the pre-colonial era, Africa's role in the world trade has been limited to sale of raw materials on the one hand and end-user of imported goods from developed countries on the other hand (Stock, 1995:325). Colonial policies and neo-colonial effects greatly jeopardise the development of manufacturing industries in Africa, particularly in SSA, where the production of finished goods was discouraged by Europeans while only raw materials production was encouraged. This situation had an adverse impact on Africa Industrialisation which is a factor that contributes to growth, world trade, development, wealth, competition and employment. According to Bamikole, Rovani and Blottmitz (2008:55), Africa was the only major developing region with negative growth during the period 1980 to 2000. Stock (1995:327), points out that the position of SSA countries in the world economy has declined between the period 1980 to 1989 and subsequently the value of exports followed the same pattern at an average rate of 4.5 per cent per annum. While firms in developed countries have adopted different kinds of quality management systems to achieve higher productivity, customer satisfaction, employee satisfaction, and higher income, SSA countries have adopted export promotion as a development strategy, but their performances still remains meager in the world market (Mersha, 2000:119).

Africa accounts for only 0.4% of the total world export of manufactured goods (Stock, 1995:330). This relatively low contribution is due to the lack of ability in meeting the quality and delivery requirement specified by international customers (Mersha, 2000:121 cited in Austin, 1990; Nalled et al, 1994). The inability of SSA countries to meet international standards of quality simply endangers their exports trade and therefore their chances of succeeding in the international market as customer satisfaction is a fundamental principle of success.

Compared to the rest of the world, the presence of transnational corporations in Africa is extremely small and the foreign direct investment (FDI) into the continent has declined (Stock, 1995:335), Emerging Markets Private Equity Association (Empea, 2009: Online). Empea (2009: Online), advocates that foreign investors are still cautious of SSA Countries because of certain prevailing obstacles (lack of basic infrastructure and electricity, shortage of skill, political and economical reforms) inherent in this region. The FDI usually comes along with a transfer of technology, first class knowledge, skill development, and quality culture which are key ingredients for global competition. It is then obvious that the low presence of foreign investors in Africa adversely impacts on its ability to deliver highly quality products that can be sold at competitive prices.

South Africa (SA) has emerged as a country that benefits the most from the little FDI in Africa. Empea (2009:Online), proposed that SA has benefitted 70% of the

$2 billion invested SSA countries in 2008 due to its transparent rule law, economic growth rate, and deep capital market. This exception makes SA a model for fellow SSA countries to follow in terms of a world class quality management strategy, as the flux of FDI is coupled with the transfer of the latest business improvement methods, such as Six Sigma (SS).

2.2 OVERVIEW OF SOUTH AFRICA

SA is located at the southernmost tip of the African continent. It is bordered by Namibia, Botswana, Zimbabwe, and Mozambique and totally surrounds Lesotho. There are currently eleven official languages in SA but for business purposes, English is the most used. Statistics SA (2009: Online) estimated, in July 2009 the total population of SA to be at 49.32 million people.

During recent years, the SA economy has shown consistent growth with 2009 being characterised by a relative slowdown during the global recession. The manufacturing sector was one of the areas where the financial crunch seriously hit. According to Statistics SA (2009: online), the year 2009 reproduced a decrease of 12.5% in manufacturing outputs compared to 2008, with nine of the ten manufacturing divisions reporting lower production. The annual decrease of 12,5% was mainly due to lower production in the basic iron and steel, non-ferrous metal products, metal products and machinery division (-18,7% and contributing -4,1 percentage points), the motor vehicles, parts and accessories and other transport equipment division (-24,4% and contributing -2,5 percentage points), the petroleum, chemical products, rubber and plastic products division (-8,9% and contributing -2,1 percentage points), the wood and wood products, paper, publishing and printing division (-15,0% and contributing -1,5 percentage points), the furniture and other manufacturing division (-20,0% and contributing -1,1 percentage points) and the textiles, clothing, leather and footwear division (-14,6% and contributing -0,7 of a percentage point).

SABC news (2010:online) suggests that although the Africa’s biggest economy shrank by 1.8% in 2009, there are some signs of recovery in manufacturing output, taking into account the rise in factory activities, higher vehicles sales, as well as the foreign investment for the FIFA Soccer World Cup, which are positives indicators for better productivity in 2010.

2.2.1 South Africa in the context of Global Competition

After years of isolation from the rest of the world, SA has successfully re-integrated into the international arena. This return has allowed SA to compete in the world market by exporting goods produced locally. Between 1997 to 2002, the exports from SA increased by 131% from R122.8 billion in 1997 to R284.1 billion in 2002 (Ligthelm, 2004:online). The increases for that period represent an average of 26.26% per annum.

SA exports goods all over the world and the main destinations of its goods are described in Table2.1. It must be highlighted that UK and the USA were the main destinations of SA exports, with 18.3% of the total export occurring during 2002. Germany and Japan followed with 7% and 5.5% respectively.

Table 2.1: The 10 most important SA export destinations. **Source :(** Ligthelm, 2004: online).

Country	**%**
United Kingdom (UK)	9.3
United States of America (USA)	9
Germany	7
Japan	5.5
Netherlands	4.4
Belgium	3.2
Italy	2.7
Zimbabwe	2.6
Spain	2.4
France	2.3

It is also important to note that the top ten SA export destinations represents 48.4% of the total export.

The advantageous location of SA, combined with first class infrastructure and political stability, make this country the main attraction of FDI in Africa. A report of the United Nations Conference on Trade and Development (UNCTAD) suggests that in 2008 the total FDI in SA was estimated at $9 billion but with the global economic crunch, this part of the world did not escape the consequences of the down turn of foreign investment in 2009 (UNCTAD, 2010: online). UNCTAD (2010: online), highlights that the FDI in SA shrank by 24.6% in 2009. This global crisis had an adverse impact on many local industries as production dropped, consumer spending was restricted, a high retrenchment rate followed (close to a million of people lost their jobs in SA), and factories shut down. On the rating of the 2009/2010 most competitive countries, SA was rated by the world economic forum (Weforum) as the 45th most competitive country out of 134 global economies; a decline of 10 places since 2006 when SA was ranked 35th (Weforum, 2010: online). The position occupied by SA was the highest for an African country. When compared to other developing economies like Brazil, India or China, which appear on top of the list of industrial manufacturers, SA still has to dig harder in order to step up to the best in the world. The United Nations and Industrial Development Organisation UNIDO (2010:Online), declares that China has overtook Japan in becoming the world's second largest industrial manufacturer behind the USA, as its shares in the global total manufacturing value (MVA) were 15.6% slightly higher than Japan, which stands at 15.4%.

2.3 GLOBAL PERCEPTION OF EXPORTING-GOODS QUALITY

Quality is a degree of satisfaction of someone's needs. It is a whole set of features and characteristics that has satisfied a specific requirement. Many definitions can be applied to quality. However Gavin (1991) cited by Madu and Madu (2002:249), provides a comprehensive definition of quality in terms of eight dimensions or attributes that a product or service must have in order to be considered of high quality. These dimensions in terms of product quality are listed below:

- Performance: product's operating characteristics or how well a product achieves its objectives;
- Features: a supplement to a product basic function;
- Reliability: a probability that a product does not fail for at least a specific period of time under normal operating conditions;
- Durability: measures the useful life of a product or service;
- Serviceability: ease of servicing a product;

- Conformance: refers to how a product or service satisfies customers expectation;
- Perceived quality: deals with the reputation of a producer; and
- Aesthetic: personnel judgment of how a product looks sounds, smells, or tastes.

Quality is widely used as a measure of excellence. To gain a deep understanding of how consumers around the world perceived product quality coming from different countries in the world, the Gallup organisation used the responses of more than 20000 consumers from 17 countries to rank exporting countries, according to the quality of exported products (Brown, 1995:52).

Figure 2.1 below indicates the ranking of countries according to the quality of exported goods, as perceived by consumers worldwide.

It is evident that the countries that are leading this ranking are the most industrialised and are pioneers of quality initiatives. Five developing countries (China, Taiwan, South Korea, Mexico and Brazil) are emerging as countries with relative low rates in terms of excellent or very good quality products.

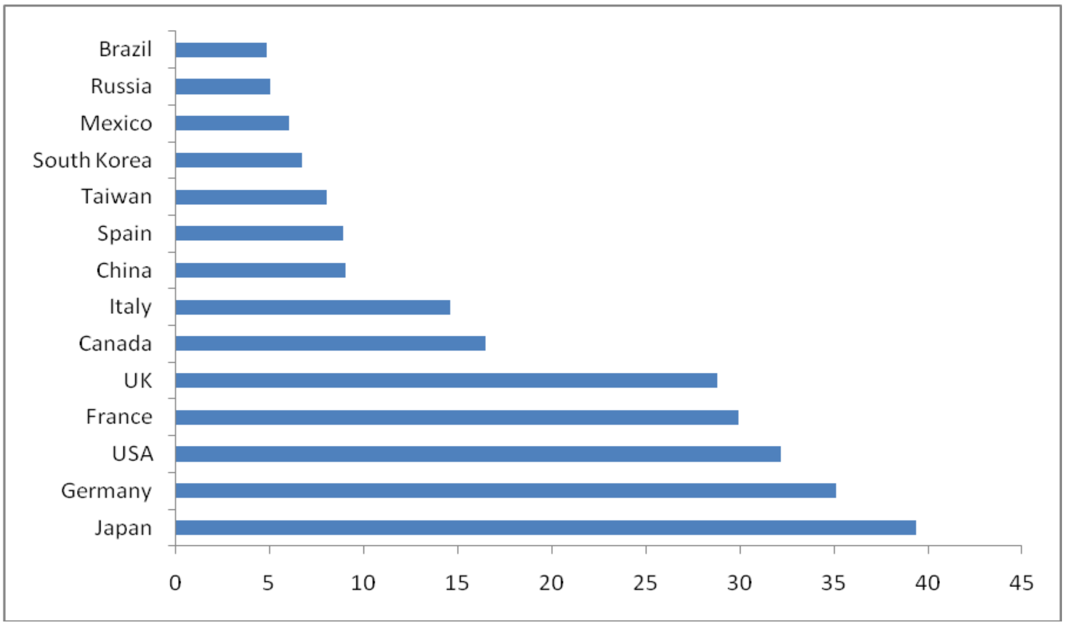

Figure 2.1: Average Score: Perceived rating manufacturer "Excellent" or "Very Good". (**Source**: Brown, 1995:22)

The countries that consumers have assessed manufactured goods as excellent or good in terms of quality, are the ones leading the exports in the international market as indicated in Table 2.2. It can be seen in Table 2.2 that SA was ranked 39th in the world as far as export revenue was concerned. Given the position of SA in the global market, and the relationship between the export revenue and the perception of global consumers on exported goods quality, it can be concluded that SA is facing quality problems and still has a long way to go in order to close the gap with the top exporting countries as far as the quality of goods or services is concerned. The competitive position occupied by the leading exporting countries is a result of a long journey for quality excellence.

Table 2.2: Top exporting countries of the year 2008 (**source**: nationmaster 2008: online)

Position	**Country**	**Export value**
1	Germany	$1354 000 000 000.00
2	China	$1220 000 000 000.00
3	United States	$1148 000 000 000.00
4	Japan	$ 678 100 000 000.00
5	France	$ 546 000 000 000.00
6	Italy	$ 502 400 000 000.00
7	Netherlands	$ 456 800 000 000.00
8	UK	$ 442 200 000 000.00
9	Canada	$ 431 100 000 000.00
10	South Korea	$ 379 000 000 000.00
39	**South Africa**	**$ 76 190 000 000.00**

In actual fact, the majority of reputable quality initiatives that have been used across the world were pioneered by industrialised countries. Even today, these countries still strive to continuously improve by putting customers' satisfaction in the front line of business activities.

2.4 BRIEF OVERVIEW OF THE DEVELOPMENT OF QUALITY INITIATIVES

As time continues to move around the clock, the management of product and or service quality has taken on many faces, from simple inspection to total quality management (TQM), ISO 9001(2008), and to nowadays Six Sigma (SS). Many positive improvements have been achieved as a result of the use of these quality management concepts. However, the mutation from one concept to another simply highlights the strength that the latest methodology has. Manjelsdorf (1999:419), is of the opinion that: "quality has a long tradition in the industry. In and after the Second World War, we all focused on quality control. In the 1980s, quality managements systems as given in the ISO standards 9000 series, paved the way for quality related business management. Advanced companies today are in a post ISO era in search of business excellence to meet the challenges of globalization in all market segments." In developed countries, the development of quality initiatives had different facets depending on the continent and the country.

2.4.1 Example of quality evolution in America

The real starting point of efforts toward improving product/service quality in the USA started when Deming and Juran (prominent quality Guru) returned to the USA after assisting in the rebuilding of Japanese industries after the Second World War (Goldman, 2005:217). The work of Juran and Deming greatly helped the Japanese to manufacture goods of higher quality, which eventually impacted positively on European and American markets. In response, the USA developed many quality initiatives as listed below:

- Management by objectives (MBO) to motivate managers to accomplish something;
- Management by commitment (MBC) this commitment was shown by written contracts;
- Zero-base budget (ZBB) used as management tool to evaluate expenses; and
- TQM adopted all over the USA when companies began to apply the Deming and Juran ideas of quality management (Goldman, 2005:218).

Furthermore many other quality concepts (business process re-engineering, continuous process improvement, ISO 9000, Six Sigma, the Malcolm Baldrige award, etc.) were developed with the aim of strengthening products and service quality. All these quality improvement concepts have value as they contributed to improving companies' products or service quality. On the other hand, the birth of a new quality management system simply highlights the weakness of the previous one, as all these concepts differ in some way in terms of use and implementation.

Informal quality frameworks like the Malcolm Baldrige award, have also played a role in boosting organisations' efforts toward quality improvement in America. The Malcolm Baldrige quality award is a comprehensive quality framework that portrays quality excellence practice that an organisation needs to follow in order to win the prize.

Given the existence of numerous quality management systems nowadays, and the context of globalisation, quality is now a marketing tool for global competition and organisations are using reputable quality management concepts to enhance their image. When Motorola won the Malcolm Baldrige quality award in the late 1980s, it puts the company in the spotlight of excellence given the reputation of the award. That achievement was a result of dedication from the entire organisation to improve the quality of their product. The quality concept that was developed at Motorola is known as SS (a registered Motorola trademark) and it helped them to save billions in US dollars by reducing the defect rate to 3.4 per million opportunities. This quality management approach is now widely used both by service and manufacturing industries.

2.5 THIRD WORLD IN THE CONTEXT OF GLOBAL COMPETION

Many developing countries have adopted exports as a development strategy (Mersha, 2000:119). Achieving this will depend on many factors including meeting the requirements quality excellence. Achieving quality excellence will enhance competiveness both in the internal and international market. In order to close the gap with developed countries, third world countries are following the footsteps of industrialised countries in terms of quality management in order to boost the quality of their products and therefore enhance their reputation in the global market. Even though the FDI in this region plays a significant part with regards to the adoption of quality initiatives, the move toward best practice here is now a reality. As pictured in Figure 2.3, five developing countries are among the 14 countries where manufactured goods were rated as excellent or good by consumers around the globe.

Antony and Desai (2009:413), are of the opinion that the latest quality management philosophies like SS are relatively new in developing countries and that very little is being done in of terms assessing its usage in third world countries. The popularity of SS picked up when Motorola won the Malcolm Baldrige quality award, thereafter many organisations adopted SS as their weapon for business improvement. Many success stories have been written about the positive effect associated with the used of SS. It is notable that this success stories belong to American or European organisation. Nevertheless, the study of Miguel and Andrietta (2009:124), reveals that the proportions of companies using SS in developing countries are doing so according to best practices stated in the literature but more still has to be done in terms of financial benefits associated with the usage of this practice and the key elements associated with Six Sigma implementation. Given this evidence, the third world is trying slowly but surely to match up with industrialised nations in terms of quality excellence which is a fundamental principle for success in a competitive environment.

2.6 GENERAL VIEW OF SOUTH AFRICA ORGANISATIONS

The post 1994 presidential election period has systematically changed the political, social, cultural, international and economic perception of SA. The transition to democracy has allowed SA to return to the international arena. Denton and Vloeberghts (2002:84), state that: "during the sanction years, SA was isolated and depended heavily on itself to provide its needs. Economic growth stemmed largely from government intervention and subsidies. As a result of international boycotts, huge organisations were created, financed and subsidies were freely granted to ensure the economic survival of the minority government and its supporters. Examples are Eskom, Krygkor, Iscor, Sasol, Telekom, Spoornet and SABC to name a few”. The isolation of SA from the rest of the world has drastically influenced the ability of local industries to deliver world class outputs given the fact that organisations were relying mostly on government support rather than using quality management methodologies to optimise their operations in order to be more profitable. Nonetheless, the exposure of SA market (after the 1994 presidential election) to global competition has forced local organisations to change business practice, in order to cope with the international demand, as well as to protect local markets against international challengers (Denton and Vloeberghts, 2002:85).

The return of SA to the international scene implies exporting goods/services that meet international standards and satisfying global consumers. This was a challenge that business organisation in SA faced. The shift toward best practice was a must to ensure success. Munro (1997:37-5) cited in Denton and Vloeberghts (2002:85), suggests that industries in SA have opportunities for growth but the challenge is to drive the signal of change. The transformation of businesses in SA could not be done without the impact of challenges that local organisations will reveal, given the diversity of SA society. Roodt (1997:16), indentified the following as fears to come in a SA business environment:

- Top management positions for the most part white;
- A general labour force principally black and unqualified;
- Gap between poor and wealthy;
- Illiteracy prevailing among a greater portion of the labour force;
- A greater demand of skill and technology;
- A labour relation that tends towards conflict and violence;
- Affirmative action as new criterion for jobs and promotion; and
- Employment Equity Acts No. 55 of 1998 that organizations need to follow, otherwise they face the prospect of heavy fines for non compliance.

Nevertheless, the strong FDI in SA has contributed to downsize some of these challenges. For example, some of the multinational firms often force local counterparts to adopt quality management practices which require a culture change and bring people to work together to achieved common goals. The strong FDI in SA is one contributor that puts local industries in a very competitive position and therefore provides an opportunity to catch up with developed countries that have been striving for excellence for a century.

To deliver world class products or services, SA business organisations have adopted numerous management practices prevailing in industrialised countries such as: ISO 9001(2008), Just in Time, continuous improvement, reengineering, lean system, Total Quality Management, Six Sigma and others. Muir (2005:Online), points out that 3119 organizations was certified as ISO 9001(2008) quality management users across SA in 2005, which was 36th position in the world. As indicated in Table 2.3, the developed countries have the greatest number of ISO 9001(2008) certificates, China is taking the top position with 143 823 companies having ISO 9001(2008) certificates and only two developing countries (China and India) are part of the top ten position. SA was languishing in the 36th spot which was encouraging given the history of this country.

Table 2.3: Top 10 countries with ISO 9001(2008)certificates. **Source**: (Muir 2005: online)

Country	2004 certificates	2005 certificates	% Growth
1. China	132 926	143 823	+8.2%
2. Italy	84 485	98 028	+16.0%
3. Japan	48 989	53 771	+9.8%
4. Spain	40 972	47 445	+15.8%
5. UK	50 884	45 612	-10.4
6. USA	37 285	44 270	+18.7%
7. Germany	26 654	39 816	+49.4%
8. India	12 558	24 660	+96.4%
9. France	21 769	24 441	+12.3%
10. Australia	17 365	16 922	-2.6%
36. South Africa	**2 486**	**3 119**	**+25.5%**

Between 2004 and 2005, there was an increase of 25% in ISO 9001(2008) certification in SA which highlights a growing change of SA organisations toward best practice pertaining to world class organisation. According to the South African Bureau of Standards SABS (2010: online), the months of January and February 2010 have witnessed the issue of 67 new ISO 9001(2008) certificates in SA.

It is unavoidable that the move toward world class practices is completed without some misinterpretation or a total deviation of the requirement regarding quality management practice. With regard to this, the usage of quality concepts in SA could raise some questions as to whether local organisations are using them effectively or just because they seek certification, after which back to old practices. During the first two months of the year 2010, one hundred and fifty organisations in SA lost their ISO 9001(2008) certificates due to non compliance with the requirement (SABS, 2010:online). This simply means that adopting a quality improvement is one issue; maintaining it is another. As quality becomes a useful tool for competition, expressions like globalisation, standardisation, and customer satisfaction become more and more recurrent on organisation agendas across the globe. Meanwhile SA is striving to level with industrialized nation in terms of quality culture. It is from this perspective that some informal organisations like the South African Quality Institute (SAQI) are promoting quality culture throughout the country.

2.7 OVERVIEW OF ORGANISATIONS PROMOTING QUALITY EXCELLENCE IN SOUTH AFRICA

2.7.1 Brief Overview of South African Quality Institute

The South African Quality Institute (SAQI) is a national organization that promotes and organises quality efforts in SA by developing quality awareness and assisting in putting in place quality principles based on ISO 9001(2008) (Merwe, 2007: Online). Thomaz (2009: Online), is of the opinion that SAQI sees quality primarily as a catalyst for economy expansion and this view is reinforced during the quality week in SA, when individual and organisations are encouraged to create quality awareness and emphasis the importance of quality as a tool for customer satisfaction, global competition, generator of revenue and jobs creation. Improving quality reduces cost and therefore improves productivity which is what a country needs in order to be more competitive.

Fourie (2008: online), advocates that an industry standard should be established for the regulation of quality given the international low rating of SA products or services quality, and also government should be playing an important role in spreading quality standards. The development of Japan after the Second World War was a result of a significant investment by their government in quality improvement. The SA government has an imperative role to play in the journey toward excellence because it is the richest entity of the nation. By promoting, creating, sponsoring and sustaining quality events that lead to the adoption of quality culture by the entire nation, the government will allow institutions, industries and individuals to follow its footsteps for a more comprehensive move to quality excellence.

2.7.2 Brief Overview of the South Africa Excellence Foundation (SAEF)

The SAEF provides a useful framework and path to create a culture of organisational excellence throughout South Africa. This organisation developed the South Africa Excellence Model (SAEM) which is a framework for an assessment that allows organisations to do a regular self judgment of their performance against best practices.

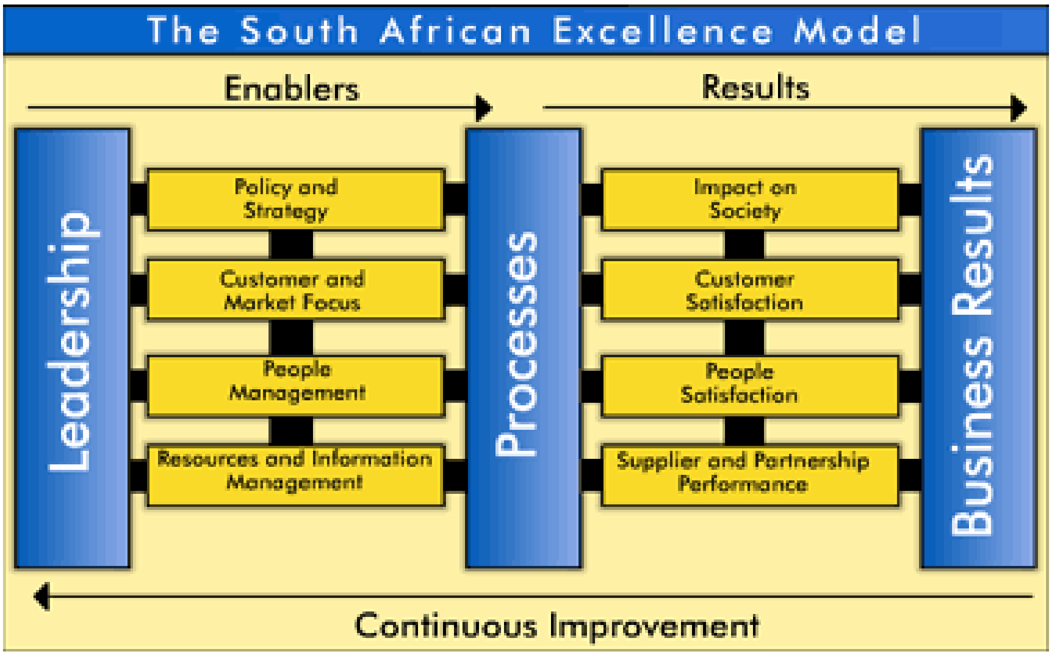

Figure 2.2: The South African Excellence Model. **Source** :(SAEF, 1997:6)

As specified in Figure 2.2, the SAEM has two main criteria, namely: Enablers and Results. The two groups have various sub-criteria to ensure total organisational effectiveness in improving performance.

The SAEF also deals with the South African Excellence Award, which is the most prominent prize for organisational achievement for excellence that a South African organisation can win.

2.7.3 Proudly South Africa

It is a campaign aiming to enhance the SA image by promoting the trade of locally produced products and services, in order to upon preserve and improve the existing employment rate, economic growth, and to facilitate the creation of more employment opportunities in SA. To be fully certified as proudly SA, organisations have to meet certain criteria that will enable them to compete both locally and internationally. Proudly SA (2010: online), maintains that the membership for this campaign is not exclusive to any particular type of business or organisation but all members have to meet the following criteria:

- Local content: a minimum of 50% of the total production cost must belong to SA;
- Higher quality product: the product or service must be of a higher quality to compete locally and internationally;
- Good labour practice: comply with labour practice and adhere to fair labour practices; and
- Environmental standards: production processes must not be harmful to the environment.

2.8 CONCLUSION

Many organisations in SA have embarked on the journey of quality excellence to challenge industrialised nations' competitive positions in the local and global market. However, adopting a specific quality management system is not indicative of achieving excellence. The leadership of SA business organisations has to optimally be knowledgeable of features surrounding an innovative approach, aiming to improve the efficiency of business processes. For SA organisations seeking or using the Six Sigma quality management system, a conceptual model will be developed in order to alleviate the research problem. Chapter 3 will look at relevant literature under discussion in this area.

CHAPTER 3: SIX SIGMA LITERATURE REVIEW

3.1 INTRODUCTION

A literature review is a critical examination and analysis of a published body of knowledge that has been theorised and conceptualised by many scholars (Mouton, 2001:87). Watkins (2008:130), describes a literature review as a focus on a very specific problem that needs to be mitigated.

In this chapter, a literature review will be conducted with regard to available publications that will help to lessen the research problem. To this end, the following areas will be underpinned:

- Back ground to Six Sigma including its history and definitions.
- The rationale behind Six Sigma usage and its benefits.
- The difference between Six Sigma and others quality initiatives.
- The Six Sigma methodology tools and techniques for process improvement.
- The key personnel in charge of Six Sigma implementation.
- The key elements for a successful introduction.

3.2 BACKGROUND TO SIX SIGMA

The enthusiasm on quality improvement in America businesses started in the late 1950 when prominent quality gurus (Edwards Deming, Joseph Juran and other) returned from Japan. Their assistance there had helped in the rebuilding of the industry by teaching quality techniques and methodologies, with the aim of enhancing industrial output (Goldman, 2005:217). A few years later, Japanese manufacturing output began to pick up both in quality and quantity. This eventually attracted the attention of global consumers mainly because of its already mentioned characteristics and low prices (Raisinghani, Ette, Pierce, Cannon, & Airplay, 2005:492).

In response to the threat of the Japanese reputation for excellence in manufacturing output, American manufacturers started to develop and implement many quality initiatives such as: Quality circle, Zero defects, Management by objectives, Management by Commitment, Zero Based Budget, Total Quality Management, Malcolm Baldrige Award, and Six Sigma to improve product and service quality which are fundamental for customer satisfaction (Goldman, 2005:208; Raisinghani *et al*., 2005:492).

3.3 HISTORY OF SIX SIGMA

Antony and Banuelas (2002:26), point out that the Six Sigma quality management was first pioneered at Motorola Corporation (US Electronic manufacturer) in the late 1980s as a mechanism to streamline organisational performance with emphasis on minimising quality cost by means of defects reduction. This view is supported by Schroeder, linderman, Liedtke and Choo (2008:537), as well as Kumar, Nowicki, Marquez, and Verma (2008:456), who are of the opinion that Six Sigma was initiated at Motorola to down scale variations in order to create a process that is less likely to produce defects. Coronado and Antony (2002:92), point out that a defect can be classified as an imperfection that causes a shortfall or failure of a process that triggers customer complaints. Breyfolgle (2003:5), asserts that the father of Six Sigma was the late Bill Smith, a senior engineer and scientist at Motorola. It was Bill Smith who crafted the original statistics and formulas that were the beginning of the Six Sigma culture. Jack Germaine a Senior Vice President at Motorola was named quality director and charged with the implementing of Six Sigma throughout the corporation. The result was a culture of quality within Motorola, and led to a period of unprecedented growth and sales. In 1988, Motorola was awarded the Malcolm Baldrige National Quality Award.

As Motorola's success became popular, Six Sigma was registered as its trademark and many companies in the USA (General Electric, Raytheon, Allied Signal, Honeywell, Sony, Caterpillar, American express, Ford, and Johnson) adopted this concept, and consequently returned incredible results (Breyfolgle, 2003:5; Senapati, 2004: 683; & Schroeder *et al.,* 2007:536-537).

Antony (2009:274), found that currently companies across the world ranging from small businesses, private and public to large organizations have adopted this philosophy to substantially improve:

- Quality level,
- Customer satisfaction,
- Market share,
- Employees moral,
- Organizational culture,
- People development,
- Return on investment, and
- Much more.

3.4 STATISTICAL BASIS OF SIX SIGMA

The expression Six Sigma consists of two words, Six (6) and Sigma (σ). The σ comes from the Greek Alphabet and it is known as a standard deviation in statistics and indicates how values from a process output are dispersed around the target value of a product specification in a normal distribution curve, which was first introduced by Carl Frederick Gauss (Raisinghani *et al*., 2005:491). Figure 3.1 shows the six (6) that refers to the number of standard deviations from the target to the specification limits at each side of the normal distribution curve of a process producing almost no products out of specification limits (Foster, 2007:437). As indicated on Figure 3.1, the concept of ±3Sigma was introduced by Walter Shewhart in 1922 as a measurement of process output variation at each side of the target value under the normal distribution curve (Raisinghani et al., 2005:491-492).

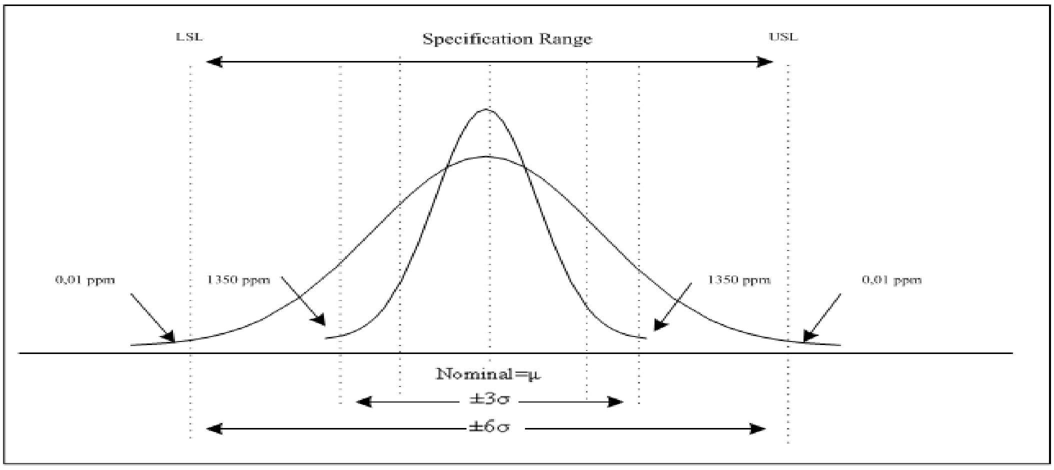

Figure 3.1: Normal Distribution with Sigma Impact. **Source**: (Dogu and Firuza, 2008:1096)

When the distribution is centered as indicated in Table 3.1, a ±3Sigma corresponds to a sigma level of 3 which indicates in this case 2700 defects per million opportunities (DPMO). Under the same condition a ±6 Sigma as a depicted in Table 3.1, will map to a sigma level of 6 which indicates in this case a 0.002 DPMO.

Table 3.1: Defects per million opportunities with a centred distribution. **Source**: (Breyfolgle, 2003:14)

Specification limit	Sigma Level	Percentage	Defects per million opportunities
±1Sigma	1	68.27%	317300
±2Sigma	2	95.45%	45500
±3Sigma	3	99.73%	2700
±4Sigma	4	99.9937%	63
±5Sigma	5	99.999943%	.57
±6Sigma	6	99.9999998%	.002

The Six Sigma objective is to reduce a process variation, which will result in no more than 3.4 DPMO as indicated in Table 3.2 in the long term (Antony, 2008:274).

Table 3.2: Defects per million opportunities with 1.5 Standard Deviation Shift. **Source**: (Breyfolgle, 2003:14)

Specification limit	Sigma Level	Percentage	Defects per million opportunities
±1Sigma	1	30.23%	697700
±2Sigma	2	69.13%	308700
±3Sigma	3	93.32%	66810
±4Sigma	4	99.93790%	6210
±5Sigma	5	99.9760%	233
±6Sigma	6	99.999660%	**3.4**

The 3.4 DPMO are calculated on the basis that every process is likely or tends to increase its variability over time, due to unavoidable assignable causes such as loss of calibration of measuring equipment, wear and tear of machine, operator fatigue, supplier quality variation, and variation in temperature (Biehl, 2005: online).

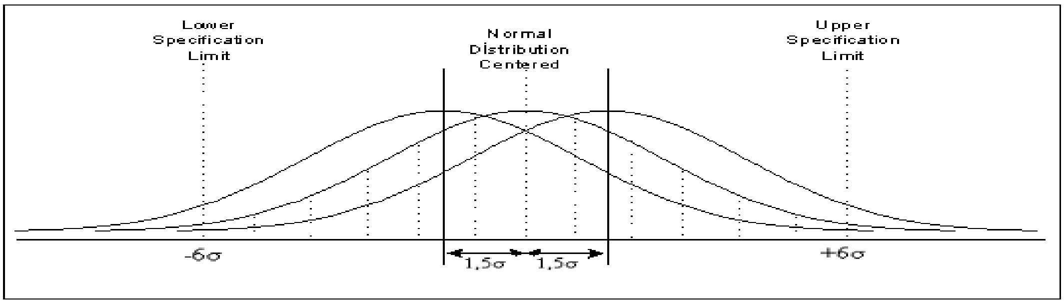

Figure 3.2: Normal Distribution with 1.5 Standard Deviation Shift: **Source**: (Dogu and Firuza, 2008:1096)

In such a case, Figure 3.2 portrays an example of process variation of ±1.5σ from the target which is common and the resulting defects rate under one of the shifted curves beyond the Six Sigma is 3.4 DPMO in a long run as illustrated in Table 3.2. Therefore, for Six Sigma only a shift of at most 1.5σ is permitted on one of the sides of the target value of the normal distribution curve.

3.5 SIX SIGMA DEFINED

Six Sigma has various perspectives and is defined in literature and by people in different ways. According to Raisinghani *et al*., (2005:491), defining Six Sigma in simple terms is not possible because it consists of problem solving methodology and focuses on optimisations of financial returns, including culture change within an organization. Furthermore, the researches of Kwak and Anbari (2006:708-709), and Antony and Banuelas (2002:21), returned that Six Sigma definitions can be categorised in two segments which cover business and statistical explanation.

3.5.1 Six Sigma business definitions

According to Antony and Banuelas (2002:21), Six Sigma is a strategic business improvement mechanism used to optimise profitability, remove waste, reduce cost of quality and enhance the effectiveness and efficiency of all operations to meet or go beyond customers' requirements and expectations. Kwak and Anbari (2006:708), portray Six Sigma as a business tactic that emphasis the need to improve the understanding of customer requirements, business system, productivity, and financial performance. Chou and Su (2008:2694), are of the opinion that Six Sigma is a top down initiative led by top management and the hierarchy of trained personnel, who work on projects that are aimed to scale down waste and mistake proof processes that create value and yield to the improvement of products and services quality and tremendous customers' satisfaction. Antony (2004:1006), describes Six Sigma as an inexorable and rigorous quest of the elimination of non-value added activities and variations in core business processes to achieve continuous and breakthrough improvement in organisational performance that impact on the bottom line result. The study of Black and Revere

(2006:260), refer to Six Sigma as a breakthrough strategy that combines improvement metrics and new management philosophy to significantly reduce defects by the mean of designing, improving, and monitoring business activities that result in strengthening a market place position, customer satisfaction and improved financial profit. Six Sigma is a systematic, highly disciplined and profit driven approach that brings together management, financial and methodological elements to improve process and product concurrently, resulting in customer satisfaction and financial results (Antony & Desai, 2009:413 cited in Tang *et al.*, 2007). Ditahardiyani, Ractnayani and Angwar (2008:178), note that Six Sigma is a business management process for continuous process and product quality improvement that provides tangible business results to the bottom line and operational excellence. Miguel and Andrietta (2009:125), see Six Sigma as a management practice that seeks to maximise company financial earnings in any sector of activity of any size for the aim of raising market share, optimising customer satisfaction, downscaling defects and reducing cost of manufacturing or service activities.

Six Sigma is a business strategy known as an imperative for operations and business excellence (Antony, 2006:234).

3.5.2 Statistical definition of Six Sigma

Black and Revere (2006:259), describes Six Sigma as a methodology used to assess a process capability in terms its abilities to deliver outputs that meet or exceed customer requirements. Six Sigma is a quality oriented philosophy that seeks a process of ± 6 sigma variation even if a process mean shifts by ±1.5 sigma that results tin a maximum of 3.4 DPMO (Motwani, Kumar, and Antony, 2004:273). Antony (2008:107), is of the opinion that Six Sigma is a concept that relies on statistical techniques to identify, analyse, and solve problems that results in a noticeable down turn of nonconformities in all aspect of business organisation. Eckes (2001:11), advocates that Six Sigma is a concept that provides a statistical measurement of a product or service performance by identifying problems, establishing root causes, formulating hypotheses, testing them and maintaining progressions that hunt or improve customer satisfaction. The Study of

Chou and Su (2008:2694), proposes that Six Sigma uses numerous statistical applications to improve the sigma level of a process performance to reflect or exceed customer needs. Antony and Banuelas (2002:21), define the Six Sigma statistical viewpoint as a rigorous quality control concept that monitors and improves a process of an organisation that operate at 3 Sigma level to a 6 sigma level and therefore achieves a reduction of process variation so that it will result in no more than 3.4 DPMO in a long term.

Six Sigma is a quality improvement methodology that incorporates management philosophies and statistical techniques in a well structured fashion to optimise business activities, thereby focusing on variation reduction in all processes, involving top management and operating force to work closely in the hunt of customer satisfaction and financial return.

3.6 THE RATIONALE OF SIX SIGMA USAGE

Six Sigma is a powerful business management strategy that has been exploited by many world class organisations such as Motorola, General Electric (GE), Honey Well, Bombardier, ABB, Sony, American Express, Fords, Boing, Raytheon, and Caterpillar (Antony, 2006:234; Kumar, Antony, and Douglas, 2009:625). It was first implemented in the manufacturing environment and eventually extended to other functional areas such as marketing, engineering, purchasing, servicing, and administrative support due to the fact that organisation were able to substantiate the benefits of this approach in financial terms by linking process improvement with cost savings (Kwak & Anbari, 2006:709; Kumar *et al*., 2008:456; Antony & Banuelas, 2002:20).

Kumar *et al*., (2008:456-457), propose that the Six Sigma approach was developed as a tool to strengthen the reliability and the quality of products by focusing on process defects reduction. Ditahardiyani, Ractnayani, and Angwar (2008:178), propose that on a long term basis it will result in a process producing output with no more than 3.4 DPMO so as to meet customer expectations. The study of Kumar *et al*., (2008:457), citing Harry (1998), proposed that traditional organisations that adhere to conventional framework have started to adopt Six

Sigma as a method to streamline operations with the aim of enhancing reputation, customer trust, market share and profitability.

Table 3.3: Six Sigma industrial applications. **Source**: (Kumar *et al*. 2008:458)

References	Industrial application of Six Sigma
Hendricks and Kelbaugh (1998)	Successfully implement many Six Sigma projects that improved the net profit
Lanyon (20030	Improved HR processes by using Six Sigma
Motwani et al., (2004)	Down chemicals achieved a target of $1.5 billion in earning before tax in 2000 as a result of SS implementation
Knowles et al. ,(2005)	Successful application of Six Sigma within a UK confectionery plant of a major food producer
Banuelas e al., (2005)	Use of Six Sigma to reduce waste in a coating process
Snee (2005)	Six Sigma benefited Motorola, Allied signal, general electric etc..
Edgeman et al., (2005)	Saving of between $2 to $3 million at an office of the chief of technology officer at Washington DC using Six Sigma
Ehie and Sheu (2005)	Demonstrates the value of Six Sigma and Theory of Constraint
Liu (2006)	Presented an application of Six Sigma to reduce cycle time and defects in clinical report entry
Mukhopadhyay and Ray (2006)	Used Six Sigma to reduce the yarn packing defects

Table 3.3 illustrates some areas where Six Sigma has been used successfully to improve manufacturing and service processes.

Kwak and Anbari (2006:709) citing (Anbari, 2002), note that Six Sigma is more widespread than other quality concepts like TQM and continuous quality improvement (CQI) because it measures and reports financial results, uses additional and more advanced data analysis tools, focuses on customer demands and makes use of project management tools and methodology.

Table 3.4: Rating of process improvement techniques. **Source**: (Kumar *et al*., 2008:457)

Process improvement tool	Impact (%)
Six Sigma	53.6
Process mapping	35.3
Root cause analysis	33.5
Cause and effect analysis	31.3
ISO 9001	21
Statistical process control	20.1
TQM	10.3
Malcolm Baldrige criteria	9.8
Knowledge Management	5.8

As illustrated in Table 3.4, Kumar *et al*., (2008:457), advocate that Six Sigma is a quality management concept that yields the highest result due to the fact that it incorporates many other quality techniques which do not have much application outside the manufacturing industry.

Table 3.5: Contrasting Six Sigma and TQM. **Source**: (Barney, 2002:13)

Six Sigma	**TQM**
Executive ownership	Self directed
Business strategy execution system	Quality initiative
Truly cross functional	Largely within a single function
Emphasises on training	No mass training in statistics and quality
Business results oriented	Quality oriented

Comparing the views of Kwak and Anbari with that of Kumar *et al.,* it is clear that Six Sigma is significantly different from other quality management approaches like TQM, as illustrated in Table 3.5.

Six Sigma is considered as a highly structured and one of the most effective improvement frameworks that uses statistical and non statistical tools/techniques to eliminate process variation; therefore improving process efficiency and effectiveness including capability, which impact upon on financial return that most companies claimed to be upward. Six Sigma provides business executives and leaders with a strategy, methodology, infrastructure, tool and techniques to change the way business are run (Kumar *et al.,* 2009:625). The study of Eckes (2001:11), stipulates that there are three keys elements for quality: customer, process and employee, and if an organisation wants to be or remain a world class quality company, it must focuses on these three essential elements. Consumer drives the level of accomplishment that a process must deliver at a world class level of quality by involving employees in process much more closely (Eckes, 2008:11). This is what Six Sigma is striving to produce (Servicebazaar, 2005: online)

The fundamental idea behind the Six Sigma philosophy is to continuously reduce variation in process with the aim of eliminating defects or failure in every product or service (Antony & Banuelas, 2002:20-21 cited by Hoerl, 1998).

3.7 DIFFERENCE BETWEEN SIX SIGMA AND OTHER QUALITY IMPROVEMENT INITIATIVES

Six Sigma was initially created as a continuous quality improvement technique but nowadays, it has evolved into a complete strategical approach for business improvement that differs completely from other quality initiatives like TQM (Barney, 2002:14). According to the Servicebazaar (2005: Online; Kumar *et al.*, 2008:458), Six Sigma is regarded as an expansion on other quality concepts like ISO 9001, TQM, Statistical process control, Deming statistical quality control and Statistical Engineering (SE). Table 3.6 illustrates some major differences between Six Sigma and other quality concepts.

Table 3.6: Comparison between Six Sigma and other quality programs. **Source**: (Senapati, 2004:689)

Attribute	Six Sigma	Deming Cycle	TQM	SE
Process centric approach	High emphasis	Implicit	Implicit	High emphasis
Customer focus	Implicit	Invisible	Explicit	Implicit
Statistical approach	Has a statistical base	No confinement to statistical approach	Tools have statistical base	Usage of simple statistical tools
Behavioral content	Exists	Does not emphasis the behavioral side of problem solving	Emphasizes the behavioral approach to problem solving	Talks less about behavioral attributes
Easiness	Tough to implement in terms of goals	Simplest guide to solve problems	Easier to implement	Moderately difficult
Cost	High to medium investment	Usually low investment projects	Usually moderate	No publicized estimates available
Duration	High	Depends on project sizes	Project sizes are moderate	No figure are made available
Executive role	Top down	Not emphasized	Top Down	Bottom up

Kumar *et al.*, (2008:458) citing Anbari (2002), and Kwak and Anbari (2006:709), proposed that Six Sigma is a methodology consisting of the followings:

- TQM.
- Key personnel,
- Strong customer focus,
- Project management,

- Additional data analysis tools, and
- Financial results.

Kumar *et al*., (2008:458) and Antony (2006:239), put forward that Six Sigma utilises five phases for process improvement which are known as DMAIC (Define, Measure, Analyse, Improve, and Control). These five phases show a similarity with the Deming Plan-Do-Check-Act (PDCA) cycle (Senapati 2004:684). However, the focus target of 3.4 DPMO along with a good integration of powerful problem solving tools and techniques into DMAIC framework have triggered a noticeable success rate of Six Sigma compared to TQM (Kumar *et al*., 2008:458; Antony, 2009:278).

The study of Antony (2009:244-245), suggests that Six Sigma and other quality management concepts present some similarities as illustrated on Table 3.6 but these philosophies contrast in many critical areas because Six Sigma accentuates more in the areas listed below:

- Six Sigma emphasises the achievement of financial returns.
- Six Sigma starts from the leadership and a clear curriculum of top management role is provided within the Six Sigma framework.
- Six Sigma methodology of problem solving integrates the human, process and statistical elements in a disciplined manner.
- Six Sigma provides an organisational infrastructure consisting of key trained personnel for an effective implementation of this approach.
- Six Sigma emphasises the data driven decision making approach instead of hypothesis.
- Six Sigma uses the concept of statistical thinking that encourages the use of powerful statistical tools and techniques for process variability reduction.

Six Sigma focuses on driving business results directly in comparison to many other quality initiatives. Projects and key personnel are carefully selected to accelerate business performance. Six Sigma differs from other quality initiatives because it is a business philosophy; leadership is completely involved and committed; powerful statistical tools and techniques are used to validate data; the focus is on a specific project; the best people are 100% dedicated to defects reduction which generate astonishing benefits.

3.8 SIX SIGMA BENEFITS

Antony (2008:107), advocates that the Six Sigma usage has been gaining ground with impressive results over the last 20 years and the benefits generated from its implementation worldwide can be classified as follow:

- Defects reduction.
- Operational cost reduction.
- Increased customer satisfaction and other shareholders.

The research of the Servicebazaar (2005: online), suggests that Six Sigma focuses on the reduction of process variation as well as enhancing its capability, which leads to the following:

- Productivity improvement.
- Higher throughput.
- Higher level of quality.
- Cycle time reduction.
- Defects reduction.
- Greater customer satisfaction.
- Standardized improvement methodology in the organisation.
- Drastic improvement in the bottom line.

Chou and Su (2008:2693 citing Maleyeft and Kaminsky, 2002), present a different perspective on Six Sigma benefits by saying: “The main benefit of a Six Sigma program is the elimination of subjectivity in decision making by creating a system where everyone in the organization collects, analyses, and displays data in a consistent way’’. As a result, Six Sigma is a concept that provides an opportunity to everyone in the value chain to actively participate in the journey to quality excellence.

The significant impact of Six Sigma implementation on organizational performance really boosts exuberant financial returns on a balance sheet which could not be obtained by other means (Antony & Banuelas, 2002:21). In the manufacturing sector, Six Sigma was first implemented successfully at Motorola and thereafter many other manufacturing organisations fruitfully followed its footsteps (Kwak & Anbari, 2006:710). Table 3.7 portrays the benefits generated from the implementation of Six Sigma by some manufacturing organisation.

Table 3.7: Benefits of Six Sigma in manufacturing sector. **Source**: (Kumar *et al*., 2006:459)

Company/Projects	Metric/measures	Benefits/ Savings
Motorola (1992)	In process defect levels	150 times reduction
Raytheon /aircraft integration system	Depot maintenance inspection time	Reduced 88%
GE/Railcar leasing business	Turnaround time at repair shops	62 % reduction
Allied signal Honeywell/ bendix IQ brake pads	Concept to shipment cycle time	Reduced from 18 months to 8 months
Hughes aircrafts missile systems group / wave soldering operation	Quality / productivity	Improves 1000% /improved 500%
Borg Warner Turbo systems	Financial	$ 1.5 million annually since 2002
General electric	Financial	$ 2 billion in 1999
Motorola (1999)	Financial	$ 15 billion over 11years

Antony (2006:236 citing Yilmaz and Chatterjee, 2000), found that most of the service processes operate at a sigma quality level below 3.5 which generates 23000 DPMO and by improving the above sigma quality level to just four sigma, the defects rate will go down significantly to 6210 DPMO. This will in turn generate impressive financial results due to an improved service delivery and customer satisfaction.

Kwak and Anbari (2006:710-711), highlight that most service organisations remain skeptical about the effectiveness of Six Sigma in this particular sector. Antony (2006:236), however presents a different view in that the best way to convince a service orientated company to initiate, develop, implement and maintain Six Sigma strategy, is through the three rudimentary principles of statistical thinking. These principles include:

- All work occurs in a system of interconnected processes.
- All processes exhibit variability.
- All processes create data that explains variability. By knowing the sources of

variability and devising effective strategies to reduce or eliminate them, incredible results can be achieved.

Although the skepticism shown by some service organizations about the relevance of Six Sigma in this particular sector of activity, many organisations in this sector have benefited in many ways as a result of Six Sigma implementation (Antony, 2006:237; Kwak & Anbari, 2006:710-711).

Table 3.8: Key benefits of Six Sigma in service organizations. **Source** (Antony, 2006:237-238)

Company	Benefits
City bank Group	Reduced internal call backs by 80%, external call Backs by 85% Reduce credit processing time by 50% Reduced cycle time by 67%
JP Morgan Chase	Increased customer satisfaction, efficiency and cycle times by over 30%
Healthcare industry	Increased radiology throughput by 33% Decreased cost per radiology procedure by 21.5 % which generates a cost saving of $1.2 million Reduced medication and laboratory errors and therefore patients safety
British telecom whole sale	Increased level of customer satisfaction Established more robust and effective processes Creates common language for business process improvement Cost saving of over $100 million
Financial service	Administrative cost reduction in excess of $ 74000 per annum Improved customer satisfaction Saving generated unnecessary processing cost (about $700 000 / year
Utility company	Annual saving of $ 1.7 million from improving service delivery Increased customer satisfaction and retention

The benefits listed in Table 3.8 derived from the successful implementation of Six Sigma in some service oriented organisations.

3.9 TOOLS AND TECHNIQUES FOR SIX SIGMA PROCESS IMPROVEMENT

McQuater, Scurr, Dale, and Hallmal (1995:38), propose a comprehensible definition regarding quality tools and techniques as follows:

- Tools and techniques are ways or mechanisms by which a particular problem can be solved.
- A tool is a devise having a clear function and is used on its own.

- A technique (set of tools) requires more thought, complexity, skill and training for effective use.

Table 3.9: Frequently used tools and techniques. (**Source:** Antony, 2006:242)

The 7 basic quality control tools	**The seven management tools**	**Other tools**	**Techniques**
Cause and effect diagram	Affinity diagram	Brainstorming	Benchmarking
Check sheet	Arrow diagram	Control plan	Design of experiments
Control chart	Matrix diagram	Flow chart	Failure mode and effects analysis (FMAEA)
Graphs	Matrix and data analysis method	Force field analysis	Fault tree analysis
Histogram	Process decision	Hypothesis testing	Process capability analysis
Pareto diagram	Programme chart	Process Mapping	Poka joke
Scatter diagram	Relations diagram	Questionnaire	Problem solving methodology
	Systematic diagram	Sampling	Quality costing
		Gant chart	Quality function deployment (QFD)
		SERVQUAL	Quality improvement teams
		Regression and correlation analysis	Statistical process control (SPC)
		SIPOC	
		Project team Charter	
		Kano Model	

The most commonly used tools and techniques for a Six Sigma project for process improvement are listed in Table 3.9. It is important to point out that these tools and techniques are not new but were brought together in a very disciplined and systematic manner to gain significant benefits when tackling process quality related problems (Antony, 2006:241).

3.10 SIX SIGMA METHODOLOGY FOR PROCESS IMPROVEMENT

Dogu and Firuzan (2008:1102), advocate that process improvement methodology is a tactic used to identify process problems, measure, analyse, and find solutions in order to implement and sustain the most efficient way of operating that will lead to a breakthrough. As a problem solving methodology, Six Sigma makes use of a generally accepted and well defined continuous improvement framework known as DMAIC (Antony, 2006:239, Eckes, 2003:29).

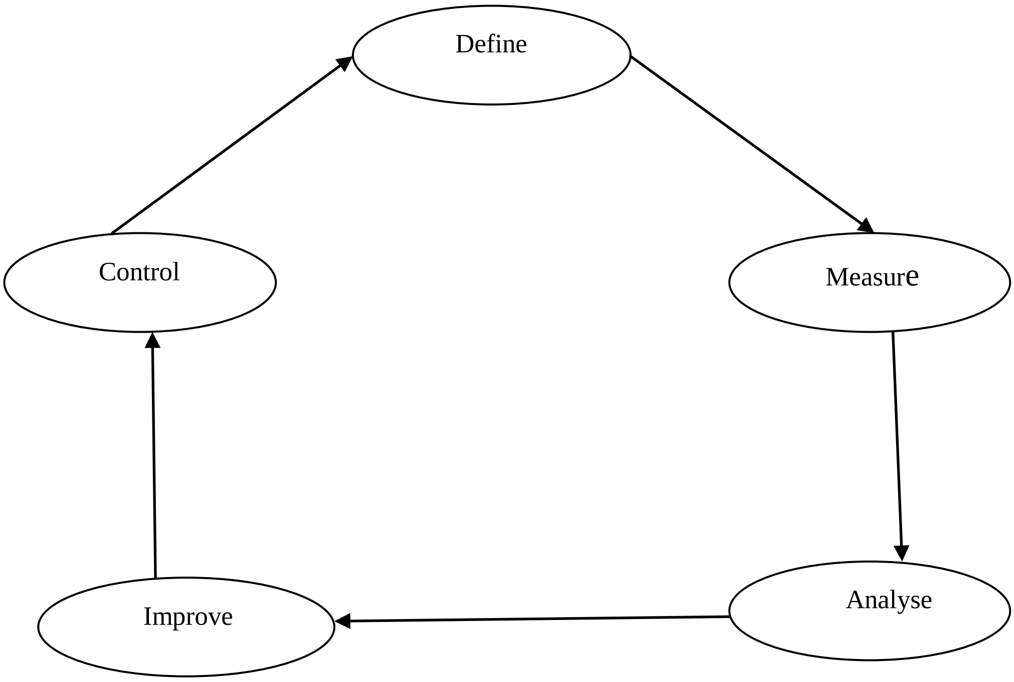

Figure 3.3: DMAIC improvement Methodology. **Source**: (Eckes, 2003:29)

As indicated in Figure 3.3, the DMAIC model is a closed loop process that eliminates unproductive stages which allows the improvement process to be more efficient (Kwak and Anbari, 2006:706). The letter (D) represents the definition of the problem, (M) measures the problem, (A) analysis of data, (I) improvement of the process by removing root causes of defects and (C) controlling or monitoring process to prevent problems.

3.10.1 Define phase

This is the first phase of any Six Sigma project and consists of three tollgates: a charter, customer needs and requirements, and process map (Eckes, 2003:30).

- **The charter:** A charter is a set of documents that illustrates the objectives and motivation for a Six Sigma team to perform its workload effectively and it includes the following:

- The business case.
- The problem statement.
- Project scope.
- Goals and objectives.
- Milestones.
- Roles and responsibilities of Six Sigma project team member.

- **Customer needs and requirements:** A customer can be seen as someone who receives a product or service (need), from a process that transforms its requirements into characteristics or needs, that will play a critical role in its satisfaction (Eckes, 2003:32).

- **Process map:** A process is a series of activities that transforms inputs (raw materials) into outputs (product, service or information) for a customer (Anjard, 1996:223). A higher level of process map must be created to reflect the mirror picture of current activities and should indicate the following:
  - Name of the process.
  - Start and end points of the process.
  - Output of the process.
  - Customer of the process.
  - Supplier of the process.
  - Input of the process.

3.10.2 The measure phase

The creations of the data collection plan and implementation plan are the two major steps in this phase.

- **Creation of the data collection plan:** A data collection plan portrays the necessary key areas that will lead to the final calculation of the Sigma level. According to Eckes (2003:36-40), it consists of the following:
  - What to measure: Requirements obtained during the define phase.
  - The type of measure: Input, process or output measurement.
  - The type of data: Discrete or continuous data.

- Operational definition: Have an agreement with all relevant people involved in the process in order to avoid contrasting ideas over what is being described.
- Target specification: Measure the performance of the product or service to meet customer needs.
- Data collection forms: Tools used to collect data.
- Sampling: Taking a portion of the total population when measuring the entire population in order to minimise cost and time.

- **Implementation of the data collection plan**

This step consists of taking the data collection plan and implementing it in order to generate the current sigma level of the process (Eckes, 2003:41).

3.10.3 Analysis phase

Many authors consider this phase as the most crucial because more often, people seem to omit it and jump straight to improvement phase (Eckes, 2003:42-43). This phase consists of three scrutinising steps: data, process, and root cause analysis of the current performance.

- **Data analysis:** In order to improve the effectiveness and efficiency of a process in such a way that it can create a product or service that meets customer requirements, the data obtained at the measure phase must be analysed (Eckes, 2003:43). The type of tools or techniques used to analysed data are listed in Table 3.10, which also illustrates the most widely used tools and techniques for the Six Sigma process improvement at each stage of the DMAIC.

- **Process analysis:** A process analysis consists of an in-depth process mapping and a detailed analysis of the spot where the greatest inefficiency occurs.
- **Root cause analysis:** This is the most important step of the analysis phase. Eckes (2003:54), advocates that it covers the stages listed below:

- The open step: brainstorming session with all project team members aiming to unearth all causes of inefficiency
- The narrow steps: downscaling the reasons of inefficiency
- The closed steps: validation of all narrowed reasons of inefficiency.

Table 3.10: commonly used tools at each phase of DMAIC. **Source**: (Antony, 2002:242, Dogu and Firuzan, 2008:1104)

Project phase	Commonly used Tools	
Define	➢ Project charter ➢ Benchmarking survey ➢ Flow chart ➢ QFD	➢ Process map ➢ Brain storming ➢ SIPOC ➢ GANTT chart
Measure	➢ QFD ➢ FMEA ➢ Gage R&R ➢ Run chart ➢ Pareto analysis	➢ Pareto analysis ➢ Quality costing ➢ SERVQUAL ➢ Histograms ➢ KANO model
Analyze	➢ Cause and effect diagram ➢ Tree diagram ➢ Brainstorming ➢ SPC ➢ Process map ➢ FMEA ➢ Capability analysis	➢ Histogram ➢ Pareto chart ➢ Run chart ➢ Hypothesis testing ➢ Regression and correlation analysis ➢ Affinity diagram
Improve	➢ Force field diagrams ➢ New seven tools ➢ Quality costing	➢ QFD ➢ SIPOC ➢ GANTT chart
Control	➢ SPC ➢ FMEA ➢ Gage R&R	➢ Benchmarking

3.10.4 Improvement phase

This phase involves generating and selecting solutions for implementation of doing things better, cheaper or faster and thereafter calculating the new sigma level (Eckes, 2003:61).

3.10.5 Control phase

A tracking mechanism of measurements has to be put in place in order to sustain the newly implemented solution to ensure that growth is not lost over time (Anbari & Kwak, 2004:6).

Moreover, many authors argue that Six Sigma is an approach which when used effectively, minimises variability from any process or product by using the DMAIC methodology or a design/redesign for Six Sigma (DFSS). Banuelas and Antony (2003:334), propose that the DFSS is a methodology used when a process has to be designed or redesigned. During a Six Sigma project, DFSS follows a sequence known as DMADV which means Define, Measure, Analyse, Design and Verify.

The DFSS mainly focuses on bringing new processes by eliminating existing one so as to enable new processes to operate at a sigma level of 6, therefore generating only 3.4 DPMO.

3.11 ORGANISATIONAL INFRASTRUCTURE FOR SIX SIGMA

Coronado and Antony (2002:94), are of the opinion that some features like communication skill, long term focus, team work, resources availably pertaining to the organisation, have to be visible prior to embarking on Six Sigma implementation programme. Moreover, the researches of Pyzdek (2000: Online) and Antony and Banuelas (2002:21), suggest that Six Sigma provides and organizational infrastructure that assures and supports the effective implementation of this methodology in an organisation. The main reason why 80% of TQM implementation failed was due to the lack of tangible infrastructure to support its introduction.

Henderson and Evans (2000:270), point out that reaching the long term target of 3.4 DPMO requires a complete commitment of each component of the value chain, and an active participation by everyone with specific roles and responsibilities within an organisation. The employees in an organization practicing Six Sigma are seen as catalysts who institutionalise change and are highly trained on statistics, problems solving, and lead the group in selecting and completing Six Sigma projects (Henderson and Evans, 2000:270; Antony and Banuelas, 2002:22). According to Anbari and Kwak (2004:5), a Six Sigma project is selected, performed, accomplished, and reviewed by individuals who are ranked according to a belt system in a powerful matrix organizational structure as follows:

- Champion.
- Master black belt (MBB).
- Black belt (BB).
- Yellow belt (YB).
- Green belts (GB).

Table 3.11: role, profile and training in the Six Sigma belt system. **Source**: (Coronado and Antony, 2002: 96)

	Green belts	Black Belts	Champions
Profile	Technical Background	Technical degree	Senior manager
	Respected by peers	Respected by peers and management	Respected leader and mentor of business issues
	skill in basic and advanced tools	Master of basic and advanced tools	Strong proponent of Six Sigma
Role	Lead important process improvement team Lead, train, and coach on tools and analysis Assist Black belts Typically part time on projects	Lead strategic, high impact process improvement project Change agent Teach and mentor cross functional team members Full time project leader Convert gain into $	Provide resources and strong leadership for projects Inspire a shared vision Establish plan and create infrastructure Develop metrics Convert gain into $
Training	Two to three days sessions with one month in between to apply project review in second session	Four weeks sessions with three weeks in between to apply project review in sessions two, three and four	One week champion training Six Sigma development and implementation plan
Number	One per 20 employees	One per 50 to 100 employees	One per business unit

Table 3.11 illustrates the role, profile and training required for people in the Six Sigma belt system.

3.11.1 Champions

Champions are individuals who occupy strategic position in an organisation, have a full understanding of Six Sigma deployment, and are fully committed to its success (Pyzdek, 2000: online). Anbari and Kwak (2004:6), maintain the following: “Champions create the vision, approve Six Sigma project charters, review project progress, and ensure the success of Six Sigma projects in their business unit".

3.11.2 Black Belts

The term Black Belt was first introduced by the Motorola Corporation to describe trained employees with extensive experience in applying statistics in business process improvement (Ingle & Roe, 2001: 275 citing Chase, 1999).

A BB candidate selection focused on the technical aspect of individuals who are highly rated in their area of expertise as well as by others colleagues (Pyzdek, 2000: online; Coronado & Antony, 2002: 96). Their training lasts four to six weeks and focuses mainly on statistical methods and Six Sigma methodology to enable them to complete four to six projects per year on a full time basis (Anbari & Kwak, 2004:5). The number of active BB in an organisation will typically be one to every fifty to hundred employees (Pyzdek, 2000: online, Coronado & Antony, 2002: 96).

3.11.3 Master Black Belts

A Master Black Belt is an experienced BB who provides technical support to BB, GB, and YB including other project team members (Anbari & Kwak, 2004:5). Ingle and Roe (2001:278), define an example of a MBB at Motorola as a person having BB experience for at least five years, as well as having successfully mentored a minimum of five BB candidates. MBB are fully skilled quality leaders having the responsibility of Six Sigma strategic deployment, training, mentoring and results (Henderson & Evens, 2000:270). According to Pyzdek (2000: online) a company of a thousand employees should have a MBB. However, Colorado and Antony (2002: 96), propose that a business group or a big manufacturing site should have one MBB.

3.11.4 Yellow Belts

Yellow Belts in Six Sigma terms represent individuals with a technical background who receive two to three weeks training on Six Sigma methodology;

after which they work on Six Sigma projects on a temporary basis (Anbari & Kwak, 2004:5). Pyzdek (2000: online) and Coronado & Antony (2002: 96), assert that a proportion of twenty employees should have one YB.

3.11.5 Green Belts

A Green Belt is a specialised person leading a Six Sigma team member, capable of forming and facilitating a Six Sigma team and managing Six Sigma projects from start to finish (Pyzdek. 2000: online).

3.12 KEY ELEMENTS FOR SIX SIGMA IMPLEMENTATION

Companies embarking on Six Sigma implementation programmes have shown contrasting results due to the complexity of this methodology and therefore, attention must be drawn to the key elements of Six Sigma to make it possible (Coronado & Antony, 2002:92-93). Coronado and Antony(2002:93 citing Rockart, 1979) state that: “Critical success factors are those factors which are critical to the success of any organization in the sense that, if objectives associated with the factors are not achieved, the organization will fail – perhaps catastrophically”. Therefore, the importance given to key input variables for the successful management of a process output can be attributed to Six Sigma critical success factors for an effective completion of a Six Sigma programme (Antony & Banuelas, 2002:21).The research of Antony and Banuelas (2002:21-23), Coronado and Antony (2002:93-98), Pyzdek (2000: online), Antony (2006:242-243), and Henderson and Evans (2000:269-277), identified the following key elements for the successful introduction and implementation of Six Sigma programme in an organisation:

- Management involvement and commitment.
- Culture change.
- Communication.
- Organization infrastructure.
- Training.
- Project management skill.
- Project prioritisation and selection, reviews and tracking.

- Understanding the Six Sigma methodology, tools and techniques.
- Linking Six Sigma to business strategy.
- Linking Six Sigma to human resource.
- Linking Six Sigma to customer.
- Linking Six Sigma to supplier.

3.12.1 Management involvement and commitment

Henderson and Evans (2000:269), noted that those who implemented Six Sigma have all agreed that a top management involvement is the most critical factor for a Six Sigma programme. Kwak and Anbari (2006: 712), propose that a Six Sigma implementation requires top management involvement, dedication, project selection and review, resource provision and training. Furthermore, the research of Antony and Banuelas (2002:21) and Pyzdek (2000: online), suggests that senior management should be taught Six Sigma principles needed for the preparation of their organisation on the brink of adopting this concept.

At GE, the Six Sigma initiatives were endorsed by Jack Welch (a former CEO) who restructured the business setting to that of Six Sigma entity, by personally spending time in every Six Sigma training, completing a weekly and monthly Six Sigma review, making factory visits, and monitoring Six Sigma project progress (Henderson & Evans, 2000:269-270). Moreover, Antony and Banuelas (2002:21), found that a lack of top management support and commitment toward the Six Sigma implementation will simply jeopardise the time, energy, resources and enthusiasm behind this concept.

3.12.2 Culture change

Coronado and Antony (2002:93), contend that as a breakthrough management strategy, Six Sigma involves changing an organisations' traditional culture to enable its welcoming. A successful introduction of Six Sigma implementation requires a total organisation culture shift, where a transfer of the responsibility regarding product process quality is given to employees (Antony and Banuelas, 2002:21).

The research of Kwak and Anbari (2006:713), assert that factors such as: communication channel, overcoming resistance to chance, and education of senior management, employees, and customers on Six Sigma benefits are required for the cultural change of individuals reluctant to the Six Sigma implementation programme. “Six Sigma initiatives require the right mind set and attitude of people working within the organisation at all levels. The people within the organisation must be made known and be aware of the need to change. Companies that have been successful in managing change have identified that the best way to tackle resistance to change is through increased sustained communication, motivation and education” (Antony & Banuelas, 2002:22).

3.12.3 Communication

Henderson and Evens (2000:277), propose that the cultural change that requires Six Sigma introduction and its implementation brings two fundamentals fears: fear of change and fear of not keeping up with the new standard. A good communication plan addressing Six Sigma methodology, the benefits of it and how it is related to people’s work is an important way to reduce or drive out reluctance to change (Banuelas & Antony, 2002: 94).

Banuelas and Antony (2002: 94) citing Air Academy Associates (1998), state the following: “When Six Sigma was launched in Sony Electronics, as a part of the communication plan, slogans such as ‘show me the data’ were frequently seen on internal magazines and pins worn by employees. The idea was to communicate a new management style based on facts and data as Six Sigma claims”. Communicating or publishing the success and Six Sigma setbacks project implementation will help a business project team to identify best practices and avoid mistakes during future projects (Antony & Banuelas, 2002:22; Coronado & Antony, 2002 94; Kwak & Anbari, 2006:712-713).

3.12.4 Organizational infrastructure

The main reason why only 10% of TQM implementation succeeded, was the lack of tangible infrastructure to support its introduction. On the other hand, Six Sigma provides an adequate organisational structure with a clear role and responsibility to ensure success when implementing this approach. Refer to 3.9 for a detailed analysis regarding the Six Sigma organizational infrastructure.

3.12.5 Training

According to Coronado and Antony (2002:94), one can become more knowledgeable by learning that is one of the critical factors to ensure the success of Six Sigma Implementation. Pyzdek (2000: online), proposes that basis skills should be provided to all employees to ensure that relevant literacy and numeracy skills are processed by everyone. Literacy and numeracy skills will allow employees to grasp the fundamental principle behind the tools and techniques of Six Sigma during training sessions (Kwak & Anbari, 2006:713).

There is usually a hierarchy of experts denoted by the belt systems (refer to 3.9) who receive special training on Six Sigma principles and thereafter spread this within an organisation to ensure that everyone speaks the same language during projects selection, execution, completion and implementation (Antony & Banuelas, 2002:22).

3.12.6 Project management skills

Due to the fact that most of the Six Sigma projects failed as a result of a poor project management knowledge and a lack of meeting roles and responsibilities, it would be wise for a project team to possess project management skills that will allow them to meet the milestones of different project phases (Antony & Banuelas, 2002:22).

3.12.7 Project prioritisation and selection, reviews and tracking

The selection of the Six Sigma project has to be a well thought of and careful process because a wrong selecting approach will delay results and increase time, money and frustration (Antony, 2006:243; Antony & Banuelas, 2002:22). For an effective completion of a Six Sigma project, champions, BB, GB, and project managers have to look at some critical elements of project management such as: Time, Cost, and Quality because these elements will help them to identify the project scope, objectives, and resources needed to accomplish a project at a very competitive cost, in order to meet specific business objectives (Banuelas & Antony, 2002:98). The research of Antony (2006:243), provides some useful criteria that should be looked at when selecting a Six Sigma project. These criteria are listed below:

- Top management must support, select and approve projects.
- Linking projects to strategic business goals.
- Select projects that can be achieved within a six months time frame.
- The project objectives must be clear, achievable, and measurable.
- Project selection should be linked to business benefits, feasibility criteria, and organisational impact.
- Select projects based on realistic and good metrics (DPMO, sigma level).
- Select a project that will impact on a process, customer or business.

A project review system is another means to assess the status of the Six Sigma project in order to ensure its completion and closure (Kwak and Anbari, 2006:712). The project review phase enables the Six Sigma catalysts to ensure the following:

- The Six Sigma methodology is followed effectively by BB and GB and YB.
- Champions identified BB and GB setbacks for project progress (Antony & Banuelas, 2002:23).

Moreover, a tracking mechanism of projects and documentation should be put in place to ensure that all completed, accepted and implemented projects can be tracked for further references in terms of projects constrains and best practices (Antony & Banuelas, 2002:23; Kwak & Anbari, 2006:712).

3.12.8 Understanding the Six Sigma methodology, tools and techniques

According to Antony and Banuelas (2002:23), most of the Six Sigma training involves the rationale behind the DMAIC methodology, the tools and techniques for process improvement. Refer to 3.7 and 3.8 for a detailed analysis regarding these critical success factors of Six Sigma implementation.

3.12.9 Linking Six Sigma to business strategy

The overall goal of every business organisation is to make profit and this can be achieved by substantial cost saving generated from the reduction of process variation which implies 3.4 DPMO. This means fewer customer complaints, lower quality and production costs, and finally higher income (Coronado & Antony, 2002: 95-96). This is what Six Sigma is striving to achieve (Ingle & Roe, 2002:274).

Six Sigma cannot be treated as another isolated activity; therefore the link between Six Sigma project and business has to be obvious so that the result illustrates a fully integrated philosophy into a business culture rather than just a limited usage of few tools and techniques (Antony & Banuelas, 2002:23 cited by Dale, 2002). This has to be demonstrated in monetary terms and how it can be used to strengthen the business strategy (Coronado & Antony 2002:96).

3.12.10 Linking Six Sigma to the customer

Customer satisfaction is an ultimate goal for business survival, and Six Sigma is revolves around the concept of critical to quality characteristics (most important attributes to customer) (Servicebazaar, 2005: online). Critical to Customer characteristics can be quantified by the means of a tool called QDF, which translates the needs and customer requirements into engineering language that lead to customer satisfaction (Antony & Banuelas, 2002:43). Antony and Banuelas 2002:23), put forward that one of the key elements for Six Sigma project success is the ability to link this to customer needs. Therefore, all projects should begin with the determination of customer requirements which everyone in the value chain should strive to achieve (Antony & Banuelas, 2002:23 citing Harry and Schroeder, 2000).

3.12.11 Linking Six Sigma to Human Resources

A human resource based action is needed to be put in place in order to promote desired actions and results, thereby ensuring the long term requirement of 3.4 DPMO of Six Sigma goal (Henderson & Evens, 2000:275). The study of Antony and Banuelas (2002:23) citing Harry and Schroeder (2000), states that 61% of top Six Sigma companies have linked reward schemes to business strategy while underperforming organisation did not emphasise this linkage too much.

Henderson and Evens (2000:276), state the following: “Any employee at GE Appliances who wants to be considered for promotion must be Six Sigma green belt – trained. This also includes senior executives (Hendricks and Kelbaugh, 1998). In fact, across all GE businesses, no one will be promoted without the full Six Sigma training and a completed project. This in itself is an impressive behaviour driver”.

Adding a specific Six Sigma section to the annual performance evaluation form and awarding executive compensation based on Six Sigma goals attainment are two other reasons for linking Six Sigma to human resources (Henderson & Evans, 2002:276-277).

3.12.12 Linking Six Sigma to suppliers

Most business organisations using Six Sigma cannot operate without outsourcing some raw materials or services that will be used in the processing of products or services. With regard to this, extending Six Sigma to suppliers becomes a necessity to ensure that variability will be reduced, in order to fulfil the needs of customer requirements (Coronado & Antony, 2002:97). To achieve this, Six Sigma companies must ensure the following:

- Supplier must actively participate in the dynamic of culture change that comes with Six Sigma, by getting upfront support from their leadership (Antony & Banuelas, 2002:23).
- A criteria selection of suppliers based on an acceptable Six Sigma performance capability level will make certain that only those with a Six

Sigma culture can be part of the value chain, and for that reason deliver raw materials (Coronado & Antony, 2002:97 cited by Pande *et al*,. 2000); (Antony & Banuelas, 2002:23).

Given the interdependence between an organisation and its suppliers, a solid mutually beneficial relationship will enhance the ability of both to create value that will lead to a bottom line of customer satisfaction.

3.13 CONCLUSION

This chapter discloses a theory gathered from various literatures sources in connection to the research problem. The Six Sigma origin, definition, benefits and differences with other quality initiative were uncovered. Top management involvement and commitment, culture change, communication, organisation infrastructure, training, project management skill, project prioritisation and selection, reviews and tracking, understanding the Six Sigma methodology, tools and techniques, linking Six Sigma to business strategy, linking Six Sigma to human resource and linking Six Sigma to supplier were identified as the critical success factors for implementing a Six Sigma programme within an organisation.

Having an appropriate theory on Six Sigma definition and implementation requirements simply allows the student researcher to look forward to the next chapter, which will tackle the research survey, design and methodology.

CHAPTER 4: RESEARCH DESIGN AND METHODOLOGY

4.1 INTRODUCTION

The previous chapter reviewed the literature pertaining to the key elements for the successful implementation of the Six Sigma approach. The current chapter focuses on the limitation of the survey, and the research design and methodology which outlines the process used to obtained the data. This chapter also looks at the research design, the population, the sampling type, the data collection instrument, and finally, ethical considerations pertaining to this study.

4.2 THE SURVEY ENVIRONMENT

To achieve operational and service excellence, SA organisations embarked on numerous quality improvement programmes such as: Total Quality Management, ISO 9001:2008, Quality Circle, Just in Time, the SA excellence model and the Six Sigma. The main areas of activities prevailing in SA can be classified into manufacturing or service organisations. However the specific industry sectors in which SA organisations perform are:

- Aerospace.
- Consultation.
- Finance.
- Petroleum.
- Automotive.
- Education.
- Food services.
- Utilities.
- Chemical.
- Electronics.
- Government.
- Transportation.
- Computer / Software.
- Consumer goods.

- Hospitality.
- Telecommunications.

The research was limited to the Western Cape organisations using Six Sigma quality management. Furthermore, the questionnaires were directed to personnel with knowledge of Six Sigma.

4.3 AIM OF THIS CHAPTER

The aim of this chapter and the survey contained therein is to determine the key factors associated with the implementation of Six Sigma in SA business organisations; the critical objective being to solve the research problem as defined in Chapter 1, Paragraph 1.3, which reads as follows:

"South African enterprises who implement Six Sigma, do not consider critical implementation issues associated with the concept, resulting in either an inefficient implementation or a product that does not deliver on expectations".

4.4 THE TARGET POPULATION

According to Watkins (2008:54), a population can be defined as the total number of people that represent the main subject of research interest. The target population for this research was selected from organisations that implemented Six Sigma within the Western Cape Province. These organisations were identified from various sources:

- The Six Sigma South Africa website (www.sixsigmasouthafrica.co.za).
- A personal investigation across the Cape Town organisations.
- Previous reports with regard to Six Sigma available at the Cape Peninsula University of Technology.

The questionnaires were distributed physically and by means of email by the student researcher.

4.5 THE CHOICE OF SAMPLING METHOD

A sample is a portion of a population under consideration for the purpose of the research (Collis and Hussey, 2003:155-160). According to Burns and Grove (1997:365), the selected sample should have similar characteristics to the population under study, to make possible the derivation of the results that will represent the population. For the purpose of this study, random sampling was used. This is when all members of a population have equal chance of being selected (Watkins, 2008:54). In this study, 30 respondents were selected by unsystematic or random distribution of questionnaires.

4.6 DATA COLLECTION

Data collection is a means by which a researcher collects reliable information in order to meet the research objectives. For this research study, a questionnaire served as a data collection method. A questionnaire is a technique designed to obtain reliable responses by providing to respondents a list of carefully structured questions chosen after considerable testing. Questionnaires form part of the wider definition of 'survey research'. A 'survey' is defined by Remenyi *et al.* (2002:290), as: "…the collection of a large quantity of evidence usually numeric, or evidence that will be converted to numbers, normally by means of a questionnaire."

Two approaches can be referred to in order to structure questions:

- 'closed ended questions'
- 'opened ended' questions.

'Closed ended questions' were used in the questionnaire because this technique implies a quantitative research approach and allows respondents to quickly rate a list of well structured questions with predetermined answers.

The data was collected over a period of two months. The questionnaires were sent to Six Sigma organisations and personnel (having knowledge of Six Sigma) across the Western Cape Province. A total of 22 respondents confidently replied.

4.7 MEASUREMENT SCALES

The survey used in the research was based on the well-known Likert scale, where respondents were asked to respond to a question or statement. When using the Likert scale, respondents are asked to respond to each of the statements by choosing one of the five agreement choices listed below:

- Strongly Agree.
- Agree.
- Undecided.
- Disagree.
- Strongly Disagree.

The advantages of using the popular Lickert scale according to Emory and Cooper (1995:180-181) are:

- Easy and quick to construct.
- Each item meets an empirical test for discriminating ability.
- The Lickert scale is probably more reliable than the Thurston scale, and it provides a greater volume of data than the Thurston differential scale.
- The Lickert scale is also treated as an interval scale.

According to Remenyi, Money & Twite (1995:224), interval scales facilitate meaningful statistics when calculating means, standard deviation and Pearson correlation coefficients.

4.8 SURVEY DESIGN

Watkins (2008:140), is of the opinion that the prevailing survey design used in the world of business and management belongs to ‘descriptive survey’. Leedy & Ormrod (2001:196), state that: “a survey is simple in design; poses a series of questions to willing participants; summarises their responses with percentages, frequency count, or more sophisticated statistical indexes; and then draws interferences about a particular population from the responses of the sample”. The questionnaire of the survey was designed after a critical evaluation of the research title, the research question, the investigative (sub-) questions, and the key research objectives. Moreover, the questionnaire was designed in such away so as to enable the student researcher to mitigate the research problem, to answer to the research question and associated investigative (sub-) questions, and to accomplish the primary research objectives of the research study.

The statements or questions within the survey were designed with the following principles in mind:

- Avoidance of double-barreled questions or statements.
- Avoidance of double-negative questions or statements.
- Avoidance of prestige bias.
- Avoidance of leading questions or statements.
- Avoidance of the assumption of prior knowledge.

4.9 THE VALIDATION SURVEY QUESTIONS

The author has developed a survey questionnaire reflecting the research problem to be uncovered. Polit and Hungler (1999:445), suggest that validity of an instrument refers to the point that a tool measures what it is projected to quantify. In order to achieve content validity during the survey, the questions or statement questions were derived from a literature review which underpinned the area under investigation. The questionnaire was also reviewed and approved by the promoter.

4.10 RESPONDENT BRIEFING

Prior to the collection of data, the author clearly explained the purpose of the study to each respondent. Each participant was given the choice to participate or not. The nature and quality of the participants' performance was guaranteed to be kept confidential. Finally, participants were toll that data could not be fabricated to support a particular conclusion; therefore their honest contribution was critical to ensure that their assistance became useful data.

4.11 SURVEY QUESTIONS

The questionnaire was directed to personnel in the Western Cape who had knowledge of Six Sigma. The questionnaire consisted of two sections. The first section looked at the respondent and organisational demographics and included the following:

- The sector of activities.
- The total number of employees.
- When they started using Six sigma.
- The job title and employment interval of the respondent.

The second section consisted of a list of questions and statements with regard to Six Sigma practices within the respondent's organisation as listed below:

Table 4.1: Research Questionnaire. (**Sourc**e: Own source).

The reasons for implementing Six Sigma.	**To what extent do you agree with each of the statements below?** ➢ To reduce cost. ➢ To improve customer satisfaction. ➢ To improve product /Service quality. ➢ To improve company reputation and much more.
The Key personnel driving Six Sigma.	**To what extent do you agree with each of the statements below?** ➢ Our organization has appointed a Six Sigma Champion. ➢ Our organization uses a Black belt on full time basis. ➢ We also involve a process leader and employees during Six Sigma projects.
The Six Sigma methodology	**To what extent do you agree with each of the statements below?** ➢ We always use the DMAIC methodology during process improvement project. ➢ We consider the DFSS methodology when redesigning a project.
Mechanism in place to ensure Six Sigma Success.	**To what extent do you agree with each of the statements below?** ➢ A communication channel has been put in place to ensure a general awareness of Six Sigma principles. ➢ All the people involved in Six Sigma project have received adequate training. ➢ Six Sigma has been linked to all the Stakeholders. ➢ A reward scheme has been linked to everyone involved to Six Sigma project**.**

Top management commitment to Six Sigma.	**To what extent do you agree with each of the statements below?** ➢ Employees are encouraged to participate when implementing Six Sigma. ➢ The leadership is committed and dedicated on project selection and review as well as on provision of resources. ➢ Leadership does not support activities and investment that have long-term benefits. ➢ Senior executives accommodate and encourage change**.**
Key elements for Six Sigma implementation.	**To what extent do you agree with each of the statements below?** ➢ Top management involvement and commitment. ➢ Culture Change. ➢ Communication. ➢ Organization infrastructure. ➢ Training. ➢ Project management skill. ➢ Project selection and prioritization, review and tracking. ➢ Linking Six Sigma to suppliers. ➢ Linking Six Sigma to business strategy. ➢ Linking Six Sigma to customer. ➢ Linking Six Sigma to Human resource. ➢ Understanding of Six Sigma methodology, Tools and Techniques.
The Six Sigma tools and techniques.	**To what extent do you agree with each of the statements below?** ➢ We are using Six Sigma tools and techniques in a well disciplined manner at each stage of the DMAIC ➢ We are using the basic quality control tools of Six Sigma. ➢ We often rely on quality techniques to solve problems
The most used tools and techniques of Six Sigma in your organisations.	**To what extent do you agree with each of the statements below?** ➢ Cause and effect diagram ➢ Check sheet ➢ Control chart ➢ Graphs ➢ Histogram ➢ Pareto diagram ➢ Scatter diagram ➢ Brainstorming ➢ Flow chart ➢ Hypothesis testing ➢ Process mapping ➢ Questionnaires ➢ Sampling ➢ Gant chart ➢ SERVQUAL ➢ Regression and correlation analysis ➢ Project team charter ➢ Benchmarking

	➢ Design of experiment ➢ Failure mode and effects analysis (FMAEA) ➢ Fault tree analysis ➢ Process capability analysis ➢ Poka joke ➢ Problem solving methodology ➢ Kano model ➢ Quality function deployment (QFD) ➢ Statistical process control ➢ Quality improvement team ➢ SIPOC ➢ Quality costing

4.12 CONCLUSION

In this chapter, the limitation of the survey was elaborated on. The target population was defined, and the type of sampling was discussed. An overview of the survey design was provided as well as the reasons for using the Lickert scale. This chapter was completed with an in-depth illustration of the respondent briefing and a list of questions posed in the survey.

In Chapter 5, results from the survey will be analysed in detail and interpreted.

CHAPTER 5: DATA ANALYSIS AND INTERPRETATION OF RESULTS

5.1 INTRODUCTION

Data analysis is "the process of bringing order, structure and meaning to the mass of collected data" (De Vos, 2002:339). This chapter discusses the statistical analysis of the questionnaire compiled by L. Nguenang for the purpose of obtaining the qualification Magister Technologiae: Quality in the Faculty of Engineering at the Cape Peninsula University of Technology. The aim of this study is to determine whether a single alternate process can be developed for the implementation of Six Sigma to ensure successful implementation thereof in South African enterprises. In this chapter the data obtained from the completed questionnaires will be presented and analysed.

In most social research the analysis entails three major steps done in the following order:

- Cleaning and organising the information that was collected which is called the data preparation step;
- Describing the information that was collected (Descriptive Statistics); and
- Testing the assumptions made through hypothesis and modeling (Inferential Statistics).

The responses to the questionnaire developed by the researcher for the purpose of obtaining information regarding the benefits of the implementation of the Six Sigma quality management system in SA enterprises; the tools and techniques necessary for the sustainability of Six Sigma in SA industries; and the factors that can influence Six Sigma implementation in the context of the SA business environment have been analysed using SAS software.

5.2 METHOD OF ANALYSIS

5.2.1 Validation of the survey results

A descriptive analysis of the survey results returned by the research questionnaire respondents, are reflected below. The responses to the questions obtained through the questionnaires are indicated in table format for easy reference. Data validation is the process of ensuring that a programme operates on clean, correct and useful data. The construct validation however can only be taken to the point where the questionnaire measures what it is suppose to measure. Construct validation should be addressed in the planning phases of the survey and when the questionnaire is developed. These questionnaires are supposed to measure the potential benefits of implementing Six Sigma in SA enterprises, the key driving factors for the sustainability of Six Sigma in SA enterprises, the tools and techniques of Six Sigma prevailing in SA enterprises and the extent to which Six Sigma methodology is used in SA enterprises.

5.2.2 Data format

The data, which was received in questionnaires format, was coded and captured on a database that was developed on Microsoft Access for this purpose. These questionnaires are captured twice and then the two datasets are compared to make sure that the information captured was done correctly. When the database was developed, rules are used with respect to the questionnaire that set boundaries for the different variables (questions). For instance the Likert scale is used as follows:

- Strongly disagree is coded as 1
- Disagree is coded as 2
- Undecided is coded as 3
- Agree is coded as 4
- Strongly agree is coded as 5.

A boundary is set on Microsoft Access as less than 6. This means if the number 6 or a number more than 6 is captured, an error will show until a number less than 6 is captured. It was then imported into SAS-format through the SAS ACCESS module. This information which was double checked for correctness is then analysed by the custodian of this document.

5.2.3 Preliminary analysis

The reliability of the statements in the questionnaire, posed to small businesses enterprises in Western Cape, South Africa, is measured using the Cronbach Alpha tests (see Paragraph 5.3.1). An uni-variate descriptive analysis was performed on all the original variables, displaying frequencies, percentages, cumulative frequencies, cumulative percentages, means, standard deviations, range, median, mode, etc. These descriptive statistics are discussed in Paragraphs 5.3.2 and 5.3.3. (See also computer printouts in Appendix B & C).

5.2.4 Interferential statistics

Inferential statistics used are:

- Cronbach Alpha test. Cronbach's Alpha is an index of reliability associated with the variation accounted for by the true score of the "underlying construct". Construct is the hypothetical variables that are being measured (Cooper & Schindler, 2001:216-217). Another way to put it would be that Cronbach's Alpha measures how well a set of items (or variables) measures a single uni-dimensional latent construct. When data has a multidimensional structure, Cronbach's Alpha will usually be low.
- Chi-square tests for nominal data. The Chi-square (two-sample) tests are probably the most widely used nonparametric test of significance that is useful for tests involving nominal data, but it can be used for higher scales as well like cases where persons, events or objects are grouped in two or more nominal categories such as 'yes-no' or cases A, B, C or D. The technique is used to test for significant differences between the observed distribution of data among categories and the expected distribution based on the null hypothesis. It has to be calculated with actual counts rather than percentages (Cooper & Schindler, 2001:499).
- The SAS software computes a P-value (probability value) that measures statistical significance when comparing variables with each other, determining relationship between variables or determining association between variables. Results will be regarded as significant if the p-values are smaller than 0.05, because this value presents an acceptable level on a

95% confidence interval ($p \leq 0.05$). The p-value is the probability of observing a sample value as extreme as, or more extreme than, the value actually observed, given that the null hypothesis is true. This area represents the probability of a Type 1 error that must be assumed if the null hypothesis is rejected (Cooper & Schindler, 2001:509).

- The p-value is compared to the significance level (α) and on this basis, the null hypothesis is either rejected or not rejected. If the p value is less than the significance level, the null hypothesis is rejected (if p value $<\alpha$, reject null). If the p value is greater than or equal to the significance level, the null hypothesis is not rejected (if p value $\geq\alpha$, do not reject null). Thus with $\alpha=0.05$, if the p value is less than 0.05, the null hypothesis will be rejected. The p value is determined by using the standard normal distribution. The small p value represents the risk of rejecting the null hypothesis.
- A difference has statistical significance if there is good reason to believe the difference does not represent random sampling fluctuations only. Results will be regarded as significant if the p-values are smaller than 0.05, because this value is used as a cut-off point in most behavioural science research.

5.2.5 Assistance to researcher

The conclusions made by the researcher were validated by the statistical report. Help was given to interpret the outcome of the data. The final report written by the researcher was validated and checked by the statistician to exclude any misleading interpretations. All inferential statistics are discussed in Paragraph 5.3.4.

5.2.6 Sample

The target population is employees of industries which uses Six Sigma quality management system in the Western Cape, South Africa. A sample was drawn from the target population and the sample realisation was randomly selected.

Twenty two employees from various Six Sigma organisations in the Western Cape effectively responded.

5.3 ANALYSIS

In total, 22 respondents from various Six Sigma organisations in the Western Cape completed the questionnaire. Descriptive statistics will be given for each variable and only the respondents who completed the entire questionnaire, will be used in the inferential statistics.

5.3.1 Reliability testing

Reliability tests (Cronbach's Alpha Coefficient) are done on the questions/statements (which is the measuring instrument in this case) posed to industries. The Cronbach's Alpha Coefficients for each item are more than 0.70 (the acceptable level according to Nunnally, 1978**:** 245), and thus these items (statements) in the questionnaire, prove to be reliable and consistent for all the items in the scale.

The results of the Cronbach Alpha tests for the raw variables are shown in Annexure E (Table 5.1), and Annexure A. It shows the correlation between the respective item and the total sum score (without the respective item) and the internal consistency of the scale (coefficient alpha) if the respective item would be deleted. By deleting the items (statements) one by one each time with the statement with the highest Cronbach Alpha value, the Alpha value will increase. In the right-most column of Table 5.1 (Annexure E), it can be seen that the reliability of the scale would be higher if any of these statements is deleted.

For instance, if statement B34 is deleted from this measuring scale then the Cronbach Alpha Coefficient will increase to 0.9563. This however is not needed as the alpha for each item is greater than 0.70.

Due to the voluminous nature of Table 5.1, for ease of reference, it will be contained within the ambit of Annexure E.

5.3.2 Descriptive statistics

Due to the voluminous nature of Tables 5.2 and 5.3, for ease of reference, they will be contained within the ambit of Annexure F.

Table 5.2 (Annexure F) shows the descriptive statistics for all the categorical demographic variables as well as the variables measuring the quality of small businesses with the frequencies in each category and the percentage out of total number of questionnaires. Take note that the descriptive statistics are based on the total sample and are shown in Annexure B & C.

Table 5.3 (Annexure G) shows the descriptive statistics for all the categorical demographic variables in terms of the mean, median, standard deviation and range. Take note that the descriptive statistics are based on the total sample. These descriptive statistics are also shown in Annexure D.

5.3.3 Uni-variate graphs

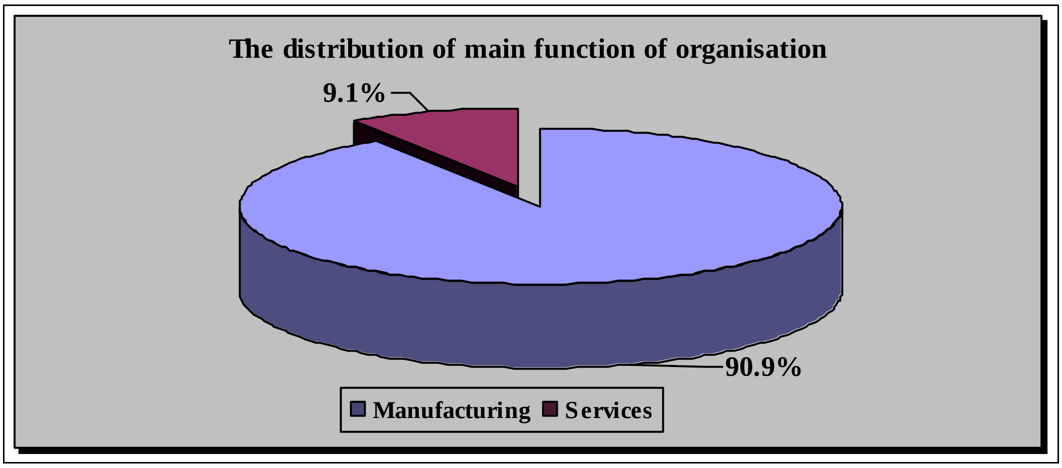

Figure 5. 1: Main function of organisation

The main function of the organisations that took part in this survey, is mostly manufacturing (90.9%).

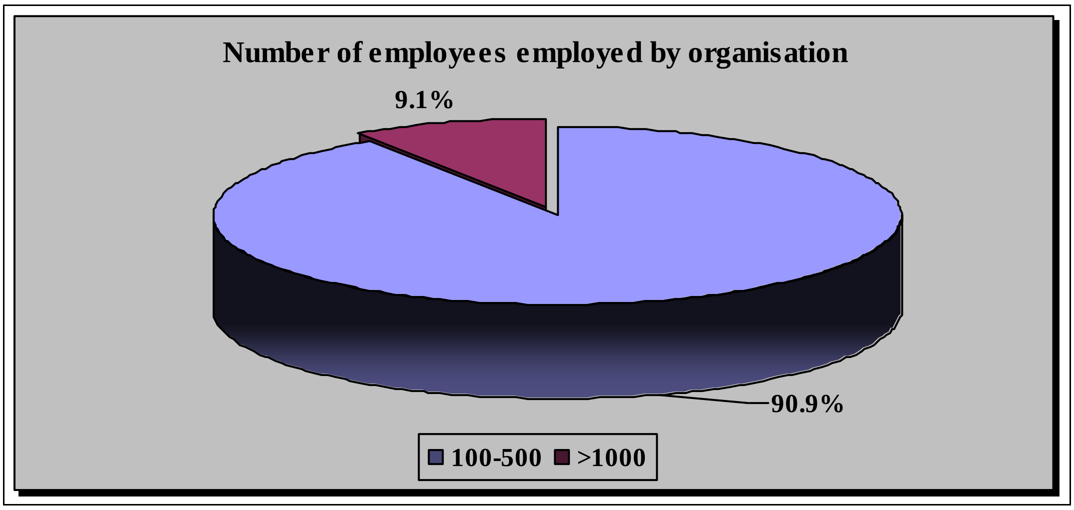

Figure 5. 2: Number of employees employed

Most of the organisations have 100-500 (90.9%) employees.

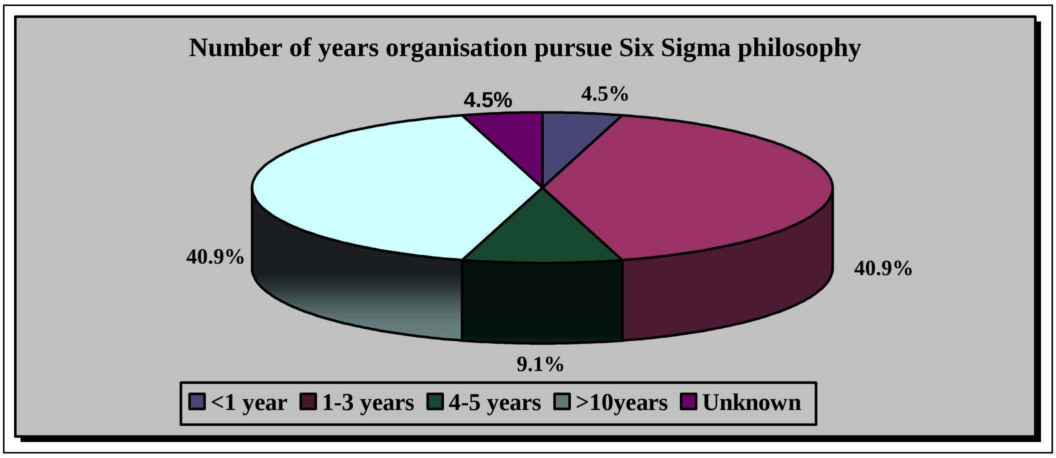

Figure 5. 3: Number of years organisation pursue Six Sigma philosophy

Just over 40 % of the respondents pursue Six Sigma Philosophy for more than 10 years and just 40% pursue Six Sigma Philosophy for one to three years. Nearly 10 % pursue the Six Sigma philosophy for four to five years.

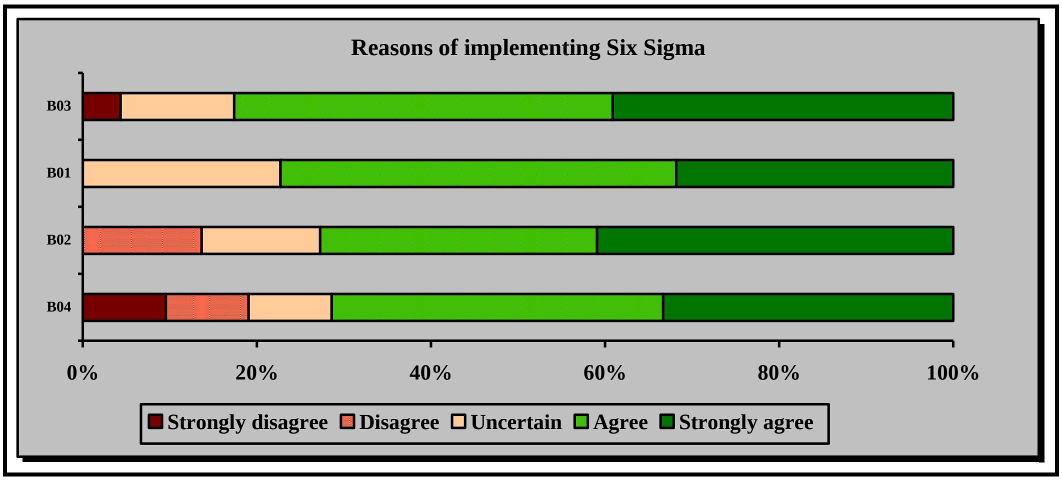

Figure 5.4: Reasons of implementing Six Sigma

The respondents' statements are sorted according to mostly agree to least agree with statement. The respondents agreed mostly with all the statements regarding the reasons for implementing Six Sigma in the organisation, but the following two statements they agreed with the most:

- To improve product/service quality (86.4% agree to strongly agree)
- To reduce cost (77.3% agree to strongly agree)

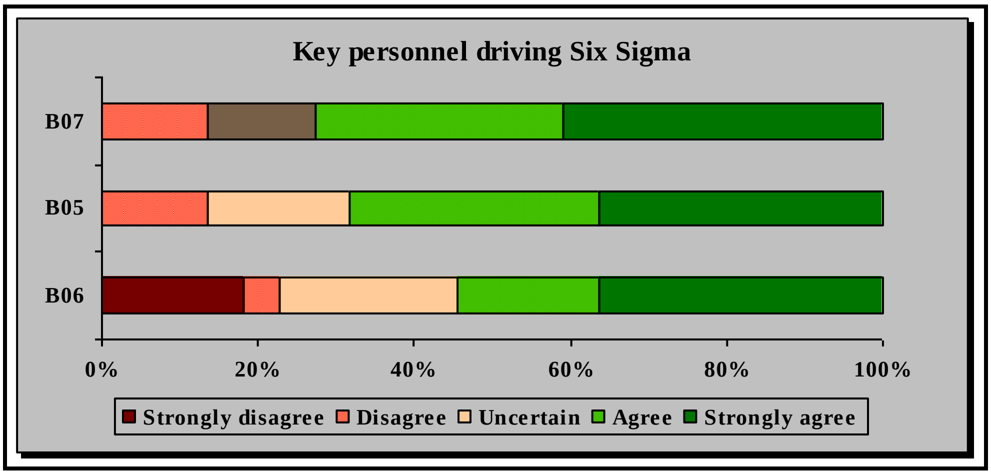

Figure 5.5: Key personnel driving Six Sigma

Most of the organisations (72.7% agree to strongly agree) involve a process leader and employees during Six Sigma projects.

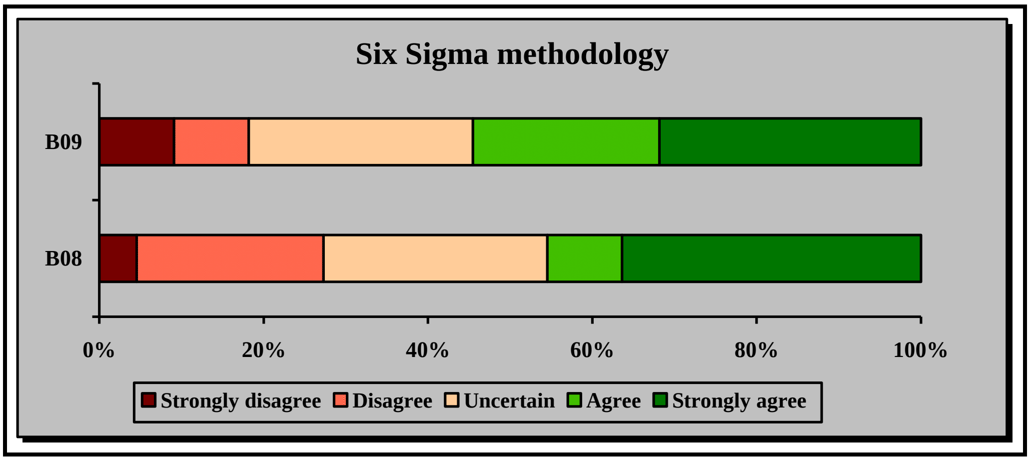

Figure 5.6: Six Sigma methodologies

The DFSS methodology, when redesigning a project is used in nearly 55% of the organisations and the DMAIC methodology is always used during process improvement of a project in 45% of the organisations. When a cross reference was made with regards to the two methodology statements (B08 and B09), it seems that 31.8% of the industries uses both methodologies, 13.6 % uses none of these methodologies, 13,6% was undecided and the rest use either one or the other when redesigning a project. This cross reference table can also be found in Annexure B.

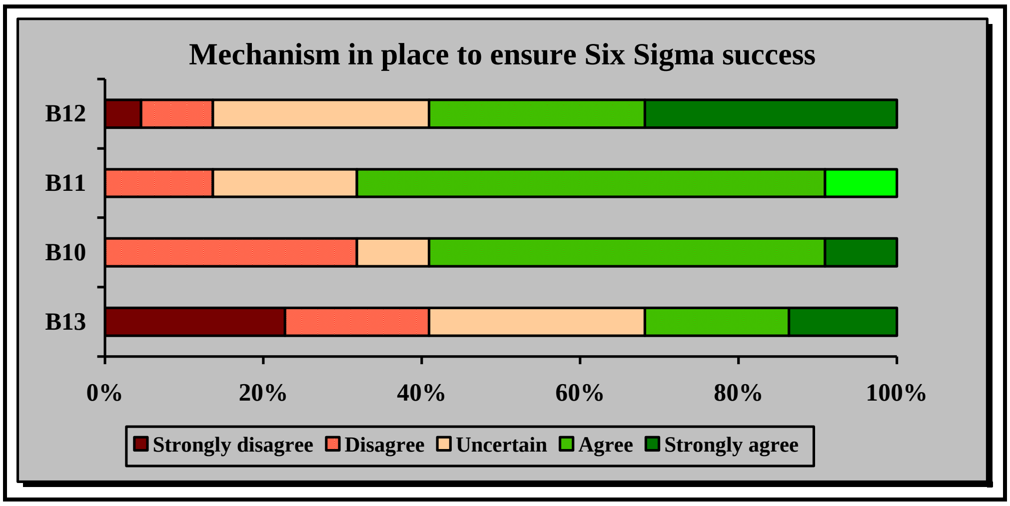

Figure 5.7: Mechanism in place to ensure Six Sigma successes

More of the respondents indicated that all the people involved in the Six Sigma project have received adequate training (68.2% agree to strongly agree) than respondents indicating that Six Sigma has been linked to all stakeholders (59.1%

agree to strongly agree). The total score however for the statement "Six Sigma has been linked to all stakeholders" is higher than the total score for the statement "All the people involved on Six Sigma project have received adequate training." The reason is that more respondents strongly agree with the first statement (31.8% strongly agree) than with the second statement (9.1% strongly agree).

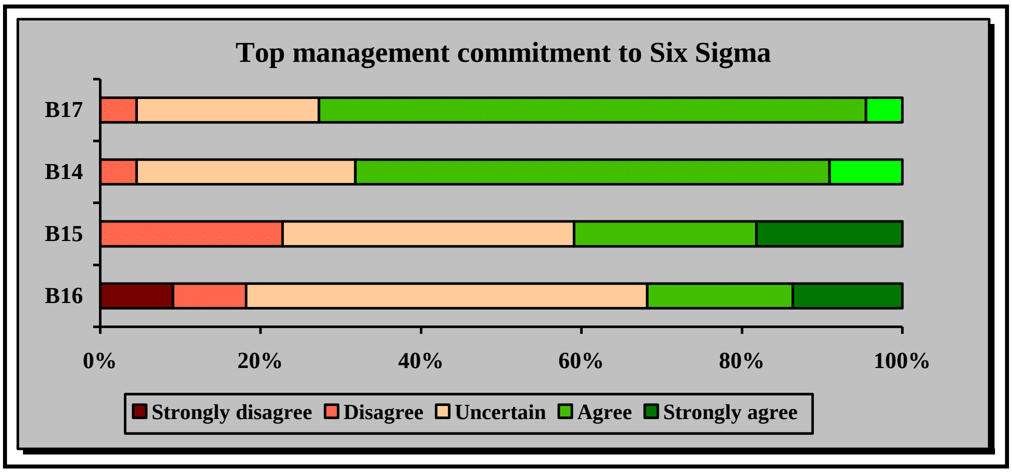

Figure 5.8: Top management commitment to Six Sigma

More respondents agreed with the following statements:

- Senior executives accommodate and encourage change (72.7% agree to strongly agree).
- Employees are encouraged to participate when implementing Six Sigma (68.2% agree to strongly agree).

Take note that a large percentage of the respondents (22% to 50%) were undecided with regard to the top management's commitment to Six Sigma.

The respondents agreed the least with the statement "Leadership does not support activities and investment that have long-term benefits."

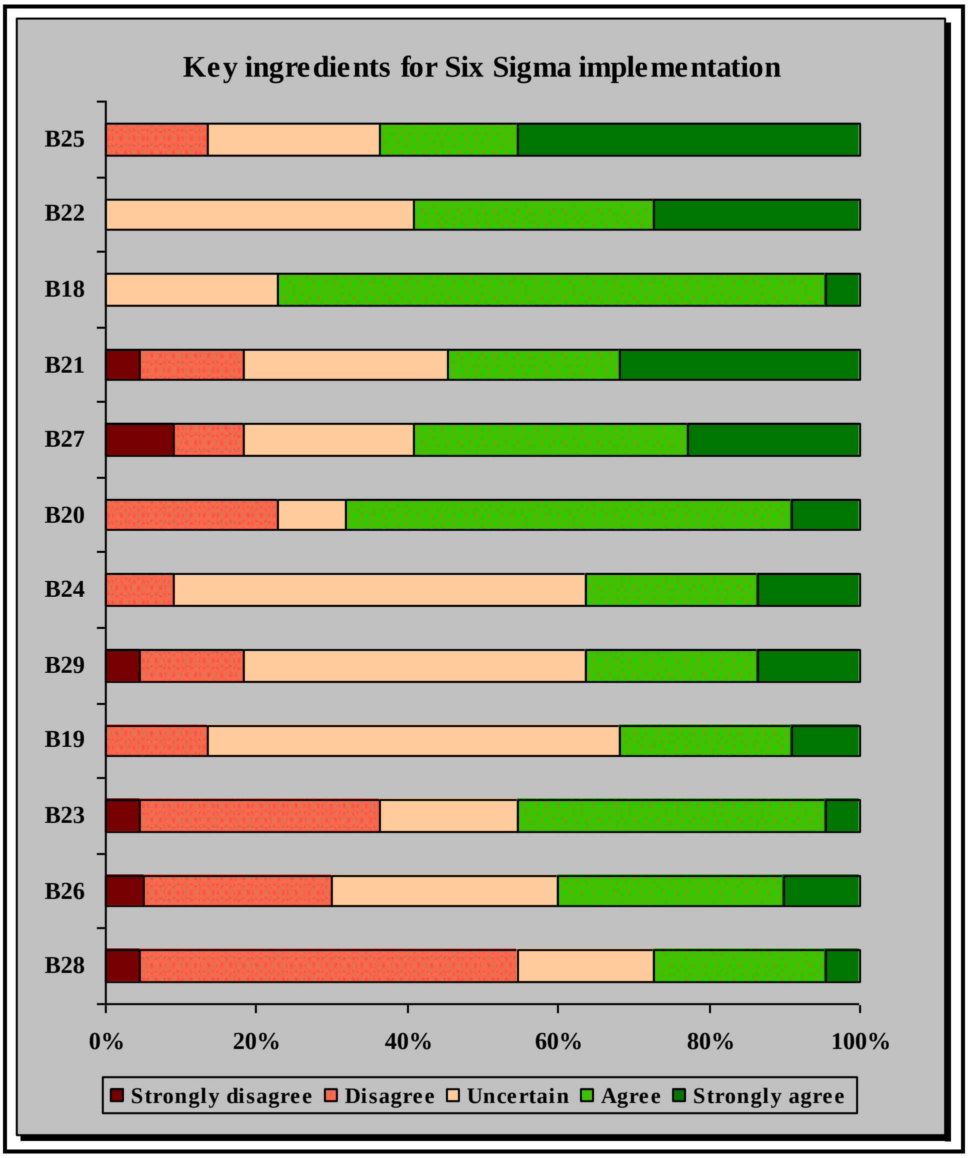

Figure 5.9: Key ingredients for Six Sigma implementation

The statements that the respondents scored the highest or agreed more with, regarding the key ingredients for Six Sigma implementation are:

- Understanding of Six Sigma methodology, tools and techniques (63.6% agree to strongly agree).
- Training (59.1% agree to strongly agree).
- Top management involvement and commitment (77.3% agree to strongly agree).
- Organisation infrastructure (54.6% agree to strongly agree).
- Linking Six Sigma to customer (59.1% agree to strongly agree).
- Communication (68.2% agree to strongly agree).

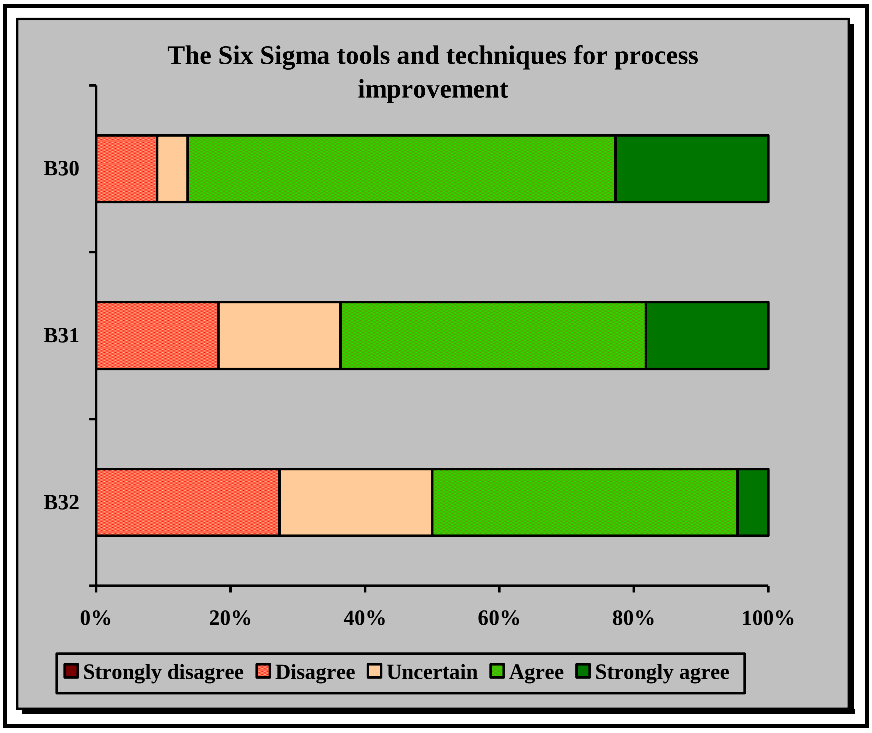

Figure 5.10: The Six Sigma tools and techniques for process improvement

The statement regarding tools and techniques for process improvement that was mostly agreed to by the respondents are "We are using the basic quality control tools of Six Sigma" (86.4% agreed to strongly agree).

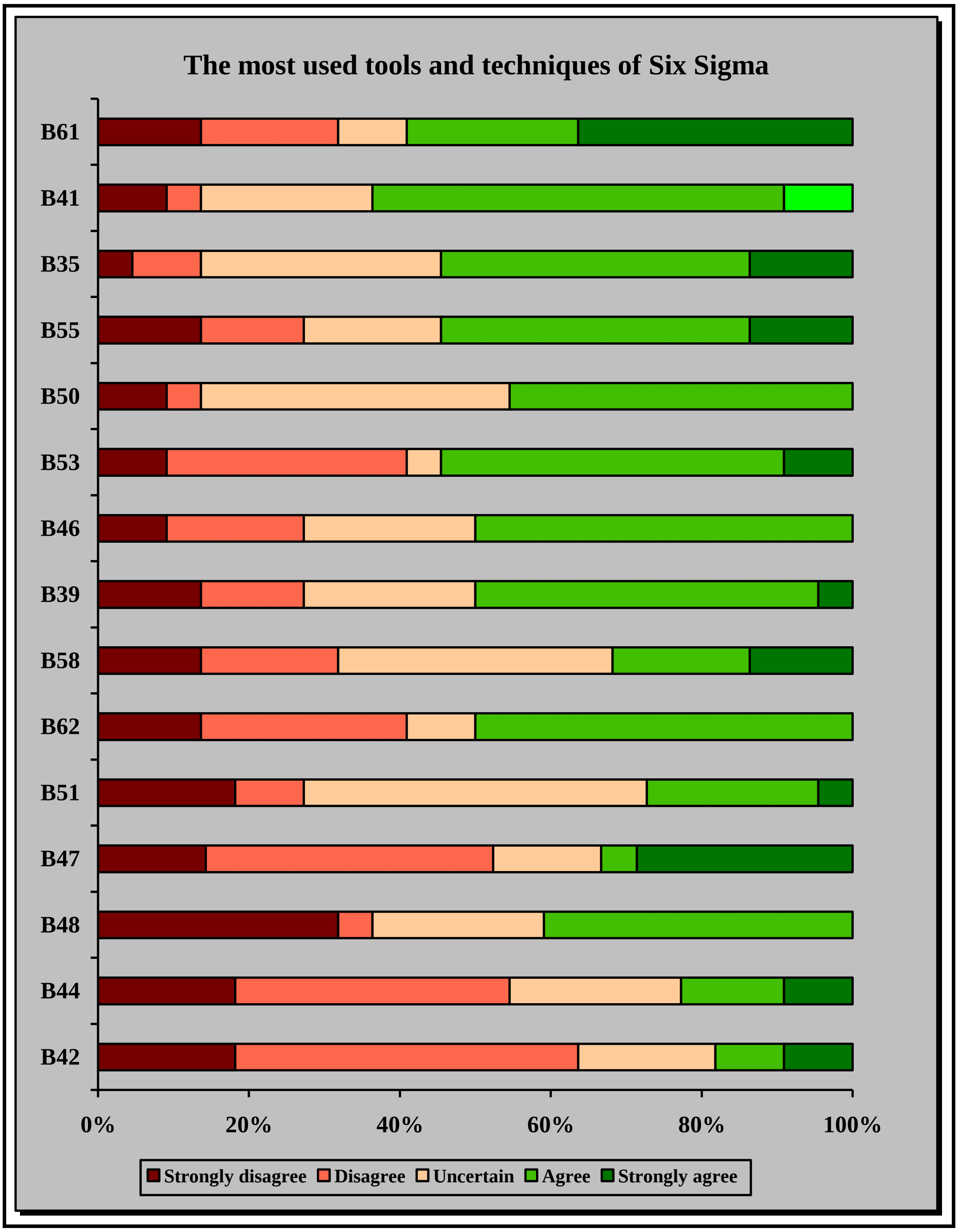

Figure 5.11: The most used tools and techniques of Six Sigma

Figure 5.11 shows the statements with regard to the most used tools or techniques of Six Sigma that the respondents least agreed with and Figure 5.12 shows the statement with which the respondents most agreed with.

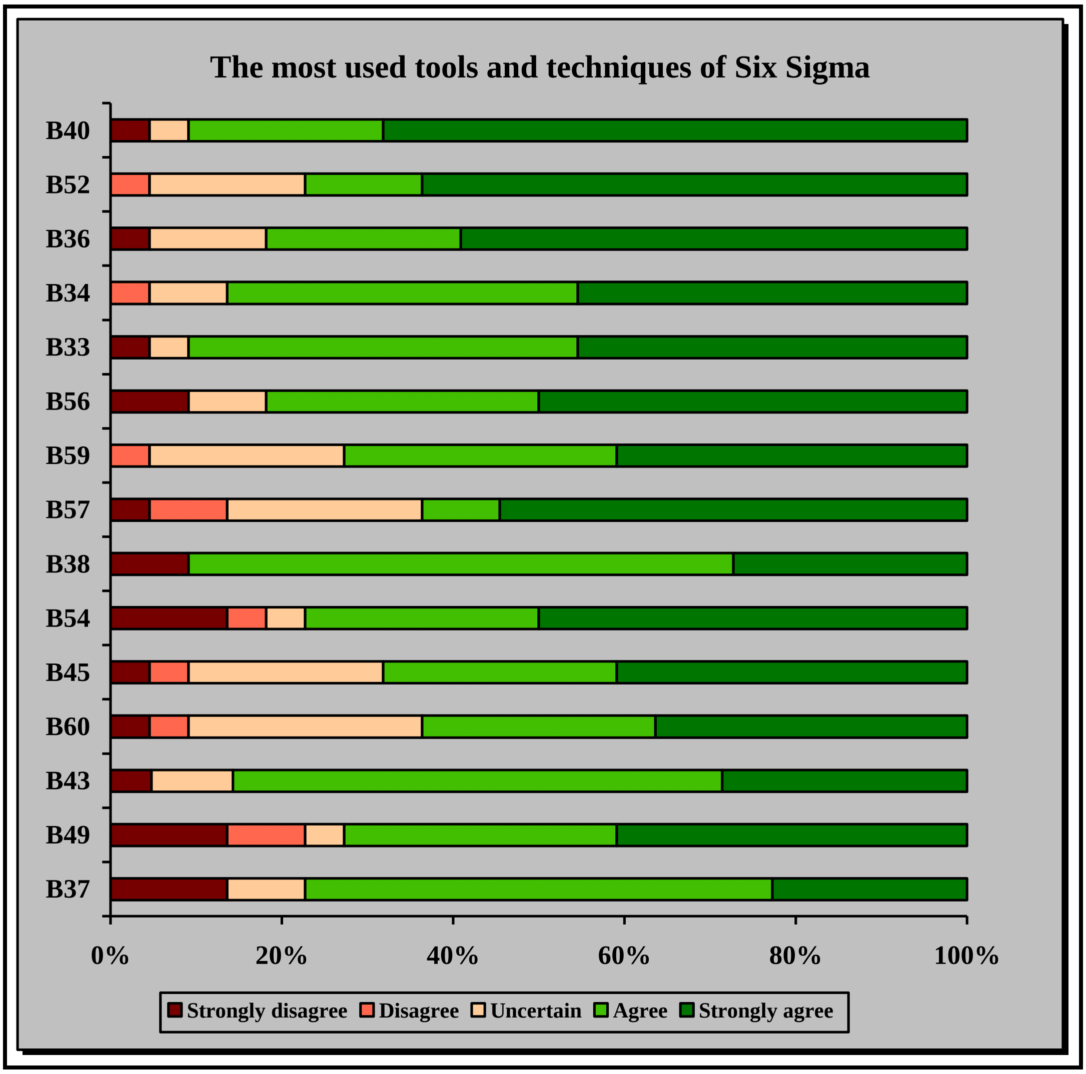

Figure 5.12: The most used tools and techniques of Six Sigma

The statements with regard to the most used tools or techniques that the respondents most agreed with are as follows:

- Brainstorming (90.9% agreed to strongly agree)
- Failure mode and effects analysis (77.3% agree to strongly agree).
- Graphs (71.8% agree to strongly agree).
- Check sheet (86.4% agree to strongly agree).
- Cause and effect diagram (90.9% agree to strongly agree).
- Problem solving methodology (81.8% agree to strongly agree).
- Statistical process control (72.7% agree to strongly agree).
- Quality costing (63.6% agree to strongly agree).
- Pareto diagram (90.9% agree to strongly agree).
- Process capability analysis (77.3% agree to strongly agree).
- Sampling (68.2% agree to strongly agree).

- Quality improvement team (63.6% agree to strongly agree).
- Process mapping (81.8% agree to strongly agree).
- Project team charter (82.7% agree to strongly agree)
- Histogram (76.3% agree to strongly agree).

5.3.4 Inferential statistics

The Pearson chi-square test was used to determine whether there were statistically significant differences in the proportion of respondents that agree with the proportion of respondents that disagreed with the statements. Due to the voluminous nature of Table 5.4, for ease of reference, will be contained within the ambit of Annexure H. Table 5.4 shows where statistically significant differences of proportions occurred.

Annexure B will show all the chi-square tests. Due to the fact that and expected frequency of 5 is necessary to use the Chi-square test, the groups that are more or less the same are aggregated. For instance "Strongly disagree" and "Disagree" are grouped together to form the category "Disagree". Thus with only 3 categories "Disagree", "Undecided" and "Agree" the expected frequency will be 22/3=7.14 which is more than 5.

The hypothesis being tested is as follows:

- H_0 = There is no difference between the proportions of responses with regard to the measuring instrument.
- H_1 = There is a difference between the proportions of responses with regard to the measuring instrument.

For all the mentioned statements in Table 5.4 (Annexure H), the H_0 hypothesis was rejected and it could be concluded that there is a difference between the proportions. Thus for the following statements, there were statistically significant more respondents who agree to strongly agree with the statement than respondents who were either undecided or disagree to strongly disagree:

- Implement Six Sigma to reduce cost (77.3% agree to strongly agree and 22.7% is undecided).
- Implement Six Sigma to improve customer satisfaction (72.7% agree to strongly agree, 13.6% is undecided and 13.6% disagree to strongly disagree).
- Our organisation has appointed a Six Sigma Champion (68.2% agree to strongly agree, 18.2% is undecided and 13.6% disagree to strongly disagree).
- The organisation also involves a process leader and employees during Six Sigma projects (72.7% agree to strongly agree, 13.6% is undecided and 13.6% disagree to strongly disagree).
- A communication channel has been put in place to ensure a general awareness of Six Sigma principles (59.1% agree to strongly agree, 9.1% is undecided).
- All the people involved in the Six Sigma project have received adequate training (68.2% agree to strongly agree, 13.6% disagree to strongly disagree).
- Six Sigma has been linked to all the stakeholders (59.1% agree to strongly agree, 13.6% disagree to strongly disagree).
- Employees are encouraged to participate when implementing Six Sigma (68.2% agree to strongly agree, 4.6% disagree to strongly disagree).
- Senior executives accommodate and encourage change (72.7% agree to strongly agree, 4.6% disagree to strongly disagree).
- Top management involvement and commitment (77.3% agree to strongly agree, 22.7% is undecided).
- Communication (68.2% agree to strongly agree, 9.1% is undecided).
- Understanding of Six Sigma methodology, tools and techniques (63.6% agree to strongly agree, 13.6% disagree to strongly disagree).
- Linking Six Sigma to customer (59.1% agree to strongly agree, 18.2% disagree to strongly disagree).
- We are using the basic quality control tools of Six Sigma (86.4% agree to strongly agree, 4.6% is undecided and 9.1% disagree to strongly disagree).

- We often rely on quality techniques to solve problems (63.6% agree to strongly agree, 18.2% is undecided and 18.2% disagree to strongly disagree).
- Cause and effect diagram as most used tool/technique (90.9% agree to strongly agree, 4.6% is undecided and 4.6% disagree to strongly disagree).
- Check sheet as most used tool/technique (86.4% agree to strongly agree, 9.1% is undecided and 4.6% disagree to strongly disagree).
- Graphs as most used tool/technique (81.8% agree to strongly agree, 13.6% is undecided and 4.6% disagree to strongly disagree).
- Histogram as most used tool/technique (77.3% agree to strongly agree, 9.1% is undecided and 13.6% disagree to strongly disagree).
- Pareto diagram as most used tool/technique (90.9% agree to strongly agree, 9.1% disagree to strongly disagree).
- Brainstorming as most used tool/technique (90.9% agree to strongly agree, 4.6% is undecided and 4.6% disagree to strongly disagree).
- Flow chart as most used tool/technique (63.6% agree to strongly agree and 13.6% disagree to strongly disagree).
- Process mapping as most used tool/technique (81.8% agree to strongly agree, 9.1% is undecided and 9.1% disagree to strongly disagree).
- Sampling as most used tool/technique (68.2% agree to strongly agree and 9.1% disagree to strongly disagree).
- Project team charter as most used tool/technique (72.7% agree to strongly agree and 4.6% is undecided).
- Failure mode and effects analysis (FMAEA) as most used tool/technique (77.3% agree to strongly agree and 4.6% disagree to strongly disagree).
- Process capability analysis as most used tool/technique (77.3% agree to strongly agree and 4.6% undecided).
- Problem solving methodology as most used tool/technique (81.8% agree to strongly agree 9.1 undecided and 9.1% disagree to strongly disagree).
- Quality costing as most used tool/technique (63.6% agree to strongly agree and 13.6% disagree to strongly disagree).
- Statistical process control as most used tool/technique (72.7% agree to strongly agree and 4.6% disagree to strongly disagree).

- Quality improvement team as most used tool/technique (63.6% agree to strongly agree and 9.1% disagree to strongly disagree).

Statistically significant more respondents were undecided on project selection and prioritisation, review and tracking as a key ingredient for Sigma Six implementation (25.4% agree to strongly agree 54.6% undecided and 9.1% disagree to strongly disagree).

Statistically significant more respondents disagree to strongly disagree that "Hypothesis testing" is one of the most used tools or techniques of Six Sigma in their organisation (18.2% agree to strongly agree, 18.2% undecided and 63.6% disagree to strongly disagree).

For the following statements, there were statistically significant fewer respondents who were undecided than disagree or agree (the proportion of respondents who disagree was not different (statistically significant) from the proportion of respondents who agree):

- SERVQUAL is the most used tool/technique (31.8% agree to strongly agree 13.6% undecided and 50.0% disagree to strongly disagree).
- Fault tree analysis is the most used tool/technique (54.6% agree to strongly agree 4.6% undecided and 40.9% disagree to strongly disagree).
- SIPOC is the most used tool/technique (59.1% agree to strongly agree 9.1% undecided and 31.8% disagree to strongly disagree).
- Kano model is the most used tool/technique (50.0% agree to strongly agree 9.1% undecided and 40.9% disagree to strongly disagree).

5.4 DISCUSSIONS AND CONCLUSIONS

As for the results obtained through this survey, the following analogies can be drawn from this research:

- The main reasons for implementing Six Sigma is to improve product/service quality and to reduce cost.
- The key personnel driving Six Sigma should involve process leaders and employees during Six Sigma projects.

- The organisations use the DFSS methodology when redesigning a project and the DMAIC methodology during process improvement of a project simultaneously or either the one or the other. There are only a few organisations that do not use any of the two methodologies.
- The mechanisms in place to ensure Six Sigma success is that all the people involved in the Six Sigma project should have received adequate training and Six Sigma should be linked to all stake holders.
- Under the top management commitment to Six Sigma, heading the statements that contribute the most are "Senior executives accommodate and encourage change" and "Employees are encouraged to participate when implementing Six Sigma".
- The key ingredients for Six Sigma implementation are the understanding of Six Sigma methodology; tools and techniques; training; top management involvement and commitment; Organisation infrastructure; linking Six Sigma to customer and communication.
- The organisations mainly use the basic quality control tools of Six Sigma.

The most used tools and techniques used by the organisations are:

- Brainstorming.
- Failure mode and effects analysis.
- Graphs.
- Check sheet.
- Cause and effect diagram.
- Problem solving methodology.
- Statistical process control.
- Quality costing.
- Pareto diagram.
- Process capability analysis.
- Sampling.
- Quality improvement team.
- Process mapping.
- Project team charter.
- Histogram.

To determine the sustainability of small businesses from the questionnaire was problematic due to the plethora of external and internal factors having an impact. As a result, it could not be determined whether the sustainability was influenced by the lack of having a quality strategy in operation.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 INTRODUCTION

This chapter will conclude the study and provide guidelines on how Six Sigma can be effectively implemented within SA organisations. Attention will be redirected to the research problem, and subsequent investigative questions and objectives. A brief overview of the research will be exemplified. This chapter will conclude with a set of recommendations to mitigate the research problem.

6.2 THE RESEARCH THUS FAR

In Chapter One, an introduction and background of the proposed research was provided. The research process was explained, the research problem stated, and the research question, and investigative questions and research objectives formulated. The research design and methodology, which include the data collection design and methodology, was depicted. This chapter concluded with an overview of the chapters and content analysis. In Chapter Two, a holistic perspective of organisations that have implemented Six Sigma in South Africa was provided, as well as a glimpse of quality management in SA. Chapter Three disclosed a theory gathered from various literatures source in connection with the research problem. The Six Sigma origin, definition, benefits and differences with other quality initiatives, were uncovered. Top management involvement and commitment, culture change, communication, organisation infrastructure, training, project management skill, project prioritisation and selection, reviews and tracking, understanding the Six Sigma methodology, tools and techniques, linking Six Sigma to business strategy, linking Six Sigma to human resource and linking Six Sigma to supplier, were identified as the critical success factors for implementing a Six Sigma programme within an organisation. In Chapter Four, the limitation of the survey was elaborated on. The target population was defined, and the type of sampling was discussed. An overview of the survey design was provided as well as the reasons of using the Lickert scale. This chapter was completed with an in depth illustration of the respondent briefing and a list of questions posed in the survey. In Chapter Five, the data gleaned from the survey was analysed and interpreted.

6.3 FINDINGS OR ANALOGIES DRAWN FROM THE DATA ANALYSIS

As for the results obtained through this survey, the following analogies can be drawn from this research:

- The main reasons for implementing Six Sigma is to improve product/service quality and to reduce cost.
- The key personnel driving Six Sigma should involve a process leader and employees during Six Sigma projects.
- The organisations use the DFSS methodology when redesigning a process and the DMAIC methodology during process improvement of a project simultaneously or either the one or the other. There are only a few organisations that do not use any of the two methodologies.
- The mechanisms in place to ensure Six Sigma success is that all the people involved in the Six Sigma project should have received adequate training and Six Sigma should be linked to all stake holders.
- Under the top management commitment to Six Sigma, heading the statements that contribute the most are "Senior executives accommodate and encourage change" and "Employees are encouraged to participate when implementing Six Sigma".
- The key ingredients for Six Sigma implementation are the understanding of Six Sigma methodology, tools and techniques; training; top management involvement and commitment; organisation infrastructure; and linking Six Sigma to customer and communication.
- The organisations mainly use the basic quality control tools of Six Sigma.

The most used tools and techniques used by the organisations are:

- Brainstorming.
- Failure mode and effects analysis.
- Graphs.

- Check sheet.
- Cause and effect diagram.
- Problem solving methodology.
- Statistical process control.
- Quality costing.
- Pareto diagram.
- Process capability analysis.
- Sampling.
- Quality improvement team.
- Process mapping.
- Project team charter.
- Histogram.

To determine the sustainability of small businesses from the questionnaire was problematic due to the plethora of external and internal factors having an impact. As a result, it could not be determined whether the sustainability was influenced by the lack of having a quality strategy in operation.

6.4 ANALOGIES DRAWN FROM THE LITERATURE REVIEW

Six Sigma is a quality improvement methodology that incorporates management philosophies and statistical techniques in a well structured fashion to optimize business activities, thereby focusing on variation reduction in all processes, involving top management and operating force to work closely in the hunt of customer satisfaction and financial return. Antony (2008:274), found that currently, companies across the world ranging from small businesses, private and public to large organisations have adopted this philosophy to substantially improve:

- Quality level.
- Customer satisfaction.
- Market share.
- Employees' morale.
- Organizational culture.

- People development.
- Return on investment, and
- Much more.

To ensure a successful introduction and implementation of Six Sigma programme in an organisation, the following steps are required:

- SIX SIGMA METHODOLOGY FOR PROCESS IMPROVEMENT

As a problem solving methodology, Six Sigma makes use of a general accepted and well defined continuous improvement framework known as DMAIC (Antony, 2006:239; Anbari and Kwak, 2004:6; Eckes, 2003:29). As indicated in Figure 3.3, the DMAIC model is a closed loop process that eliminates unproductive stages which allows the improvement process to be more efficient (Kwak and Anbari, 2006:706). The letter (D) represents the definition of the problem, (M) measures the problem, (A) analysis of data, (I) improvement of the process by removing root causes of defects and (C) the controlling or monitoring process to prevent problems (Antony, 2006:706).

- ORGANISATIONAL INFRASTRUCTURE FOR SIX SIGMA

Pyzdek (2000: Online) and Antony & Banuelas (2002:21), suggest that Six Sigma provides and organisational infrastructure that assures and supports the effective implementation of this methodology in an organisation. The main reason why 80% of TQM implementation failed was the lack of a tangible infrastructure to support its introduction. Henderson and Evans (2000:270), point out that to reach the long term target of 3.4 DPMO requires a complete commitment from each component of the value chain, and the active participation of everyone with specific roles and responsibilities within an organisation. The employees in an organisation practising Six Sigma are seen as catalysts who institutionalise change and are highly trained in statistics and problems solving, and lead groups in selecting and completing Six Sigma projects (Henderson and Evans, 2000:270; Antony and Banuelas, 2002:22). According to Anbari and Kwak (2004:5), a Six Sigma project is selected, performed, accomplished, and reviewed by individuals who are ranked according to a belt system in a powerful matrix organisational structure as follows:

- Champion.
- Master black belt.
- Black belt.
- Yellow belt.
- Green belts.

- KEY ELEMENTS FOR SIX SIGMA IMPLEMENTATION

Companies embarking on the Six Sigma implementation programme have shown contrasting results due to the complexity of this methodology and therefore, attention must be drawn to the key elements of Six Sigma, to make it possible (Coronado and Antony, 2002:92-93). Coronado and Antony(2002:93 citing Rockart, 1979) state that: “critical success factors are those factors which are critical to the success of any organisation in the sense that, if objectives associated with the factors are not achieved, the organisation will fail – perhaps catastrophically”. Therefore, the importance given to key input variables for the successful management of a process output can be attributed to Six Sigma critical success factors for the effective completion of a Six Sigma programme (Antony and Banuelas, 2002:21). The research of Antony and Banuelas (2002:21-23), Coronado and Antony (2002:93-98), Pyzdek (2000: online), Antony (2006:242-243), and Henderson and Evans (2000:269-277), identified the key elements for the successful introduction and implementation of Six Sigma programme in an organisation:

- Management involvement and commitment (refer to paragraph 3.121).
- Culture change (refer to paragraph 3.12.2).
- Communication (refer to paragraph 3.12.3).
- Organisation infrastructure (refer to paragraph 3.11).
- Training (refer to paragraph 3.12.5).
- Project management skill (refer to paragraph 3.12.6).
- Project prioritisation and selection, reviews and tracking (refer to paragraph 3.12.7).

- Understanding the Six Sigma methodology, tools and techniques (refer to paragraph 3.9 & 3.10).
- Linking Six Sigma to business strategy (refer to paragraph 3.12.9).
- Linking Six Sigma to human resource (refer to paragraph 3.12.11).
- Linking Six Sigma to customer (refer to paragraph 3.12.10).
- Linking Six Sigma to supplier (refer to paragraph 3.12.12).

6.5 RESEARCH PROBLEM REVISITED

The research problem which was formulated in Chapter 1, paragraph 1.3 reads as follows: "South African enterprises who implement Six Sigma, do not consider critical implementation issues associated with the concept, resulting in either an inefficient implementation or a product that does not deliver on expectations".

Recommendations to mitigate the research problem cumulate as the result of the literature review and data analysis. The following recommendations are made as a result of this research study:

- The leadership of SA business organisations should be educated on the Six Sigma principles needed for the preparation of their organisation on the brink of adopting this concept.
- The leadership of SA business organisations should be aware that the Six Sigma implementation requires a substantial investment and positive results after a long period.
- The top management of SA organisations should be involved, dedicated on project selection and review, and on resource provision and training.
- The top management of SA organisations should restructure their business setting to that of Six Sigma entity by personally spending time in every Six Sigma training, completing a weekly and monthly Six Sigma review, making factory visits, and monitoring Six Sigma project progress.
- The people within the SA organisations must be made aware of the need to change via a communication channel in order to overcome any resistance to chance. The communication channel should also address the Six Sigma methodology, its benefits and how it is related to people's work.

- The communication of Six Sigma success and setbacks during project implementation will also help SA businesses project team to identify best practices and avoid mistakes during future projects.
- To reach the long term target of 3.4 DPMO, SA enterprises should ensure a complete commitment of each component of the value chain, and an active participation of everyone with specific roles and responsibilities within their organisation.
- To ensure that SA enterprises meet the requirements of the Six sigma organisational infrastructure, the leadership should appoint key personnel according to the following criteria:
  - A Six Sigma Champion per business unit (generally occupying a strategic position).
  - A black belt selected based on technical aspects and who are highly rated in their area of expertise as well as by others colleagues. The number of active black belts in an organisation will typically be one for every fifty to hundred employees.
  - A master black belt who is a fully skilled, qualified leader having the responsibility of Six Sigma strategic deployment, training, mentoring and results. Master black belts should be individuals with at least five years of black belt experience. Business groups or big manufacturing site should have one.
  - Yellow belts are individuals with a technical background who receive two to three weeks training on Six Sigma methodology and there after work on Six Sigma projects on a temporary basis. For every 20 employees within an organisation there should be one yellow belt.
  - Green belts are specialised persons leading a Six Sigma team member, capable of forming and facilitating a Six Sigma team and managing Six Sigma projects from start to finish.
- Basis skills should be provided to all employees within SA organisations to ensure that relevant literacy and numeracy skills are processed by everyone so as to allow them to grasp the fundamental principle behind the tools and techniques of Six Sigma during training sessions.

- To ensure effective project completion, SA organisations should ensure that the project team possesses project management skills that will allow them to meet the milestones of different project phases.
- To ensure an effective selection of a Six Sigma project, champions, BB, GB, and the project manager have to look at some critical elements of project management such as: Time, Cost, and Quality because these elements will help them identify the project scope, objectives, and resources needed to accomplish a project at a very competitive cost in order to meet a specific business objectives.
- SA organisations should expand the use of the tools and techniques of Six Sigma in a highly disciplined manner at each phase of the DMAIC methodology.
- SA organisations should not treat Six Sigma as an isolated activity; therefore the link between Six Sigma project and business strategy has to be obvious so that the result illustrates a fully integrated philosophy into a business culture rather than just a limited usage of few tools and techniques.
- The link between Six Sigma and customer focus should be obvious in every aspect of the value chain to ensure that all the Six Sigma activities are directed toward customer satisfaction.
- SA organisations should develop and put in place a human resource based action in order to promote desired actions and results and therefore ensure the long term requirement of 3.4 DPMO of Six Sigma goal. Adding specific Six Sigma section to the annual performance evaluation form and awarding executive compensation based on Six Sigma goals attainment is an example.
- SA organisations should bring their suppliers in line with the dynamics of culture change that comes along with Six Sigma and a criteria selection of suppliers, based on an acceptable Six Sigma performance capability level, will make certain that only those with a Six Sigma culture can be part of the value chain and therefore deliver raw materials.

6.6 THE RESEARCH QUESTION REVISITED

The research problem which was formulated in Chapter 1, paragraph 1.4 reads as follows: "Can a structured single alternate process be developed for the implementation of Six Sigma to ensure successful implementation thereof in South African enterprises?"

Based on the literature review and best practices, as well as the analysis of the survey findings, a framework for an alternative and effective implementation of Six Sigma in SA enterprises was developed by the researcher and illustrated in Figure 6.1.

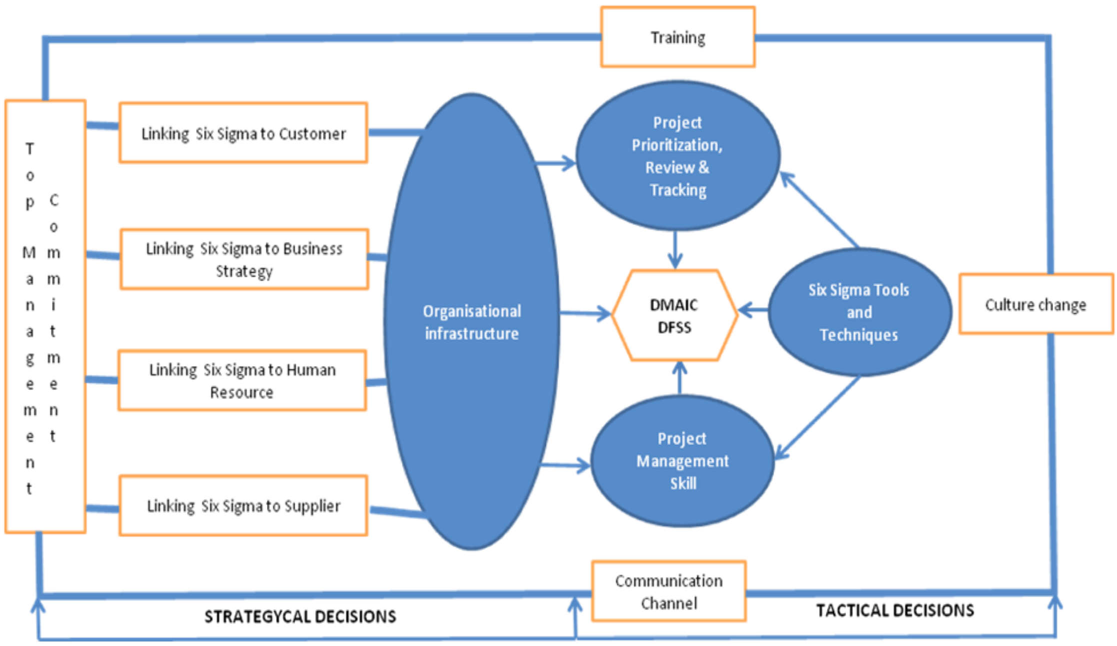

Figure 6.1: Framework of Six Sigma implementation for SA organisation. (**Source**: Adapted from Six Sigma literature review contained within the ambit of Chapter 3)

The above framework consists of some critical and soft elements which play a critical role in the successful implementation of Six Sigma within SA enterprises.

Figure 6.1 shows two main sections, mainly a strategical and a tactical section. The strategical section relies on leadership who has the responsibility to fully understand Six Sigma, show commitment to it, and communicate its benefits to the entire organisation to ensure a smooth culture change to that of Six Sigma entity. The top management also has the responsibility to establish an organisational infrastructure with adequate training that will effectively implement Six Sigma by linking it to:

- Business strategy,
- Supplier,
- Customer, and
- Human resource.

The tactical section looks at the DMAIC methodology (the centre of Six Sigma implementation) which provides a five step continuous improvement approach and suggests the use of tools and techniques in a very specific and disciplined manner during a process improvement project.

6.7 KEY RESEARCH OBJECTIVES REVISITED

The five main objectives that were stated in Chapter 1, paragraph 1.5 of this study and associated findings are listed below:

- To formulate a structured single process to aid the successful implementation of Six Sigma in SA industries.

  Paragraph 6.6 and Figure 6.1 provides some guidelines for SA industries to follow in order to have a standardised process when implementing Six Sigma.

- To explore the benefits of the implementation of the Six Sigma quality management system in SA enterprises.

  After the analysis of data, it was found that the main reasons for implementing Six Sigma is to improve product/service quality and to reduce costs. (refer to Figure 5.13, Chapter 5)

- To identify the tools and techniques for the suitability of Six Sigma in SA industries.

After the analysis of data, it was found that the most used tools and techniques for the suitability of Six Sigma in SA industries were: Brainstorming, Failure mode and effects analysis, Graphs, Check sheet, Cause and effect diagram, Problem solving methodology, Statistical process control, Quality costing, Pareto diagram, Process capability analysis, Sampling, Quality improvement team, Process mapping, Project team charter and Histogram (refer to Figure 5.11 & 12, Chapter 5)

- To determine factors that can influence the Six Sigma implementation in the context of SA business environment.

After the analysis of data, it was found that the key elements for Six Sigma implementation in the context of a SA business environment are: the understanding of Six Sigma methodology, tools and techniques; training; top management involvement and commitment; organisation infrastructure; linking Six Sigma to customer and communication. However, factors such as Culture change, Project management skill, Linking Six Sigma to supplier, Linking Six Sigma to business strategy, Linking Six Sigma to human resource, Project prioritisation, selection, reviews and tracking received less consideration (refer to Figure 5.9, Chapter 5.)

6.8 FINAL CONCLUSION

This research has led to many interesting and important findings. First, the majority of SA organisations that have implemented Six Sigma, are from manufacturing and did so just before and after the year 2000. Secondly, the main reasons for implementing Six Sigma in SA enterprises are to improve product/service quality and to reduce costs. Thirdly, the key personnel driving Six Sigma do not involve process leaders and employees during Six Sigma projects. The SA organisations use the DFSS methodology when redesigning a process and the DMAIC methodology during process improvement or both simultaneously. Furthermore, it was found that there are only few organisations that do not use any of the two methodologies. The mechanisms in place to ensure Six Sigma success were not efficient because the individual involved in the Six Sigma project did not receive adequate training and Six Sigma was not linked to all stakeholders. Under the role of the top management commitment to Six Sigma, heading this has been mainly to accommodate and encourage change and employees are encouraged to participate when implementing Six Sigma. Also, it was found that the key ingredients for Six Sigma implementation in SA enterprises are: the understanding of Six Sigma methodology, tools and techniques; training; top management involvement and commitment; organisation infrastructure; and linking Six Sigma to customer and communication. The organisations mainly use the basic quality control tools of Six Sigma. Finally the most used tools and techniques used by the SA organisations are: Brainstorming, Failure mode and effects analysis, Graphs, Check sheet, Cause and effect diagram, Problem solving methodology, Statistical process control, Quality costing, Pareto diagram, Process capability analysis, Sampling, Quality improvement team, Process mapping Project team charter, and Histogram.

This research project was conducted with a number of boundaries such as the number of companies involved, budget, data collection, time among others. For further research, more people, companies, adequate budget and at least two data collection methodologies should be taken into account. The open ended questions had a disadvantage in that respondents simply ticked an answer; the reasons for their choice were not clear. It would therefore be advantageous to use other data collection methodologies to gain a deeper understanding of the research question and sub-questions. Moreover, this research was conducted in a single province of SA; however it is important to know how Six Sigma implementations are tackled in the rest of the country. Finally, it would be important to perform a comparative analysis of Six Sigma implementation between the manufacturing and service sector as well as with other sectors of industries in SA. A comparative analysis of Six Sigma implementation among developing countries could also be put into perspective.

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Annexure A: Cronbach Alpha Coefficients

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum	Label
B01	22	4.09091	0.75018	90.00000	3.00000	5.00000	B01
B02	22	4.00000	1.06904	88.00000	2.00000	5.00000	B02
B03	22	4.18182	0.95799	92.00000	1.00000	5.00000	B03
B04	21	3.76190	1.30018	79.00000	1.00000	5.00000	B04
B05	22	3.90909	1.06499	86.00000	2.00000	5.00000	B05
B06	22	3.50000	1.50396	77.00000	1.00000	5.00000	B06
B07	22	4.00000	1.06904	88.00000	2.00000	5.00000	B07
B08	22	3.50000	1.33631	77.00000	1.00000	5.00000	B08
B09	22	3.59091	1.29685	79.00000	1.00000	5.00000	B09
B10	22	3.36364	1.04860	74.00000	2.00000	5.00000	B10
B11	22	3.63636	0.84771	80.00000	2.00000	5.00000	B11
B12	22	3.72727	1.16217	82.00000	1.00000	5.00000	B12
B13	22	2.81818	1.36753	62.00000	1.00000	5.00000	B13
B14	22	3.72727	0.70250	82.00000	2.00000	5.00000	B14
B15	22	3.36364	1.04860	74.00000	2.00000	5.00000	B15
B16	22	3.18182	1.09702	70.00000	1.00000	5.00000	B16
B17	22	3.72727	0.63109	82.00000	2.00000	5.00000	B17
B18	22	3.81818	0.50108	84.00000	3.00000	5.00000	B18
B19	22	3.27273	0.82703	72.00000	2.00000	5.00000	B19
B20	22	3.54545	0.96250	78.00000	2.00000	5.00000	B20
B21	22	3.63636	1.21677	80.00000	1.00000	5.00000	B21
B22	22	3.86364	0.83355	85.00000	3.00000	5.00000	B22
B23	22	3.09091	1.06499	68.00000	1.00000	5.00000	B23
B24	22	3.40909	0.85407	75.00000	2.00000	5.00000	B24
B25	22	3.95455	1.13294	87.00000	2.00000	5.00000	B25
B26	20	3.15000	1.08942	63.00000	1.00000	5.00000	B26
B27	22	3.54545	1.22386	78.00000	1.00000	5.00000	B27
B28	22	2.72727	1.03196	60.00000	1.00000	5.00000	B28
B29	22	3.27273	1.03196	72.00000	1.00000	5.00000	B29
B30	22	4.00000	0.81650	88.00000	2.00000	5.00000	B30
B31	22	3.63636	1.00216	80.00000	2.00000	5.00000	B31
B32	22	3.27273	0.93513	72.00000	2.00000	5.00000	B32
B33	22	4.27273	0.93513	94.00000	1.00000	5.00000	B33
B34	22	4.27273	0.82703	94.00000	2.00000	5.00000	B34
B35	22	3.50000	1.01183	77.00000	1.00000	5.00000	B35
B36	22	4.31818	1.04135	95.00000	1.00000	5.00000	B36
B37	22	3.72727	1.24142	82.00000	1.00000	5.00000	B37
B38	22	4.00000	1.06904	88.00000	1.00000	5.00000	B38
B39	22	3.13636	1.16682	69.00000	1.00000	5.00000	B39
B40	22	4.50000	0.96362	99.00000	1.00000	5.00000	B40
B41	22	3.50000	1.05785	77.00000	1.00000	5.00000	B41
B42	22	2.45455	1.18431	54.00000	1.00000	5.00000	B42
B43	22	3.90909	1.10880	86.00000	1.00000	5.00000	B43
B44	22	2.59091	1.22121	57.00000	1.00000	5.00000	B44
B45	22	3.95455	1.13294	87.00000	1.00000	5.00000	B45
B46	22	3.13636	1.03719	69.00000	1.00000	4.00000	B46
B47	21	2.95238	1.49921	62.00000	1.00000	5.00000	B47
B48	22	2.72727	1.31590	60.00000	1.00000	4.00000	B48
B49	22	3.77273	1.44525	83.00000	1.00000	5.00000	B49
B50	22	3.22727	0.92231	71.00000	1.00000	4.00000	B50
B51	22	2.86364	1.12527	63.00000	1.00000	5.00000	B51
B52	22	4.36364	0.95346	96.00000	2.00000	5.00000	B52
B53	22	3.13636	1.24577	69.00000	1.00000	5.00000	B53
B54	22	3.95455	1.43019	87.00000	1.00000	5.00000	B54
B55	22	3.27273	1.27920	72.00000	1.00000	5.00000	B55
B56	22	4.13636	1.20694	91.00000	1.00000	5.00000	B56
B57	22	4.00000	1.27242	88.00000	1.00000	5.00000	B57
B58	22	3.00000	1.23443	66.00000	1.00000	5.00000	B58
B59	22	4.09091	0.92113	90.00000	2.00000	5.00000	B59
B60	22	3.86364	1.12527	85.00000	1.00000	5.00000	B60
B61	22	3.50000	1.50396	77.00000	1.00000	5.00000	B61
B62	22	2.95455	1.17422	65.00000	1.00000	4.00000	B62

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.954875
Standardized	0.951721

Cronbach Coefficient Alpha with Deleted Variable

	Raw Variables		Standardized Variables		
Deleted Variable	Correlation with Total	Alpha	Correlation with Total	Alpha	Label
B01	0.267536	0.954864	0.253184	0.951913	B01
B02	0.161139	0.955409	0.205167	0.952112	B02
B03	0.144076	0.955354	0.180543	0.952214	B03
B04	0.207221	0.955495	0.251155	0.951921	B04
B05	0.485323	0.954199	0.463353	0.951034	B05
B06	0.681438	0.953291	0.658012	0.950210	B06
B07	0.517216	0.954078	0.481680	0.950957	B07
B08	0.575320	0.953822	0.556275	0.950642	B08
B09	0.758466	0.952971	0.756670	0.949789	B09
B10	0.577644	0.953857	0.601776	0.950450	B10
B11	0.753520	0.953439	0.752662	0.949806	B11
B12	0.737892	0.953158	0.726672	0.949917	B12
B13	0.498222	0.954198	0.492176	0.950913	B13
B14	0.415701	0.954491	0.443827	0.951117	B14
B15	0.270555	0.954989	0.310125	0.951676	B15
B16	-.183801	0.956734	-.183240	0.953699	B16
B17	0.371192	0.954620	0.407543	0.951269	B17
B18	0.412994	0.954602	0.434670	0.951155	B18
B19	0.042422	0.955531	0.053880	0.952735	B19
B20	0.689618	0.953514	0.714847	0.949968	B20
B21	0.420257	0.954489	0.415281	0.951236	B21
B22	-.093020	0.955927	-.065255	0.953221	B22
B23	-.019589	0.956066	0.022088	0.952865	B23
B24	0.517185	0.954147	0.542058	0.950703	B24
B25	0.779906	0.953011	0.794806	0.949625	B25
B26	0.353418	0.954703	0.391252	0.951337	B26
B27	0.765290	0.952992	0.739973	0.949860	B27
B28	0.263537	0.955003	0.294226	0.951742	B28
B29	0.286917	0.954919	0.275477	0.951820	B29
B30	0.483080	0.954265	0.492958	0.950910	B30
B31	0.535527	0.954027	0.530178	0.950753	B31
B32	0.472842	0.954259	0.478052	0.950973	B32
B33	0.597880	0.953845	0.579192	0.950545	B33
B34	-.219322	0.956274	-.233372	0.953901	B34
B35	0.393255	0.954531	0.400561	0.951298	B35
B36	0.279031	0.954953	0.264834	0.951864	B36
B37	0.668019	0.953412	0.651576	0.950238	B37
B38	0.555491	0.953933	0.534654	0.950734	B38
B39	0.793062	0.952924	0.766102	0.949748	B39
B40	0.599796	0.953821	0.598733	0.950462	B40
B41	0.684241	0.953452	0.648900	0.950249	B41
B42	0.465160	0.954289	0.454975	0.951070	B42
B43	0.455245	0.954316	0.444651	0.951113	B43
B44	0.195489	0.955447	0.190610	0.952172	B44
B45	0.484246	0.954204	0.464787	0.951028	B45
B46	0.565362	0.953907	0.552459	0.950659	B46
B47	0.701561	0.953183	0.677473	0.950128	B47
B48	0.686967	0.953297	0.663806	0.950186	B48
B49	0.768725	0.952842	0.762226	0.949765	B49
B50	0.361179	0.954623	0.371359	0.951420	B50
B51	0.576335	0.953837	0.572864	0.950572	B51
B52	0.502326	0.954156	0.485185	0.950943	B52
B53	0.742307	0.953078	0.751379	0.949812	B53
B54	0.773638	0.952823	0.746847	0.949831	B54
B55	0.710949	0.953201	0.677686	0.950127	B55
B56	0.605442	0.953696	0.583745	0.950526	B56
B57	0.567988	0.953853	0.555849	0.950644	B57
B58	0.805372	0.952806	0.798457	0.949610	B58
B59	-.053358	0.955946	-.034475	0.953096	B59
B60	0.829681	0.952817	0.814346	0.949541	B60
B61	0.822162	0.952529	0.809650	0.949561	B61
B62	0.789866	0.952930	0.795689	0.949621	B62

Annexure B: Descriptive statistics: Frequency tables

A01	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Manufacturing	20	90.91	20	90.91
Service	2	9.09	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	14.7273
DF	1
Pr > ChiSq	0.0001

Sample Size = 22

A02	Frequency	Percent	Cumulative Frequency	Cumulative Percent
100-500	20	90.91	20	90.91
>1000	2	9.09	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	14.7273
DF	1
Pr > ChiSq	0.0001

Sample Size = 22

A03	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	1	4.55	1	4.55
<1yr	1	4.55	2	9.09
1-3yrs	9	40.91	11	50.00
4-5yrs	2	9.09	13	59.09
>10yrs	9	40.91	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	16.1818
DF	4
Pr > ChiSq	0.0028

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.

Sample Size = 22

A04_1	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	2	9.09	2	9.09
1	3	13.64	5	22.73
2	1	4.55	6	27.27
3	2	9.09	8	36.36
4	2	9.09	10	45.45
5	1	4.55	11	50.00
6	1	4.55	12	54.55
8	2	9.09	14	63.64
10	1	4.55	15	68.18
17	1	4.55	16	72.73
18	1	4.55	17	77.27
19	1	4.55	18	81.82
20	1	4.55	19	86.36
25	2	9.09	21	95.45
28	1	4.55	22	100.00

A04_2	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	7	31.82	7	31.82
1	2	9.09	9	40.91
2	2	9.09	11	50.00
3	2	9.09	13	59.09
4	1	4.55	14	63.64
5	2	9.09	16	72.73
6	2	9.09	18	81.82
8	3	13.64	21	95.45
11	1	4.55	22	100.00

A05	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Industrial Engineer	2	9.09	2	9.09
Industrial Engineering Trainee	1	4.55	3	13.64
Junior Project Manager Trainee	1	4.55	4	18.18
Manufacturing Dev Consultant	1	4.55	5	22.73
Process Engineer	1	4.55	6	27.27
Process Person	1	4.55	7	31.82
Production Analysis	1	4.55	8	36.36
Production Engineer	1	4.55	9	40.91
Production Foreman	1	4.55	10	45.45
Production Manager	1	4.55	11	50.00
Production Planner	1	4.55	12	54.55
Project Manager	1	4.55	13	59.09

Quality Engineer	5	22.73	18	81.82
Quality Foreman	1	4.55	19	86.36
Quality Technician	1	4.55	20	90.91
SQD	1	4.55	21	95.45
Team Leader	1	4.55	22	100.00

B01	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Undecided	5	22.73	5	22.73
Agree	10	45.45	15	68.18
Strongly agree	7	31.82	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	1.7273
DF	2
Pr > ChiSq	0.4216

Sample Size = 22

B02	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree	3	13.64	3	13.64
Undecided	3	13.64	6	27.27
Agree	7	31.82	13	59.09
Strongly agree	9	40.91	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	4.9091
DF	3
Pr > ChiSq	0.1786

Sample Size = 22

B03	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	1	4.55	1	4.55
Undecided	2	9.09	3	13.64
Agree	10	45.45	13	59.09
Strongly agree	9	40.91	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	11.8182
DF	3
Pr > ChiSq	0.0080

Sample Size = 22

B04	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	1	4.55	1	4.55
Strongly disagree	2	9.09	3	13.64
Disagree	2	9.09	5	22.73
Undecided	2	9.09	7	31.82
Agree	8	36.36	15	68.18
Strongly agree	7	31.82	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	12.3636
DF	5
Pr > ChiSq	0.0301

WARNING: The table cells have expected counts less
than 5. Chi-Square may not be a valid test.
Sample Size = 22

B05	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree	3	13.64	3	13.64
Undecided	4	18.18	7	31.82
Agree	7	31.82	14	63.64
Strongly agree	8	36.36	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	3.0909
DF	3
Pr > ChiSq	0.3778

Sample Size = 22

B06	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	4	18.18	4	18.18
Disagree	1	4.55	5	22.73
Undecided	5	22.73	10	45.45
Agree	4	18.18	14	63.64
Strongly agree	8	36.36	22	100.00

Chi-Square Test

for Equal Proportions
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
Chi-Square 5.7273
DF 4
Pr > ChiSq 0.2205

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.

Sample Size = 22

B07	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree	3	13.64	3	13.64
Undecided	3	13.64	6	27.27
Agree	7	31.82	13	59.09
Strongly agree	9	40.91	22	100.00

Chi-Square Test
for Equal Proportions
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
Chi-Square 4.9091
DF 3
Pr > ChiSq 0.1786

Sample Size = 22

B08	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	1	4.55	1	4.55
Disagree	5	22.73	6	27.27
Undecided	6	27.27	12	54.55
Agree	2	9.09	14	63.64
Strongly agree	8	36.36	22	100.00

Chi-Square Test
for Equal Proportions
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
Chi-Square 7.5455
DF 4
Pr > ChiSq 0.1097

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.

Sample Size = 22

B09	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	2	9.09	2	9.09
Disagree	2	9.09	4	18.18
Undecided	6	27.27	10	45.45
Agree	5	22.73	15	68.18
Strongly agree	7	31.82	22	100.00

Chi-Square Test
for Equal Proportions
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
Chi-Square 4.8182
DF 4
Pr > ChiSq 0.3065

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.

Sample Size = 22

B10	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree	7	31.82	7	31.82
Undecided	2	9.09	9	40.91
Agree	11	50.00	20	90.91
Strongly agree	2	9.09	22	100.00

Chi-Square Test
for Equal Proportions
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
Chi-Square 10.3636
DF 3
Pr > ChiSq 0.0157

Sample Size = 22

B11	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree	3	13.64	3	13.64
Undecided	4	18.18	7	31.82
Agree	13	59.09	20	90.91
Strongly agree	2	9.09	22	100.00

Chi-Square Test
for Equal Proportions
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
Chi-Square 14.0000
DF 3
Pr > ChiSq 0.0029

Sample Size = 22

B12	Frequency	Percent	Cumulative Frequency	Cumulative Percent

Strongly disagree	1	4.55	1	4.55
Disagree	2	9.09	3	13.64
Undecided	6	27.27	9	40.91
Agree	6	27.27	15	68.18
Strongly agree	7	31.82	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	6.6364
DF	4
Pr > ChiSq	0.1564

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.
Sample Size = 22

B13	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	5	22.73	5	22.73
Disagree	4	18.18	9	40.91
Undecided	6	27.27	15	68.18
Agree	4	18.18	19	86.36
Strongly agree	3	13.64	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	1.1818
DF	4
Pr > ChiSq	0.8811

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.
Sample Size = 22

B14	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree	1	4.55	1	4.55
Undecided	6	27.27	7	31.82
Agree	13	59.09	20	90.91
Strongly agree	2	9.09	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	16.1818
DF	3
Pr > ChiSq	0.0010

Sample Size = 22

B15	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree	5	22.73	5	22.73
Undecided	8	36.36	13	59.09
Agree	5	22.73	18	81.82
Strongly agree	4	18.18	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	1.6364
DF	3
Pr > ChiSq	0.6512

Sample Size = 22

B16	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	2	9.09	2	9.09
Disagree	2	9.09	4	18.18
Undecided	11	50.00	15	68.18
Agree	4	18.18	19	86.36
Strongly agree	3	13.64	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	13.0000
DF	4
Pr > ChiSq	0.0113

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.
Sample Size = 22

B17	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree	1	4.55	1	4.55
Undecided	5	22.73	6	27.27
Agree	15	68.18	21	95.45
Strongly agree	1	4.55	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	23.8182

DF 3
Pr > ChiSq <.0001
Sample Size = 22

B18	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Undecided	5	22.73	5	22.73
Agree	16	72.73	21	95.45
Strongly agree	1	4.55	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	16.4545
DF	2
Pr > ChiSq	0.0003

Sample Size = 22

B19	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree	3	13.64	3	13.64
Undecided	12	54.55	15	68.18
Agree	5	22.73	20	90.91
Strongly agree	2	9.09	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	11.0909
DF	3
Pr > ChiSq	0.0112

Sample Size = 22

B20	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree	5	22.73	5	22.73
Undecided	2	9.09	7	31.82
Agree	13	59.09	20	90.91
Strongly agree	2	9.09	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	14.7273
DF	3
Pr > ChiSq	0.0021

Sample Size = 22

B21	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	1	4.55	1	4.55
Disagree	3	13.64	4	18.18
Undecided	6	27.27	10	45.45
Agree	5	22.73	15	68.18
Strongly agree	7	31.82	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	5.2727
DF	4
Pr > ChiSq	0.2604

WARNING: The table cells have expected counts less
than 5. Chi-Square may not be a valid test.
Sample Size = 22

B22	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Undecided	9	40.91	9	40.91
Agree	7	31.82	16	72.73
Strongly agree	6	27.27	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	0.6364
DF	2
Pr > ChiSq	0.7275

Sample Size = 22

B23	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	1	4.55	1	4.55
Disagree	7	31.82	8	36.36
Undecided	4	18.18	12	54.55
Agree	9	40.91	21	95.45
Strongly agree	1	4.55	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	11.6364
DF	4

Pr > ChiSq 0.0203
WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.
Sample Size = 22

B24	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree	2	9.09	2	9.09
Undecided	12	54.55	14	63.64
Agree	5	22.73	19	86.36
Strongly agree	3	13.64	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	11.0909
DF	3
Pr > ChiSq	0.0112

Sample Size = 22

B25	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree	3	13.64	3	13.64
Undecided	5	22.73	8	36.36
Agree	4	18.18	12	54.55
Strongly agree	10	45.45	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	5.2727
DF	3
Pr > ChiSq	0.1529

Sample Size = 22

B26	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	2	9.09	2	9.09
Strongly disagree	1	4.55	3	13.64
Disagree	5	22.73	8	36.36
Undecided	6	27.27	14	63.64
Agree	6	27.27	20	90.91
Strongly agree	2	9.09	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	6.9091
DF	5
Pr > ChiSq	0.2275

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.
Sample Size = 22

B27	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	2	9.09	2	9.09
Disagree	2	9.09	4	18.18
Undecided	5	22.73	9	40.91
Agree	8	36.36	17	77.27
Strongly agree	5	22.73	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	5.7273
DF	4
Pr > ChiSq	0.2205

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.
Sample Size = 22

B28	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	1	4.55	1	4.55
Disagree	11	50.00	12	54.55
Undecided	4	18.18	16	72.73
Agree	5	22.73	21	95.45
Strongly agree	1	4.55	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	15.2727
DF	4
Pr > ChiSq	0.0042

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.
Sample Size = 22

B29	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	1	4.55	1	4.55

Disagree	3	13.64	4	18.18
Undecided	10	45.45	14	63.64
Agree	5	22.73	19	86.36
Strongly agree	3	13.64	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	10.7273
DF	4
Pr > ChiSq	0.0298

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.

Sample Size = 22

B30	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree	2	9.09	2	9.09
Undecided	1	4.55	3	13.64
Agree	14	63.64	17	77.27
Strongly agree	5	22.73	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	19.0909
DF	3
Pr > ChiSq	0.0003

Sample Size = 22

B31	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree	4	18.18	4	18.18
Undecided	4	18.18	8	36.36
Agree	10	45.45	18	81.82
Strongly agree	4	18.18	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	4.9091
DF	3
Pr > ChiSq	0.1786

Sample Size = 22

B32	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree	6	27.27	6	27.27
Undecided	5	22.73	11	50.00
Agree	10	45.45	21	95.45
Strongly agree	1	4.55	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	7.4545
DF	3
Pr > ChiSq	0.0587

Sample Size = 22

B33	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	1	4.55	1	4.55
Undecided	1	4.55	2	9.09
Agree	10	45.45	12	54.55
Strongly agree	10	45.45	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	14.7273
DF	3
Pr > ChiSq	0.0021

Sample Size = 22

B34	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree	1	4.55	1	4.55
Undecided	2	9.09	3	13.64
Agree	9	40.91	12	54.55
Strongly agree	10	45.45	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	11.8182
DF	3
Pr > ChiSq	0.0080

Sample Size = 22

B35	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	1	4.55	1	4.55

Disagree	2	9.09	3	13.64
Undecided	7	31.82	10	45.45
Agree	9	40.91	19	86.36
Strongly agree	3	13.64	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	10.7273
DF	4
Pr > ChiSq	0.0298

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.

Sample Size = 22

B36	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	1	4.55	1	4.55
Undecided	3	13.64	4	18.18
Agree	5	22.73	9	40.91
Strongly agree	13	59.09	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	15.0909
DF	3
Pr > ChiSq	0.0017

Sample Size = 22

B37	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	3	13.64	3	13.64
Undecided	2	9.09	5	22.73
Agree	12	54.55	17	77.27
Strongly agree	5	22.73	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	11.0909
DF	3
Pr > ChiSq	0.0112

Sample Size = 22

B38	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	2	9.09	2	9.09
Agree	14	63.64	16	72.73
Strongly agree	6	27.27	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	10.1818
DF	2
Pr > ChiSq	0.0062

Sample Size = 22

B39	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	3	13.64	3	13.64
Disagree	3	13.64	6	27.27
Undecided	5	22.73	11	50.00
Agree	10	45.45	21	95.45
Strongly agree	1	4.55	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	10.7273
DF	4
Pr > ChiSq	0.0298

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.

Sample Size = 22

B40	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	1	4.55	1	4.55
Undecided	1	4.55	2	9.09
Agree	5	22.73	7	31.82
Strongly agree	15	68.18	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	23.8182
DF	3
Pr > ChiSq	<.0001

Sample Size = 22

B41	Frequency	Percent	Cumulative Frequency	Cumulative Percent

Strongly disagree	2	9.09	2	9.09
Disagree	1	4.55	3	13.64
Undecided	5	22.73	8	36.36
Agree	12	54.55	20	90.91
Strongly agree	2	9.09	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	18.4545
DF	4
Pr > ChiSq	0.0010

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.

Sample Size = 22

B42	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	4	18.18	4	18.18
Disagree	10	45.45	14	63.64
Undecided	4	18.18	18	81.82
Agree	2	9.09	20	90.91
Strongly agree	2	9.09	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	9.8182
DF	4
Pr > ChiSq	0.0436

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.

Sample Size = 22

B43	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	2	9.09	2	9.09
Undecided	2	9.09	4	18.18
Agree	12	54.55	16	72.73
Strongly agree	6	27.27	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	12.1818
DF	3
Pr > ChiSq	0.0068

Sample Size = 22

B44	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	4	18.18	4	18.18
Disagree	8	36.36	12	54.55
Undecided	5	22.73	17	77.27
Agree	3	13.64	20	90.91
Strongly agree	2	9.09	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	4.8182
DF	4
Pr > ChiSq	0.3065

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.

Sample Size = 22

B45	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	1	4.55	1	4.55
Disagree	1	4.55	2	9.09
Undecided	5	22.73	7	31.82
Agree	6	27.27	13	59.09
Strongly agree	9	40.91	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	10.7273
DF	4
Pr > ChiSq	0.0298

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.

Sample Size = 22

B46	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	2	9.09	2	9.09
Disagree	4	18.18	6	27.27
Undecided	5	22.73	11	50.00
Agree	11	50.00	22	100.00

Chi-Square Test
for Equal Proportions

ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
Chi-Square 8.1818
DF 3
Pr > ChiSq 0.0424
Sample Size = 22

B47	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	1	4.55	1	4.55
Strongly disagree	3	13.64	4	18.18
Disagree	8	36.36	12	54.55
Undecided	3	13.64	15	68.18
Agree	1	4.55	16	72.73
Strongly agree	6	27.27	22	100.00

Chi-Square Test
for Equal Proportions
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
Chi-Square 10.7273
DF 5
Pr > ChiSq 0.0571
WARNING: The table cells have expected counts less
than 5. Chi-Square may not be a valid test.
Sample Size = 22

B48	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	7	31.82	7	31.82
Disagree	1	4.55	8	36.36
Undecided	5	22.73	13	59.09
Agree	9	40.91	22	100.00

Chi-Square Test
for Equal Proportions
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
Chi-Square 6.3636
DF 3
Pr > ChiSq 0.0952
Sample Size = 22

B49	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	3	13.64	3	13.64
Disagree	2	9.09	5	22.73
Undecided	1	4.55	6	27.27
Agree	7	31.82	13	59.09
Strongly agree	9	40.91	22	100.00

Chi-Square Test
for Equal Proportions
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
Chi-Square 10.7273
DF 4
Pr > ChiSq 0.0298
WARNING: The table cells have expected counts less
than 5. Chi-Square may not be a valid test.
Sample Size = 22

B50	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	2	9.09	2	9.09
Disagree	1	4.55	3	13.64
Undecided	9	40.91	12	54.55
Agree	10	45.45	22	100.00

Chi-Square Test
for Equal Proportions
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
Chi-Square 11.8182
DF 3
Pr > ChiSq 0.0080
Sample Size = 22

B51	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	4	18.18	4	18.18
Disagree	2	9.09	6	27.27
Undecided	10	45.45	16	72.73
Agree	5	22.73	21	95.45
Strongly agree	1	4.55	22	100.00

Chi-Square Test
for Equal Proportions
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
Chi-Square 11.1818
DF 4
Pr > ChiSq 0.0246
WARNING: The table cells have expected counts less
than 5. Chi-Square may not be a valid test.
Sample Size = 22

B52	Frequency	Percent	Cumulative Frequency	Cumulative Percent

Disagree	1	4.55	1	4.55
Undecided	4	18.18	5	22.73
Agree	3	13.64	8	36.36
Strongly agree	14	63.64	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	18.3636
DF	3
Pr > ChiSq	0.0004

Sample Size = 22

B53	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	2	9.09	2	9.09
Disagree	7	31.82	9	40.91
Undecided	1	4.55	10	45.45
Agree	10	45.45	20	90.91
Strongly agree	2	9.09	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	13.9091
DF	4
Pr > ChiSq	0.0076

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.
Sample Size = 22

B54	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	3	13.64	3	13.64
Disagree	1	4.55	4	18.18
Undecided	1	4.55	5	22.73
Agree	6	27.27	11	50.00
Strongly agree	11	50.00	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	16.1818
DF	4
Pr > ChiSq	0.0028

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.
Sample Size = 22

B55	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	3	13.64	3	13.64
Disagree	3	13.64	6	27.27
Undecided	4	18.18	10	45.45
Agree	9	40.91	19	86.36
Strongly agree	3	13.64	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	6.1818
DF	4
Pr > ChiSq	0.1860

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.
Sample Size = 22

B56	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	2	9.09	2	9.09
Undecided	2	9.09	4	18.18
Agree	7	31.82	11	50.00
Strongly agree	11	50.00	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	10.3636
DF	3
Pr > ChiSq	0.0157

Sample Size = 22

B57	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	1	4.55	1	4.55
Disagree	2	9.09	3	13.64
Undecided	5	22.73	8	36.36
Agree	2	9.09	10	45.45
Strongly agree	12	54.55	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	18.4545

DF 4
Pr > ChiSq 0.0010

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.

Sample Size = 22

B58	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	3	13.64	3	13.64
Disagree	4	18.18	7	31.82
Undecided	8	36.36	15	68.18
Agree	4	18.18	19	86.36
Strongly agree	3	13.64	22	100.00

Chi-Square Test for Equal Proportions	
Chi-Square	3.9091
DF	4
Pr > ChiSq	0.4184

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.

Sample Size = 22

B59	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree	1	4.55	1	4.55
Undecided	5	22.73	6	27.27
Agree	7	31.82	13	59.09
Strongly agree	9	40.91	22	100.00

Chi-Square Test for Equal Proportions	
Chi-Square	6.3636
DF	3
Pr > ChiSq	0.0952

Sample Size = 22

B60	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	1	4.55	1	4.55
Disagree	1	4.55	2	9.09
Undecided	6	27.27	8	36.36
Agree	6	27.27	14	63.64
Strongly agree	8	36.36	22	100.00

Chi-Square Test for Equal Proportions	
Chi-Square	9.3636
DF	4
Pr > ChiSq	0.0526

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.

Sample Size = 22

B61	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	3	13.64	3	13.64
Disagree	4	18.18	7	31.82
Undecided	2	9.09	9	40.91
Agree	5	22.73	14	63.64
Strongly agree	8	36.36	22	100.00

Chi-Square Test for Equal Proportions	
Chi-Square	4.8182
DF	4
Pr > ChiSq	0.3065

WARNING: The table cells have expected counts less than 5. Chi-Square may not be a valid test.

Sample Size = 22

B62	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly disagree	3	13.64	3	13.64
Disagree	6	27.27	9	40.91
Undecided	2	9.09	11	50.00
Agree	11	50.00	22	100.00

Chi-Square Test for Equal Proportions	
Chi-Square	8.9091
DF	3
Pr > ChiSq	0.0305

Sample Size = 22

time_work	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0.1666666667	1	4.55	1	4.55

0.4166666667	1	4.55	2	9.09
1	1	4.55	3	13.64
1.0833333333	1	4.55	4	18.18
1.4166666667	1	4.55	5	22.73
2	1	4.55	6	27.27
3	1	4.55	7	31.82
3.0833333333	1	4.55	8	36.36
4	2	9.09	10	45.45
5.25	1	4.55	11	50.00
6.5	1	4.55	12	54.55
8.6666666667	2	9.09	14	63.64
10.25	1	4.55	15	68.18
17.916666667	1	4.55	16	72.73
18	1	4.55	17	77.27
19.5	1	4.55	18	81.82
20.333333333	1	4.55	19	86.36
25.166666667	1	4.55	20	90.91
25.666666667	1	4.55	21	95.45
28	1	4.55	22	100.00

Table of B08 by B09

Frequency / Percent / Row Pct / Col Pct	Disagree-Strongly disagree	Undecided	Agree-Strongly agree	Total
Disagree-Strongly disagree	3	2	1	6
	13.64	9.09	4.55	27.27
	50.00	33.33	16.67	
	75.00	33.33	8.33	
Undecided	1	1	4	6
	4.55	4.55	18.18	27.27
	16.67	16.67	66.67	
	25.00	16.67	33.33	
Agree-Strongly agree	0	3	7	10
	0.00	13.64	31.82	45.45
	0.00	30.00	70.00	
	0.00	50.00	58.33	
Total	4	6	12	22
	18.18	27.27	54.55	100.00

Sample Size = 22

Annexure C: Comparisons of proportions

B01	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Undecided	5	22.73	5	22.73
Agree-Strongly agree	17	77.27	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	6.5455
DF	1
Pr > ChiSq	0.0105

Sample Size = 22

B02	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	3	13.64	3	13.64
Undecided	3	13.64	6	27.27
Agree-Strongly agree	16	72.73	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	15.3636
DF	2
Pr > ChiSq	0.0005

Sample Size = 22

B03	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	1	4.55	1	4.55
Undecided	2	9.09	3	13.64
Agree-Strongly agree	19	86.36	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	27.9091
DF	2
Pr > ChiSq	<.0001

Sample Size = 22

B04	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	1	4.55	1	4.55
Disagree-Strongly disagree	4	18.18	5	22.73
Undecided	2	9.09	7	31.82
Agree-Strongly agree	15	68.18	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	22.7273
DF	3
Pr > ChiSq	<.0001

Sample Size = 22

B05	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	3	13.64	3	13.64
Undecided	4	18.18	7	31.82
Agree-Strongly agree	15	68.18	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	12.0909
DF	2
Pr > ChiSq	0.0024

Sample Size = 22

B06	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	5	22.73	5	22.73
Undecided	5	22.73	10	45.45
Agree-Strongly agree	12	54.55	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	4.4545
DF	2
Pr > ChiSq	0.1078

Sample Size = 22

B07	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	3	13.64	3	13.64
Undecided	3	13.64	6	27.27

	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	16	72.73	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	15.3636
DF	2
Pr > ChiSq	0.0005

Sample Size = 22

B08	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	6	27.27	6	27.27
Undecided	6	27.27	12	54.55
Agree-Strongly agree	10	45.45	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	1.4545
DF	2
Pr > ChiSq	0.4832

Sample Size = 22

B09	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	4	18.18	4	18.18
Undecided	6	27.27	10	45.45
Agree-Strongly agree	12	54.55	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	4.7273
DF	2
Pr > ChiSq	0.0941

Sample Size = 22

B10	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	7	31.82	7	31.82
Undecided	2	9.09	9	40.91
Agree-Strongly agree	13	59.09	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	8.2727
DF	2
Pr > ChiSq	0.0160

Sample Size = 22

B11	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	3	13.64	3	13.64
Undecided	4	18.18	7	31.82
Agree-Strongly agree	15	68.18	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	12.0909
DF	2
Pr > ChiSq	0.0024

Sample Size = 22

B12	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	3	13.64	3	13.64
Undecided	6	27.27	9	40.91
Agree-Strongly agree	13	59.09	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	7.1818
DF	2
Pr > ChiSq	0.0276

Sample Size = 22

B13	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	9	40.91	9	40.91
Undecided	6	27.27	15	68.18
Agree-Strongly agree	7	31.82	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	0.6364
DF	2
Pr > ChiSq	0.7275

Sample Size = 22

B14	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	1	4.55	1	4.55
Undecided	6	27.27	7	31.82
Agree-Strongly agree	15	68.18	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	13.7273
DF	2
Pr > ChiSq	0.0010

Sample Size = 22

B15	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	5	22.73	5	22.73
Undecided	8	36.36	13	59.09
Agree-Strongly agree	9	40.91	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	1.1818
DF	2
Pr > ChiSq	0.5538

Sample Size = 22

B16	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	4	18.18	4	18.18
Undecided	11	50.00	15	68.18
Agree-Strongly agree	7	31.82	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	3.3636
DF	2
Pr > ChiSq	0.1860

Sample Size = 22

B17	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	1	4.55	1	4.55
Undecided	5	22.73	6	27.27
Agree-Strongly agree	16	72.73	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	16.4545
DF	2
Pr > ChiSq	0.0003

Sample Size = 22

B18	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Undecided	5	22.73	5	22.73
Agree-Strongly agree	17	77.27	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	6.5455
DF	1
Pr > ChiSq	0.0105

Sample Size = 22

B19	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	3	13.64	3	13.64
Undecided	12	54.55	15	68.18
Agree-Strongly agree	7	31.82	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	5.5455
DF	2
Pr > ChiSq	0.0625

Sample Size = 22

B20	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	5	22.73	5	22.73
Undecided	2	9.09	7	31.82
Agree-Strongly agree	15	68.18	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	12.6364
DF	2
Pr > ChiSq	0.0018

Sample Size = 22

B21	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	4	18.18	4	18.18
Undecided	6	27.27	10	45.45
Agree-Strongly agree	12	54.55	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	4.7273
DF	2
Pr > ChiSq	0.0941

Sample Size = 22

B22	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Undecided	9	40.91	9	40.91
Agree-Strongly agree	13	59.09	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	0.7273
DF	1
Pr > ChiSq	0.3938

Sample Size = 22

B23	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	8	36.36	8	36.36
Undecided	4	18.18	12	54.55
Agree-Strongly agree	10	45.45	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	2.5455
DF	2
Pr > ChiSq	0.2801

Sample Size = 22

B24	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	2	9.09	2	9.09
Undecided	12	54.55	14	63.64
Agree-Strongly agree	8	36.36	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	6.9091
DF	2
Pr > ChiSq	0.0316

Sample Size = 22

B25	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	3	13.64	3	13.64
Undecided	5	22.73	8	36.36
Agree-Strongly agree	14	63.64	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	9.3636
DF	2
Pr > ChiSq	0.0093

Sample Size = 22

B26	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	2	9.09	2	9.09
Disagree-Strongly disagree	6	27.27	8	36.36
Undecided	6	27.27	14	63.64
Agree-Strongly agree	8	36.36	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	3.4545
DF	3
Pr > ChiSq	0.3267

Sample Size = 22

B27	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	4	18.18	4	18.18

Undecided	5	22.73	9	40.91
Agree-Strongly agree	13	59.09	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	6.6364
DF	2
Pr > ChiSq	0.0362

Sample Size = 22

B28	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	12	54.55	12	54.55
Undecided	4	18.18	16	72.73
Agree-Strongly agree	6	27.27	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	4.7273
DF	2
Pr > ChiSq	0.0941

Sample Size = 22

B29	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	4	18.18	4	18.18
Undecided	10	45.45	14	63.64
Agree-Strongly agree	8	36.36	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	2.5455
DF	2
Pr > ChiSq	0.2801

Sample Size = 22

B30	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	2	9.09	2	9.09
Undecided	1	4.55	3	13.64
Agree-Strongly agree	19	86.36	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	27.9091
DF	2
Pr > ChiSq	<.0001

Sample Size = 22

B31	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	4	18.18	4	18.18
Undecided	4	18.18	8	36.36
Agree-Strongly agree	14	63.64	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	9.0909
DF	2
Pr > ChiSq	0.0106

Sample Size = 22

B32	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	6	27.27	6	27.27
Undecided	5	22.73	11	50.00
Agree-Strongly agree	11	50.00	22	100.00

for Equal Proportions

Chi-Square	2.8182
DF	2
Pr > ChiSq	0.2444

Sample Size = 22

B33	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	1	4.55	1	4.55
Undecided	1	4.55	2	9.09
Agree-Strongly agree	20	90.91	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	32.8182
DF	2
Pr > ChiSq	<.0001

Sample Size = 22

B34	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	1	4.55	1	4.55
Undecided	2	9.09	3	13.64
Agree-Strongly agree	19	86.36	22	100.00

Chi-Square Test for Equal Proportions	
Chi-Square	27.9091
DF	2
Pr > ChiSq	<.0001

Sample Size = 22

B35	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	3	13.64	3	13.64
Undecided	7	31.82	10	45.45
Agree-Strongly agree	12	54.55	22	100.00

Chi-Square Test for Equal Proportions	
Chi-Square	5.5455
DF	2
Pr > ChiSq	0.0625

Sample Size = 22

B36	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	1	4.55	1	4.55
Undecided	3	13.64	4	18.18
Agree-Strongly agree	18	81.82	22	100.00

Chi-Square Test for Equal Proportions	
Chi-Square	23.5455
DF	2
Pr > ChiSq	<.0001

Sample Size = 22

B37	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	3	13.64	3	13.64
Undecided	2	9.09	5	22.73
Agree-Strongly agree	17	77.27	22	100.00

Chi-Square Test for Equal Proportions	
Chi-Square	19.1818
DF	2
Pr > ChiSq	<.0001

Sample Size = 22

B38	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	2	9.09	2	9.09
Agree-Strongly agree	20	90.91	22	100.00

Chi-Square Test for Equal Proportions	
Chi-Square	14.7273
DF	1
Pr > ChiSq	0.0001

Sample Size = 22

B39	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	6	27.27	6	27.27
Undecided	5	22.73	11	50.00
Agree-Strongly agree	11	50.00	22	100.00

Chi-Square Test for Equal Proportions	
Chi-Square	2.8182
DF	2
Pr > ChiSq	0.2444

Sample Size = 22

B40	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	1	4.55	1	4.55
Undecided	1	4.55	2	9.09
Agree-Strongly agree	20	90.91	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	32.8182
DF	2
Pr > ChiSq	<.0001

Sample Size = 22

B41	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	3	13.64	3	13.64
Undecided	5	22.73	8	36.36
Agree-Strongly agree	14	63.64	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	9.3636
DF	2
Pr > ChiSq	0.0093

Sample Size = 22

B42	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	14	63.64	14	63.64
Undecided	4	18.18	18	81.82
Agree-Strongly agree	4	18.18	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	9.0909
DF	2
Pr > ChiSq	0.0106

Sample Size = 22

B43	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	2	9.09	2	9.09
Undecided	2	9.09	4	18.18
Agree-Strongly agree	18	81.82	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	23.2727
DF	2
Pr > ChiSq	<.0001

Sample Size = 22

B44	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	12	54.55	12	54.55
Undecided	5	22.73	17	77.27
Agree-Strongly agree	5	22.73	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	4.4545
DF	2
Pr > ChiSq	0.1078

Sample Size = 22

B45	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	2	9.09	2	9.09
Undecided	5	22.73	7	31.82
Agree-Strongly agree	15	68.18	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	12.6364
DF	2
Pr > ChiSq	0.0018

Sample Size = 22

B46	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	6	27.27	6	27.27
Undecided	5	22.73	11	50.00
Agree-Strongly agree	11	50.00	22	100.00

Chi-Square Test for Equal Proportions

Chi-Square	2.8182
DF	2
Pr > ChiSq	0.2444

Sample Size = 22

B47	Frequency	Percent	Cumulative Frequency	Cumulative Percent

0	1	4.55	1	4.55
Disagree-Strongly disagree	11	50.00	12	54.55
Undecided	3	13.64	15	68.18
Agree-Strongly agree	7	31.82	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	10.7273
DF	3
Pr > ChiSq	0.0133

Sample Size = 22

B48	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	8	36.36	8	36.36
Undecided	5	22.73	13	59.09
Agree-Strongly agree	9	40.91	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	1.1818
DF	2
Pr > ChiSq	0.5538

Sample Size = 22

B49	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	5	22.73	5	22.73
Undecided	1	4.55	6	27.27
Agree-Strongly agree	16	72.73	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	16.4545
DF	2
Pr > ChiSq	0.0003

Sample Size = 22

B50	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	3	13.64	3	13.64
Undecided	9	40.91	12	54.55
Agree-Strongly agree	10	45.45	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	3.9091
DF	2
Pr > ChiSq	0.1416

Sample Size = 22

B51	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	6	27.27	6	27.27
Undecided	10	45.45	16	72.73
Agree-Strongly agree	6	27.27	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	1.4545
DF	2
Pr > ChiSq	0.4832

Sample Size = 22

B52	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	1	4.55	1	4.55
Undecided	4	18.18	5	22.73
Agree-Strongly agree	17	77.27	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	19.7273
DF	2
Pr > ChiSq	<.0001

Sample Size = 22

B53	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	9	40.91	9	40.91
Undecided	1	4.55	10	45.45
Agree-Strongly agree	12	54.55	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	8.8182

DF 2
Pr > ChiSq 0.0122
Sample Size = 22

B54	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	4	18.18	4	18.18
Undecided	1	4.55	5	22.73
Agree-Strongly agree	17	77.27	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	19.7273
DF	2
Pr > ChiSq	<.0001

Sample Size = 22

B55	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	6	27.27	6	27.27
Undecided	4	18.18	10	45.45
Agree-Strongly agree	12	54.55	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	4.7273
DF	2
Pr > ChiSq	0.0941

Sample Size = 22

B56	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	2	9.09	2	9.09
Undecided	2	9.09	4	18.18
Agree-Strongly agree	18	81.82	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	23.2727
DF	2
Pr > ChiSq	<.0001

Sample Size = 22

B57	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	3	13.64	3	13.64
Undecided	5	22.73	8	36.36
Agree-Strongly agree	14	63.64	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	9.3636
DF	2
Pr > ChiSq	0.0093

Sample Size = 22

B58	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	7	31.82	7	31.82
Undecided	8	36.36	15	68.18
Agree-Strongly agree	7	31.82	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	0.0909
DF	2
Pr > ChiSq	0.9556

Sample Size = 22

B59	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	1	4.55	1	4.55
Undecided	5	22.73	6	27.27
Agree-Strongly agree	16	72.73	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	16.4545
DF	2
Pr > ChiSq	0.0003

Sample Size = 22

B60	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	2	9.09	2	9.09
Undecided	6	27.27	8	36.36

Agree-Strongly agree	14	63.64	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	10.1818
DF	2
Pr > ChiSq	0.0062

Sample Size = 22

B61	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	7	31.82	7	31.82
Undecided	2	9.09	9	40.91
Agree-Strongly agree	13	59.09	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	8.2727
DF	2
Pr > ChiSq	0.0160

Sample Size = 22

B62	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	9	40.91	9	40.91
Undecided	2	9.09	11	50.00
Agree-Strongly agree	11	50.00	22	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	6.0909
DF	2
Pr > ChiSq	0.0476

Sample Size = 22

Annexure D: Descriptive statistics: Uni-variate with means & standard deviations where appropriate

Variable: B01 (B01)

N	22	Sum Weights	22
Mean	4.09090909	Sum Observations	90
Std Deviation	0.75018035	Variance	0.56277056
Skewness	-0.1538092	Kurtosis	-1.1064404
Uncorrected SS	380	Corrected SS	11.8181818
Coeff Variation	18.337742	Std Error Mean	0.15993899

Basic Statistical Measures

Location		Variability	
Mean	4.090909	Std Deviation	0.75018
Median	4.000000	Variance	0.56277
Mode	4.000000	Range	2.00000
		Interquartile Range	1.00000

Variable: B02 (B02)

N	22	Sum Weights	22
Mean	4	Sum Observations	88
Std Deviation	1.06904497	Variance	1.14285714
Skewness	-0.7717168	Kurtosis	-0.56875
Uncorrected SS	376	Corrected SS	24
Coeff Variation	26.7261242	Std Error Mean	0.22792115

Basic Statistical Measures

Location		Variability	
Mean	4.000000	Std Deviation	1.06904
Median	4.000000	Variance	1.14286
Mode	5.000000	Range	3.00000
		Interquartile Range	2.00000

Variable: B03 (B03)

N	22	Sum Weights	22
Mean	4.18181818	Sum Observations	92
Std Deviation	0.95799213	Variance	0.91774892
Skewness	-1.8257526	Kurtosis	4.83275234
Uncorrected SS	404	Corrected SS	19.2727273
Coeff Variation	22.9085074	Std Error Mean	0.20424461

Basic Statistical Measures

Location		Variability	
Mean	4.181818	Std Deviation	0.95799
Median	4.000000	Variance	0.91775
Mode	4.000000	Range	4.00000
		Interquartile Range	1.00000

Variable: B04 (B04)

N	21	Sum Weights	21
Mean	3.76190476	Sum Observations	79
Std Deviation	1.30018314	Variance	1.69047619
Skewness	-1.0199852	Kurtosis	0.10269892
Uncorrected SS	331	Corrected SS	33.8095238
Coeff Variation	34.5618302	Std Error Mean	0.28372322

Basic Statistical Measures

Location		Variability	
Mean	3.761905	Std Deviation	1.30018
Median	4.000000	Variance	1.69048
Mode	4.000000	Range	4.00000
		Interquartile Range	2.00000

Variable: B05 (B05)

N	22	Sum Weights	22
Mean	3.90909091	Sum Observations	86
Std Deviation	1.06498786	Variance	1.13419913
Skewness	-0.58489	Kurtosis	-0.8241524
Uncorrected SS	360	Corrected SS	23.8181818
Coeff Variation	27.2438754	Std Error Mean	0.22705617

Basic Statistical Measures

Location		Variability	
Mean	3.909091	Std Deviation	1.06499
Median	4.000000	Variance	1.13420
Mode	5.000000	Range	3.00000
		Interquartile Range	2.00000

Variable: B06 (B06)

N	22	Sum Weights	22
Mean	3.5	Sum Observations	77
Std Deviation	1.50396302	Variance	2.26190476
Skewness	-0.6005187	Kurtosis	-0.9734154
Uncorrected SS	317	Corrected SS	47.5
Coeff Variation	42.970372	Std Error Mean	0.32064599

Basic Statistical Measures

Location		Variability	
Mean	3.500000	Std Deviation	1.50396
Median	4.000000	Variance	2.26190

```
    Mode     5.000000     Range                   4.00000
                          Interquartile Range     2.00000


                     Variable:  B07  (B07)
N                           22    Sum Weights                 22
Mean                         4    Sum Observations            88
Std Deviation       1.06904497    Variance            1.14285714
Skewness            -0.7717168    Kurtosis              -0.56875
Uncorrected SS             376    Corrected SS                24
Coeff Variation     26.7261242    Std Error Mean      0.22792115

                  Basic Statistical Measures
        Location                    Variability
    Mean     4.000000     Std Deviation           1.06904
    Median   4.000000     Variance                1.14286
    Mode     5.000000     Range                   3.00000
                          Interquartile Range     2.00000


                     Variable:  B08  (B08)
N                           22    Sum Weights                 22
Mean                       3.5    Sum Observations            77
Std Deviation       1.33630621    Variance            1.78571429
Skewness            -0.1317063    Kurtosis            -1.3862063
Uncorrected SS             307    Corrected SS              37.5
Coeff Variation     38.1801774    Std Error Mean      0.28490144

                  Basic Statistical Measures
        Location                    Variability
    Mean     3.500000     Std Deviation           1.33631
    Median   3.000000     Variance                1.78571
    Mode     5.000000     Range                   4.00000
                          Interquartile Range     3.00000


                     Variable:  B09  (B09)
N                           22    Sum Weights                 22
Mean                3.59090909    Sum Observations            79
Std Deviation       1.29684933    Variance            1.68181818
Skewness            -0.5799622    Kurtosis            -0.5358239
Uncorrected SS             319    Corrected SS        35.3181818
Coeff Variation     36.1147914    Std Error Mean      0.27648921

                  Basic Statistical Measures
        Location                    Variability
    Mean     3.590909     Std Deviation           1.29685
    Median   4.000000     Variance                1.68182
    Mode     5.000000     Range                   4.00000
                          Interquartile Range     2.00000


                     Variable:  B10  (B10)
N                           22    Sum Weights                 22
Mean                3.36363636    Sum Observations            74
Std Deviation       1.04860245    Variance             1.0995671
Skewness            -0.2838424    Kurtosis            -1.3636833
Uncorrected SS             272    Corrected SS        23.0909091
Coeff Variation     31.1746675    Std Error Mean      0.22356279

                  Basic Statistical Measures
        Location                    Variability
    Mean     3.363636     Std Deviation           1.04860
    Median   4.000000     Variance                1.09957
    Mode     4.000000     Range                   3.00000
                          Interquartile Range     2.00000


                     Variable:  B11  (B11)
N                           22    Sum Weights                 22
Mean                3.63636364    Sum Observations            80
Std Deviation       0.84771146    Variance            0.71861472
Skewness            -0.7291069    Kurtosis            0.11718453
Uncorrected SS             306    Corrected SS        15.0909091
Coeff Variation     23.3120651    Std Error Mean      0.18073269

                  Basic Statistical Measures
        Location                    Variability
    Mean     3.636364     Std Deviation           0.84771
    Median   4.000000     Variance                0.71861
    Mode     4.000000     Range                   3.00000
                          Interquartile Range     1.00000


                     Variable:  B12  (B12)
N                           22    Sum Weights                 22
Mean                3.72727273    Sum Observations            82
Std Deviation       1.16217441    Variance            1.35064935
Skewness            -0.6122476    Kurtosis            -0.2418989
Uncorrected SS             334    Corrected SS        28.3636364
Coeff Variation     31.1802889    Std Error Mean      0.24777642

                  Basic Statistical Measures
        Location                    Variability
    Mean     3.727273     Std Deviation           1.16217
    Median   4.000000     Variance                1.35065
    Mode     5.000000     Range                   4.00000
                          Interquartile Range     2.00000
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Variable: B13 (B13)

N	22	Sum Weights	22
Mean	2.81818182	Sum Observations	62
Std Deviation	1.36752692	Variance	1.87012987
Skewness	0.11374954	Kurtosis	-1.0842978
Uncorrected SS	214	Corrected SS	39.2727273
Coeff Variation	48.5251487	Std Error Mean	0.29155772

Basic Statistical Measures

Location		Variability	
Mean	2.818182	Std Deviation	1.36753
Median	3.000000	Variance	1.87013
Mode	3.000000	Range	4.00000
		Interquartile Range	2.00000

Variable: B14 (B14)

N	22	Sum Weights	22
Mean	3.72727273	Sum Observations	82
Std Deviation	0.70250017	Variance	0.49350649
Skewness	-0.4645063	Kurtosis	0.657851
Uncorrected SS	316	Corrected SS	10.3636364
Coeff Variation	18.8475656	Std Error Mean	0.14977354

Basic Statistical Measures

Location		Variability	
Mean	3.727273	Std Deviation	0.70250
Median	4.000000	Variance	0.49351
Mode	4.000000	Range	3.00000
		Interquartile Range	1.00000

Variable: B15 (B15)

N	22	Sum Weights	22
Mean	3.36363636	Sum Observations	74
Std Deviation	1.04860245	Variance	1.0995671
Skewness	0.26131519	Kurtosis	-1.0204069
Uncorrected SS	272	Corrected SS	23.0909091
Coeff Variation	31.1746675	Std Error Mean	0.22356279

Basic Statistical Measures

Location		Variability	
Mean	3.363636	Std Deviation	1.04860
Median	3.000000	Variance	1.09957
Mode	3.000000	Range	3.00000
		Interquartile Range	1.00000

Variable: B16 (B16)

N	22	Sum Weights	22
Mean	3.18181818	Sum Observations	70
Std Deviation	1.09702471	Variance	1.2034632
Skewness	-0.1554237	Kurtosis	0.1877706
Uncorrected SS	248	Corrected SS	25.2727273
Coeff Variation	34.4779193	Std Error Mean	0.23388645

Basic Statistical Measures

Location		Variability	
Mean	3.181818	Std Deviation	1.09702
Median	3.000000	Variance	1.20346
Mode	3.000000	Range	4.00000
		Interquartile Range	1.00000

Variable: B17 (B17)

N	22	Sum Weights	22
Mean	3.72727273	Sum Observations	82
Std Deviation	0.6310851	Variance	0.3982684
Skewness	-0.9817459	Kurtosis	1.71796339
Uncorrected SS	314	Corrected SS	8.36363636
Coeff Variation	16.9315514	Std Error Mean	0.13454779

Basic Statistical Measures

Location		Variability	
Mean	3.727273	Std Deviation	0.63109
Median	4.000000	Variance	0.39827
Mode	4.000000	Range	3.00000
		Interquartile Range	1.00000

Variable: B18 (B18)

N	22	Sum Weights	22
Mean	3.81818182	Sum Observations	84
Std Deviation	0.50108108	Variance	0.25108225
Skewness	-0.4129003	Kurtosis	0.75173665
Uncorrected SS	326	Corrected SS	5.27272727
Coeff Variation	13.1235522	Std Error Mean	0.10683085

Basic Statistical Measures

Location		Variability	
Mean	3.818182	Std Deviation	0.50108
Median	4.000000	Variance	0.25108
Mode	4.000000	Range	2.00000
		Interquartile Range	0

Variable: B19 (B19)

N	22	Sum Weights	22

Mean	3.27272727	Sum Observations	72
Std Deviation	0.82703246	Variance	0.68398268
Skewness	0.53722656	Kurtosis	0.19675491
Uncorrected SS	250	Corrected SS	14.3636364
Coeff Variation	25.2704362	Std Error Mean	0.17632391

Basic Statistical Measures

Location		Variability	
Mean	3.272727	Std Deviation	0.82703
Median	3.000000	Variance	0.68398
Mode	3.000000	Range	3.00000
		Interquartile Range	1.00000

Variable: B20 (B20)

N	22	Sum Weights	22
Mean	3.54545455	Sum Observations	78
Std Deviation	0.96250035	Variance	0.92640693
Skewness	-0.669984	Kurtosis	-0.6587075
Uncorrected SS	296	Corrected SS	19.4545455
Coeff Variation	27.1474458	Std Error Mean	0.20520576

Basic Statistical Measures

Location		Variability	
Mean	3.545455	Std Deviation	0.96250
Median	4.000000	Variance	0.92641
Mode	4.000000	Range	3.00000
		Interquartile Range	1.00000

Variable: B21 (B21)

N	22	Sum Weights	22
Mean	3.63636364	Sum Observations	80
Std Deviation	1.21676599	Variance	1.48051948
Skewness	-0.4368785	Kurtosis	-0.7306961
Uncorrected SS	322	Corrected SS	31.0909091
Coeff Variation	33.4610648	Std Error Mean	0.25941538

Basic Statistical Measures

Location		Variability	
Mean	3.636364	Std Deviation	1.21677
Median	4.000000	Variance	1.48052
Mode	5.000000	Range	4.00000
		Interquartile Range	2.00000

Variable: B22 (B22)

N	22	Sum Weights	22
Mean	3.86363636	Sum Observations	85
Std Deviation	0.83354976	Variance	0.69480519
Skewness	0.27357381	Kurtosis	-1.5094805
Uncorrected SS	343	Corrected SS	14.5909091
Coeff Variation	21.574229	Std Error Mean	0.1777134

Basic Statistical Measures

Location		Variability	
Mean	3.863636	Std Deviation	0.83355
Median	4.000000	Variance	0.69481
Mode	3.000000	Range	2.00000
		Interquartile Range	2.00000

Variable: B23 (B23)

N	22	Sum Weights	22
Mean	3.09090909	Sum Observations	68
Std Deviation	1.06498786	Variance	1.13419913
Skewness	-0.1956801	Kurtosis	-1.0930132
Uncorrected SS	234	Corrected SS	23.8181818
Coeff Variation	34.4554895	Std Error Mean	0.22705617

Basic Statistical Measures

Location		Variability	
Mean	3.090909	Std Deviation	1.06499
Median	3.000000	Variance	1.13420
Mode	4.000000	Range	4.00000
		Interquartile Range	2.00000

Variable: B24 (B24)

N	22	Sum Weights	22
Mean	3.40909091	Sum Observations	75
Std Deviation	0.85407097	Variance	0.72943723
Skewness	0.56284803	Kurtosis	-0.1390404
Uncorrected SS	271	Corrected SS	15.3181818
Coeff Variation	25.0527486	Std Error Mean	0.18208854

Basic Statistical Measures

Location		Variability	
Mean	3.409091	Std Deviation	0.85407
Median	3.000000	Variance	0.72944
Mode	3.000000	Range	3.00000
		Interquartile Range	1.00000

Variable: B25 (B25)

N	22	Sum Weights	22
Mean	3.95454545	Sum Observations	87
Std Deviation	1.13293856	Variance	1.28354978
Skewness	-0.5519232	Kurtosis	-1.1769387

Uncorrected SS	371	Corrected SS	26.9545455
Coeff Variation	28.6490211	Std Error Mean	0.24154331

Basic Statistical Measures

Location		Variability	
Mean	3.954545	Std Deviation	1.13294
Median	4.000000	Variance	1.28355
Mode	5.000000	Range	3.00000
		Interquartile Range	2.00000

Variable: B26 (B26)

N	20	Sum Weights	20
Mean	3.15	Sum Observations	63
Std Deviation	1.08942283	Variance	1.18684211
Skewness	-0.0549529	Kurtosis	-0.6326708
Uncorrected SS	221	Corrected SS	22.55
Coeff Variation	34.5848518	Std Error Mean	0.24360235

Basic Statistical Measures

Location		Variability	
Mean	3.150000	Std Deviation	1.08942
Median	3.000000	Variance	1.18684
Mode	3.000000	Range	4.00000
		Interquartile Range	2.00000

NOTE: The mode displayed is the smallest of 2 modes with a count of 6.

Variable: B27 (B27)

N	22	Sum Weights	22
Mean	3.54545455	Sum Observations	78
Std Deviation	1.2238609	Variance	1.4978355
Skewness	-0.7155409	Kurtosis	-0.1313324
Uncorrected SS	308	Corrected SS	31.4545455
Coeff Variation	34.5191535	Std Error Mean	0.26092802

Basic Statistical Measures

Location		Variability	
Mean	3.545455	Std Deviation	1.22386
Median	4.000000	Variance	1.49784
Mode	4.000000	Range	4.00000
		Interquartile Range	1.00000

Variable: B28 (B28)

N	22	Sum Weights	22
Mean	2.72727273	Sum Observations	60
Std Deviation	1.03195691	Variance	1.06493506
Skewness	0.60741806	Kurtosis	-0.5853533
Uncorrected SS	186	Corrected SS	22.3636364
Coeff Variation	37.83842	Std Error Mean	0.22001395

Basic Statistical Measures

Location		Variability	
Mean	2.727273	Std Deviation	1.03196
Median	2.000000	Variance	1.06494
Mode	2.000000	Range	4.00000
		Interquartile Range	2.00000

Variable: B29 (B29)

N	22	Sum Weights	22
Mean	3.27272727	Sum Observations	72
Std Deviation	1.03195691	Variance	1.06493506
Skewness	-0.0354524	Kurtosis	0.02459063
Uncorrected SS	258	Corrected SS	22.3636364
Coeff Variation	31.5320167	Std Error Mean	0.22001395

Basic Statistical Measures

Location		Variability	
Mean	3.272727	Std Deviation	1.03196
Median	3.000000	Variance	1.06494
Mode	3.000000	Range	4.00000
		Interquartile Range	1.00000

Variable: B30 (B30)

N	22	Sum Weights	22
Mean	4	Sum Observations	88
Std Deviation	0.81649658	Variance	0.66666667
Skewness	-1.1547595	Kurtosis	1.93984962
Uncorrected SS	366	Corrected SS	14
Coeff Variation	20.4124145	Std Error Mean	0.17407766

Basic Statistical Measures

Location		Variability	
Mean	4.000000	Std Deviation	0.81650
Median	4.000000	Variance	0.66667
Mode	4.000000	Range	3.00000
		Interquartile Range	0

Variable: B31 (B31)

N	22	Sum Weights	22
Mean	3.63636364	Sum Observations	80
Std Deviation	1.00216216	Variance	1.004329
Skewness	-0.4129003	Kurtosis	-0.7569771
Uncorrected SS	312	Corrected SS	21.0909091
Coeff Variation	27.5594595	Std Error Mean	0.21366169

Basic Statistical Measures

Location		Variability	
Mean	3.636364	Std Deviation	1.00216
Median	4.000000	Variance	1.00433
Mode	4.000000	Range	3.00000
		Interquartile Range	1.00000

Variable: B32 (B32)

N	22	Sum Weights	22
Mean	3.27272727	Sum Observations	72
Std Deviation	0.93512506	Variance	0.87445887
Skewness	-0.2223454	Kurtosis	-1.203752
Uncorrected SS	254	Corrected SS	18.3636364
Coeff Variation	28.5732657	Std Error Mean	0.19936933

Basic Statistical Measures

Location		Variability	
Mean	3.272727	Std Deviation	0.93513
Median	3.500000	Variance	0.87446
Mode	4.000000	Range	3.00000
		Interquartile Range	2.00000

Variable: B33 (B33)

N	22	Sum Weights	22
Mean	4.27272727	Sum Observations	94
Std Deviation	0.93512506	Variance	0.87445887
Skewness	-2.1440453	Kurtosis	6.48536263
Uncorrected SS	420	Corrected SS	18.3636364
Coeff Variation	21.8859056	Std Error Mean	0.19936933

Basic Statistical Measures

Location		Variability	
Mean	4.272727	Std Deviation	0.93513
Median	4.000000	Variance	0.87446
Mode	4.000000	Range	4.00000
		Interquartile Range	1.00000

NOTE: The mode displayed is the smallest of 2 modes with a count of 10.

Variable: B34 (B34)

N	22	Sum Weights	22
Mean	4.27272727	Sum Observations	94
Std Deviation	0.82703246	Variance	0.68398268
Skewness	-1.1295533	Kurtosis	1.23176363
Uncorrected SS	416	Corrected SS	14.3636364
Coeff Variation	19.3560788	Std Error Mean	0.17632391

Basic Statistical Measures

Location		Variability	
Mean	4.272727	Std Deviation	0.82703
Median	4.000000	Variance	0.68398
Mode	5.000000	Range	3.00000
		Interquartile Range	1.00000

Variable: B35 (B35)

N	22	Sum Weights	22
Mean	3.5	Sum Observations	77
Std Deviation	1.01183473	Variance	1.02380952
Skewness	-0.6067725	Kurtosis	0.47318892
Uncorrected SS	291	Corrected SS	21.5
Coeff Variation	28.9095638	Std Error Mean	0.21572389

Basic Statistical Measures

Location		Variability	
Mean	3.500000	Std Deviation	1.01183
Median	4.000000	Variance	1.02381
Mode	4.000000	Range	4.00000
		Interquartile Range	1.00000

Variable: B36 (B36)

N	22	Sum Weights	22
Mean	4.31818182	Sum Observations	95
Std Deviation	1.04135277	Variance	1.08441558
Skewness	-1.829725	Kurtosis	3.6977484
Uncorrected SS	433	Corrected SS	22.7727273
Coeff Variation	24.1155378	Std Error Mean	0.22201716

Basic Statistical Measures

Location		Variability	
Mean	4.318182	Std Deviation	1.04135
Median	5.000000	Variance	1.08442
Mode	5.000000	Range	4.00000
		Interquartile Range	1.00000

Variable: B37 (B37)

N	22	Sum Weights	22
Mean	3.72727273	Sum Observations	82
Std Deviation	1.24142078	Variance	1.54112554
Skewness	-1.3983615	Kurtosis	1.31644014
Uncorrected SS	338	Corrected SS	32.3636364
Coeff Variation	33.306411	Std Error Mean	0.2646718

Basic Statistical Measures

Location		Variability	
Mean	3.727273	Std Deviation	1.24142
Median	4.000000	Variance	1.54113
Mode	4.000000	Range	4.00000
		Interquartile Range	0

Variable: B38 (B38)

N	22	Sum Weights	22
Mean	4	Sum Observations	88
Std Deviation	1.06904497	Variance	1.14285714
Skewness	-2.0579116	Kurtosis	4.67434211
Uncorrected SS	376	Corrected SS	24
Coeff Variation	26.7261242	Std Error Mean	0.22792115

Basic Statistical Measures

Location		Variability	
Mean	4.000000	Std Deviation	1.06904
Median	4.000000	Variance	1.14286
Mode	4.000000	Range	4.00000
		Interquartile Range	1.00000

Variable: B39 (B39)

N	22	Sum Weights	22
Mean	3.13636364	Sum Observations	69
Std Deviation	1.16682126	Variance	1.36147186
Skewness	-0.6842609	Kurtosis	-0.5697147
Uncorrected SS	245	Corrected SS	28.5909091
Coeff Variation	37.2029968	Std Error Mean	0.24876713

Basic Statistical Measures

Location		Variability	
Mean	3.136364	Std Deviation	1.16682
Median	3.500000	Variance	1.36147
Mode	4.000000	Range	4.00000
		Interquartile Range	2.00000

Variable: B40 (B40)

N	22	Sum Weights	22
Mean	4.5	Sum Observations	99
Std Deviation	0.96362411	Variance	0.92857143
Skewness	-2.634286	Kurtosis	8.01806291
Uncorrected SS	465	Corrected SS	19.5
Coeff Variation	21.4138691	Std Error Mean	0.20544535

Basic Statistical Measures

Location		Variability	
Mean	4.500000	Std Deviation	0.96362
Median	5.000000	Variance	0.92857
Mode	5.000000	Range	4.00000
		Interquartile Range	1.00000

Variable: B41 (B41)

N	22	Sum Weights	22
Mean	3.5	Sum Observations	77
Std Deviation	1.05785047	Variance	1.11904762
Skewness	-1.194715	Kurtosis	1.29709561
Uncorrected SS	293	Corrected SS	23.5
Coeff Variation	30.2242992	Std Error Mean	0.22553448

Basic Statistical Measures

Location		Variability	
Mean	3.500000	Std Deviation	1.05785
Median	4.000000	Variance	1.11905
Mode	4.000000	Range	4.00000
		Interquartile Range	1.00000

Variable: B42 (B42)

N	22	Sum Weights	22
Mean	2.45454545	Sum Observations	54
Std Deviation	1.18431305	Variance	1.4025974
Skewness	0.87564435	Kurtosis	0.19470977
Uncorrected SS	162	Corrected SS	29.4545455
Coeff Variation	48.249791	Std Error Mean	0.25249639

Basic Statistical Measures

Location		Variability	
Mean	2.454545	Std Deviation	1.18431
Median	2.000000	Variance	1.40260
Mode	2.000000	Range	4.00000
		Interquartile Range	1.00000

Variable: B43 (B43)

N	22	Sum Weights	22
Mean	3.90909091	Sum Observations	86
Std Deviation	1.10879991	Variance	1.22943723
Skewness	-1.650052	Kurtosis	2.94113245
Uncorrected SS	362	Corrected SS	25.8181818
Coeff Variation	28.3646487	Std Error Mean	0.23639693

Basic Statistical Measures

Location		Variability	
Mean	3.909091	Std Deviation	1.10880
Median	4.000000	Variance	1.22944

Mode	4.000000	Range	4.00000
		Interquartile Range	1.00000

Variable: B44 (B44)

N	22	Sum Weights	22
Mean	2.59090909	Sum Observations	57
Std Deviation	1.22120514	Variance	1.49134199
Skewness	0.54479958	Kurtosis	-0.4614725
Uncorrected SS	179	Corrected SS	31.3181818
Coeff Variation	47.1342334	Std Error Mean	0.26036181

Basic Statistical Measures

Location		Variability	
Mean	2.590909	Std Deviation	1.22121
Median	2.000000	Variance	1.49134
Mode	2.000000	Range	4.00000
		Interquartile Range	1.00000

Variable: B45 (B45)

N	22	Sum Weights	22
Mean	3.95454545	Sum Observations	87
Std Deviation	1.13293856	Variance	1.28354978
Skewness	-0.9841738	Kurtosis	0.58649865
Uncorrected SS	371	Corrected SS	26.9545455
Coeff Variation	28.6490211	Std Error Mean	0.24154331

Basic Statistical Measures

Location		Variability	
Mean	3.954545	Std Deviation	1.13294
Median	4.000000	Variance	1.28355
Mode	5.000000	Range	4.00000
		Interquartile Range	2.00000

Variable: B46 (B46)

N	22	Sum Weights	22
Mean	3.13636364	Sum Observations	69
Std Deviation	1.03718734	Variance	1.07575758
Skewness	-0.8590017	Kurtosis	-0.4980125
Uncorrected SS	239	Corrected SS	22.5909091
Coeff Variation	33.0697412	Std Error Mean	0.22112908

Basic Statistical Measures

Location		Variability	
Mean	3.136364	Std Deviation	1.03719
Median	3.500000	Variance	1.07576
Mode	4.000000	Range	3.00000
		Interquartile Range	2.00000

Variable: B47 (B47)

N	21	Sum Weights	21
Mean	2.95238095	Sum Observations	62
Std Deviation	1.49920614	Variance	2.24761905
Skewness	0.38416109	Kurtosis	-1.4116435
Uncorrected SS	228	Corrected SS	44.952381
Coeff Variation	50.7795628	Std Error Mean	0.3271536

Basic Statistical Measures

Location		Variability	
Mean	2.952381	Std Deviation	1.49921
Median	2.000000	Variance	2.24762
Mode	2.000000	Range	4.00000
		Interquartile Range	3.00000

Variable: B48 (B48)

N	22	Sum Weights	22
Mean	2.72727273	Sum Observations	60
Std Deviation	1.31590339	Variance	1.73160173
Skewness	-0.4092246	Kurtosis	-1.6580633
Uncorrected SS	200	Corrected SS	36.3636364
Coeff Variation	48.249791	Std Error Mean	0.28055155

Basic Statistical Measures

Location		Variability	
Mean	2.727273	Std Deviation	1.31590
Median	3.000000	Variance	1.73160
Mode	4.000000	Range	3.00000
		Interquartile Range	3.00000

Variable: B49 (B49)

N	22	Sum Weights	22
Mean	3.77272727	Sum Observations	83
Std Deviation	1.44524897	Variance	2.08874459
Skewness	-1.0208901	Kurtosis	-0.3152455
Uncorrected SS	357	Corrected SS	43.8636364
Coeff Variation	38.3078041	Std Error Mean	0.30812812

Basic Statistical Measures

Location		Variability	
Mean	3.772727	Std Deviation	1.44525
Median	4.000000	Variance	2.08874
Mode	5.000000	Range	4.00000
		Interquartile Range	2.00000

Variable: B50 (B50)

N	22	Sum Weights	22
Mean	3.22727273	Sum Observations	71
Std Deviation	0.92230654	Variance	0.85064935
Skewness	-1.2977752	Kurtosis	1.34465848
Uncorrected SS	247	Corrected SS	17.8636364
Coeff Variation	28.5785125	Std Error Mean	0.19663641

Basic Statistical Measures

Location		Variability	
Mean	3.227273	Std Deviation	0.92231
Median	3.000000	Variance	0.85065
Mode	4.000000	Range	3.00000
		Interquartile Range	1.00000

Variable: B51 (B51)

N	22	Sum Weights	22
Mean	2.86363636	Sum Observations	63
Std Deviation	1.12527053	Variance	1.26623377
Skewness	-0.3700535	Kurtosis	-0.3757091
Uncorrected SS	207	Corrected SS	26.5909091
Coeff Variation	39.2951614	Std Error Mean	0.23990848

Basic Statistical Measures

Location		Variability	
Mean	2.863636	Std Deviation	1.12527
Median	3.000000	Variance	1.26623
Mode	3.000000	Range	4.00000
		Interquartile Range	2.00000

Variable: B52 (B52)

N	22	Sum Weights	22
Mean	4.36363636	Sum Observations	96
Std Deviation	0.95346259	Variance	0.90909091
Skewness	-1.2016353	Kurtosis	0.15449624
Uncorrected SS	438	Corrected SS	19.0909091
Coeff Variation	21.8501843	Std Error Mean	0.20327891

Basic Statistical Measures

Location		Variability	
Mean	4.363636	Std Deviation	0.95346
Median	5.000000	Variance	0.90909
Mode	5.000000	Range	3.00000
		Interquartile Range	1.00000

Variable: B53 (B53)

N	22	Sum Weights	22
Mean	3.13636364	Sum Observations	69
Std Deviation	1.24577207	Variance	1.55194805
Skewness	-0.2814541	Kurtosis	-1.2958829
Uncorrected SS	249	Corrected SS	32.5909091
Coeff Variation	39.7202689	Std Error Mean	0.2655995

Basic Statistical Measures

Location		Variability	
Mean	3.136364	Std Deviation	1.24577
Median	4.000000	Variance	1.55195
Mode	4.000000	Range	4.00000
		Interquartile Range	2.00000

Variable: B54 (B54)

N	22	Sum Weights	22
Mean	3.95454545	Sum Observations	87
Std Deviation	1.43019388	Variance	2.04545455
Skewness	-1.3096237	Kurtosis	0.41592723
Uncorrected SS	387	Corrected SS	42.9545455
Coeff Variation	36.1658224	Std Error Mean	0.30491836

Basic Statistical Measures

Location		Variability	
Mean	3.954545	Std Deviation	1.43019
Median	4.500000	Variance	2.04545
Mode	5.000000	Range	4.00000
		Interquartile Range	1.00000

Variable: B55 (B55)

N	22	Sum Weights	22
Mean	3.27272727	Sum Observations	72
Std Deviation	1.2792043	Variance	1.63636364
Skewness	-0.5645871	Kurtosis	-0.707296
Uncorrected SS	270	Corrected SS	34.3636364
Coeff Variation	39.086798	Std Error Mean	0.27272727

Basic Statistical Measures

Location		Variability	
Mean	3.272727	Std Deviation	1.27920
Median	4.000000	Variance	1.63636
Mode	4.000000	Range	4.00000
		Interquartile Range	2.00000

Variable: B56 (B56)

N	22	Sum Weights	22

Mean	4.13636364	Sum Observations	91
Std Deviation	1.2069424	Variance	1.45670996
Skewness	-1.7151885	Kurtosis	2.58379388
Uncorrected SS	407	Corrected SS	30.5909091
Coeff Variation	29.1788273	Std Error Mean	0.25732098

Basic Statistical Measures

Location		Variability	
Mean	4.136364	Std Deviation	1.20694
Median	4.500000	Variance	1.45671
Mode	5.000000	Range	4.00000
		Interquartile Range	1.00000

Variable: B57 (B57)

N	22	Sum Weights	22
Mean	4	Sum Observations	88
Std Deviation	1.27241802	Variance	1.61904762
Skewness	-0.9153485	Kurtosis	-0.3369332
Uncorrected SS	386	Corrected SS	34
Coeff Variation	31.8104505	Std Error Mean	0.27128043

Basic Statistical Measures

Location		Variability	
Mean	4.000000	Std Deviation	1.27242
Median	5.000000	Variance	1.61905
Mode	5.000000	Range	4.00000
		Interquartile Range	2.00000

Variable: B58 (B58)

N	22	Sum Weights	22
Mean	3	Sum Observations	66
Std Deviation	1.2344268	Variance	1.52380952
Skewness	0	Kurtosis	-0.6415707
Uncorrected SS	230	Corrected SS	32
Coeff Variation	41.14756	Std Error Mean	0.26318068

Basic Statistical Measures

Location		Variability	
Mean	3.000000	Std Deviation	1.23443
Median	3.000000	Variance	1.52381
Mode	3.000000	Range	4.00000
		Interquartile Range	2.00000

Variable: B59 (B59)

N	22	Sum Weights	22
Mean	4.09090909	Sum Observations	90
Std Deviation	0.92113237	Variance	0.84848485
Skewness	-0.5948756	Kurtosis	-0.63296
Uncorrected SS	386	Corrected SS	17.8181818
Coeff Variation	22.5165691	Std Error Mean	0.19638608

Basic Statistical Measures

Location		Variability	
Mean	4.090909	Std Deviation	0.92113
Median	4.000000	Variance	0.84848
Mode	5.000000	Range	3.00000
		Interquartile Range	2.00000

Variable: B60 (B60)

N	22	Sum Weights	22
Mean	3.86363636	Sum Observations	85
Std Deviation	1.12527053	Variance	1.26623377
Skewness	-0.8112009	Kurtosis	0.31457587
Uncorrected SS	355	Corrected SS	26.5909091
Coeff Variation	29.124649	Std Error Mean	0.23990848

Basic Statistical Measures

Location		Variability	
Mean	3.863636	Std Deviation	1.12527
Median	4.000000	Variance	1.26623
Mode	5.000000	Range	4.00000
		Interquartile Range	2.00000

Variable: B61 (B61)

N	22	Sum Weights	22
Mean	3.5	Sum Observations	77
Std Deviation	1.50396302	Variance	2.26190476
Skewness	-0.5081312	Kurtosis	-1.2708628
Uncorrected SS	317	Corrected SS	47.5
Coeff Variation	42.970372	Std Error Mean	0.32064599

Basic Statistical Measures

Location		Variability	
Mean	3.500000	Std Deviation	1.50396
Median	4.000000	Variance	2.26190
Mode	5.000000	Range	4.00000
		Interquartile Range	3.00000

Variable: B62 (B62)

N	22	Sum Weights	22
Mean	2.95454545	Sum Observations	65
Std Deviation	1.17421799	Variance	1.37878788
Skewness	-0.4869135	Kurtosis	-1.4167876

Uncorrected SS	221	Corrected SS	28.9545455
Coeff Variation	39.7427626	Std Error Mean	0.25034412

Basic Statistical Measures

Location		Variability	
Mean	2.954545	Std Deviation	1.17422
Median	3.500000	Variance	1.37879
Mode	4.000000	Range	3.00000
		Interquartile Range	2.00000

Variable: time_work

N	22	Sum Weights	22
Mean	9.73106061	Sum Observations	214.083333
Std Deviation	9.29815265	Variance	86.4556427
Skewness	0.77712117	Kurtosis	-0.8867149
Uncorrected SS	3898.82639	Corrected SS	1815.5685
Coeff Variation	95.5512768	Std Error Mean	1.98237281

Basic Statistical Measures

Location		Variability	
Mean	9.731061	Std Deviation	9.29815
Median	5.875000	Variance	86.45564
Mode	4.000000	Range	27.83333
		Interquartile Range	16.00000

NOTE: The mode displayed is the smallest of 2 modes with a count of 2.

Annexure E: (Table 5.1: Cronbach's Alpha Coefficient for all the items forming the measuring instrument)

Statements (Test all statements without current input)	Variable nr.	Correlation with total	Cronbach's Alpha Coefficient
Section B: Reasons for implementing Six Sigma in the organisation.			
1. To reduce costs.	B01	0.2675	0.9549
2. To improve customer satisfaction.	B02	0.1611	0.9554
3. To improve product/service quality.	B03	0.1441	0.9554
4. To improve company reputation and much more.	B04	0.2072	0.9555
Section B: Key personnel driving Six Sigma in the organisation.			
5. Our organisation has appointed a Six Sigma Champion.	B05	0.4853	0.9542
6. Our organisation uses a Black Belt on full time basis.	B06	0.6814	0.9533
7. We also involve process leader and employees during Six Sigma projects.	B07	0.5172	0.9541
Section B: Six Sigma methodology			
8. We always use the DMAIC methodology during process improvement project.	B08	0.5753	0.9538
9. We consider the DFSS methodology when redesigning a project.	B09	0.7585	0.9530
Section B: Mechanism in place to ensure Six Sigma in your organisation.			
10. A communication channel has been put in place to ensure a general awareness of Six Sigma principles.	B10	0.5776	0.9539
11. All the people involved in Six Sigma project have received adequate training.	B11	0.7535	0.9534
12. Six Sigma has been linked to all the stakeholders.	B12	0.7379	0.9532
13. A reward scheme has been linked to everyone involved in Six Sigma project.	B13	0.4982	0.9542
Section B: Top management commitment to Six Sigma in your organisation.			
14. Employees are encouraged to participate when implementing Six Sigma.	B14	0.4157	0.9550
15. The leadership is committed and dedicated to project selection and review as well as to provision of resources.	B15	0.2706	0.9550

16. Leadership does not support activities and investments that have long-term benefits.	B16	-0.1838	0.9567
17. Senior executives accommodate and encourage change.	B17	0.3712	0.9546
Section B: Key ingredients for Six Sigma implementation in your organisation.			
18. Top management's involvement and commitment.	B18	0.4130	0.9546
19. Culture change.	B19	0.0424	0.9555
20. Communication.	B20	0.6896	0.9535
21. Organisation infrastructure.	B21	0.4206	0.9545
22. Training.	B22	-0.0930	0.9559
23. Project management skill.	B23	-0.0196	0.9561
24. Project selection and prioritisation, review and tracking.	B24	0.5172	0.9541
25. Understanding of Six Sigma methodology, tools and techniques.	B25	0.7799	0.9530
26. Linking Six Sigma to business strategy.	B26	0.3534	0.9547
27. Linking Six Sigma to the customer.	B27	0.7653	0.9530
28. Linking Six Sigma to human resources.	B28	0.2635	0.9550
29. Linking Six Sigma to the supplier.	B29	0.2869	0.9549
Section B: The Six Sigma tools and techniques for process improvement.			
30. We use the basic quality control tools of Six Sigma.	B30	0.4831	0.9543
31. We often rely on quality techniques to solve problems.	B31	0.5355	0.9540
32. We use Six Sigma tools and techniques in a well disciplined manner at each stage of the DMAIC.	B32	0.4728	0.9543
Section B: The most used tools and techniques of Six Sigma in my organisation.			
33. Cause and effect diagram.	B33	0.5979	0.9538
34. Check sheet.	B34	-0.2193	0.9563
35. Control chart.	B35	0.3933	0.9545
36. Graphs.	B36	0.2790	0.9550
37. Histogram.	B37	0.6680	0.9534
38. Pareto diagram.	B38	0.5555	0.9539
39. Scatter Diagram.	B39	0.7931	0.9529
40. Brainstorming.	B40	0.5998	0.9538

41. Flow chart.	B41	0.6842	0.9534
42. Hypothesis testing.	B42	0.4652	0.9543
43. Process mapping.	B43	0.4552	0.9543
44. Questionnaires.	B44	0.1955	0.9554
45. Sampling.	B45	0.4842	0.9542
46. Gant chart.	B46	0.5654	0.9539
47. SERVQUAL.	B47	0.7016	0.9532
48. Regression and correlation analysis.	B48	0.6870	0.9533
49. Project team charter.	B49	0.7687	0.9528
50. Benchmarking.	B50	0.3612	0.9546
51. Design of experiment.	B51	0.5763	0.9538
52. Failure mode and effects analysis (FMAEA).	B52	0.5023	0.9542
53. Fault tree analysis.	B53	0.7423	0.9531
54. Process capability analysis.	B54	0.7736	0.9528
55. Poka joke.	B55	0.7109	0.9532
56. Problem solving methodology.	B56	0.6054	0.9537
57. Quality costing.	B57	0.5680	0.9538
58. Quality function deployment (QFD).	B58	0.8054	0.9528
59. Statistical process control.	B59	-0.0534	0.9559
60. Quality improvement team.	B60	0.8297	0.9528
61. SIPOC.	B61	0.8222	0.9525
62. Kano model.	B62	0.7899	0.9529
Cronbach's Coefficient Alpha for standardized variables			**0.9517**
Cronbach's Coefficient Alpha for raw variables			**0.9549**

Annexure F: (Table 5. 2: Descriptive statistics for all the variables)

Variables	Categories	Frequency	Percentage out of total
Section A: Organisation and respondent demographics.			
1. Classify your organisation's main function.	Manufacturing	20	90.9%
	Service	2	9.1%
2. Number of people employed by your organisation.	100-500	20	90.9%
	>500-1000	0	0.0%
	>1000	2	9.1%
3. How long has your organisation been pursuing the Six Sigma philosophy?	< 1 year	1	4.6%
	1-3 years	9	40.9%
	4-5 years	2	9.1%
	6-10 years	0	0.0%
	> 10 years	9	40.9%
	Unknown	1	4.6%
Section B: Reasons for implementing Six Sigma in the organisation.			
1. To reduce costs.	Strongly disagree	0	0.0%
	Disagree	0	0.0%
	Undecided	5	22.7%
	Agree	10	45.4%
	Strongly agree	7	31.8%
2. To improve customer satisfaction.	Strongly disagree	0	0.0%
	Disagree	3	13.6%
	Undecided	3	13.6%
	Agree	7	31.8%
	Strongly agree	9	40.9%
3. To improve product/service quality.	Strongly disagree	1	4.6%
	Disagree	0	0.0%
	Undecided	2	9.1%
	Agree	10	45.4%
	Strongly agree	9	40.9%

4. To improve company reputation and much more.	Strongly disagree	2	9.1%
	Disagree	2	9.1%
	Undecided	2	9.1%
	Agree	8	36.4%
	Strongly agree	7	31.8%
	Unknown	1	4.6%
Section B: Key personnel driving Six Sigma in the organisation.			
5. Our organisation has appointed a Six Sigma Champion.	Strongly disagree	0	0.0%
	Disagree	3	13.6%
	Undecided	4	18.2%
	Agree	7	31.8%
	Strongly agree	8	36.4%
6. Our organisation uses a Black belt on a full time basis.	Strongly disagree	4	18.2%
	Disagree	1	4.6%
	Undecided	5	22.7%
	Agree	4	18.2%
	Strongly agree	8	36.4%
7. We also involve process leader and employees during Six Sigma projects.	Strongly disagree	0	0.0%
	Disagree	3	13.6%
	Undecided	3	13.6%
	Agree	7	31.8%
	Strongly agree	9	40.9%
Section B: Six Sigma methodology.			
8. We always use the DMAIC methodology during process improvement project.	Strongly disagree	1	4.6%
	Disagree	5	22.7%
	Undecided	6	27.3%
	Agree	2	9.1%
	Strongly agree	8	36.4%
9. We consider the DFSS methodology when redesigning a project.	Strongly disagree	2	9.1%
	Disagree	2	9.1%
	Undecided	6	27.3%
	Agree	5	22.7%
	Strongly agree	7	31.8%

Section B: Mechanism in place to ensure Six Sigma in your organisation.			
10. A communication channel has been put in place to ensure a general awareness of Six Sigma principles.	Strongly disagree	0	0.0%
	Disagree	7	31.8%
	Undecided	2	9.1%
	Agree	11	50.0%
	Strongly agree	2	9.1%
11. All the people involved on Six Sigma project have received adequate training.	Strongly disagree	0	0.0%
	Disagree	3	13.6%
	Undecided	4	18.2%
	Agree	13	59.1%
	Strongly agree	2	9.1%
12. Six Sigma has been linked to all the stakeholders.	Strongly disagree	1	4.6%
	Disagree	2	9.1%
	Undecided	6	27.3%
	Agree	6	27.3%
	Strongly agree	7	31.8%
13. A reward scheme has been linked to everyone involved in Six Sigma project.	Strongly disagree	5	22.7%
	Disagree	4	18.2%
	Undecided	6	27.3%
	Agree	4	18.2%
	Strongly agree	3	13.6%
Section B: Top management's commitment to Six Sigma in your organisation.			
14. Employees are encouraged to participate when implementing Six Sigma.	Strongly disagree	0	0.0%
	Disagree	1	4.6%
	Undecided	6	27.3%
	Agree	13	59.1%
	Strongly agree	2	9.1%
15. The leadership is committed and dedicated to project selection and review as well as to provision of resources.	Strongly disagree	0	0.0%
	Disagree	5	22.7%
	Undecided	8	36.4%
	Agree	5	22.7%
	Strongly agree	4	18.2%

16. Leadership does not support activities and investments that have long-term benefits.	Strongly disagree	2	9.1%
	Disagree	2	9.1%
	Undecided	11	50.0%
	Agree	4	18.2%
	Strongly agree	3	13.6%
17. Senior executives accommodate and encourage change.	Strongly disagree	0	0.0%
	Disagree	1	4.6%
	Undecided	5	22.7%
	Agree	15	68.2%
	Strongly agree	1	4.6%
Section B: Key ingredients for Six Sigma implementation in your organisation.			
18. Top management involvement and commitment.	Strongly disagree	0	0.0%
	Disagree	0	0.0%
	Undecided	5	22.7%
	Agree	16	72.7%
	Strongly agree	1	4.6%
19. Culture change.	Strongly disagree	0	0.0%
	Disagree	3	13.6%
	Undecided	12	54.6%
	Agree	5	22.7%
	Strongly agree	2	9.1%
20. Communication.	Strongly disagree	0	0.0%
	Disagree	5	22.7%
	Undecided	2	9.1%
	Agree	13	59.1%
	Strongly agree	2	9.1%
21. Organisation infrastructure.	Strongly disagree	1	4.6%
	Disagree	3	13.6%
	Undecided	6	27.3%
	Agree	5	22.7%
	Strongly agree	7	31.8%

22. Training.	Strongly disagree	0	%
	Disagree	0	%
	Undecided	9	40.9%
	Agree	7	31.8%
	Strongly agree	6	27.3%
23. Project management skill.	Strongly disagree	1	4.6%
	Disagree	7	31.8%
	Undecided	4	18.2%
	Agree	9	40.9%
	Strongly agree	1	4.6%
24. Project selection and prioritisation, review and tracking.	Strongly disagree	0	0.0%
	Disagree	2	9.1%
	Undecided	12	54.6%
	Agree	5	22.7%
	Strongly agree	3	13.6%
25. Understanding of Six Sigma methodology, tools and techniques.	Strongly disagree	0	0.0%
	Disagree	3	13.6%
	Undecided	5	22.7%
	Agree	4	18.2%
	Strongly agree	10	45.4%
26. Linking Six Sigma to business strategy.	Strongly disagree	1	4.6%
	Disagree	5	22.7%
	Undecided	6	27.3%
	Agree	6	27.3%
	Strongly agree	2	9.1%
	Unknown	2	9.1%
27. Linking Six Sigma to the customer.	Strongly disagree	2	9.1%
	Disagree	2	9.1%
	Undecided	5	22.7%
	Agree	8	36.4%
	Strongly agree	5	22.7%

28. Linking Six Sigma to human resources.	Strongly disagree	1	4.6%
	Disagree	11	50.0%
	Undecided	4	18.2%
	Agree	5	22.7%
	Strongly agree	1	4.6%
29. Linking Six Sigma to the supplier.	Strongly disagree	1	4.6%
	Disagree	3	13.6%
	Undecided	10	45.4%
	Agree	5	22.7%
	Strongly agree	3	13.6%
Section B: The Six Sigma tools and techniques for process improvement.			
30. We use the basic quality control tools of Six Sigma.	Strongly disagree	0	0.0%
	Disagree	2	9.1%
	Undecided	1	4.6%
	Agree	14	63.6%
	Strongly agree	5	22.7%
31. We often rely on quality techniques to solve problems.	Strongly disagree	0	0.0%
	Disagree	4	18.2%
	Undecided	4	18.2%
	Agree	10	45.4%
	Strongly agree	4	18.2%
32. We use Six Sigma tools and techniques in a well disciplined manner at each stage of the DMAIC.	Strongly disagree	0	0.0%
	Disagree	6	27.3%
	Undecided	5	22.7%
	Agree	10	45.4%
	Strongly agree	1	4.6%
Section B: The most used tools and techniques of Six Sigma in my organisation.			
33. Cause and effect diagram.	Strongly disagree	1	4.6%
	Disagree	0	0.0%
	Undecided	1	4.6%
	Agree	10	45.4%
	Strongly agree	10	45.4%

34. Check sheet.	Strongly disagree	0	0.0%
	Disagree	1	4.6%
	Undecided	2	9.1%
	Agree	9	40.9%
	Strongly agree	10	45.4%
35. Control chart.	Strongly disagree	1	4.6%
	Disagree	2	9.1%
	Undecided	7	31.8%
	Agree	9	40.9%
	Strongly agree	3	13.6%
36. Graphs.	Strongly disagree	1	4.6%
	Disagree	0	0.0%
	Undecided	3	13.6%
	Agree	5	22.7%
	Strongly agree	13	59.1%
37. Histogram.	Strongly disagree	3	13.6%
	Disagree	0	0.0%
	Undecided	2	9.1%
	Agree	12	54.6%
	Strongly agree	5	22.7%
38. Pareto diagram.	Strongly disagree	2	9.1%
	Disagree	0	0.0%
	Undecided	0	0.0%
	Agree	14	63.6%
	Strongly agree	6	27.3%
39. Scatter Diagram.	Strongly disagree	3	13.6%
	Disagree	3	13.6%
	Undecided	5	22.7%
	Agree	10	45.4%
	Strongly agree	1	4.6%

40. Brainstorming.	Strongly disagree	1	4.6%
	Disagree	0	0.0%
	Undecided	1	4.6%
	Agree	5	22.7%
	Strongly agree	15	68.2%
41. Flow chart.	Strongly disagree	2	9.1%
	Disagree	1	4.6%
	Undecided	5	22.7%
	Agree	12	54.6%
	Strongly agree	2	9.1%
42. Hypothesis testing.	Strongly disagree	4	18.2%
	Disagree	10	45.4%
	Undecided	4	18.2%
	Agree	2	9.1%
	Strongly agree	2	9.1%
43. Process mapping.	Strongly disagree	2	9.1%
	Disagree	0	0.0%
	Undecided	2	9.1%
	Agree	12	54.6%
	Strongly agree	6	27.3%
44. Questionnaires.	Strongly disagree	4	18.2%
	Disagree	8	36.4%
	Undecided	5	22.7%
	Agree	3	13.6%
	Strongly agree	2	9.1%
45. Sampling.	Strongly disagree	1	4.6%
	Disagree	1	4.6%
	Undecided	5	22.7%
	Agree	6	27.3%
	Strongly agree	9	40.9%

46. Gant chart.	Strongly disagree	2	9.1%
	Disagree	4	18.2%
	Undecided	5	22.7%
	Agree	11	50.0%
	Strongly agree	0	0.0%
47. SERVQUAL.	Strongly disagree	3	13.6%
	Disagree	8	36.4%
	Undecided	3	13.6%
	Agree	1	4.6%
	Strongly agree	6	27.3%
	Unknown	1	4.6%
48. Regression and correlation analysis.	Strongly disagree	7	31.8%
	Disagree	1	4.6%
	Undecided	5	22.7%
	Agree	9	40.9%
	Strongly agree	0	0.0%
49. Project team charter.	Strongly disagree	3	13.6%
	Disagree	2	9.1%
	Undecided	1	4.6%
	Agree	7	31.8%
	Strongly agree	9	40.9%
50. Benchmarking.	Strongly disagree	2	9.1%
	Disagree	1	4.6%
	Undecided	9	40.9%
	Agree	10	45.4%
	Strongly agree	0	0.0%
51. Design of experiment.	Strongly disagree	4	18.2%
	Disagree	2	9.1%
	Undecided	10	45.4%
	Agree	5	22.7%
	Strongly agree	1	4.6%

52. Failure mode and effects analysis (FMAEA).	Strongly disagree	0	0.0%
	Disagree	1	4.6%
	Undecided	4	18.2%
	Agree	3	13.6%
	Strongly agree	14	63.6%
53. Fault tree analysis.	Strongly disagree	2	9.1%
	Disagree	7	31.8%
	Undecided	1	4.6%
	Agree	10	45.4%
	Strongly agree	2	9.1%
54. Process capability analysis.	Strongly disagree	3	13.6%
	Disagree	1	4.6%
	Undecided	1	4.6%
	Agree	6	27.3%
	Strongly agree	11	50.0%
55. Poka joke.	Strongly disagree	3	13.6%
	Disagree	3	13.6%
	Undecided	4	18.2%
	Agree	9	40.9%
	Strongly agree	3	13.6%
56. Problem solving methodology.	Strongly disagree	2	9.1%
	Disagree	0	0.0%
	Undecided	2	9.1%
	Agree	7	31.8%
	Strongly agree	11	50.0%
57. Quality costing.	Strongly disagree	1	4.6%
	Disagree	2	9.1%
	Undecided	5	22.7%
	Agree	2	9.1%
	Strongly agree	12	54.6%

58. Quality function deployment (QFD).	Strongly disagree	3	13.6%
	Disagree	4	18.2%
	Undecided	8	36.4%
	Agree	4	18.2%
	Strongly agree	3	13.6%
59. Statistical process control.	Strongly disagree	0	0.0%
	Disagree	1	4.6%
	Undecided	5	22.7%
	Agree	7	31.8%
	Strongly agree	9	40.9%
60. Quality improvement team.	Strongly disagree	1	4.6%
	Disagree	1	4.6%
	Undecided	6	27.3%
	Agree	6	27.3%
	Strongly agree	8	36.4%
61. SIPOC.	Strongly disagree	3	13.6%
	Disagree	4	18.2%
	Undecided	2	9.1%
	Agree	5	22.7%
	Strongly agree	8	36.4%
62. Kano model.	Strongly disagree	3	13.6%
	Disagree	6	27.3%
	Undecided	2	9.1%
	Agree	11	50.0%
	Strongly agree	0	0.0%

Annexure G (Table 5. 3): Descriptive statistics – Mean, Median, Standard Deviation and Range

Variable		N	Mean	Std Dev	Median	Range
A4.	Time worked for the organisations.	22	9.73	9.2982	5.875	27.83
Section B: Reasons of implementing Six Sigma in the organisation.						
1.	To reduce costs.	22	4.09	0.75012	4.00	2.0
2.	To improve customer satisfaction.	22	4.00	1.0690	4.00	3.0
3.	To improve product/service quality.	22	4.18	0.9580	4.00	4.0
4.	To improve company reputation and much more.	21	3.76	1.3002	4.00	4.0
Section B: Key personnel driving Six Sigma in the organisation.						
5.	Our organisation has appointed a Six Sigma Champion.	22	3.91	1.0650	4.00	3.0
6.	Our organisation uses a Black Belt on a full time basis.	22	3.50	1.5040	4.00	4.0
7.	We also involve the process leader and employees during Six Sigma projects.	22	4.00	1.0690	4.00	3.0
Section B: Six Sigma methodology.						
8.	We always use the DMAIC methodology during process improvement project.	22	3.50	1.3363	3.00	4.0
9.	We consider the DFSS methodology when redesigning a project.	22	3.59	1.2968	4.00	4.0
Section B: Mechanism in place to ensure Six Sigma in your organisation.						
10.	A communication channel has been put in place to ensure a general awareness of Six Sigma principles.	22	3.36	1.0486	4.00	3.0
11.	All the people involved on Six Sigma project have received adequate training.	22	3.64	0.8477	4.00	3.0
12.	Six Sigma has been linked to all the stakeholders.	22	3.73	1.1622	4.00	4.0
13.	A reward scheme has been linked to everyone involved to Six Sigma project.	22	2.82	1.3675	3.00	4.0

Section B: Top management commitment to Six Sigma in your organisation.					
14. Employees are encouraged to participate when implementing Six Sigma.	22	3.73	0.7025	4.00	3.0
15. The leadership is committed and dedicated to project selection and review as well as to provision of resources.	22	3.36	1.0486	3.00	3.0
16. Leadership does not support activities and investment that have long-term benefits.	22	3.18	1.0970	3.00	4.0
17. Senior executives accommodate and encourage change.	22	3.72	0.6311	4.00	3.0
Section B: Key ingredients for Six Sigma implementation in your organisation.					
18. Top management involvement and commitment.	22	3.82	0.5011	4.00	2.0
19. Culture change.	22	3.27	0.8270	3.00	3.0
20. Communication.	22	3.54	0.9625	4.00	3.0
21. Organisation infrastructure.	22	3.64	1.2168	4.00	4.0
22. Training.	22	3.86	0.8335	4.00	2.0
23. Project management skill.	22	3.09	1.0650	3.00	4.0
24. Project selection and prioritisation, review and tracking.	22	3.41	0.8541	3.00	3.0
25. Understanding of Six Sigma methodology, tools and techniques.	22	3.95	1.1329	4.00	3.0
26. Linking Six Sigma to business strategy.	20	3.15	1.0894	3.00	4.0
27. Linking Six Sigma to the customer.	22	3.54	1.2239	4.00	4.0
28. Linking Six Sigma to human resources.	22	2.72	1.0320	2.00	4.0
29. Linking Six Sigma to the supplier.	22	3.27	1.0320	3.00	4.0
Section B: The Six Sigma tools and techniques for process improvement.					
30. We a use the basic quality control tools of Six Sigma.	22	4.00	0.8165	4.00	3.0
31. We often rely on quality techniques to solve problems.	22	3.64	1.0022	4.00	3.0

32. We use Six Sigma tools and techniques in a well disciplined manner at each stage of the DMAIC.	22	3.27	0.9351	3.50	3.0
Section B: The most used tools and techniques of Six Sigma in my organisation.					
33. Cause and effect diagram.	22	4.27	0.9351	4.00	4.0
34. Check sheet.	22	4.27	0.8270	4.00	3.0
35. Control chart.	22	3.50	1.0118	4.00	4.0
36. Graphs.	22	4.32	1.0414	5.00	4.0
37. Histogram.	22	3.73	1.2414	4.00	4.0
38. Pareto diagram.	22	4.00	1.0690	4.00	4.0
39. Scatter Diagram.	22	3.14	1.1668	3.50	4.0
40. Brainstorming.	22	4.50	0.9636	5.00	4.0
41. Flow chart.	22	3.50	1.0578	4.00	4.0
42. Hypothesis testing.	22	2.45	1.1843	2.00	4.0
43. Process mapping.	22	3.91	1.1088	4.00	4.0
44. Questionnaires.	22	2.59	1.2212	2.00	4.0
45. Sampling.	22	3.95	1.1329	4.00	4.0
46. Gant chart.	22	3.14	1.0372	3.50	3.0
47. SERVQUAL.	21	2.95	1.4992	2.00	4.0
48. Regression and correlation analysis.	22	2.73	1.3159	3.00	3.0
49. Project team charter.	22	3.77	1.4452	4.00	4.0
50. Benchmarking.	22	3.23	0.9223	3.00	3.0
51. Design of experiment.	22	2.86	1.1253	3.00	4.0
52. Failure mode and effects analysis (FMAEA).	22	4.36	0.9535	5.00	3.0
53. Fault tree analysis.	22	3.14	1.2458	4.00	4.0
54. Process capability analysis.	22	3.95	1.4302	4.50	4.0
55. Poka joke.	22	3.27	1.2792	4.00	4.0
56. Problem solving methodology.	22	4.14	1.2069	4.50	4.0
57. Quality costing.	22	4.00	1.2724	5.00	4.0
58. Quality function deployment (QFD).	22	3.00	1.2344	3.00	4.0
59. Statistical process control.	22	4.09	0.9211	4.00	3.0
60. Quality improvement team.	22	3.86	1.1253	4.00	4.0
61. SIPOC.	22	3.50	1.5040	4.00	4.0
62. Kano model.	22	2.95	1.1742	3.50	3.0

Annexure H: (Table 5.4: Statistically Significant Chi-square tests)

Statement	Category	N	Percentage	Chi-square	P-Value
Section B: Reasons for implementing Six Sigma in the organisation.					
1. To reduce costs.	Undecided	5	22.7%	6.5455	0.0105*
	Agree	17	77.3%		
2. To improve customer satisfaction.	Disagree	3	13.6%	15.3636	0.0005***
	Undecided	3	13.6%		
	Agree	16	72.7%		
3. To improve product/service quality.	Disagree	1	4.6%	27.9091	<0.0001***
	Undecided	2	9.1%		
	Agree	19	86.4%		
4. To improve company reputation and much more.	Disagree	4	18.2%	22.7273	<0.0001***
	Undecided	2	9.1%		
	Agree	15	68.2%		
Section B: Key personnel driving Six Sigma in the organisation.					
5. Our organisation has appointed a Six Sigma Champion.	Disagree	3	13.6%	12.0909	0.0024**
	Undecided	4	18.2%		
	Agree	15	68.2%		
7. We also involve the process leader and employees during Six Sigma projects	Disagree	3	13.6%	15.3636	0.0005***
	Undecided	3	13.6%		
	Agree	16	72.7%		
Section B: Mechanism in place to ensure Six Sigma in your organisation.					
10. A communication channel has been put in place to ensure a general awareness of Six Sigma principles.	Disagree	7	31.8%	8.27.2	0.0160*
	Undecided	2	9.1%		
	Agree	13	59.1%		
11. All the people involved on Six Sigma project have received adequate training.	Disagree	3	13.6%	12.0909	0.0024**
	Undecided	4	18.2%		
	Agree	15	68.2%		
12. Six Sigma has been linked to all the stakeholders.	Disagree	3	13.6%	7.1818	0.0276*
	Undecided	6	27.3%		
	Agree	13	59.1%		

Section B: Top management's commitment to Six Sigma in your organisation.					
14. Employees are encouraged to participate when implementing Six Sigma.	Disagree	1	4.6%	13.7273	0.0010**
	Undecided	6	27.3%		
	Agree	15	68.2%		
17. Senior executives accommodate and encourage change.	Disagree	1	4.6%	16.4545	0.0003***
	Undecided	5	22.7%		
	Agree	16	72.7%		
Section B: Key ingredients for Six Sigma implementation in your organisation.					
18. Top management involvement and commitment.	Undecided	5	22.7%	6.5455	0.0105*
	Agree	17	77.3%		
20. Communication.	Disagree	5	22.7%	12.6364	0.0018**
	Undecided	2	9.1%		
	Agree	15	68.2%		
24. Project selection and prioritisation, review and tracking.	Disagree	2	9.1%	6.9091	0.0316*
	Undecided	12	54.6%		
	Agree	8	25.4%		
25. Understanding of Six Sigma methodology, tools and techniques.	Disagree	3	13.6%	9.3636	0.0093**
	Undecided	5	22.7%		
	Agree	14	63.6%		
27. Linking Six Sigma to the customer.	Disagree	4	18.2%	6.6364	0.0362*
	Undecided	5	22.7%		
	Agree	13	59.1%		
Section B: The Six Sigma tools and techniques for process improvement.					
30. We use the basic quality control tools of Six Sigma.	Disagree	2	9.1%	27.9091	<0.0001***
	Undecided	1	4.6%		
	Agree	19	86.4%		
31. We often rely on quality techniques to solve problems.	Disagree	4	18.2%	9.0909	0.0106*
	Undecided	4	18.2%		
	Agree	14	63.6%		
Section B: The most used tools and techniques of Six Sigma in my organisation.					
33. Cause and effect diagram.	Disagree	1	4.6%	32.8182	<0.0001***
	Undecided	1	4.6%		
	Agree	20	90.9%		

34. Check sheet.	Disagree	1	4.6%	27.9091	<0.0001***
	Undecided	2	9.1%		
	Agree	19	86.4%		
36. Graphs.	Disagree	1	4.6%	23.5455	<0.0001***
	Undecided	3	13.6%		
	Agree	18	81.8%		
37. Histogram.	Disagree	3	13.6%	19.1818	<0.0001***
	Undecided	2	9.1%		
	Agree	17	77.3%		
38. Pareto diagram.	Disagree	2	9.1%	14.7273	0.0001***
	Agree	20	90.9%		
40. Brainstorming.	Disagree	1	4.6%	32.8182	<0.0001***
	Undecided	1	4.6%		
	Agree	20	90.9%		
41. Flow chart.	Disagree	3	13.6%	9.3636	0.0093**
	Undecided	5	22.7%		
	Agree	14	63.6%		
42. Hypothesis testing.	Disagree	14	63.6%	9.0909	0.0106*
	Undecided	4	18.2%		
	Agree	4	18.2%		
43. Process mapping.	Disagree	2	9.1%	23.2727	<0.0001***
	Undecided	2	9.1%		
	Agree	18	81.8%		
45. Sampling.	Disagree	2	9.1%	12.6364	0.0018**
	Undecided	5	22.7%		
	Agree	15	68.2%		
47. SERVQUAL.	Disagree	11	50.0%	10.7273	0.0133*
	Undecided	3	13.6%		
	Agree	7	31.8%		
49. Project team charter.	Disagree	5	22.7%	16.4545	0.0003***
	Undecided	1	4.6%		
	Agree	16	72.7%		
52. Failure mode and effects analysis (FMAEA).	Disagree	1	4.6%	19.7273	<0.0001***
	Undecided	4	18.2%		
	Agree	17	77.3%		
53. Fault tree analysis.	Disagree	9	40.9%	8.8182	0.0122*
	Undecided	1	4.6%		
	Agree	12	54.6%		

54. Process capability analysis.	Disagree	4	18.2%	19.7273	<0.0001***
	Undecided	1	4.6%		
	Agree	17	77.3%		
56. Problem solving methodology.	Disagree	2	9.1%	23.2727	<0.0001***
	Undecided	2	9.1%		
	Agree	18	81.8%		
57. Quality costing.	Disagree	3	13.6%	9.3636	0.0093**
	Undecided	5	22.7%		
	Agree	14	63.6%		
59. Statistical process control.	Disagree	1	4.6%	16.4545	0.0003***
	Undecided	5	22.7%		
	Agree	16	72.7%		
60. Quality improvement team.	Disagree	2	9.1%	10.1818	0.0062**
	Undecided	6	27.3%		
	Agree	14	63.6%		
61. SIPOC.	Disagree	7	31.8%	8.2727	0.0160*
	Undecided	2	9.1%		
	Agree	13	59.1%		
62. Kano model.	Disagree	9	40.9%	6.0909	0.0476*
	Undecided	2	9.1%		
	Agree	11	50.0%		