Quality improvement within the parachute manufacturing industry: A case study of Parachute Industries of Southern Africa (PISA)

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Abstract

Total quality management (TQM) has brought about global attention and is being implemented in various sectors ranging from manufacturing and customer service (airports, restaurants, automobile dealers, etc……). TQM has developed largely due to customer demands for better quality products and a memorable customer service experience.

This study revolves around the Durban-based manufacturing facility, which is the main parachute manufacturer of the three sites for Zodiac, with the other two manufacturing facilities being located in France and the United States of America respectively. The manufacturing plant must ensure that customers are content with the quality of manufactured goods and service received from this site. This study centres on the knowledge of employees on TQM during the year 2016 at the parachute and equipment manufacturing factory.

The aim of this study is to develop and implement a plan for a TQM system at the Parachute Industries of Southern Africa (PISA). The research objectives explore the extent of quality concerns at PISA; explore the degree to which quality tools are employed at PISA; capture PISA's management and employees' perceptions on TQM; and explore the challenges in adopting TQM principles at PISA. Embracing a culture of TQM and creativity in quality instead of mere compliance, should drive the business quality strategy.

The significance of the study will add to the body of knowledge in the field of TQM, in general, and the manufacturing of parachute and related equipment, in particular. Parachute manufacturing organisations globally will benefit from the study in that they can use the findings coming of this study to enhance their performance to deliver quality products that could save skydivers' lives.

A comprehensive literature review was executed to obtain a clear understanding of total management comprising of different facets ranging from the history of TQM; the founders; the different costs associated with quality; dimensions of quality; quality management systems (QMS); the benefits of implementing TQM; barriers in achieving TQM; awards presented for the implementation of TQM and; the criticism of TQM.

To achieve the objectives of the study and effectively answer the research question, it was necessary to approach the research from different angles. The research method

to this study was both exploratory and descriptive; therefore, both qualitative and quantitative research approaches were executed. The research methods included surveys in the form of questionnaires and in-depth interviews. The population considered for this study consisted of permanent employees based in the Durban-based manufacturing plant. The population was selected from senior management; middle management; machinists (sewing); quality inspectors and sewing machine mechanics.

The subsequent descriptive and inferential statistical analyses quantify the results as statistically important in relation to the questions of this study. There were some observations of quality that exposed possible areas for development within the Durban based manufacturing site's quality management system. These areas need to be addressed by management in order to renovate positive perception and buy in to the quality management system.

It is also proposed that future research should be conducted at the France and American parachute manufacturing sites, belonging to the Zodiac group. Another survey should be conducted for the senior management team at the three (South Africa, France and America) parachute manufacturing sites. Such a survey could determine the perception of senior management to TQM and create an alignment with all employees. An effective strategy for communication and quality improvement can be determined for implementation.

The first objective revealed interviews with top management that it will be difficult to sustain PISA as a profitable organisation in the long-term. The survey results conclude that employees recognize the quality concerns and the impact they can have on the current business and in the long-term.

The second objective exposed that PISA's top management acquires training, to learn and to deploy the relevant quality tools. This would improve the quality performance internally, by eliminating the rework and rejection costs. Also, by eliminating internal quality concerns, quality products can be sent to customers.

The third objective discovered PISA's top management to be sent on training on TQM and also on the ISO 9001 training. The knowledge gained through the training could be shared with the employees at a lower level, and employees would buy into TQM and the ISO 9001 QMS, because top management would be driving the initiative.

The fourth and final objective revealed would be for non-quality personnel to be sent on TQM training externally and to spend more time with the quality inspectors internally analysis the quality problems being experienced to eliminate repeating the mistake.

The study was able to effectively conclude that TQM manufacturing impacts positively on the manufacturing process and, if implemented correctly, the manufacturing process will run smoothly and efficiently. The more TQM tools, techniques and principles applied to the manufacturing process, the more likely it was to run smoothly, efficiently and achieve customer satisfaction by supplying a quality product.

Declaration of Authorship

I, **Bradley Naidoo**, do hereby affirm:

i. That the work within this research dissertation, submitted in fulfilment of the requirements for the MASTER'S DEGREE IN PHILOSOPHY: QUALITY MANAGEMENT at the DURBAN UNIVERSITY OF TECHNOLOGY (DUT), KWA–ZULU NATAL (KZN), is my own independent work.

ii. This dissertation/thesis does not contain other persons' writing, unless specifically acknowledged as being obtained from other researchers. Where other written sources have been quoted, then:

a) Their words have been re-written, but the general information attributed to them has been referenced;

b) Where their exact words have been used, their writing has been placed inside quotation marks, and referenced. ; and

c) This dissertation/thesis does not contain text, graphics or tables copied and pasted from the Internet, unless specifically acknowledged and referenced.

Signature of Student/Researcher:

……

Bradley Naidoo

Student Number: 20353489

Date: **……**

Dedication

- I wish to dedicate this piece of work in its entirety to my baby girl Leah Naidoo (Born 12th August 2011). I hope that I have inspired you to pursue your dreams no matter what obstacles you may encounter and that learning never ends. I am looking forward to teaching and guiding you through life and know that you will grow up to be an exceptional individual.

- I am grateful to my wonderful and loving wife, Melissa, who is always at my side giving me the encouragement and love during my years of study. This is OUR TRIUMPH, as your positive energy and warmth have kept me focused. You are truly my pillar of strength and building block of success.

- This study is also dedicated to my parents, Chris and Kogie Naidoo. I thank you for your support and playing a key role in my upbringing.

- To my brother, Brandon and family, thanks for the support and belief.

- To my family, thank you for your continued prayer and support and for keeping such a valued interest in my journey.

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- My heartfelt gratitude goes out to all the respondents for taking time to complete my questionnaires. Your input has been valuable in completing my research.

- My gratitude and appreciation to the industry experts for offering your valuable time in sharing your expertise in this research.

- I am extremely thankful to my creator and saviour, Lord Shiva and Jesus Christ. The completion of this study would have not been possible without your belief, guidance, protection and strength.

"If you are planning for ONE year, grow rice"
"If you are planning for TEN years, grow trees"
"If you are planning for HUNDRED years, educate your children" - Confucius

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Abbreviations and Acronyms

With reference to this study, the following abbreviations and acronyms apply:

AC	Appraisal costs
ASQ	American Society for Quality
B. TECH	Bachelor of Technology
CAR	Corrective Action Reports
CEO	Chief Executive Officer
DUT	Durban University of Technology
EFC	External failure costs
EFQM	European Foundation for Quality Management
EMAIL	Electronic mail
EQA	European Quality Award
FMEA	Failure mode and effect analysis
GM	General Manager
IFC	Internal failure costs
ISO	International Standards Organisation
MBNQA	Malcolm Baldrige National Quality Award
M. Phil	Master of Philosophy
NIST	National Institute of Standards and Technology
PC	Prevention costs
PDCA	Plan, do, check, act
PISA	Parachute Industries of Southern Africa
PPM	Parts per million
QMS	Quality Management System
QRQC	Quick response quality control
SQCDP	Safety, Quality, Cost, Delivery, People
TQM	Total Quality Management

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CHAPTER ONE

INTRODUCTION TO THE RESEARCH

"Quality means doing it right when no one is looking" – Henry Ford

1.1 Introduction

Parachute Industries of Southern Africa (PISA) is a manufacturer of parachutes (round and square) and related equipment such as harness containers, bags, release devices, loops, cargo parachutes, flares and brake chutes. Producing a quality product is imperative due to a parachute and related equipment being a safety critical product. When customers return products due to quality issues, there are various costs incurred which cannot be recovered. The costs range from wages, salaries, material, transportation and consumables. Customer returns could impact the deliveries to other customers because of rework or having to remanufacture the product. Furthermore, customer returns could result in customer dissatisfaction, which could influence customers to move onto other suppliers.

The aim of this study is to develop an implementation plan for a TQM system at PISA. TQM is a philosophy intended to achieve quality in a broad sense. One of the gurus, namely, Ishikawa, is the founder of the eight quality tools (process flowcharting, check sheets, histogram, scatter diagrams, stratification, pareto analysis, cause and effect analysis and brainstorming) (Juran, 1993: 35). The gurus that have also contributed to the field of TQM were Juran who tried to get businesses to move away from conformance to specification to a more user-based approach (fitness for use) and Deming who asserted that quality starts with top management (Deming, 1994: 23). Feigenbaum focused on total quality control and Taguchi and Shingo specialised in statistical methods (Deming, 1994: 23).

This introductory chapter provides the research context which provides the background to the research and research problem. It tables the aims, objectives, research questions, conceptual framework, research methodology, delimitations of the study, the definitions of terms, significance and structure of the dissertation. A case study approach is adopted due to the problem being contextually embedded. The dissertation structure is then presented.

1.2 Background of Parachute Industries of Southern Africa (PISA)

Parachute Industries of Southern Africa is based in Verulam, Canelands, as shown in the aerial view Figure 1.1. PISA belongs to a group by the name of ZODIAC, with its head office based in Paris and design entity based in Joue Le Tours, France (Figure 1.2). PISA, as part of the Zodiac group, has been developing and manufacturing a wide range of parachutes, in South Africa, for the world markets. For over 80 years, the Zodiac Parachute and Protection Division has been producing parachutes for military, tactical, survival, sports, cargo-drop and air transport (Zodiac, 2015: 5). The market for parachutes is compelled by a number of factors, such as increasing demand by militaries for future battlefields' operations, airplane recovery parachute system, and growth of aero sports (Market Research, 2015: 1). According to Market Research (2015), the sports division is projected to grow at a moderately higher compound annual rate of growth (CARG) during the forecast period 2015 to 2020, predominantly driven by the growth of aero sports. Given the extreme nature of aero sports, product quality is paramount and there should be no compromise as far as quality is concerned.

Figure 1.1: The aerial view of Parachute Industries of Southern Africa (PISA)

Source: Google Maps (2018)

Figure 1.2: The aerial view of Joue Les Tours, France

Source: Google Maps (2018)

1.3 Research Statement

The majority of PISA's customers are based abroad (France, Belgium, United Kingdom, Spain, Oman, Ukraine, Pakistan and Libya). There are various costs (wages, salaries, materials, consumable expenses, and transportation) associated with delivering the product to the customer. These costs are not shown to the customer but billed to the customer in the product price. When a defective product is returned, the initial costs incurred in getting the product to the customer cannot be recovered and further costs accrue when a product is returned. The situation is compounded by fluctuating exchange rates (euro to rand or dollar to the rand). PISA statistics show, that, from the year 2010 to the year 2014 there were 3 519 products returned by various customers (Rajappen, 2015: 7). Customer returns ranged from raw material defects, incorrect dimensions, parts missing or deviation from the specification. Customer returns do not generate an income and drains the organisations net profit. There are cost implications in terms of material, labour, transport and overheads (e.g., water and electricity). Furthermore, customer returns disrupt current production due to repairing or remanufacturing the product, which delays deliveries to other customers – further impacting on service delivery. There is also the possibility of the customer losing confidence and trust in the supplier due to quality issues.

The major concern is that if a customer does not identify a non-conformance during final inspection this could result in subsequent equipment malfunction which could lead to the disability or even death of the skydiver. If product failure results in disability

or death, product liability claims could be raised against the manufacturer.

This could lead to exorbitant costs and the eventual demise of the organisation. Due to costs, loyalty, current production and liability, it would be in the interest of PISA to implement a robust quality management system. There are various costs associated with ensuring quality, such as prevention costs, appraisals costs and failure costs. The failure costs are significantly higher when the defect is detected externally at the customer end rather than at the factory. Prevention and appraisal costs share an inverse relationship with failure cost and TQM aims to optimise the relationship at the least cost.

This research will be different from other studies conducted into the analysis of TQM as it focuses particularly on the parachute manufacturing industry. Furthermore, while most studies resonate around the principles' and techniques' aspects of TQM, this study pursues the perspectives of the employees and their perceptions on how TQM will improve customer satisfaction by providing a quality product.

The aim of this study is to develop and implement a plan for a TQM system at PISA.

1.4 Research Objectives

The research objectives of the study were as follows:

i. To quantify the extent of quality concerns at PISA.;

ii. To explore, the degree to which quality tools are employed at PISA.;

iii. To capture the perceptions of PISA's management and employees on TQM; and

iv. To explore the challenges in adopting TQM principles at PISA.

1.5 Research Questions

This research was based on four research questions:

i. What is the extent of quality concerns at PISA?

ii. To what extent are quality tools being used at PISA?

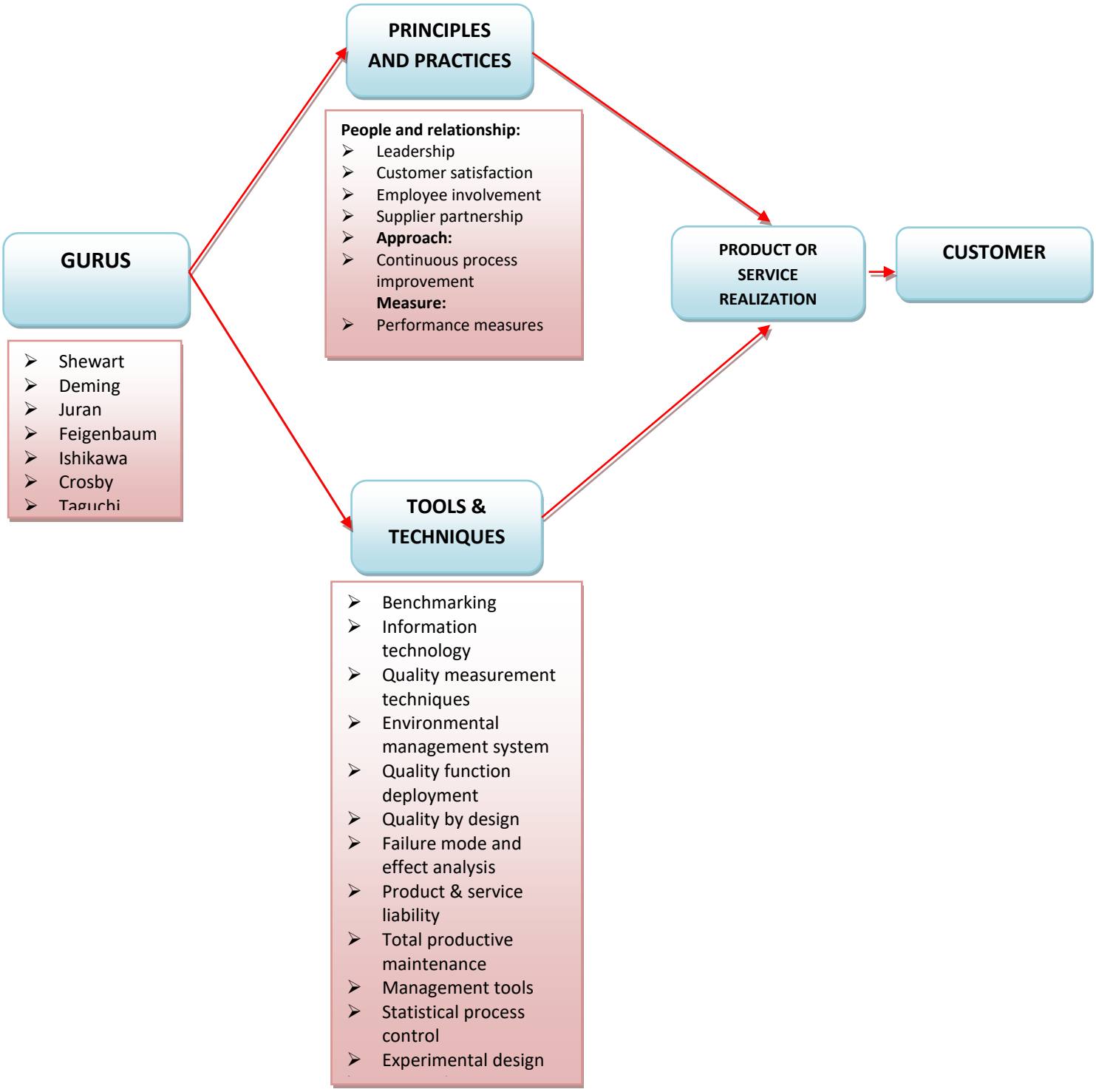
iii. What are PISA's management and employee's perceptions of TQM?

iv. What are the challenges in adopting TQM principles at PISA?

1.6 Conceptual Framework

According to Popper (1994), a framework is a set of basic assumptions and essential principles in which dialogue and actions can be articulated. The conceptual framework adopted for this study is the one that was proposed by Besterfield (2011), as represented in Figure 1.3, which outlines the development of principles and practices together with tools and techniques of TQM. The framework summarises the interaction of the different facets and how it contributes to meeting customers' needs. According to Struebing and Klaus (1997, cited in Yusof and Aspinwall 2000), a thorough implementation plan should describe what the organisation does, what it is aiming to do and how it is successfully going to do it, ensuring that each step builds on the previous one.

Figure 1.3: Conceptual framework



Source: Besterfield *et al.* (2011)

The conceptual framework links various elements and operationalises the variables so that research questions of this study could be answered. For this study, customer satisfaction is the key area of focus due to the nature of products being produced by PISA

1.7 Research Methodology

Sekaran and Bougie (2010) state that an exploratory study is carried out when not much is known about the situation at hand or no information is available on how comparable problems or research issues have been resolved in the past, as is in the case of this study. This study adopted both the qualitative and quantitative research methods. According to Creswell (2008), the drive of this type of study is that both qualitative and quantitative research, in mixture, offers a better understanding of a research problem or concern. Data was collected through surveys in the form of questionnaires and in-depth interviews. The population considered for this study comprised only permanent employees that are based in the Durban manufacturing plant. The population (120) comprised senior management; middle management; machinists (sewing); quality inspectors and sewing machine mechanics. As per Sekaran and Bougie (2010), a population (N) of 120 participants requires a sample (S) of 92 participants. Participants were randomly chosen from the payroll.

The data was statistically analysed using descriptive and inferential statistics and included reliability statistics; factor analysis; KMO and Bartlett's test; rotated component matrix; section analysis; correlations and hypothesis testing. The described research design and methodology will be deliberated in more detail in chapter four.

1.8 Significance of the Study

This study is important for a number of reasons. The findings of the study will add to the body of knowledge in the field of TQM in general and to the practice of manufacturing of parachutes and related equipment. The selected organisation will be able to focus on areas that need improvement and in doing so reduce costs, through TQM, and become more efficient. While the organisation may not be representative of all organisations, the recommendations could be applicable to other organisations in the same industry, specifically those that can run product lines relating to parachutes and related equipment. Parachute manufacturing organisations globally will benefit from the study in that they can use the outcomes of this study to enhance their performance and to deliver a quality product to the end user.

1.9 Delimitation of the Study

The delimitations of this research ensured that the limitations of the study are made clear. Thus, this study will be limited to the following constraints:

i. Physical geographical location - Only the Durban based manufacturing plant will be included in this study as the problem statement relates directly to Parachute Industries of Southern Africa (PISA). The head office based in Paris, France, design entity based in Joue Les Tours, France, and the manufacturing plant in the United States of America (USA) will be excluded from this study due to their geographical locations;

ii. Industry - The study centres on the manufacturing sector and precisely the manufacturing of parachute and related equipment; and

iii. Sample - The research sample will comprise participants that are in senior management, middle management, sewing machinist, quality inspectors and sewing machine mechanics. Contract employees have been excluded from this study.

1.10 Definitions of Terms

Table 1.1: Definitions of terms

Aesthetics	Appearance, feel, smell, taste (Garvin: 1984).
Appraisal costs	Costs of activities designed to ensure quality or uncover defects (Oakland: 2003).
Cause and effect diagrams	A diagram used to search for the cause(s) of a problem; also called fishbone diagram (Stevenson: 2002).
Check sheets	A tool for recording and organizing data to identify a problem (Stevenson: 2002).
Conformance	How well a product or service relates to design specifications, and to the customer's expectations (Garvin: 1984).
Control charts	A chart used to monitor the central tendency of a process (Stevenson: 2002).
Continuous improvement	Philosophy that pursues to make a never – ending development to the method of transforming inputs into outputs (Owen: 2002).
Durability	The useful life of the product or service (Garvin: 1984).
External failure costs	Failures discovered after delivery to the customer. (Dale and Plunkett: 1991).
Flowcharts	A diagram of the steps in a process (Stevenson: 2002).

Histograms	A chart of an empirical frequency distribution (Stevenson: 2002).
Internal failure costs	Failures discovered during production (Oakland: 2003).
Pareto analysis	Technique for classifying problem areas according to degree of importance and focusing on the most important (Stevenson: 2002).
Perceived Quality	Indirect assessment of quality (Garvin: 1984).
Performance	Key features of the product or service (Garvin: 1984).
Prevention costs	Costs of preventing defects from occurring (Oakland: 2003).
Population	The larger group is referred to as a population, and the smaller group selected from a population is referred to as a sample Sekaran and Bougie (2010).
Quality	The ability of a product or service to consistently meet or exceed customer expectations (Wild: 2002).
Reliability	Occurs when a test measures the same thing more than once and results in the same outcomes (Garvin: 1984).
Scatter diagrams	A graph that shows the degree and direction of relationship between two variables (Stevenson: 2002).
Serviceability	Handling of complaints or checking on customer satisfaction (Garvin: 1984).
Special features	Additional features (Garvin: 1984).
Validity	Refers to the results of a test, not the test itself. The results must be interpreted within the context in which the test occurs (Joppe: 2003).

1.11 Structure of Dissertation

This study consists of six chapters which are represented in Table 1.2.

Table 1.2: Outline of the contents of each chapter

CHAPTER 1	**INTRODUCTION** **This chapter focuses on the following aspects:** - The background to Parachute Industries of Southern Africa (PISA) - Research statement; - Research objectives; - Research questions; - Conceptual framework; - Research methodology applied; - Limitations and delimitations of the study; - Definitions of terms used; - Significance of the study and structure of the dissertation; and - The chapter concludes and highlights expectations in chapter 2
CHAPTER 2	**LITERATURE REVIEW** This chapter presents the existing body of literature in terms of total quality management. This chapter critically examines the relevant literature and how it relates to the study. This chapter explores the following aspects: - Introduction; - History and evolution of total quality management; - Definitions of quality; - Total quality management gurus and their beliefs; - Tools and techniques; - Dimensions of quality; - Review of an empirical study on the dimensions of quality; - Cost of quality; - Quality management system (QMS); - Benefits of total quality management; - Challenges in achieving total quality management; - Review of empirical studies on the challenges in achieving total quality management; - Quality awards; - Criticism of total quality management; and - The chapter concludes and highlights expectations in chapter 3.
CHAPTER 3	**RESEARCH METHODOLOGY** This chapter is based on the following aspects:

	➢ The research method used ➢ Target population ➢ Data collection ➢ The research instrument ➢ Questionnaire design ➢ The circulation of questionnaires ➢ The collection of questionnaires ➢ Ethical considerations ➢ Data analysis ➢ Validity and reliability; ➢ Techniques used to validate the study; and ➢ The chapter concludes and highlights expectations in chapter 4.
CHAPTER 4	**DATA PRESENTATION, ANALYSIS AND INTERPRETATION** This chapter presents the data obtained from the questionnaire and in-depth interviews analysis, supported by relevant literature which is integrated into this discussion. This chapter explores: ➢ The sample size; ➢ The research instrument; ➢ Reliability statistics; ➢ Factor analysis; ➢ KMO and Bartlett's test; ➢ Rotated component matrix; ➢ Section analysis; ➢ Correlations and hypothesis testing; and ➢ The chapter concludes and highlights expectation in chapter 5.
CHAPTER 5	**STATEMENT OF FINDINGS AND DISCUSSION** In this chapter responses from respondents are analysed, together with supporting literature. The following aspects were discussed: ➢ Phase 1: Quantitative Data; ➢ Phase 2: Qualitative Data; and ➢ Summary.
CHAPTER 6	**SUMMARY, CONCLUSION AND RECOMMENDATIONS** This chapter focuses on the following aspects: ➢ Introduction;

	▪ Summary of the research findings; ▪ Research objective; ▪ Research questions; ▪ Recommendations for future research; ▪ Limitations of the study; ▪ Recommendations; and ▪ Conclusion.
BIBLIOGRAPHY **APPENDICES**	

1.12 Summary

This chapter presented an overview of the study in relation to the background of PISA, the research statement, research objectives of the study, research questions, conceptual framework, research methodology applied, significance of the study, delimitations of the study and definitions of terms used and the structure of the dissertation. Chapter two will critically review the relevant literature and signpost how the different aspects relate to the study.

CHAPTER TWO

LITERATURE REVIEW

"Quality is never an accident; it is always the result of high intention, sincere effort, intelligent direction and skill-full execution; it represents the wise choice of many alternatives" – William Foster

2.1 Introduction

The preceding chapter covered the general overview of the study. It focused on the research study, background of PISA, research statement, research objectives, research questions, the conceptual framework, research methodology applied, delimitations of the study and the significance of this study. Chapter One covered the foundation of the study. This chapter reviews the literature by various scholars and industry experts on TQM. The chapter commences with the history and evolution of total quality management. Thereafter, quality is defined, and its dimensions are explored. The discussion then focuses on the tools and techniques used and the various costs associated with quality. Finally, the criticisms, benefits and challenges in achieving TQM are discussed.

2.2 History and Evolution of Total Quality Management

During the 1950's, quality management developed into quality assurance and total quality control methods developed the empire of quality efforts mainly focussing on manufacturing and around product design and incoming raw materials (Stevenson, 2002: 394). During the 1960's, emphasis was on employee motivation, awareness and the expectations of accomplishment from individual employee (Stevenson, 2002: 394). In the 1970's, the quality assurance approach grew with increasing importance with Japanese automobile producers, who had been refining their products and improving their reputation as Japanese producers, opened the door to an extensive array of produced goods (Stevenson, 2002: 394).

The most iconic expert who contributed to Japanese quality is W. Edward Deming (Garvin, 1988: 180). W. Edward Deming was invited to Japan in 1950 to carry a series of lectures on statistical quality control (and the system of production) to the influential personification of the Japanese industry (Deming, 1994: 23). Other specialists, such as Joseph M. Duran, followed Deming's path in 1954 and presented talks on the

system of TQM in businesses (Garvin, 1988: 180). Their assistance influenced the Japanese radically (Deming, 1994: 23). Basically, the 1950s developed a watershed era in the Japanese revolution from "copier" to quality frontrunners (Jablonski, 1994: 42).

Weckenmann *et al*. (2015) state that the first prototype of quality management to be observed came up during the era of mass production. At that time, 1900 – 1904, events of quality inspection concentrated only on the delivery of manufactured products without recognized failures. The central purpose was to guarantee a merely adequate quality of complete products and thus evade complaints and eliminate claims for customers.

Saket (2003) states that while quality control was prevalent in the twentieth century, quality control did not occur during the eighteenth and nineteenth centuries. Nevertheless, some quality control events would be accomplished casually by individuals at shop level (Garvin, 1988: 3). The growth of quality control began during and traversed the twentieth century (Feigenbaum, 1983: 52). In 1913, JC Penney became one of the initial people who presented the essentials of the TQM viewpoint when he recommended concepts such as "customer fulfilment", fairness", "quality", "value", "associate training", and "rewards for performance" to be executive bases for the business (Jablonski, 1994: 39).

The key purpose for the foundation of the term TQM could lie in the replacement of the earlier term “control” by “management” with the reasoning that quality is not just a matter of control, it has to be managed (Dale et al., 1994: 40). According to Saket (2003), TQM is a managerial approach targeted at accomplishing quality in a broad sense. Today’s situation requires TQM to be a managerial approach and technique to attain customer satisfaction and worldwide competitiveness. According to Saket (2003), TQM is built on the principles of: quality integration; quality first; customer fulfilment; constant enhancement; prevention rather than inspection; factual-based results; and workforce participation.

Pankaj *et al.* (2013) observe that numerous management experts as well as industry frontrunners have defined TQM with the following being most regularly quoted:

i. TQM is a management philosophy that assists running associations to progress its overall use and performance towards accomplishing world class status;

ii. A set of methods and techniques used to shrink or remove discrepancy from a production process or service-delivery system in order to progress productivity, consistency and quality;

iii. TQM is an integrative thinking of management for the constant development of product and process quality to accomplish customer satisfaction; and

Hence, the reference of TQM to being a philosophy rather than a methodology or a static set of references that is going to be effective forever.

2.3 Total Quality Management Gurus and Their Beliefs

Succeeding Shewart's innovations from Bell Laboratories in the nineteenth century, the three key founders in quality management that appeared, were all Americans – W. Edwards Deming, Joseph M. Duran, and Philip B. Crosby (Evans and Lindsay, 2001:60

Penson *et al.* (1995) stresses the following Deming's fourteen points to the notion that management is a critical aspect:

i. Generate consistency of purpose to develop products and services.;

ii. Embrace new principles for a new economic age by top management take accountability and taking control for transformation to take place.;

iii. Eradicate the need for mass inspection by building quality into the product.;

iv. Decrease overall cost and move towards sole providers for items.;

v. Grow uninterruptedly and improve the system of production to improve quality and productivity and to decrease costs.;

vi. Introduce on the job training.;

vii. Inaugurate leadership.;

viii. Eliminate out anxiety so that all may possibly work efficiently for the organisation.;

ix. Break down difficulties between departments.;

x. Abolish mottos, exhortations and numerical objectives for employees.;

xi. Exclude quotas or work standards, and management by objectives; replace with leadership.;

xii. Eradicate difficulties that take from employees of their right to pride of workmanship.;

xiii. Introduce a strong education and individual improvement programme.; and

xiv. Place every person in the organisation to work to accomplish the change.

From the above fourteen points the following five points are considered to be most appropriate to PISA's management and will be explored in this study:

i. Embrace new philosophies for top management to take action and take leadership for transformation.;

ii. Generate department harmony.;

iii. Build quality into the product and eradicate the requirement for mass inspection.;

iv. Eradicate concern so that all may possibly work efficiently for the organization.; and

v. Eradicate quotas or fault-finding, and management by objectives; substitute leadership.

The reason the five points would apply to PISA's management is that leadership is a key value that is highlighted. For a philosophy like TQM to be successful, leadership is paramount.

Dr Joseph Juran lectured in Japan, where his discussion was on matters of quality: planning and organizational difficulties, management's accountability for quality and the requirement to set goals and objectives for development (Bendell *et al*., 1995: 44). Juran has used the measurement of costs to distinguish quality problems within organizations to capture the attention of top management, to drive quality initiatives (Bendell *et al*., 1995: 44).

According to Juran (1988a), external failure cost, occurs when a poor-quality products reaches the consumer–this has an inclination to be considerably greater than internal failure costs. Quality planning, quality control and quality advancement are part of the

quality circle (Juran, 1988a: 14). To implement organisation-wide tactical quality planning Juran (1988a) offers the following advice:

i. Recognize who are our customers.;
ii. Identify the necessities of those customers.;
iii. Understand those requirements into the organization's language.;
iv. Create a product that can respond to those requests.;
v. Improve the product features so as to meet the organization's requirements as well as consumer desires.;
vi. Improve methods.;
vii. Cultivate a technique which is able to produce the product.;
viii. Provide evidence that the method can produce the product under working conditions.; and
ix. Allocate the process to operations.

Philip Crosby is recognized by the notion of "do it right first time" (Bendell et al., 1995: 44). According to Crosby (1979), the following are the four fundamentals of quality management:

i. Quality is well noted as conformance to requirements;
ii. Quality is attained by prevention rather than inspection;
iii. Quality standard ought to be zero defects; and
iv. The measurement of quality is the price of non-conformance.

Crosby considers that quality standards that high reduces expenses and has the possibility of improving profit and contends that it does not cost money to evolve quality (Twaissi, 2008: 26). He encourages an objective of zero defects by creating the zero defect initiative and continuous improvement to reach quality (Crosby, 1979: 37). Crosby's fourteen philosophies of continuous quality have evolved through the total quality culture (Zairi, 1991: 17; Flood, 1993: 9). Crosby has created his own course of actions in his following fourteen-step technique (Crosby, 1979: 37):

i. Management promise;
ii. Quality improvement groups;
iii. Quality measurement;
iv. Price of quality assessment;
v. Quality attentiveness;
vi. Corrective action;
vii. Create a quality committee for the zero defects programme;
viii. Supervisors' training;
ix. Zero defect day;
x. Goals' setting; people acquire knowledge to think in terms of accomplishing goals and achieving tasks as a team;
xi. Eradication of task and inaccuracy causes;
xii. Acknowledgement; award ceremonies are created to honour those who accomplished their goals;
xiii. Quality committees; quality specialists and team leaders should meet regularly to communicate; and
xiv. Doing it again; creating a new team of representatives.

Kaoru Ishikawa is recognised as the "father of quality circles" for his part in initiating Japan's quality drive in the 1960s (Bank, 2000: 10). Ishikawa has presented quality control circles (QCCs), which operate with a limited number of volunteer employees from a division of an organisation that forms a cluster titled a quality circle (Twaissi, 2008: 26). Owen (2002) states that Ishikawa's perceptions are constructed on the notion that quality progress is a continuous method and he suggested a system of seven basic quality tools that can be used to deliver this continuous improvement. The seven basic tools are cause and effect diagrams, flowcharts, pareto diagrams, check sheets, histograms, scatter diagrams and control charts (Twaissi, 2008: 26).

Evans and Lindsay (2001) detail the vital fundamentals of Ishikawa's quality beliefs as:

i. Quality beings and finishes with learning;

ii. The first phase in accomplishing quality is to recognize the customers' needs;

iii. The eventual state of quality is when inspection is no longer compulsory;

iv. Eliminate the key reason of quality issues, not the symptoms;

v. Quality control is the concern of everyone at all levels;

vi. Outline the objectives that need to be reached;

vii. The main priority is quality and then focus on long - term returns;

viii. Markets are the entry and exit of quality;

ix. When employees provide evidence, this must not anger top management;

x. Majority of difficulties in an organisation can be resolute with basic and simple tools for investigation and problem solving; and

xi. Data, short of evidence, are false information.

The above philosophy is considered to be appropriate for PISA's management and will be explored further in this study for its potential to re-solve internal quality issues to reduce or eliminate external quality issues at the customer end.

Feigenbaum's career in quality originated more than 40 years ago as President and Chief Executive Officer (CEO) of General Systems Co (Zairi, 2013: 659). Feigenbaum (1951) defines the term total quality control (TQC), as:

i. An effective method for incorporating quality growth;

ii. Quality maintenance; and

iii. Quality development, which allows for a complete customer fulfilment.

As per Zairi (1991) Feigenbaum acknowledges the following ten principles essential for total quality achievement:

i. Quality is an organisation-wide exercise;

ii. Quality is what the consumer states it is;

iii. Quality and cost are a sum, not a difference;

iv. Quality entails both individuals and cooperation;

v. Quality is a technique of organization;

vi. Quality and invention are similarly reliant;

vii. Quality is an ethical belief;

viii. Quality involves constant improvement;

ix. Quality is the most cost effective, minimal investment intensive method to efficiency; and

x. Quality is accomplished within a total system associated with customers and service providers.

These principles would be given due consideration in this study, in particular when viewed as guidelines to be adopted internally for employees and externally to achieve customer satisfaction.

Taguchi was presented the Deming prize in 1960 in acknowledgment of his practices linking industrial methods and for performing a role as director of the Japanese Academy of Quality from 1978 to 1982 (Zairi, 1991: 17). Taguchi's guiding principles for quality development are (Zairi, 1991: 17):

i. Quality losses stem from after sale product failure;

ii. Quality built products convey a strong "indicator" irrespective of external "noise" and minimal internal noise;

iii. Robust and reinforcement of a design;

iv. To establish objectives of maximum indicator–to–noise ratios to grow a system of testing that permits one to observe transformation in system performance;

v. Set tolerances and plans before products are manufactured;

vi. Almost nothing is gained in delivering a product that just hardly satisfies the organization standard over a product that just fails;

vii. Work persistently to accomplish designs that can be produced consistently;

viii. Virtually nothing is gained in delivering a product that just merely satisfies the organization standard over a product that just fails;

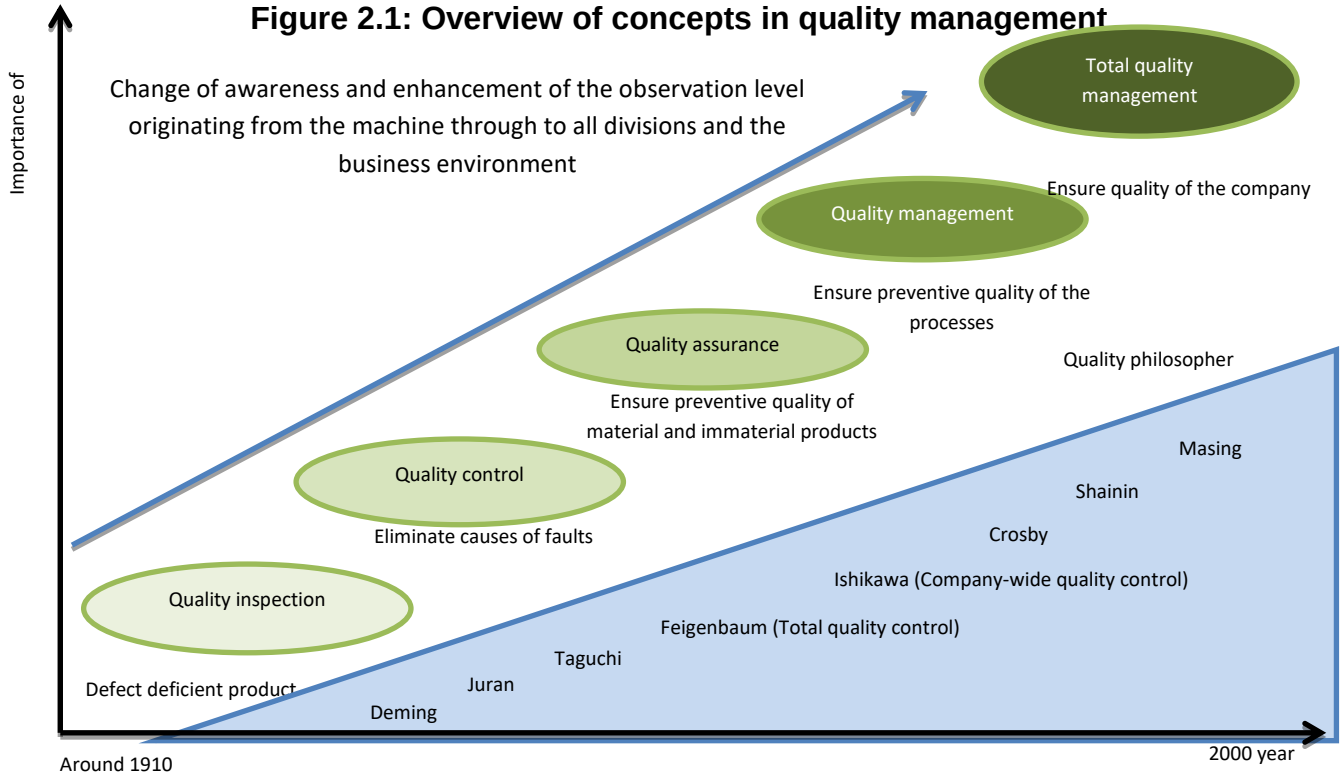
ix. Attempt to decrease variances in the components of the product; and

x. A determined effort to decrease product failure in the field will at the same time decrease the number of defectives in the factory.

Embracing principles such as the above could possibly contribute, to some extent, to resolving PISA's current quality problems. Unresolved problems encountered during the design phase could lead to costly quality issues during the manufacturing phase and eventually inconvenience the end user. Due to the nature of manufacturing, a safety critical product, like a parachute, being problematic to the end user could be detrimental. If disability or death is identified as the major contributor, product liability claims could be raised against the manufacturer. Such claims could lead to excessive costs and the eventual demise of the organisation.

In summary, Figure 2.1 describes the evolution of quality, tracing the developments, bringing quite a few changes in the name, from product-oriented quality inspection via process-oriented quality control and quality assurance to system-oriented quality management in the nowadays used sense and TQM (Weckenmann et al., 2015: 281).

Figure 2.1: Overview of concepts in quality management



Source: Weckenmann et al. (2015)

2.4 Definitions and Dimensions of Quality

A variety of definitions of quality are presented by Wilkinson, Redman, Snape and Marchington (1998), created on the beliefs of well-known quality experts, include the following:

i. Quality is conformance to principles, specifications or requirements (Crosby, 1989);
ii. Quality is about providing value (Feigenbaum, 1983); and
iii. Quality is suitability for use (Juran, 1993).

Wild (2002: 356) defines the quality of a manufactured article or service as "the degree to which it satisfied customers' requirements" and contend that quality is influenced by:

i. Design quality – the degree to which the specification of the product or service fulfils the customers' requirements; and

ii. Process quality – the degree to which the product or service, when made available to the customer, conforms to specifications.

A parachute malfunction is any failure of the system to deliver a normal rate of descent and this comprises the loss of canopy (parachute) control, which is usually caused by one or a mixture of the following: bad packing; and poor body position during canopy (parachute) deployment or faulty equipment (Anon 2015). Manufacturing defects come about when products are produced and are different from the intentional design and this presents a safety hazard during the use of the product. The manifestation of product defects may be attributed to quality issues relating to manufacturing processes or materials used.

Sebastianelli and Tamimi (2003) assume quality to be absolute, commonly recognisable and identical with innate excellence and transcendental in nature. Tamimi and Sebastianelli (1996) state that before quality can be measured, it must be well-defined which is difficult since no universal classification of quality exists. There are alternate meanings resulting from five major approaches to defining quality: transcendental, product-based, user-based, manufacturing–based, and value-based

(Tamimi and Sebastianelli, 1996: 9).

The various definitions of quality, depending on the perception it is approached from or viewed from, include:

i. The transcendental explanation of quality is derived from philosophy and borrows heavily from Plato's debate of beauty and, from this perspective; quality is the same with innate excellence (Tamimi and Sebastianelli, 1996: 9). According to Pirsig (1992), defining quality as excellence means that it is understood "ahead of definition as a direct experience independent of and prior to intelligent abstractions" and this method to defining quality is highly subjective;

ii. The product-based approach has its origins in economics where variances in the quantity of some element or attributes that are influenced by the product are considered to replicate difference in quality (Garvin, 1984: 25). Differences in the amount of certain ingredients or attribute controlled by the product are considered to imitate variance in quality, and this viewpoint of quality, centred on a measurable characteristic of the product rather than on preferences, permits a more objective evaluation of quality (Garvin, 1984: 25).;

iii. The user-based definition whereby quality is viewed as the degree to which a product or service meets or surpasses customers' expectations. The "quality of design," in essence, referred to providing fulfilment to customers by designing products that met their requirements (Tamimi and Sebastianelli, 1996: 9). Juran (1974: 29) states the extensively used "fitness for use" definition of quality, and even though subjective and rather complex, in this day in age, the user-based definition is extensively accepted and considered one of the key perceptions of TQM.

iv. The manufacturing-based approach has its origins in operations and production management (Tamimi and Sebastianelli, 1996: 9). According to Crosby (1979), the manufacturing–based approach defines quality as conformance to specifications. Quality of conformance relates to the degree to which a product meets certain design standards, and this classification has an internal focus, in contrast to the external focus of the user-based approach, and quality is considered an outcome of engineering and manufacturing practices (Tamimi and

Sebastianelli, 1996: 9). Deviations from design specifications result in substandard quality, and, as a result, increased costs, due to scrap, rework or product failure (Tamimi and Sebastianelli, 1996: 9). This meaning allows for the specific and objective measurement of quality (Tamimi and Sebastianelli, 1996: 9); and

v. The value-based definition which compares quality with performance at a suitable price, or alternatively conformance at an acceptable cost, based on the concept that consumers often consider quality in relation to price. In his first edition of total quality control, Feigenbaum (1951: 15) introduced this idea when he well-defined quality as “best for certain customer conditions… the conditions being the actual use and selling of the product".

This study aligns itself more closely with the manufacturing-based approach. The reason for this manufacturing-based approach is that quality of conformance relates to the degree to which a product meets certain design standards, which is paramount in the parachute industry. This classification has a core emphasis, and quality is considered an outcome of engineering and manufacturing practices and processes.

Deviations from design specifications result in inferior quality, and, subsequently, increased costs due to scrap, rework or product failure. This definition allows for the exact and objective measurement of quality (Sebastianelli and Tamimi, 2003: 44).

Quality, as a construct, has various dimensions, and those recognised by Garvin (1984; 1987), which are represented in Table 2.1, include: performance, features, reliability, conformance, durability, serviceability, aesthetics and perceived quality. Garvin (1984; 1987) contends that the structure for discerning product quality, based on eight dimensions, offers businesses a vocabulary with which to deliberate methods to compete tactically on quality and posits that these eight dimensions can be used to enlighten understanding between the five traditional methods to define quality (Table 2.1). “The product–based approach focuses on performance, features and durability; the user–based approach focuses on aesthetics and perceived quality; and the manufacturing–based approach focuses on conformance and reliability” (Garvin, 1984: 25).

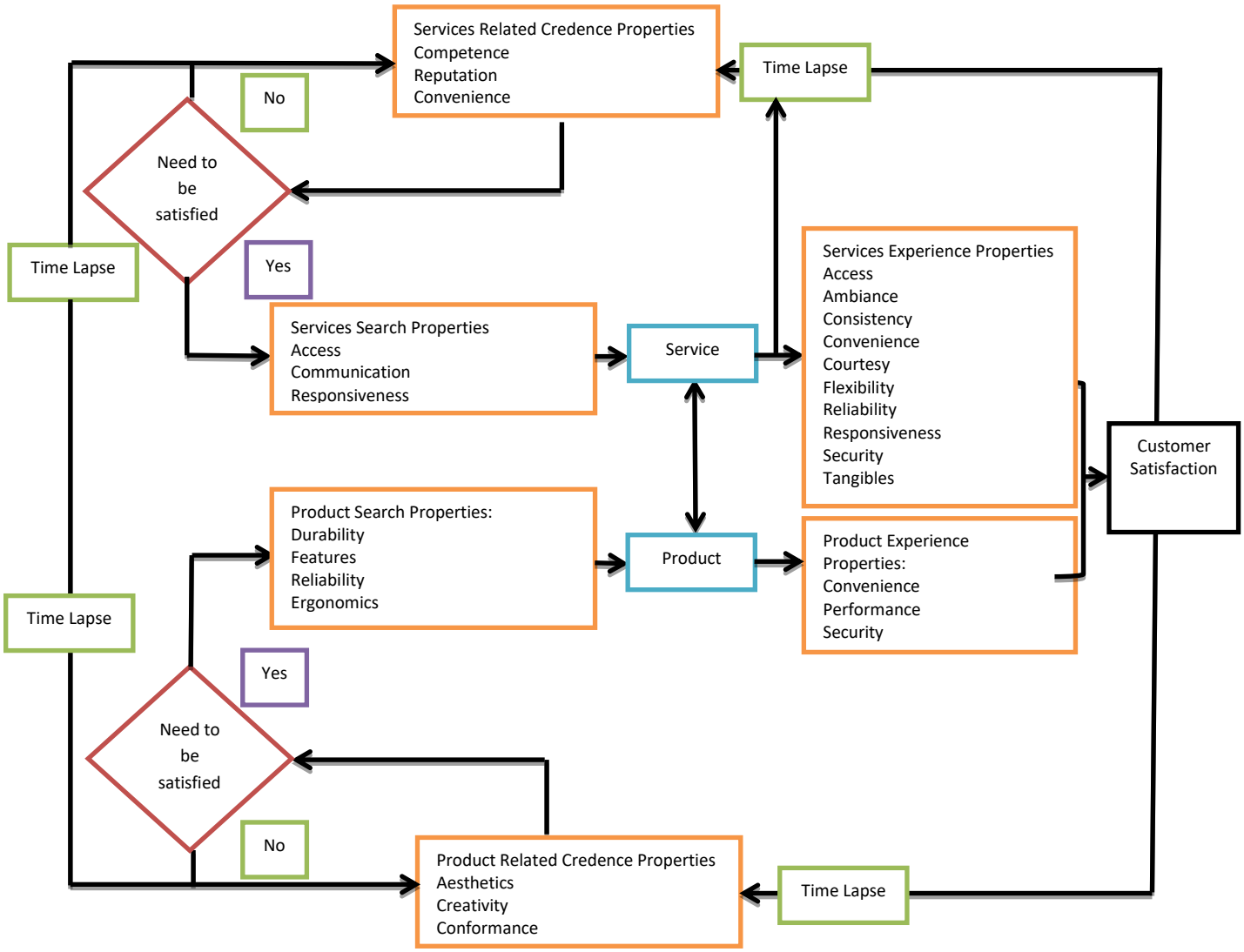
Table 2.1: Garvin's eight product quality dimensions

Item	Dimensions	Examples
i.	Performance – The key operating features of a product	Everything works: fit and finish, ride, handling, acceleration
ii.	Aesthetics – The visual appearance, sound, taste or smell	Exterior and interior design
iii.	Features – The secondary features of a product that complement its basic functioning	Safety: Anti-skid, airbags
iv.	Conformance – A product's physical performance over a specific period of time	Car matches manufacturers specifications
v.	Reliability – The products chance of failure	Infrequent need for repairs
vi.	Durability – The amount of use a consumer gets from a product before it depreciates or must be replaced.	Useful life in miles, resistance to rust
vii.	Perceived Quality – Quality based on image, brand name, or advertising rather than product attributes	Top – rated
viii.	Serviceability - The courtesy, speed, ease and competence of repair.	Ease of repair

Source: Garvin (1984)

Figure 2.2 shows a proposed tie between the customer's perceptions model and the dimensions of both service and product quality (Sen, 2012: 175). The figure demonstrates how consumer perceptions of service and product quality arise from the search and experience properties and over time embed themselves in beliefs about quality (Sen, 2012: 175).

Figure 2.2: Customers' perceptions model of the dimensions of both service and product quality.



Source: Sen (2012)

2.4.1 Review of an Empirical Study on the Dimensions of Quality

Empirical studies based on the dimensions of quality, should exhibit accuracy of modelling, sufficient population, suitable sample size, robust data collection methodologies and specific analytical methods. The following study was carefully chosen in terms of the aforementioned criteria, in order to help profile the dimensions of quality. The purpose of the study by Sebastianelli and Tamimi (2002) was to classify how product quality dimensions relate to defining quality.

The purpose of the study by Sebastianelli and Tamimi's (2002) was to classify how product quality dimensions relate to defining quality. The data for this study was collected using a mail questionnaire, which was made up of four sections. A national

sample of quality control and quality managers was randomly chosen from the membership listing of the American Society for Quality (ASQ). A total of 872 questionnaires were mailed (1000 names were originally selected but those associated with organizations situated outside the USA were excluded).

A total of 188 quality professionals, out of a sample of 872, returned finished, usable questionnaires for an overall response rate of approximately 22 percent. Of those replying, 150 (80 percent) were with production based organizations and 38 (20 percent) with service organizations. Since Garvin's framework deals with "product" dimensions, only the results from manufacturing organizations were evaluated. In terms of size, the largest percentage of these manufacturing organizations (41 percent) were mid-sized, having between 100 to 499 employees; the second highest percentage (20 percent) were large, with more than 1 000 employees. A total of 101 (67 percent) reported that their organisations were involved in TQM, with the average period of participation for this group being a little over two years.

Based on the descriptive statistics, the meaning that most closely matches that of the organizations surveyed is the user–based, and the one that is the least of how organizations explain quality is the transcendental approach. The transcendental classification is non-existent to any element of objectivity and is almost difficult to operationalize, so its last place amid definitions is not unexpected. The user-based classification ranking first displays, to some degree, how organizations have incorporated TQM and its importance to the customer. With its specific, measurable and objective technique to defining quality, the easily operationalized manufactured-based meaning does receive the second highest mean rating.

However, its second place classification to the user-based definition amongst production based organizations is an indication that businesses recognize the need of taking into account the customer's point of view, experience and fulfilment in defining and measuring the quality of their product. Apparently, the study of Sebastianelli and Tamimi (2002) met the criteria of significance to this research together with the clearness and strength of their methodology.

2.5 Tools and Techniques

Oakland (2003) states in the never-ending search for development in the methods and practices, numbers and information will custom the base for understanding, verdict

and activities; and a detailed data collecting, recording and demonstration system is crucial. In addition to the simple section of a quality system that delivers a context for recording, the following set of techniques the Japanese quality guru Ishikawa has named as the seven basic tools:

Table 2.2: Ishikawa's seven basic tools

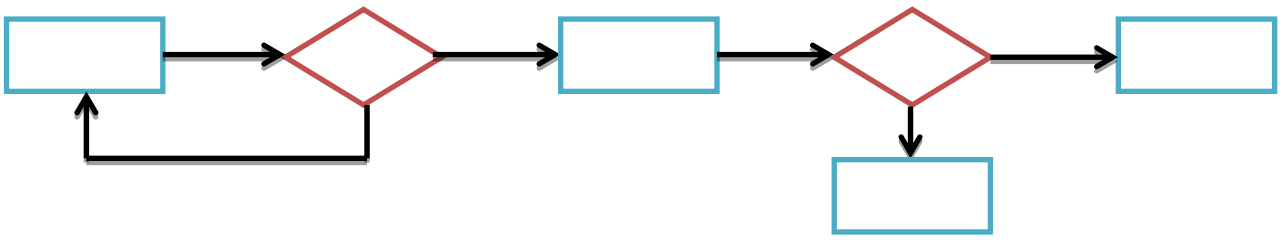
Tool	Tool Description
Process flowcharting	Warrants a full understanding of the contributions and movement of the process.
Check sheets	Is a tool for data collecting, and a rational point to start in most process control or problem solving efforts
Histogram	The frequency with which a confident value or cluster of values occurs.
Scatter diagram	Reliant on the technology, it is regularly beneficial to launch the association, if any, amid two parameters or factors. A method used to initiate such an investigation is a simple X - Y plot of the two sets of data
Stratification	Stratification is merely separating a set of data into meaningful groups. It can be used to great effect in grouping with other methods, including histogram and scatter diagrams
Pareto analysis	If the signs or causes of malfunctioning output or some other 'effect' are recognised and recorded, it will be likely to regulate what percentage can be attributed to any cause.
Cause and effect analysis and brainstorming	The inputs that disturb quality is the cause and effect diagram, also known as the Ishikawa diagram or the fishbone diagram. Prospective causes are then exposed as labelled arrows entering the main cause arrow.

Source: Oakland (2003)

Examples of Ishikawa's seven basic tools portrayed by Stevenson (2002) are depicted in Figures 2.3 -2.8.

Figure 2.3 Process Flowcharting. An illustration of the steps in a process

Figure 2.3: Process flowcharting



Source: Stevenson (2002: 479)

Figure 2.4 Check Sheet. A tool for organizing and gathering data; a tally of problems or other events by category

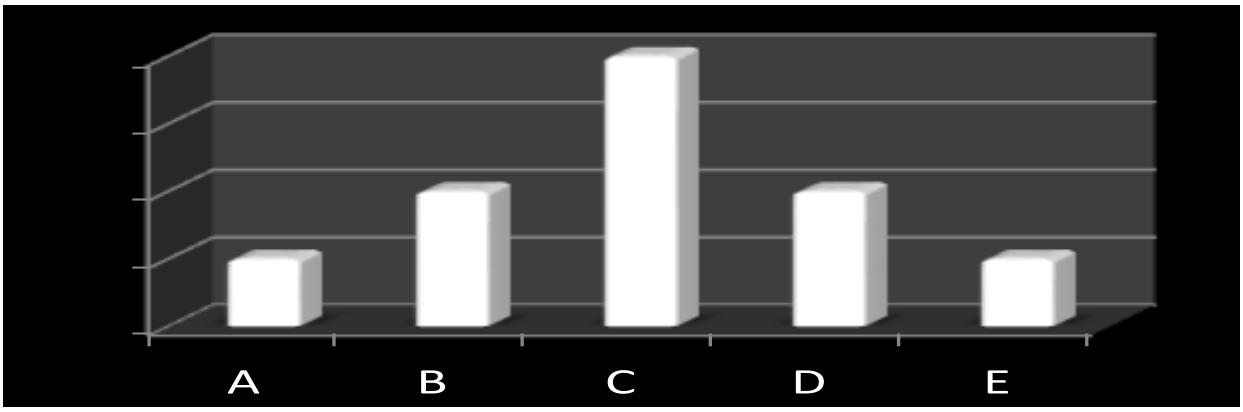
Figure 2.4: Check sheet

	DAY			
DEFECT	1	2	3	4
A	///	//	///	///
B	/	////	/	//
C	//	/	//	////

Source: Stevenson (2002:479)

Figure 2.5 Histogram. A chart that displays an empirical frequency distribution

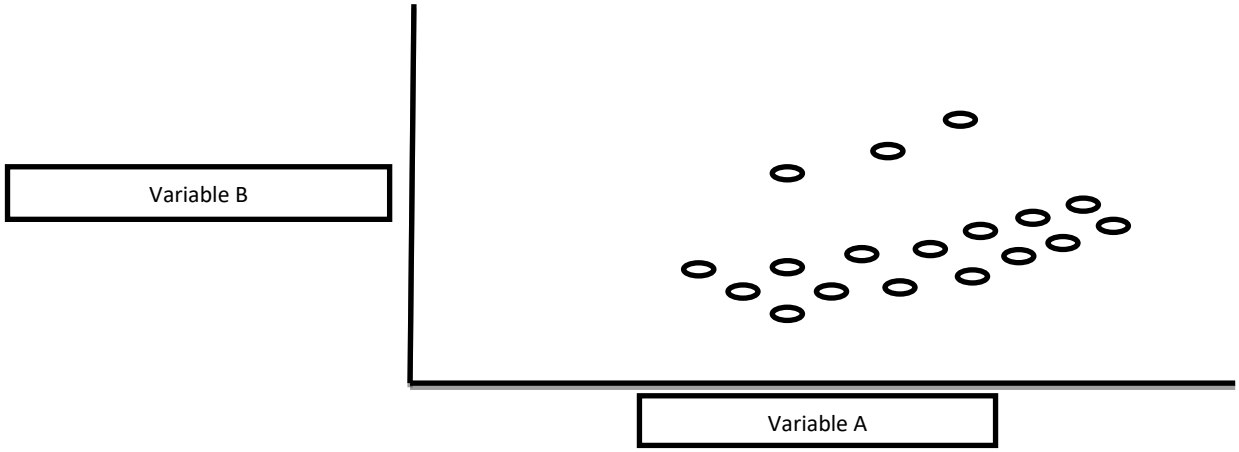
Figure 2.5: Histogram



Source: Stevenson (2002: 479)

Figure 2.6 Scatter Diagram. A chart that demonstrates the degree and direction of relationship between two variables.

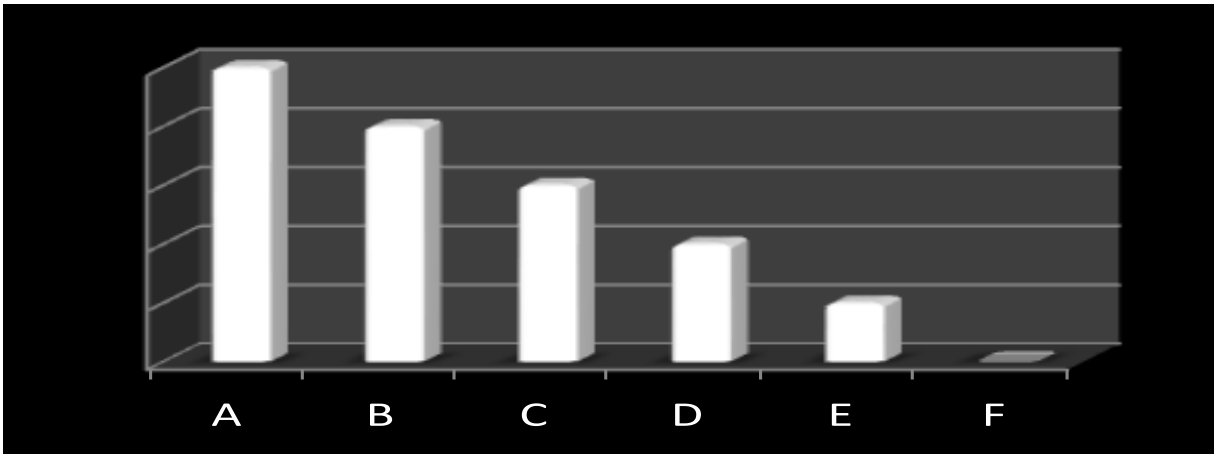
Figure 2.6: Scatter diagram



Source: Stevenson (2002: 479)

Figure 2.7 Pareto Analysis. An illustration that organizes categories from highest to lowest frequency of occurrence

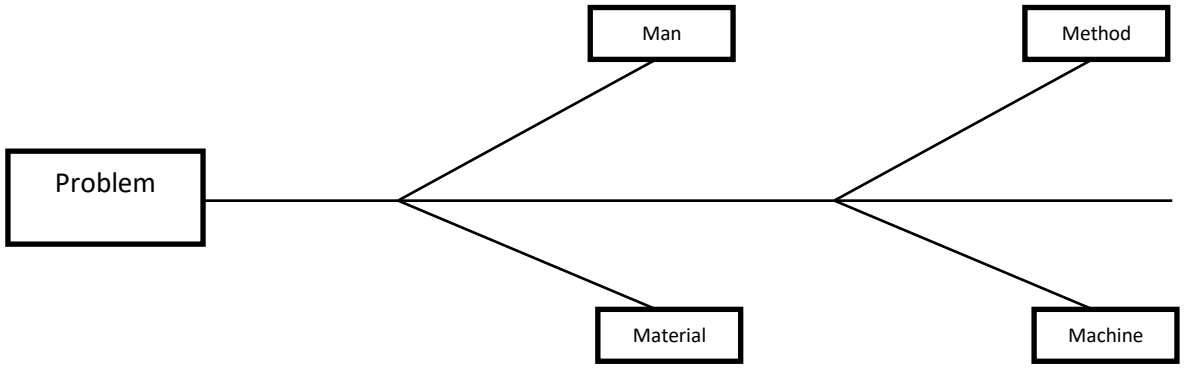
Figure 2.7: Pareto Analysis



Source: Stevenson (2002: 479)

Figure 2.8 Cause and effect analysis and brainstorming. An illustration used to create a search for the cause (s) of a problem; also known as a fishbone diagram (Stevenson, 2002: 479).

Figure 2.8: Cause and effect analysis and brainstorming



Source: Stevenson (2002: 479)

Ahire and Golhar (1996) notes that TQM literature does not offer complete judgments between large and small firms where, particularly when quality initiatives and refining quality appear to be difficult issues that are faced by small firms. Along related lines, the researcher notes that the literature does not precisely focus on manufacturing for niche markets, such as the parachute market.

The tools outlined by Stevenson (2002) are not being used at PISA. The skills are not available at PISA to teach employees or to implement. If the skills were available to teach and implement quality tools, this could improve internal quality performance and increase profit margins, by not repairing or rejecting products.

2.6 Cost of Quality

According to Tannock and Saelem (2007), "iceberg hypothesis" of manufacturing and quality costs has been moving around for many years, built on such practices and the statements of quality "gurus" such as J.M. Juran. According to this proposal, the real cost of poor quality is considerably higher than the calculation of the costs that are reflected in the traditional quality economics model. These are just the tip of the iceberg. Concealed below the surface, the greater share of the extra manufacturing cost rises from disorder and interruption–stoppages, rework and inspection bottlenecks, additional work in progress, needless additional capacity, the obligation for extra stockholding, etc. In his previous work, Juran (1988a) declared that disturbance and interfering to production made part of the "gold in the mine" the preventable significant costs of poor quality–but reflected that it was not useful to measure these features. Nevertheless, he also considered that the "hidden plant" dedicated to the production of scrap and rework, inaccuracy amendment, etc., was naturally one tenth of the total existing productive volume.

There are numerous costs accompanying quality. Feigenbaum (1956) states that quality costs can further be broken down into prevention–appraisal–failure (PAF). The PAF scheme has been commonly accepted for quality costing. The failure costs in this scheme can be further classified into two subgroups: internal failure and external failure costs. Oakland (2000) describes these costs as follows:

i. Prevention costs: These costs are related with the design, putting into practice and preservation of the TQM system which are scheduled and are approved prior to actual operation. Oakland (2003) describes prevention costs as those costs connected with preventing flaws and deficiencies from happening. Oakland (2003) states that prevention costs are reflected as an investment made to keep appraisal and failures expenses to a minimum.

Table 2.3 breaks down these prevention costs as follows:

Table 2.3: Prevention costs

No.	Prevention costs
i.	Quality control and process control engineering;
ii.	Design and mature control equipment;
iii.	Quality planning;

iv.	Manufacturing equipment for quality–maintenance and calibration;
v.	Test and inspection equipment–maintenance and calibration;
vi.	Supplier quality assurance;
vii.	Training;
viii.	Administration; and
ix.	Audit and development

Source: Dale and Plunkett (1991)

ii. Appraisal costs: These expenses are connected with the supplier's and customer's assessment of acquired materials, processes, intermediates, products and services to guarantee conformance with the specific desires. Evans (2005) describes appraisal costs as those costs linked with measuring quality directly by measuring efforts to confirm conformance to specification through the measurement and analysis of data to detect non-conformances.

As per Dale and Plunkett (1991), Table 2.4 further breaks down these appraisal costs:

Table 2.4: Appraisal costs

No.	Appraisal costs
i.	Laboratory acceptance testing;
ii.	Inspection and testing;
iii.	In-process inspection (non-inspectors);
iv.	Set-up for inspection and test;
v.	Inspection and test materials product quality audits;
vi.	Analysis of test and inspection data;
vii.	On - site performance testing, internal testing and release;
viii.	Assessment of materials and spares;
ix.	Data processing; and
x.	Inspection and test reports.

Source: Dale and Plunkett (1991)

iii. Internal failure costs: These expenses take place when the outcomes of work fail to influence the intended quality criteria and are noticed prior to customer delivery. Gryna, Chua and Defeo (2007) state that these are costs caused as a result of poor quality found before the product or service is delivered to the customer.

In Table 2.5 Dale and Plunkett (1991) break_down these internal failure costs as follows:

Table 2.5: Internal failure costs

No.	Internal failure costs
i.	Scrap;
ii.	Rework and repair;
iii.	Troubleshooting;
iv.	Defect analysis;
v.	Re-inspect;
vi.	Retest;
vii.	Adjustment permits and concessions, and
viii.	Downgrading.

Source: Dale and Plunkett (1991)

iv. External failure costs: These costs take place when products or services fail to reach intended quality standards but are not discovered until prior delivery to the customer. According to Maguad and Krone (2009), these costs occur after poor quality of products or services reach the customer.

In Table 2.6 Dale and Plunkett (1991) break_down these external failure costs as follows:

Table 2.6: External failure costs

No.	External failure costs
i.	Complaints;
ii.	Product service: liability;
iii.	Products returned or recalled;
iv.	Returned material;
v.	Repair;
vi.	Loss of customer trust;
vii.	Warranty replacement; and
viii.	Loss of sales.

Source: Dale and Plunkett (1991)

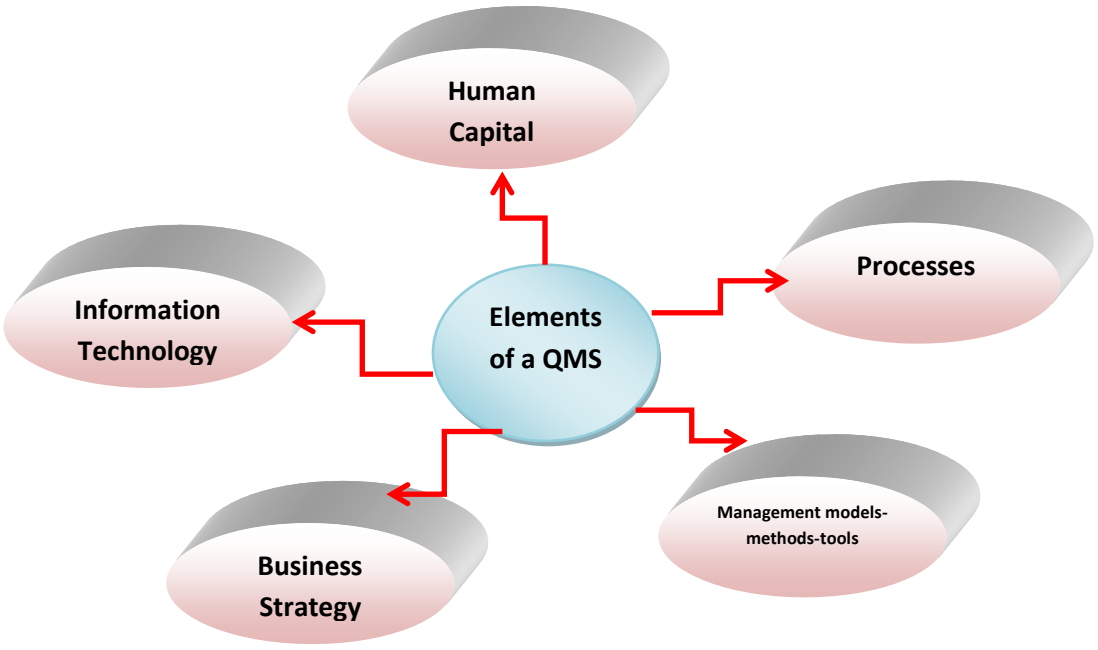
In this study, external failure costs are presently a major issue. Therefore, the study aims to develop and implement a plan for a TQM system at PISA.

2.7 Quality Management System (QMS)

According to Jose *et al*. (2015), global markets are characterized as being sophisticated in the manner in which they produce, deliver and consume products and services. By the same token, consumers of these markets are continuously becoming more demanding as they have needs of products of greater variety at lower prices and within shorter lead times (Godinho Filho & Veloso Saes, 2012: 64). This involves from organisations an extensive amount of investments devoted to building and developing effective quality management systems (QMSs) that address those needs.

Quality management systems are an integrated business method to plan and set up quality management models, methods and tools that are aligned to the business approach of an organisation (Rocha-Lona, Garza-Reyes, & Kumar, 2013). The elements that make up a QMS are outlined in Figure 2.9.

Figure 2.9: Elements of a quality management system



Source: Jose et. al (2015)

The use of a QMS is vital to support business performance, provide an array of benefits for business improvements, and thus positively affect the organisation (Marshall, Berman & Flying, 2004). Short and Rahim (1995) comment that it is the execution stage, and not the QMS values, which is the key point that can make a QMS implementation fails or be ineffective. Taylor and Wright (2003) state that the absence of connection between QMS and business strategy leads implementation to

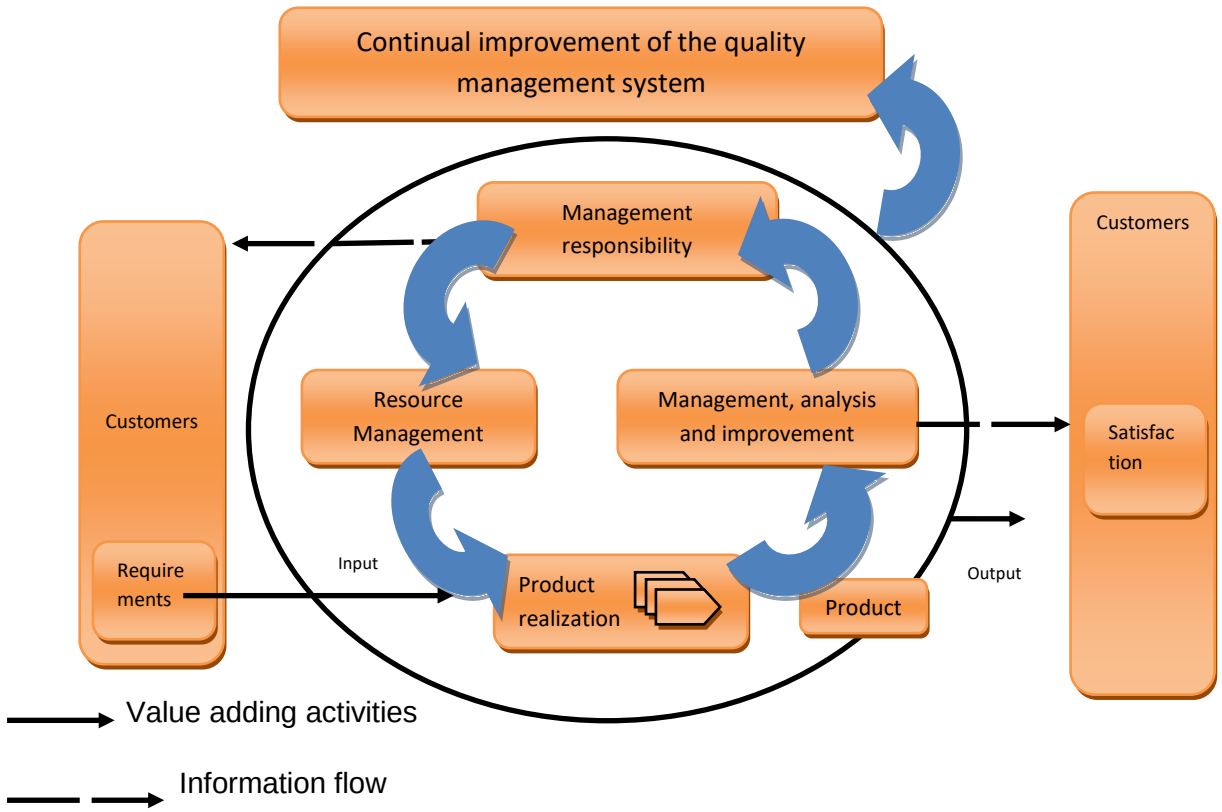
fail, while Sebastianelli and Tammi (2003) found that this issue was the most noteworthy factor which prevents effective TQM execution.

A wide variety of benefits to categorize a quality management system are presented by Jose et al. (2015) based on the philosophies of well-known quality authors. These benefits include:

i. Increased customer fulfilment;
ii. Increase in profits;
iii. Higher quality of products and services, increased output and efficiency;
iv. Improved teamwork and leadership; and
v. Higher profit margins, better return on assets, and better-quality control of business processes and procedures.

With the increased complication of entities and their relationships being considered in quality management, documentation and activities for mutual trust between partners became necessary resulting in the ISO9000 series being created (Weckenmann et al., 2015: 281). Figure 2.10, which classify the model of a process-based quality management system, details a system of suppliers and industrial customers to trust on the quality-oriented performance of a partner. The major advances of quality management over former paradigms have not been accomplished by issuing new techniques or methods, but by generating a common harmonized and internationally accepted framework of standards and accredited certification agencies, aiding mutual trust and better partnerships of enterprises (Weckenmann et. al, 2015: 281).

Figure 2.10: Model of a process-based quality management system



Source: ISO 9001: (2008)

PISA is an ISO 9001 (refer to Appendix 7 - PISA's Procedures Manual Content page (Referencing ISO Standards)) certified company. TUV Rheinland which is a German-owned organisation, is PISA's certification body of choice. TUV has a branch based in Durban, which conducts the yearly certification. PISA's ISO certification is valid for three years.:

i. Year One – Re-certification;
ii. Year Two – Surveillance audit; and
iii. Year three - Surveillance audit.

However, while having an ISO certification, statutory and regulatory requirements apply for the manufacturing of parachutes (Appendix 8), failure of products persist at PISA

2.8 Challenges in Achieving Total Quality Management

TQM specialists' state that if an organisation's culture is not in sync with the principles of TQM, the culture must be changed prior to the application of total quality plan (Sebastianelli and Tamimi, 2003: 45). There seems to be a number of reasons why

businesses are fruitless in their path to execute TQM and two of them are the absence of strategic preparation and the non-existence of the appropriate culture that can be associated with TQM initiatives (Sebastianelli and Tamimi, 2003: 45). It is essential for all organizations to be familiar with and evade these complications both before and for the period of TQM application (Tamimi and Sebastianelli, 1998: 57).

Stevenson (2014) states that businesses experience difficulties in executing TQM that have had fluctuating accomplishment in executing TQM because of the use of an incorrect method rather than with the philosophies of TQM. The following difficulties in executing TQM are highlighted by Sebastianelli & Tamimi (2003) and Stevenson (2014):

i. Lack of a companywide explanation of quality: Efforts are not coordinated; employees are occupied at cross–purposes, talking about different problems, and by means of using different measures of success;

ii. Not enough preparation for quality: short of such a plan, the likelihood of accomplishment is reduced and the need to address strategic implications of change is disregarded;

iii. Absence of customer emphasis: short of customer emphasis, there is a chance of customer displeasure;

iv. Poor or lack of communication: There is no alignment or differentiation of what is right and what is wrong which creates frustration, waste and confusion ensues during the communication process;

v. Inadequate empowerment of employees: Not investing in employees to grow within the organisation by training and internal promotion gives the impression of not believing in employees to resolve problems;

vi. Impression of quality as a “quick fix”: Quality requires a long–term, on-going effort;

vii. Significance of short–term financial outcomes: Short-term answers frequently focus on the symptoms; invest a small amount of money now – instead of spending a lot more later on;

viii. Non-existence of inspiration: Leaders must make sure employees are motivated and exhilarated;

ix. Existence of in-house political affairs and “territory” concerns: This can reduce the get up and go spirit of an organisation and interrupt the greatest of concepts;

x. Lacking resources for TQM: Don’t increase the workload without adding additional resources;

xi. Absence of management for quality: Managers need to take the lead role in this initiative; and

xii. Insufficient human resources growth, development and leadership.

It should be noted TQM is not considered to be completely implemented simply because an organisation claims to have a TQM programme in place (Ugboro & Obeng, 2000: 247). According to Sebastianelli & Tamimi (2003), a significant reason a business may perhaps not understand the benefits of TQM is not because of the failure of TQM as a way of life, but since it may be implemented reluctantly, and many organisations are not prepared to start the total cultural change that TQM requires.

Nwabueze (2001) states that one of the issues with TQM programmes is that it has a tendency to be contextual in nature and warrants that consideration be given to the existing situation. Existing problems as they relate to tactical matters, market opportunities, or forthcoming circumstances when recognizing the features of the extensive culture change need to be considered for TQM to succeed. Nwabueze (2001) concedes that it is difficult to identify precisely what culture transformation is necessary and how best to approach cultural change, which is the utmost critical component for TQM to be successful. TQM stresses that resources be accessible to sustain the business during the full period of execution and beyond, and it may perhaps prove to be too challenging for the “weak” (Nwabueze, 2001: 400).

Juran (1993) suggests that many organisations have been unsuccessful at TQM initiatives due to the chief executive officer not knowing which quality approach is suitable for their organisation and their choices have remained a gamble, that is, leaders were not trained in the method of managing quality. Juran (1993) goes further to mention that the most noteworthy factor in the accomplishment or failure of quality

initiatives was top management not showing evidence of providing individual leadership and not contributing in the process of setting or approving quality objectives Leonard and McAdam (2001b) recognise that TQM is not well associated with tactical issues and many managers find it challenging to define TQM in a strategic sense. Leonard and McAdam (2001b) state that a bureaucratic and a well-designed technique to strategy is paralleled in the method to TQM. Numerous organizations had trouble in identifying the driving forces of TQM aligned to business strategy and certain businesses were found to limit their TQM struggles to operational stages rather than implementing strategic TQM (Leonard and McAdam, 2001b: 652).

According to Deming (1987), the causes for failure of businesses are:

i. expenditures of start-up;

ii. overruns on costs;

iii. devaluation of extra inventory, and competition; and

iv. anything but the real cause, which is bad top management.

Deming (1987: 8) states the reason for failure of TQM in American industries is due to the failure of top management to manage and bring about success within their organisations).

2.8.1 Review of an Empirical Study on the Challenges in Achieving Total Quality Management

Relevant empirical studies based on TQM challenges that were considered to appropriate were those studies demonstrating accuracy of modelling, adequate population, appropriate sample size, robust data collection methodologies and detailed analytical techniques. The following two studies are based on the stricter aforementioned standards, in order to help profile the regularly-cited challenges in attaining TQM.

2.8.1.1 Study 1

The study of Salegna and Fazel (2000) met the criteria of significance to this research together with the clarity and the strength of their methodology. The purpose of the study by Salenga and Fazel (2000) was to scrutinize the severity of commonly-described encounters in attaining TQM by associating survey responses from

organizations that have executed TQM with those that have no quality management in place. A survey was done on 2000 randomly nominated manufacturing organizations and 109 usable replies were received to test the hypotheses. The survey was addressed to company presidents and CEOs who were requested to rate, on a scale of 1 to 7, the degree to which each recorded difficulty characterized a problem during TQM execution. Analysis of covariance was used to test for statistical differences between the degree of severity of the difficulties for TQM and non-TQM organizations. The outcomes exposed many of the usually reported problems to executing TQM and the found that the majority of TQM failures take in the method by which the TQM philosophy is applied rather than errors in the principles of TQM itself.

2.8.1.2 Study 2

The objective of the study by Bhat and Rajashekhar (2009) was to recognize the barriers of TQM execution in Indian industries. To accomplish this objective, a wide-ranging literature review was conducted to recognize the barriers. This was followed by a survey of quality award winning industries in India. A total of 41 finished questionnaires were received and the overall response rate was 31 percent. The outcomes of this survey propose that the most significant TQM barriers in Indian industry are: “no benchmarking of other company’s practices”; and “employees are resilient to change”. Factor analysis of the 21 potential challenges to achieving TQM execution exposed the following five underlying constructs: non-existence of customer orientation; non-existence of planning for quality; lack of total participation; lack of management commitment; and absence of resources. The author recommended that this empirical research offered a solution to the problems faced by the managers while executing TQM successfully in their industries. The study of Bhat and Rajashekhar (2009) met the criteria of relevance to this research together with the clarity and strength of their methodology.

2.9 Benefits of Total Quality Management

Santos and Escancianos (2002) consider all involved parties (employees, suppliers or customers) as internal or external customers. Vouzas and Gotzamani (2004) believe that any industry implementing TQM would inspire assurance in its customers that its products would continuously conform to their detailed prerequisites.

TQM can have a significant part in a planned formulation, in adding to the more

premeditated part of applying the strategy and execution (Leonard & McAdam, 2003: 652). Empirical evidence confirms that organisations that have executed TQM at a tactical level were found to have resilient TQM programmes with superior prolonged existence as a consequence of applying recurrent regenerative methodologies (Leonard, McAdam & Reid, 2002: 710). Numerous benefits have been recognized to accompany the execution and maintenance of TQM (Leonard, McAdam & Reid, 2002: 710). The most common advantage is the development in overall performance of an organization, both within operations and financial aspects (Leonard, McAdam & Reid, 2002: 710).

Organisations that empower their workers, which this is a significant objective of TQM, positions employees with the means to measure the quality of their individual work techniques, to interpret the measurements, and connect these measurements to objectives and take action as soon as the method is not on target (Hill 2008: 13). According to Juran (2001), the empowered work force is also aware of their customers; their requirements and expectations; how to design new products and provide services to meet these expectations; how to improve the needed work methods; how to improve and use the required quality measurements and how to constantly develop these methods.

Juran (2001) states that the costs of avoiding mistakes during the design phase are far less than the rate of amending inaccuracies during manufacturing, and the costs of avoiding mistakes all through the production phase are far less than improving inaccuracies during final inspection. The expenses of discovering and rectifying mistakes during final inspection are far less than amending the faults after the customer has received the goods (Juran 2001: 30). Good quality can also be associated with higher returns through content customers, greater market share, enhanced consumer preservation, more dedicated customers and premium prices (Hill 2008: 13).

Sun *et al*. (2004) and Talib *et al*. (2011b) state that TQM has been acknowledged as the driving force for improved business performance and quality development initiatives that lead to a maintainable competitive gain. Enhanced competitiveness may be the outcome of higher efficiency, improved product quality, improved customer accomplishment or reduced expenses, but it possibly will also be considered an advantage in itself when connecting it to an organization’s status of having an

established certified QMS (Jaeger and Aidar, 2016: 317).

The greatest benefit of TQM is that it improves and inspires quality awareness amongst the workforce within the organization which is significantly useful in attaining a preferred level of quality in a manufactured product. Customers significantly benefit as they receive superior quality products due to quality control. By introducing inspection and control during manufacturing processes, production costs will significantly decrease due to superior quality products.

TQM ensures that available resources are utilized efficiently. By manufacturing quality products and maintaining customers' satisfaction, quality control increases the goodwill and morale of customers. A good reputation can increase profit margins, thus continuously keeping customers happy. TQM improves the workplace by improving confidence of employees, which warrants a stronger relationship between management and employee, leading to an improved understanding between them.

According to Mallur (2011), TQM benefits can also be extended in the form of customer satisfaction-orientated benefits, economic improvement-orientated benefits and cost saving benefits.

In Table 2.7 Mallur (2011) customer satisfaction-orientated benefits in the following way:

Table 2.7: Customer satisfaction-orientated benefits

No.	Customer satisfaction orientated benefits
i.	Enhancement in product quality;
ii.	Improvement in product design;
iii.	Progress in production flow;
iv.	Improvement in employee morale and quality consciousness;
v.	Progress in product service; and
vi.	Development in market place acceptance.

Source: Mallur (2011)

In Table 2.8, Mallur (2011) breaks down economic improvement-orientated benefits in the following way:

Table 2.8: Economic improvement-orientated benefits

No.	Economic improvement orientated benefits
i.	Reduction in operating costs;
ii.	Reduction in operating losses;
iii.	Reduction in field service costs; and
iv.	Reduction in liability exposure.

Source: Mallur (2011)

In Table 2.9, Mallur (2011) breaks down cost-saving benefits in the following way:

Table 2.9: Cost-saving benefits

No.	Cost saving benefits
i.	Removal of non-conformance and repetitive work;
ii.	Elimination of waste costs and reject products;
iii.	Elimination of repairs and rework;
iv.	Reduced warranty and customer support costs;
v.	Process efficiency leading to improved profit per product and service; and
vi.	Fiscal discipline through elimination of unnecessary steps and wasteful expenditure.

Source: Mallur (2011)

TQM promotes manufacturing quality products which are extremely useful in appealing to more customers for the product, thereby increasing sales and profit margins. Also, due to the nature of the product being manufactured by PISA, international visitors regularly visit the Durban-based factory wanting advanced, improved designs and quality products for the end user. Zodiac promotes quality as a number one priority to its customers and this is constantly measured and monitored by senior management.

2.10 Criticism of Total Quality Management

According to Chin & Pun (2002), critics of TQM have claimed that TQM incurs unnecessary retraining expenditures, consumes enormous amounts of management time, increases administration and paperwork, requires unrealistic employee dedication levels, gives emphasis to process over results, and fails to address the requirements of small to medium businesses, service businesses, or non - profit

organisations. Being unsuccessful at TQM has been bottled down to factors that struggle with the philosophies of TQM, which are made up of absence of support and too much time and financial obligations.

Stevenson (2014) states that the main criticisms of TQM consist of:

i. overzealous support departments may perhaps track TQM programmes thoughtlessly;

ii. concentrating on quality even though other priorities could be more important;

iii. programs may not be associated to the plans of the organisation in a significant way;

iv. quality-related conclusions may perhaps not be linked to market performance; and

v. Chasing continuous improvement when dramatic change is required.

For example, consumer fulfilment may possibly be stressed to the degree that its costs far exceed any direct or indirect advantage of doing so. Failure to carefully plan prior to embarking on a programme can lead to many mistakes being made.

In summary, TQM requires an organisational culture that emphasizes continuous process development and customer fulfilment. It calls for a transformation of attitude and a prioritization of day–to–day activities. TQM also entails a long–term organization dedication and continual work force participation. According to the quality department of Zodiac which is based in France, altering a business culture is a tough test, since culture brings a set of values, methods, defiance, communication, objectives and assumptions and is frequently met with resistance by employees, who interpret this as a risk to their jobs.

TQM is costly to execute. Execution frequently comes with expenses such as:

i. Extra training,

ii. Team–building,

iii. Infrastructural,

iv. Infrastructural development; and

v. Consultation fees.

2.11 Quality Awards

Quality has developed as a vital component for organizational competitiveness, specifically for improving customer expectations and organizational performance (Prybutok and Cutshall, 2004: 558; Evans and Lindsay, 2009: 16; Yang, 2009: 931). Quality management links all functions within an organization, as well as external parties such as customers and suppliers (Yang, 2009: 931). Therefore, improvement of quality is imperative for success in the global market (Lee, 2012: 1). As TQM is a management approach, it incorporates the entire organization for the creation of quality (Lee, 2012: 1). Lee (2012) states that the importance of quality management helped to launch a number of national or regional awards: first the Deming Prize in Japan; the Malcolm Baldrige National Quality Award (MBNQA) in United States of America (USA); and the European Foundation for Quality Management (EFQM) Excellence Award in Europe. Quality awards have revealed encouraging effects on economic development through promoting best practices for business excellence and producing opportunities for continuous improvement (Fisher *et al*., 2001: 981).

In 1988, 14 leading Western European businesses formed the European Foundation for Quality Management (EFQM). The key objective of the EFQM is to identify quality accomplishment. Therefore, it launched the European Quality Award (EQA) to be, presented to the most successful exponent of TQM in Europe each year (Slack *et al*., 2010: 625). To receive an award, companies must demonstrate that their approach to TQM has contributed meaningfully to filling the needs of consumers, employees and others with an interest in the organisation for the past few years, (Slack *et al*., 2010: 625). In 1999, the model on which the European Quality Awards was improved and renamed the EFQM Excellence Model or Business Excellence Model and the changes made placed more importance on customer and market focus (Slack *et al*., 2010: 625).

The Deming Prize was established by the Board of Directors of the Japanese Union of Scientists and Engineers in 1951 and its focal purpose is to spread the quality gospel by identifying performance improvements flowing from the successful implementation of firm-wide quality control built on statistical quality control methods (Ghobadian and Woo, 1996: 10). There are ten key fundamentals in the Deming Application Prize, as well as a checklist that is used to appraise the performance (Jalahma, 2012: 38). This

checklist put emphasis on the importance of top management's active involvement in quality management activities and understanding of the foremost requirements of quality development initiatives (Jalahma, 2012: 38).

The MBNQA programme was established by the Department of Commerce's National Institute of Standards and Technology (NIST 2011) and the American Society for Quality (ASQ) in 1987 to improve the competitiveness of U.S. businesses, such as manufacturing, service, and small business. The MBNQA criteria have been updated annually based on the dynamic global environment which requires transformation in quality management (Lee, 2012: 1). The Baldrige criterion for performance superiority is made up of the following seven categories (Lee, 2012: 1):

i. Leadership;
ii. Strategic planning;
iii. Consumer focus;
iv. Measurement;
v. Analysis, and knowledge management;
vi. Workforce focus; and
vii. Operations focus and results.

These seven categories create a coherent and effective approach to organizing the activities of any successful organization or department (Lee 2012: 1). These categories can assure quality improvement throughout the organization when entirely aligned and integrated (NIST 2011).

The Zodiac group has over 100 companies globally. To recognize the performance of these companies yearly, Zodiac presents awards in the following categories:

i. Financial performance – budget versus actual;
ii. Zodiac non - conformance Rate (ZNCR) – quality performance to customers;
iii. Zodiac on time delivery (ZOTD) – Delivering to customers on time; and
iv. Supplier on time delivery (SOTD) – Suppliers receive awards for delivering raw materials on time.

Achieving the awards would be significant to PISA for the following reasons:

i. Interest new clienteles, venture capitalists and authors by giving an organisation an advantage over its competitors;

ii. Set a business at a distance from its competition and distinguishes the quality of its accomplishments from others;

iii. Being selected or nominated can be obliging for the reason that it places one at the pole position of one's field and business;

iv. Being nominated or even winning an accolade serves as testimony to a business work code, commitment and unique field. Awards appeal to customers who will be likely to consider a business that has won an award over another that has not. Achieving awards also assists in strengthening the trustworthiness of current clientele.

2.12 Summary

This chapter presented the relevant literature in terms of TQM. The chapter reviewed the history and evolution of TQM; the various definitions of TQM by different authors; the founders and their beliefs on TQM; the tools and techniques applied; dimensions of quality; the various costs associated with TQM; quality management system; benefits of TQM; challenges in achieving TQM; quality awards; criticism of TQM and empirical studies.

In the next chapter, the research methodology employed to conduct the study is discussed. This chapter details the research method; target population; the collection of data; the research instrument used; the questionnaire; administration and collection of the questionnaire; ethical considerations; data analysis and how validity and reliability were maintained.

CHAPTER THREE

RESEARCH METHODOLOGY

"If you want quality, act as if you already had it" – William James

3.1 Introduction

The previous chapter provided a review of the literature relevant for this study. This chapter discusses the research objectives and aspects such as sample selection; sample size; questionnaire design; data analysis; validity; reliability; techniques used to validate the study; elimination of bias and ethical considerations. This chapter highlights the quantitative and qualitative research methodologies as a triangulated methodological approach that was used for this study.

3.2 Aim and Rationale

The aim of this study is to develop and implement a plan for a TQM system at PISA.

The objectives of the study were:

i. To quantify the extent of quality concerns at PISA.;

ii. To explore, the degree to which quality tools are employed at PISA.;

iii. To capture the perceptions of PISA's management and employees on TQM; and

iv. To explore the challenges in adopting TQM principles at PISA.

This study is important for several reasons. The findings of the study will add to the body of knowledge in the field of TQM, in general and the parachute manufacturing related organisations, in particular. The organisation will be able to identify areas that need improvement so that it can reduce costs through TQM and become more efficient. This study seeks to capture the perceptions of employees of Parachute Industries of Southern Africa (PISA) and how quality is currently being addressed by PISA. The study allows for the perspectives of top management and middle levels of management to be ascertained. This study aims to identify the possible or potential of adopting TQM principles in the parachute and related equipment industry, particularly at PISA.

The literature reviewed has provided insight into the lack of research done in TQM within a parachute manufacturing organization and the challenges faced in implementing TQM as an effective system of operation. Hence, parachute manufacturing organisations globally will benefit from the study in that they can use the conclusions of this study to enhance their performance and to deliver a quality product to the end user.

3.3 Case Study

This study adopts a case study approach due to the quality construct being bounded to PISA's context, requiring an in-depth analysis, within a contemporary domain. According to Yin (1994), a case study design should be considered when:

i. The emphasis of the study is to answer "how" and "why" questions.

ii. Whereby one cannot influence the behaviour of persons involved in the study.

iii. Whereby one wants to explore contextual conditions because one considers them to be applicable to the spectacle being studied.; and

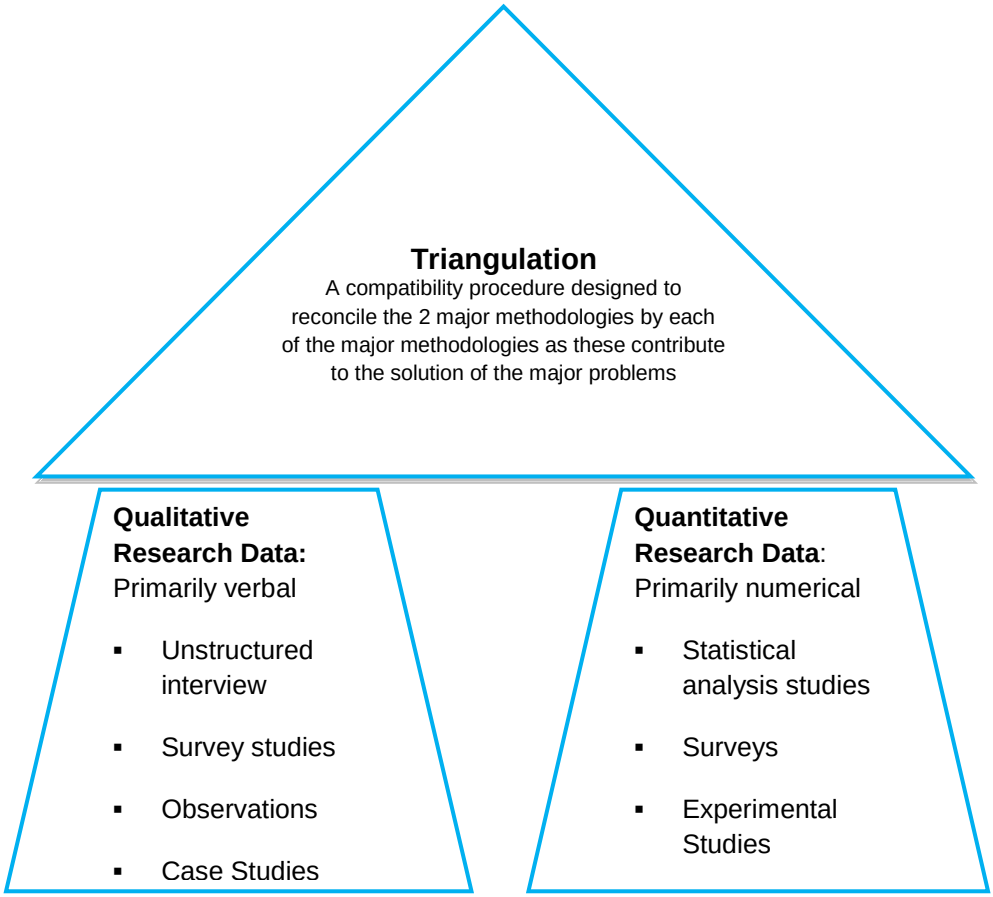
iv. The limitations are not clear between the phenomenon and context.

3.4 Research Design

3.4.1 Triangulation

Both quantitative and qualitative research methodologies were adopted as a triangulated methodological approach to this study. According to Creswell (2008) the drive for this type of study is that both qualitative and quantitative research, in mixture, offers a more concise understanding of a research problem or concern. There is a solid recommendation within the research community that research, both quantitative and qualitative should be mixed in research of many kinds (Amarantunga and Zain, 2002: 367). Leedy and Ormrod (2005) describe the interaction between qualitative and quantitative research in Figure 3.1.

Figure 3.1: Interaction between qualitative and quantitative research



Source: Adapted from Leedy and Ormrod (2005)

Edmonds and Kennedy (2013: 146) state that mixed methodology was developed as an effort to legitimatize the use of numerous methodological strategies to answering research questions with an individual study, which is considered a more practical approach to research. This importance has advanced with the increasing attention focused on "triangulation" in research (Yin, 1994). Yin (1994) states that triangulation is the grouping of methodologies in the study of similar phenomenon with the integral assumption that the effectiveness of triangulation rests on the evidence that the weakness in each single technique will be compensated by the counter–balancing strengths of another. This term is sometimes seen to denote to an extensive tactic which combines "several observers, academic perceptions, and methodologies" and is normally used interchangeably to define research strategies that combine a mixture of quantitative and qualitative research methods. Bryman and Bell (2007) debate that mixed methods not only make the most of the strong points and minimize the weakness of each technique, but supports research results and adds to theory and

knowledge development.

3.4.2 Quantitative Research Design

Horna (1994) states that quantitative research designs are considered by the concept that human behaviour can be defined by what may be called "social facts", which can be examined by methodologies that use "the deductive logic of the natural sciences". The practice is focused in the direction of the development of testable hypotheses and perception which are generalizable across settings and, in contrast, this rich methodology is further concerned with how a rich, composite report of the detailed conditions under study will develop (Amaratunga et. al, 2002: 367).

3.4.3 Qualitative Research Design

According to Sekaran and Bougie (2010), qualitative data refer to data in the arrangement of words. Qualitative data can derive from a widespread assortment of primary sources and/or secondary sources. The analysis of qualitative data is intended at making effective suggestions from the often-overwhelming volume of collected data. Johnson and Christensen (2008) illustrate the differences between qualitative and quantitative research as per Table 3.1.

Table 3.1: Difference between qualitative and quantitative research

Criteria	Qualitative Research	Quantitative Research
Purpose	To understand and interpret social interactions.	To test hypotheses, look at cause and effect and make predictions.
Group Studied	Smaller and not randomly selected.	Larger and randomly selected.
Variables	Study of the whole, not variables.	Specific variables studied
Type of data collected	Words, images or objects	Numbers and statistics
Form of data collected	Qualitative data such as open – ended responses, interviews, participant observations, field notes and reflections	Quantitative data based on precise measurements using structured and validated data – collection instruments
Type of data analysis	Identify patterns, features, themes	Identify statistical relationships
Objectivity and subjectivity	Subjectivity is expected	Objectivity is critical
Role of researcher	Researcher and his/her biases may be known to participants in the study and participant characteristics may be known to	Researcher and his/her biases are not known to participants in the study and participant characteristics are deliberately hidden from the researcher

	the researcher.	(double blind studies).
Results	Particular or specialised findings that are less generalizable	Generalizable findings that can be applied to other populations.
Scientific method	Exploratory or bottom – up: the research generates a new hypothesis and theory from the data collected.	Confirmatory or top – down: the researcher tests the hypothesis and theory with the data.
View of human behaviour	Dynamic, situational, social and personal	Regular and predictable
Most of common research objectives	Explore, discover and construct	Describe, explain and predict
Focus	Wide – angle lens; examines the breadth and depth of phenomena	Narrow – angle lens; tests a specific hypothesis
Nature of observation	Study behaviour in a natural environment	Study behaviour under controlled conditions; isolate casual effects.
Nature of reality	Multiple realities; subjective	Single reality; objective
Final report	Narrative report with contextual description and direct quotations from research participants.	Statistical report with correlations, comparisons of means and statistical significance of findings.

Source: Johnson and Christensen (2008)

3.5 Population and Sampling

3.5.1 Population

According to Van Zyl (2012), the restrictions due to inadequate time and limited research funding, the alternate strategy is to take a ration of a larger group of contributors and do the research with that reduced group. In this situation, the larger group is the population, and the smaller group designated from a population is the sample. The population for this study will be taken from the payroll that is controlled by the human resources department. Currently, there are 267 employees on site, which comprise of 120 permanent employees in the various different departments (quality, production, operations and finance). The employees are made up of a manager, middle managers, sewing machinists, quality inspectors and mechanics.

3.5.2 Sampling

As per Sekaran and Bougie (2010) a population (N) of 120 participants requires a sample (S) of 92 participants. Participants were randomly chosen from the payroll. As per Van Zyl (2012) probability sampling approaches are the most frequently used because the selection of members is determined by chance. Since the purpose of who will end up in the sample is determined by non-systematic and random rules, the

chance that the sample will truly signify the population is increased. Sekaran and Bougie (2010) state that, as soon as elements in the population have a recognized opportunity of being selected as subjects in the sample, probability sampling can be either unrestricted or restricted, because the determination of who will end up in the sample is determined by non-systematic and random rules; the chance that the sample will truly represent the population is increased.

Van Zyl (2012) states that if one can select a sample that is as near as possible to being representative of a population, then any conclusions one can make concerning that sample would also hold true for the population. Occasionally, though, random sampling leaves too much to chance, particularly if one has no assurance of equal circulations of population members from one another. In that case, stratified sampling is used to confirm that the strata (or layers) in the population are fairly represented in the sample. The sample for this study was stratified as follows:

Table 3.2: Sample population

Department	Population	Sample
Sewing machinists	36	36
Quality inspectors	37	37
Middle managers	10	10
Senior managers	8	7
Sewing machine mechanics	3	2

- Sewing machinists – are responsible for sewing panels together to produce an end product.
- Quality inspectors – consist of an in-process inspectors and final inspectors. The in-process inspector is responsible for inspecting small panels during the manufacturing process. The final inspector is responsible for inspecting a complete product before being delivered to a customer. ;
- Middle manager – consist of production supervisors, engineers, quality auditors and administrative staff.
- Senior managers – are responsible for the overall running of the business. ; and

- Sewing machine mechanics – are responsible for the maintenance of all sewing machines.

Qualitative data was collected through interviews. Five senior managers were individually invited (Refer to Appendix D for the interview schedule). In this research the qualitative research was done by way of personal interviews with five senior managers, directly involved in the everyday running of the business, who are listed in Table 3.2.

Table 3.3: Interview schedule

No.	Position
i.	General Manager
ii.	Financial Manager
iii.	Quality Products Manager
iv.	Lean Manager
v.	Purchasing Manager

The main purpose of the interviews was to extract qualitative data from the interviewees to determine the position regarding TQM activities within the Durban-based parachute manufacturing organisation.

3.6 Data Collection

3.6.1 Phase 1: Quantitative

Data which are collected at the point where they are created are termed primary data, and such data are captured for the first time with a specific purpose in mind (Wegner 1993). According to Wisniewski and Stead (1996: 7), primary data are collected directly for the purpose for which they are to be used. Employee perceptions of quality are, therefore, considered as primary data in this study as they have not been previously captured and are compulsory for a purpose: quality improvement within the parachute manufacturing industry: a case study of PISA.

As per Saunders, *et al*. (2003: 282), a self-administered questionnaire is generally handed to each respondent and collected once completed by each respondent. In this study, the questionnaire (Refer to Appendix 3) was administered on site by individual department heads, with respondents being selected via the human resources payroll.

Connolly and Connolly (2005: 73) state that employee questionnaires on quality practices will measure perceptions of management, co-workers and employees, in general.

3.6.2 Phase 2: Qualitative

This phase involved interviews with PISA's top management. Permission and willingness to participate was first sought from the General Manager of PISA, who was ensured of the participants' anonymity and confidentiality. All participants were notified that tape-recording devices will be used and permission for recording the interviews was sought by the individual managers that participated. It was explained that the interviews would be transcribed at a later stage.

Five managers, who were based full-time at the Durban based manufacturing facility, were interviewed. Prior to the interview, participants requested to view the list of pre-determined questions (Appendix 5) to gain familiarity with the questions that were going to be asked. The pre-determined questions were sent via email to the relevant managers who would be involved in the interviewing session. This request by the participants proved to be an advantage as the participants were prepared for the interview. The five managers comprised of the General Manager, Quality Products Manager, Lean, Manager, Finance Manager and Purchasing Manager. The interviews were voice recorded, to ensure reliability of data, which were later transcribed. Once the data were transcribed, the data was classified into meaningful categories using thematic analysis. The data was categorised, recognising themes or patterns into articulate categories that summarise and add meaning to the text acquired.

3.7 The Research Instrument

A questionnaire is a broad term used to describe all techniques for data collection in which each respondent is requested to answer to the similar set of questions in a predetermined order (Saunders *et al*., 2003). The research instrument for the quantitative aspect of the study was a questionnaire that collected primary data from the target population at PISA. This data involved employee perceptions of quality by means of a sit-in questionnaire that was administered by the human resources department. The research instrument for the qualitative aspect of this study focused on interviews of PISA's top management. The thought of merging qualitative and quantitative methods in a single study provided more confidence in the targeted areas

and allowed for accurate capturing (De Vos, 2005: 357).

3.7.1 Phase 1: Quantitative - The Questionnaire

Cavana *et al*. (2001) state that the design of a questionnaire should focus on three principles:

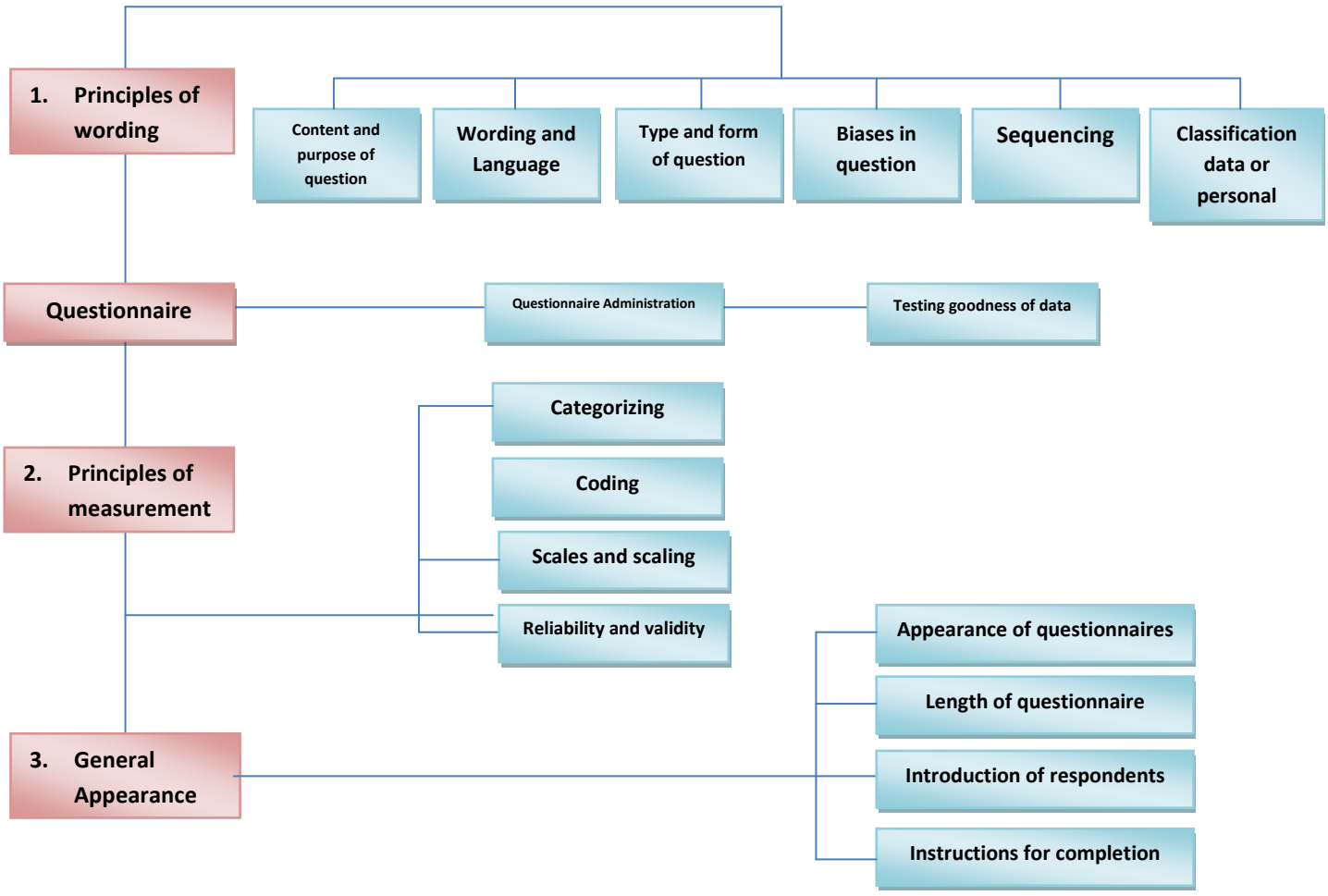
i. Planning the questionnaire to ensure that variables are categorised, scaled and coded after receipt of the response;

ii. Wording of the questionnaire; and

iii. General layout and appearance of the questionnaire.

These factors are critically important in a questionnaire design because they can eliminate biases in research. These factors are illustrated in Figure 3.2 below.

Figure 3.2: Principles of questionnaire design



Source: Cavana *et al*. (2001: 227)

A questionnaire was designed to collect quantitative data. The questionnaire was designed with a Likert scale format ranging from Strongly disagree (1) to Strongly agree (5). The questionnaire was planned with 11 sections, consisting of 5 questions each. The sections were broken down in the following way:

i. Section 1 & 2 (General organisation);

ii. Section 3: Leadership;

iii. Section 4: Training;

iv. Section 5: Customer satisfaction;

v. Section 6: Communication;

vi. Section 7: Continuous improvement;

vii. Section 8: Teamwork and resource management;

viii. Section 9: Employee participation;

ix. Section 10: Work environment and culture; and

x. Section 11: Supplier quality management.

An invitation was sent via Lotus Notes (email programme) detailing the date, time and location to the department heads. Department heads attended a de-briefing session by the researcher explaining the reason for conducting this study, the administration of the questionnaire and the collection process. The questionnaires were distributed to individual department heads, who in turn, distributed them to the individual respondents within the departments. The departmental heads randomly selected names from the human resources payroll. The questionnaires were placed in A4 envelopes with the department names and number of questionnaires to be completed. Extra questionnaires were placed in the envelope to allow for mistakes by respondents. The completed questionnaires were returned to the researcher within the same envelopes.

3.7.1.1 Pre-testing of the Questionnaire

Hair *et al*. (2011: 267), assert that no questionnaire should be administered prior to research, until the researcher has assessed the likely accuracy and consistency of the

response, by pre-testing the questionnaire using a small sample of respondents with characteristics comparable to those of the target population. An undeclared pre-test was conducted. As per Butler (2012), the method of conducting an undeclared pre-test is when the participants are not told that it is a pre-test. The pre-test is conducted as a survey. This type of pre-test allows one to check one's choice of analysis and the standardization of one's survey. Ten employees (randomly) were selected and an undeclared pre-test was conducted. During the pre-test, if any discrepancies are found or misunderstood, they would be changed and corrected before proceeding with the actual survey. There were no items that were misinterpreted by participants during this pre-test that could skew the results obtained from the study as a whole.

3.7.1.2 Administration of the Questionnaire

The researcher distributed the questionnaire to individual department heads, who, in turn, distributed them to the individual respondents within the departments. The department heads randomly selected names from the human resources payroll. The questionnaires were placed in A4 envelopes with the department names and number of questionnaires to be completed. Extra questionnaire was placed in the envelope to allow for mistakes by the respondents.

The administration of questionnaires was conducted during the period January to May 2017. The questionnaire was written in English. The entire workplace is English speaking. If required, the questionnaire would have been translated to the language required or an interpreter would have been elected to assist with the translation. The researcher visited every sitting of the survey which was conducted within the main boardroom, to check if there were any enquiries and there were no enquiries.

3.7.1.3 Collection of Questionnaires

The participants' completed questionnaires were collected by individual department heads. The department heads handed over the completed questionnaires to the researcher in an envelope with department name and number of questionnaires collected. 92 questionnaires were distributed in the various sittings within the site and 92 were returned. No participant turned down the opportunity to participate in the research.

No incentives were used in the study to influence the response rates. The response rate will be discussed in Chapter 4.

3.7.2 Phase 2: Qualitative – Interview Schedule

In the qualitative phase, in-depth individual interviews were held with PISA'S top management. An interview schedule was used to guide the process (Appendix 5). The schedule consisted of pre-determined open-ended questions which facilitated individual interviews with management. Questions revolved around PISA's overall quality performance, both internally and externally. The interview duration for the General Manager was set at 60 minutes. The interview duration for the rest of the interviewees was set at 30 minutes. The General Manager's duration of interview was longer, due to a lengthier interview relating to financial aspects of customer returns and reporting quality performance to the directors and shareholders of Zodiac. To ensure anonymity of all participants, job titles were used with no names being revealed.

3.8 Data Analysis

3.8.1 Phase 1: Questionnaire

The questionnaire was the main instrument that was used to gather data and was circulated to a number of employees, within the different levels at PISA. Descriptive statistics were used to illustrate the dataset and are effective measures in trying to summarize the data being collected. These statistics explore all technical and general aspects of the data, such as the department of employment of the sample, and provides a comprehensive insight of the distribution of the data and the position of the mean within the data. A univariate analysis in the computer statistics programme SPSS version 24.0 was used. As per Naicker (2017:63) a univariate analysis looks at one single variate at a given time, SPSS allows for the analysis and summary of each variable necessary for a comprehensive overview of all descriptive statistics required for the study. SPSS allows for the central frequency to be determined as well as the mean and standard deviation of the data set. Details covered under the topic of descriptive statistics were: department of employment; position; standard deviation; mean; and central frequency.

Factor analysis, on the other hand, is a statistical technique whose main objective is data reduction. A typical use of factor analysis is in survey research, where a researcher needs to represent a number of questions with a small number of hypothetical factors.

The results will be presented in chapter four showing the analysis of the descriptive statistics in the form of graphs, cross tabulations and other figures for the quantitative data that was collected. Inferential techniques include the use of correlations and chi square test values, which were interpreted using the p-values.

3.8.2 Phase 2: Interviews

Analysis of the data generated from the interviews involved transcribing of the tape recorded discussions, generating mutual categories, themes and patterns within the data and coding (De Vos, 2005: 357).

3.9 Ethical Considerations

Marshall and Rossman (2014) state that the purpose of ethics in research is to guarantee the protection of participants from possible harm coming from research activities. Ethical concerns were recognised and addressed in this study. In addition, there was no intimidation by department heads to employees to submit the questionnaires. Every effort was made to make sure anonymity, confidentiality, voluntary participation and that no possible harm occurred to any respondent who had partaken in the study.

This study took the guiding principles presented by Emmanuel, Wendler and Grady (2000) into consideration to make sure that the best interest and integrity of participants was not compromised in any way;

i. The research done has taken the opinions of the target population concerning the subject of interest into consideration before going forth with executing the study. This ensures that the subject being explored and examined is within the interest of the population of interest. This study took the interests of the manufacturer into consideration by looking at the level of TQM implementation within the environment in which the study took place. The study involved participants by gathering their collective opinion on whether TQM would be an effective method for the parachute manufacturing industry and gathered their opinion on the effectiveness of the questionnaire after it was administered and collected upon completion by the researcher;

ii. The study also took into account the social value that it presented to its target population. Social value refers to whether the research being conducted

influences the community in a progressive manner and provides information to the target population on which the study was founded. TQM can then be implemented into parachute and related equipment manufacturing companies, thereby improving the work ethics and methods being used by the employees working within the many value streams present within the manufacturing facility;

iii. The fair selection of partakers was also taken into account to make sure that each value stream was in the same way represented to ensure that the research done into the value of TQM within a parachute manufacturing organisation would benefit all value streams and improve the working lives of all employees involved. By ensuring that all participants were fairly nominated, it ensures that there is a valuable set of data that has been supplied by a diverse sample group;

iv. The next principle that needed to be deliberated was whether the value that the research presented outweighed the risks it offered to participants on an equally large proportion. The possibility of harm taking place had to be taken into consideration as well as the severity of the harm, should any harm be experienced by any of the partakers. To make sure that this was not the situation, there were safe guards and contingencies put into place should the respondents' feel hassled or pressurised in responding to any of the statements in the questionnaire. Respondents' were permitted to leave if they felt uncomfortable and the contact particulars of all parties involved were available to participants so that they knew who to interact with if they have any concerns. An independent ethics panel revised the proposal of the research. The research was found to be ethically competent and harmless to be administered to the target population. Before the collection of data was carried out, the research showed no harm to partakers and was considered as appropriate by the ethical panel review board;

v. Informed consent confirms that respondents' have been provided with all applicable information relating to the study before they are permitted to answer the questionnaire. The researcher made sure that respondents' were provided with a clear and concise explanation of the information relating to the research and made sure that participants were made sufficiently aware of the

value and risks that the research offered. The research did not involve respondents' to reveal any personal information and guaranteed that the identity of the participant was protected through anonymity. All involvement was on a voluntary basis and the researcher confirmed that all consent was freely given and all participants had the required mental capability to answer the questionnaire; and

vi. The final principle makes sure that a level of respect for the respondents' is retained for the length of the data collection and is sustained once the study has been finalised. The mental and physical safety of respondents was also kept in check for the length of the study and all information collected from respondents' was done so in a private and confidential manner.

Feedback will be provided to all respondents once the study is completed. This would take on the form of a short information session wherein

3.10 Validity

As per Joppe (2003), validity defines whether the research actually measures that which it was planned to measure or tests the openness of the research results. In other words, does the research tool let you to hit 'the bulls eye' of your research object? Weisberg et. al (1989), believe that a survey question's validity is determined by how well it measures the concept(s) it is planned to measure. Both convergent validity and divergent validity can be determined by first equating answers to another question measuring the same concept, then by gauging this answer to the participant's response to a question that asks for the exact opposite answer.

3.11 Reliability

According to Joppe (2003), reliability is the degree to which results are dependable over time and a correct representation of the total population under study is mentioned as reliability. If the results of a study can be repeated under a similar methodology, then the research instrument is reflected to be reliable. Researchers might also want to pre-test the reliability and validity of the survey questions. To be reliable, a survey question must be answered by respondents in a similar way each time. According to Weisberg et. al (1989), researchers can evaluate reliability by relating the answers that respondents give in one pre-test with answers in another pre-test. Bruin states

(2006) that Cronbach's alpha is a measure of internal consistency, that is, how closely linked a set of items is as a group. It is considered to be a measure of scale reliability.

The instrument's reliability or the capability of its scales to produce the same consistency is significant in the measurement analysis. Collecting data with an unpredictable scale is like taking measurements with an elastic tape measure; the same thing can be measured a number of times, but it will produce a different length each time (Flynn et al., 1990: 250). Cronbach's Alpha is a satisfactory test for internal consistency, reliability and reliabilities less than 0.60 are considered to be poor, those in the 0.70 range, adequate and those over 0.80 acceptable (Sekaran and Bougie, 2009: 325).

Reliability recognized through internal consistency, which is measure based on correlation between different items on the same tests, can be measured using Cronbach's Alpha ranges between 0.0-1.0 (Vogt *et al*., 2012: 322). Cronbach's Alpha was used to gauge the reliability of each section linking to a research question (Sekaran and Bougie, 2009: 325).

3.12 Techniques used to validate the study

The researcher used the triangulation method (mixed method approach) therefore, it was vital to include validation techniques which cover both qualitative and quantitative methods.

On the qualitative approach, the researcher focused on adapting validity concepts which confirmed credibility, transferability and trustworthiness of the research instruments. Zohrabi (2013) recommended, the study followed the listed procedures to increase validity:

i. The triangulation method of data collection using questionnaire and interviews was done. This data provided an opportunity to validate the evidence which was collected from respondents. The same results acquired indicated the validity of the data collected.

ii. The data collected and interpretations were given to the participants in the study for them to assess it. The results and interpretation of the interviews were handed over to the interviewees in order to approve the content of the interview encounter. This supported and acknowledged the credibility and honesty of the information.

3.13 Anonymity and Confidentially

Anonymity is important for participants since they know that there will be no traceability or identity of the person. It is also not to expose people and to allow people to be honest and to answer without repercussions. Confidentiality will be ensured by not having participants' details on the questionnaire. There was no identity number, name/surname, address, or telephone number. There was also a limited number of people handling the distribution and collection of questionnaire.

3.14 Limitations

The limitation of the study is that it is restricted to a niche market and is a case study. The findings, therefore, have limited generalizability outside the context of PISA. Even though participation was voluntary, participation may be limited if people felt that their jobs would be at risk by filling in a questionnaire, as this exercise was not previously conducted at PISA. To overcome this risk, confidentiality and anonymity were ensured.

3.15 SUMMARY

This chapter detailed the research methodology in terms of the appropriate use of the several techniques in accordance with important principles and practices linked with the research methodology. A mixture of a quantitative approach using the survey method and a qualitative approach through structured interviews was considered suitable for this research study. Questionnaire and interviews were the key methods of data collection. The research design decisions outlined a guide that the researcher followed in effectively addressing the research problem. Having discussed the research methodology used in this study, the next chapter deals with data presentation, analysis and interpretation of results.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

"Quality is everyone's responsibility and we never have to stop getting better" – W.E. Deming

4.1 Introduction

This chapter presents the results and discusses the findings obtained from the questionnaires in this study. The questionnaire was the primary tool that was used to collect data and was distributed to various levels of employees at PISA. The data collected from the responses were analysed with the SPSS version 24.0. The results present the descriptive statistics in the form of graphs, cross tabulations and other figures for the quantitative data that were collected. Inferential techniques include the use of correlations and chi square test values; which are interpreted using the p-values. This chapter also discusses the qualitative data that was collected through interviews with PISA's top management. Analysis of the data generated from the interviews involved transcribing of the tape-recorded discussions, generating mutual categories, themes and patterns within the data and coding in keeping with guidelines provided by De Vos (2005: 357).

4.2 Phase 1: Quantitative Data

4.3 The Sample

In total, 92 questionnaires were despatched and 92 were returned which gave a 100% response rate.

4.4 The Research Instrument

The research instrument consisted of 76 items, with a level of measurement at a nominal or an ordinal level. According to Welman *et al*. (2005), a nominal level is where individuals are positioned in different categories and are only distinguished in terms of characteristics being measured. The ordinal level of measurement imitates change among individuals in variables being measured. The questionnaire was divided into 11 questions which measured various themes and are detailed in Table

4.1. The themes that were measured were biographical data and 10 TQM tools. The 11 questions measure the various themes as illustrated below:

Table 4.1: Breakdown of 11 Questions

1	Biographical data;
2	General organisation;
3	Leadership;
4	Training;
5	Customer satisfaction;
6	Communication;
7	Continuous improvement;
8	Teamwork and resource management;
9	Employee participation;
10	Work environment and culture; and
11	Supplier quality management.

4.5 Biographical Data

This category summarises the biographical data from the respondents.

There were similar and large numbers of respondents from quality inspectors and sewing machinists (40%). Figure 4.1 depicts the departments to which respondents belonged. In terms of the number of employees, quality inspectors and sewing machinists make up the majority of employees at PISA, with the latter being higher. Sewing mechanics are made up of a ratio of 1 sewing mechanic to every 50 sewing machines. Middle management is made up of administrative staff, together with production supervisors, team leaders, engineers and quality auditors. The senior management structure of PISA is made up of the General Manager, Production Manager, Quality Manager, Supply Chain/Logistics Manager, Finance Manager, Purchasing Manager, Human Resources Manager, Sales Manager, Technical/Configuration Manager and Information Technology Manager.

Figure 4.1: Respondents' departments

Section one (General organisation) - Question 1 (i.)

Currently, there are 267 employees on site, of which 120 (Refer to Table 4.2) are permanent employees in the various departments (quality, production, operations and finance). The employees are made up of senior managers, middle managers, sewing machinists, quality inspectors and sewing machine mechanics. There are 147 contract employees. This information was sourced from a local-based labour broker. The reason for having more contract employees than permanent employees is to create flexibility during peak production periods and to be able to reduce the workforce during low production periods. The number of employees throughout the financial year (August to September) can vary considerably.

Table 4.2 Number of permanent employees

N	Minimum	Maximum	Mean	Std. Deviation
92	120.00	200.00	158.0435	29.80667

Section one (General organisation) - Question 2 (ii.)

PISA has been associated with Zodiac for 10 years (Refer to table 4.3). Over 30 years prior to Zodiac obtaining PISA, PISA was previously merged with a sports parachute manufacturing entity called Aerodyne. When Zodiac acquired PISA in 2008, Aerodyne ventured independently into the sports parachute market. Zodiac's business model solely focused on military parachutes and related equipment and excluded the sports parachute market as it was not considered feasible to maintain.

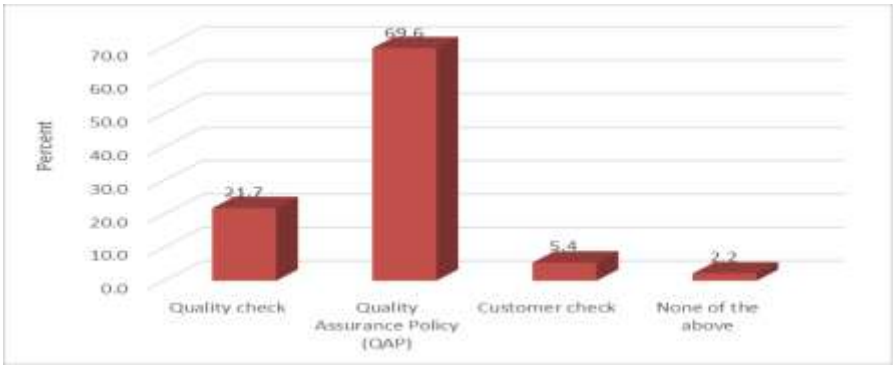
Table 4.3 Number of years Zodiac associated with PISA

N	Minimum	Maximum	Mean	Std. Deviation
92	1.00	10.00	9.5652	1.71166

Section one (General organisation) - Question 3 (iii.)

The most common annual check is that of QAP (Quality assurance policy). 69.6%, as depicted in Figure 4.2, with approximately one fifth also performing quality checks. A small percentage (2.2%) indicated that none of these were done. The QAP (contract between PISA and the parachute designers based in Joue Les Tours) is an annual product audit done by the French design entity based in Joue Les Tours, France. During this audit, products are audited to specification using drawings, manuals and inspection documents. Also, during the audit, raw materials are tested according to specification. The QAP audit takes place for three consecutive days. Non-conformances raised during the audit will require an action plan to be created.

Figure 4.2 Annual audit conducted by the French customer.



Section one (General organisation) - Question 4 (iv.)

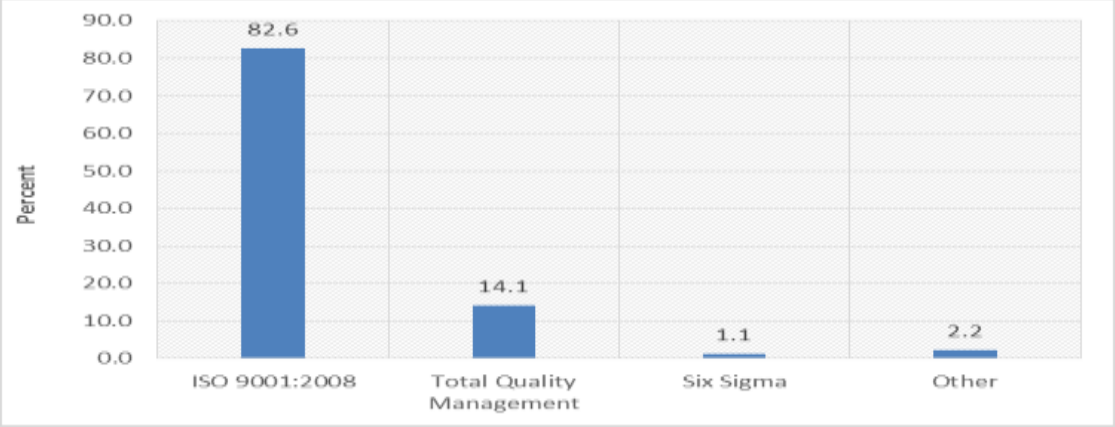
The most common QMS is ISO 9001:2008 (82.6%), as shown in Figure 4.3. TQM comprises 14.1%, six sigma 1.1% and 2.2% belongs to other. PISA is an ISO 9001:2008 certified company. PISA acquires the services of TUV Rheinland as a certification body. TUV Rheinland is a German based organisation with PISA being associated with TUV for 22 years. PISA offers TUV a contract every 3 years as a certification body.

i. Year 1: Re-certification;

ii. Year 2: Surveillance Audit; and

iii. Year 3: Surveillance Audit.

Figure 4.3 The QMS adopted by PISA



Section one (General organisation) - Question 5 (v.)

The amount of time worked per week is shown in Table 4.4.

Table 4.4 Number of hours worked at PISA

N	Minimum	Maximum	Mean	Std. Deviation
92	40.00	60.00	40.8696	4.10097

The average number of hours is 40. This is the standard as per regulation. The operating hours for PISA are as follows:

Monday to Thursday – 7:20 to 16:30; and

Friday – 7:20 to 12:40

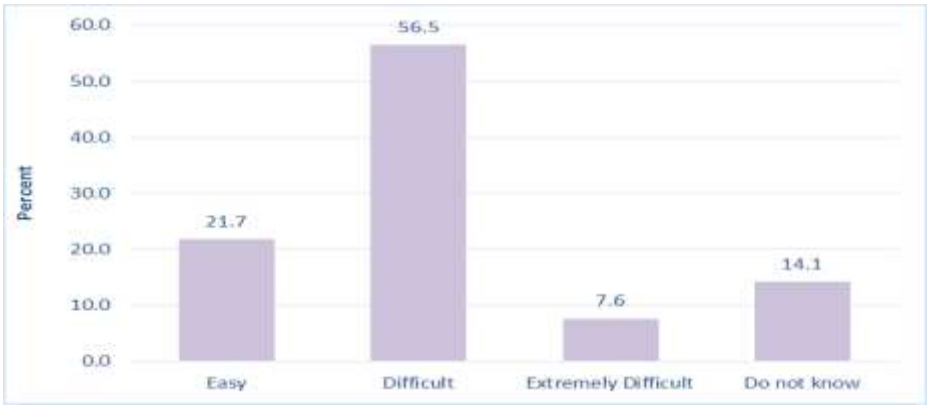
Section one (General organisation) - Question 6 (vi.)

Figure 4.4 below indicates the level of difficulty in implementing the QMS. Nearly two thirds of the respondents pointed out that it was difficult to implement. Approximately a fifth found the process easy (21.7%). 7.6% indicated that it was extremely difficult and 14.1% indicated they did not know. The 14.1% that have indicated they did not know could be employees that were transferred from a contract position into a permanent position, which is done on a yearly basis.

These employees would have not been around during the initial implementation of the QMS. The implementation was a difficult task, as the requirements to implement ISO

9001, as a lot of requirements that need to be compliant, before being certified.

Figure 4.4 Levels of difficulty to implement the QMS



Section one (General organisation) - Question 7 (vii.)

Table 4.5 below indicates the frequency at which Gemba takes place.

More than three quarters (76.1%) of the respondents indicated that Gemba (meeting where all the relevant personnel attend) occurred daily. 17.4% indicated that the Gemba took place 4 days a week. 5.4% indicated that the Gemba took place 5.4% and 1.1 indicated it took place 1.1%. The Gemba takes place on a daily basis. Senior management, middle management, sewing machinists, inspectors and sewing mechanics attend this meeting. The purpose of the Gemba is to discuss production targets and quality issues being experienced during manufacturing.

Table 4.5 Indicates the frequency at which Gemba takes place

	Frequency	Percentage (%)
Once a week	5	5.4
Every day	70	76.1
4 days a week	16	17.4
Never heard of it	1	1.1
Total	92	100.0

Section one (General organisation) - Question 8 (viii.)

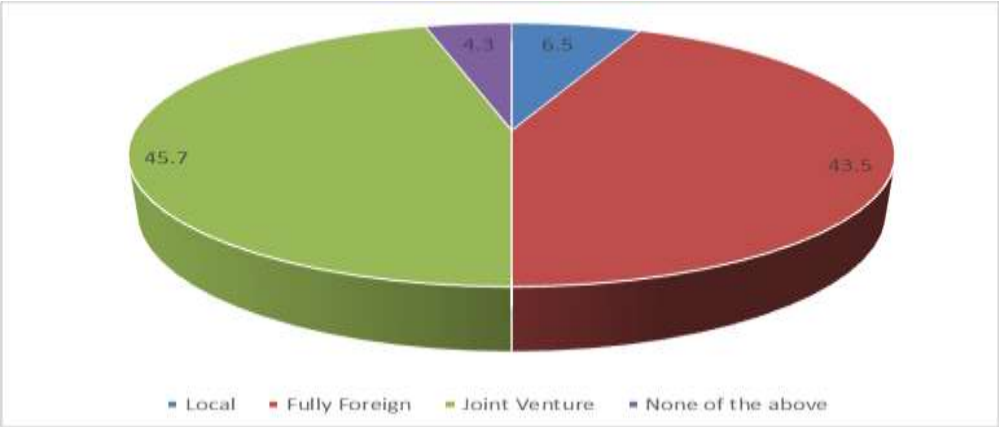
The ownership status of the organisation is shown in Figure 4.5 below.

45.7% indicated that the status of ownership is a joint venture. 43.5% indicated that the status of ownership is fully foreign. 6.5% indicated the ownership status is local and 4.3% indicated none in terms of the ownership of the company. PISA is a fully

foreign-owned company. Zodiac's head office is based in France, Paris.

The Zodiac Group also trades on the French stock exchange.

Figure 4.5 Shows ownership status of the organisation



Section one (General organisation) - Question 9 (ix.)

The average number of products returned was 3 519 as shown in Table 4.6. PISA statistics shows that, from the year 2010 to the year 2014 there were 3 519 products that were returned by various customers, with a majority of the customers based abroad. Customer returns ranged from raw material defects, incorrect dimensions, parts missing or deviation from specification. In manufacturing a safety critical product like a parachute, customer returns are not acceptable, due to causing a death or fatal injury to a skydiver. This could also potentially mean losing customers due to not delivering a quality product.

Table 4.6 Number of products returned

N	Minimum	Maximum	Mean	Std. Deviation
92	1567.00	5075.00	3519.4130	1363.11521

Section one (General organisation) - Question 10 (x.)

Figure 4.6 below indicates the awards offered by Zodiac to companies that excel in the different categories. 33.7% indicated that PISA won the Quality Award. 14.1% indicated that PISA won the Design Award. 6.5% indicated that Zodiac won the Financial Award. 46.7% indicated that PISA has not won any awards being offered by Zodiac, which is the correct indicator.

Figure 4.6 Indicates the awards offered by Zodiac

4.6 Section Analysis

This section examines the scoring patterns of the participants per variable per category. The results are first presented using summarised percentages for the variables that constitute each section.

Results are then further evaluated according to the importance of the statements. This section summarises the characteristics of the respondents' organisations. The table and graphs below summarise the scoring patterns.

4.6.1 Section 2: General Organisation

This section deals with the general organisation.

Table 4.7 depicts the results on the general organisation.

Table 4.7: Responses to section on the general organisation.

		Strongly Disagree		Disagree		Not Sure		Agree		Strongly Agree		Chi Square
Statement	Section	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	p-value
Top management shows commitment to quality	Q2.1	6	6.5%	14	15.2%	8	8.7%	37	40.2%	27	29.3%	0.000
PISA's management encourages team work	Q2.2	2	2.2%	4	4.3%	6	6.5%	43	46.7%	37	40.2%	0.000
PISA has a quality policy manual	Q2.3	1	1.1%	4	4.3%	11	12.0%	30	32.6%	46	50.0%	0.000
PISA's management communicates PISA's objective to staff	Q2.4	3	3.3%	13	14.1%	12	13.0%	41	44.6%	23	25.0%	0.000
You have been notified of customer returns due to non-conformances	Q2.5	3	3.3%	0	0.0%	9	9.8%	46	50.0%	34	37.0%	0.000
Customers visit PISA	Q2.6	0	0.0%	8	8.7%	14	15.2%	45	48.9%	25	27.2%	0.000
PISA has a high employee turnover (employees leaving for other jobs)	Q2.7	4	4.3%	29	31.5%	19	20.7%	31	33.7%	9	9.8%	0.000
Customers will move to other parachute suppliers due to customers experiencing quality	Q2.8	6	6.5%	20	21.7%	10	10.9%	37	40.2%	19	20.7%	0.000

non-conformances with PISA												
In the last 10 years you have at least once participated in PISA's stock take	Q2.9	1	1.1%	15	16.3%	12	13.0%	37	40.2%	27	29.3%	0.000
PISA measures quality performance	Q2.10	3	3.3%	0	0.0%	5	5.4%	47	51.1%	37	40.2%	0.000

Figure 4.7 below graphs the results on the general organisation.

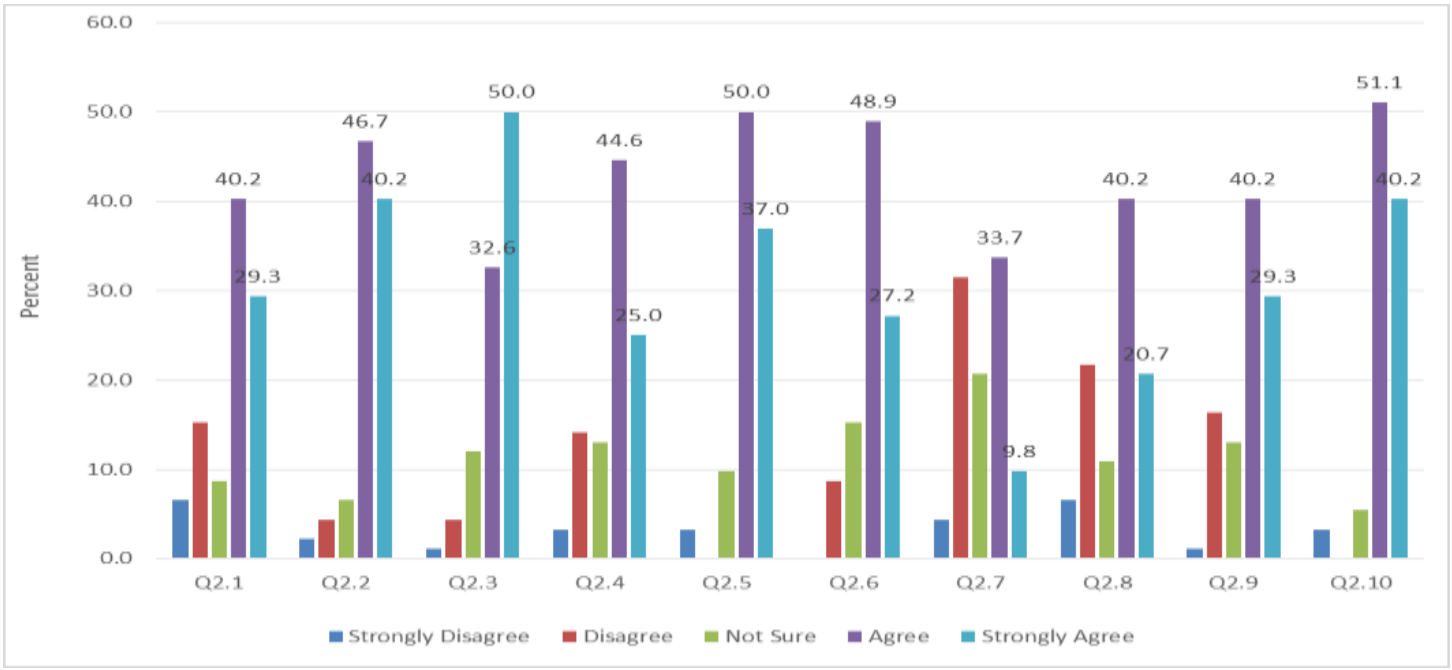


Figure 4.7: Responses to section on the general organisation

The following patterns are detected:

All of the statements demonstrate (significantly) higher levels of agreement whereas other levels of agreement are lower (but still superior than levels of disagreement)

The consequence of the differences is tested and made known in the table 4.7. Factor analysis displays the following three statements that form a sub-theme:

i. PISA has a quality policy manual;
ii. PISA's management communicates PISA's objective to staff; and
iii. You been notified of customer returns due to non-conformances.

There are high levels of agreement in relation to the sub-theme "Policy and Implementation". Respondents have an understanding of what these are and what they need to do so that these are achieved.

To determine whether the scoring patterns per statement were significantly different per option, a chi-square test was conducted. In terms of the null hypothesis, nearly the

same number of respondents scored across each option for each statement.

On the contrary, the alternative hypothesis states that there are noteworthy differences amongst the levels of strongly disagree and strongly agree. The aforementioned results are illustrated in Table 4.7. The highlighted significant values (p-values) are less than 0.05, which imply that the distributions were different, i.e., the differences in the manner in which respondents scored (strongly disagree, disagree, not sure, agree and strongly agree) were significant.

4.6.2 Section 3: Leadership

This section deals with the leadership within PISA.

Table 4.8 depicts the results on leadership.

Table 4.8: Responses to section on leadership.

		Strongly Disagree		Disagree		Not Sure		Agree		Strongly Agree		Chi Square
Statement	Section	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	p-value
Top management ensures that every employee knows PISA's objectives	Q3.1	1	1.1%	16	17.4%	8	8.7%	42	45.7%	25	27.2%	0.000
Top management invests in developing employees on total quality improvement techniques / tools	Q3.2	2	2.2%	9	9.8%	9	9.8%	48	52.2%	24	26.1%	0.000
Middle management gets employees' involvement in quality continuous improvement projects	Q3.3	1	1.1%	9	9.8%	11	12.0%	47	51.1%	24	26.1%	0.000
Top management puts safety as priority above quality	Q3.4	0	0.0%	8	8.7%	8	8.7%	36	39.1%	40	43.5%	0.000
Top management gets involved in projects to improve quality	Q3.5	1	1.1%	13	14.1%	10	10.9%	41	44.6%	27	29.3%	0.000

Figure 4.8 below graphs the results on leadership.

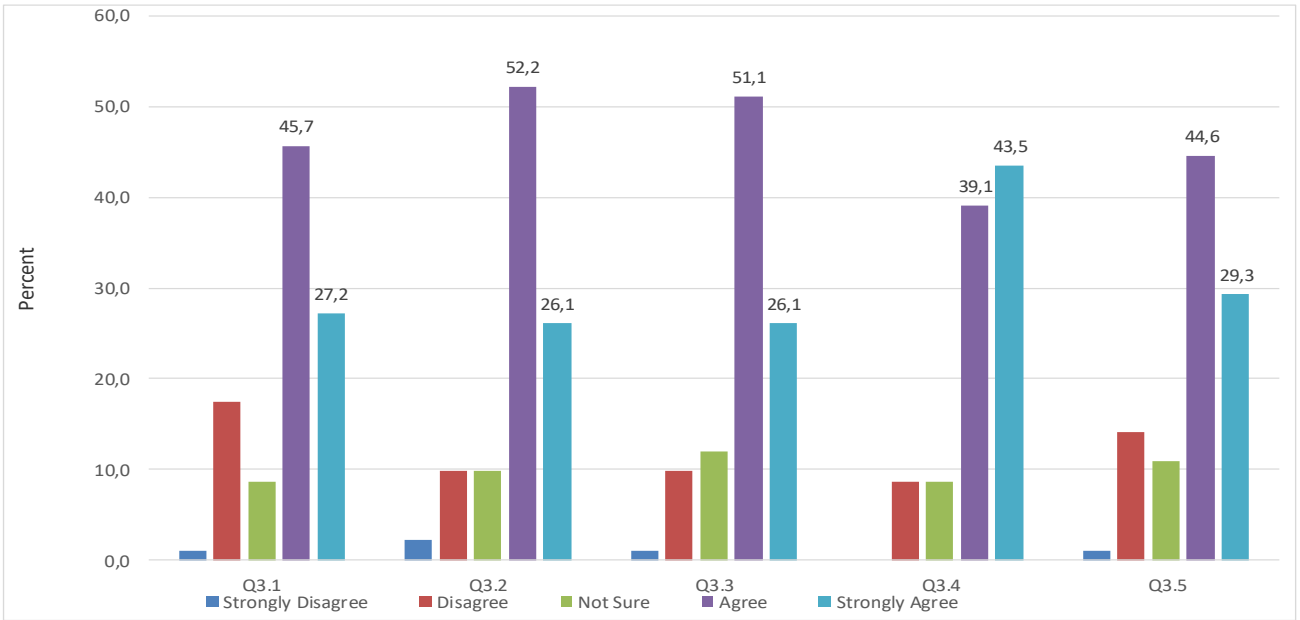


Figure 4.8: Responses to section on leadership.

The following patterns were observed within the data:

All of the statements demonstrate (significantly) higher levels of agreement whereas other levels of agreement are lower (but still superior than levels of disagreement)

The consequences of these differences is illustrated in table 4.8.

i. The patterns in show that top management is involved in the growth and development of the organisation. This is a very significant factor in terms of identifying leadership and managements involvement;
ii. Top management is involved and promotes projects being done; and
iii. Top management puts safety as a priority, which respondents have identified. All organisations within the Zodiac Group must focus on safety as a number one key performance indicator. This is communicated on a daily basis during the Gemba, together with the presence of visual management throughout the organisation.

There are high levels of agreement in relation to the sub-theme “Leadership and top management”. Respondents have an understanding of what these are and what they need to do so that these are accomplished.

To determine whether the scoring patterns per statement were significantly different per option, a chi-square test was conducted to determine whether the scoring pattern for each statement was significantly different in comparison with other options in the same question. In terms of the null hypothesis, nearly the same number of respondents scored across each option for each statement. On the contrary, the alternate hypothesis states that there is noteworthy difference between the levels of strongly disagree and strongly agree. The aforementioned results are illustrated in Table 4.8. The highlighted significant values (p-values) are less than 0.05, which imply that the distributions were different, i.e., the differences in the manner in which respondents scored (strongly disagree, disagree, not sure, agree and strongly agree) were significant.

4.6.3 Section 4: Training

This section deals with training within PISA

Table 4.9 depicts the results on training.

Table 4.9: Responses to section on training

		Strongly Disagree		Disagree		Not Sure		Agree		Strongly Agree		Chi Square
Statement	Section	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	p-value
Employees are given training in how to identify and act on quality improvement opportunities	Q4.1	5	5.4%	14	15.2%	15	16.3%	31	33.7%	27	29.3%	0.000
Employees are trained for job related skills	Q4.2	4	4.3%	5	5.4%	6	6.5%	47	51.1%	30	32.6%	0.000
Employees are trained on total quality management concepts	Q4.3	5	5.4%	21	22.8%	23	25.0%	23	25.0%	20	21.7%	0.014
Employees have been trained to use quality improvement tools, for example Ishikawa diagram	Q4.4	6	6.5%	21	22.8%	27	29.3%	24	26.1%	14	15.2%	0.004
Employees are given training on how to measure quality performance	Q4.5	4	4.3%	15	16.3%	15	16.3%	41	44.6%	17	18.5%	0.000

Figure 4.9 below graphs the results on training

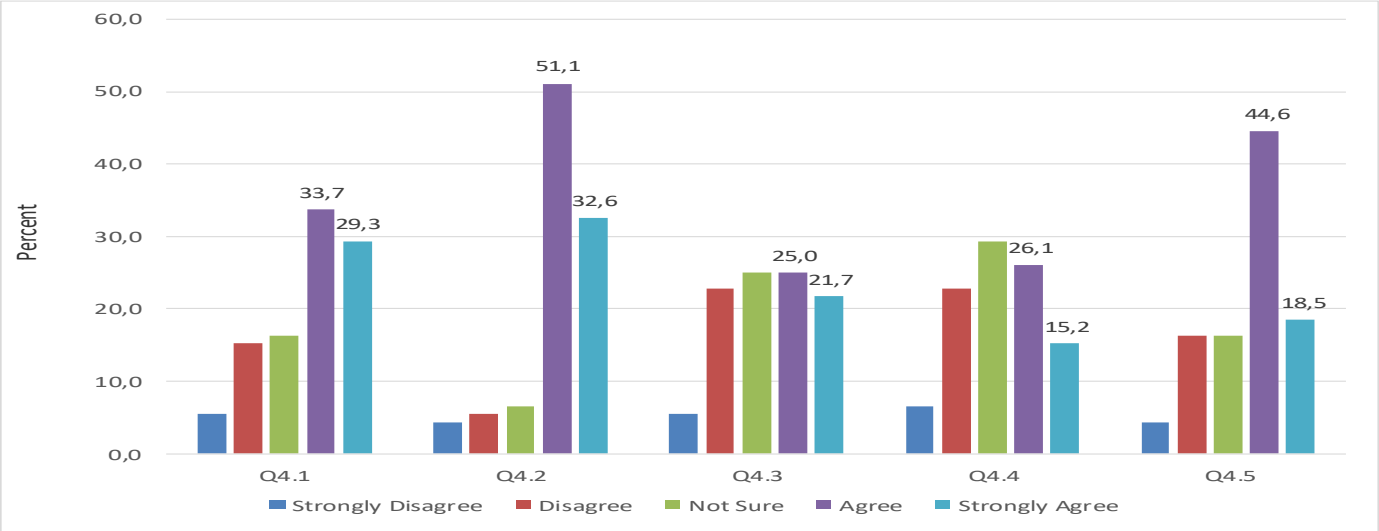


Figure 4.9: Responses to section on training

The following patterns were observed within the data:

A majority of the statements show (significantly) higher levels of agreement whilst other levels of agreement are lower (but still greater than levels of disagreement)

The significance of these differences is illustrated within table 4.9:

i. Employees are given on the job training to perform at their various functions;
ii. Training is done online in the production departments by the production supervisor; and
iii. It is also noted that employees are unsure on how to use and apply quality improvement tools. By not having the knowledge or skill on how to eliminate

quality problems both internally or externally at the customer-level, would mean there would be no improvement in terms of the quality performance. Employees are given training on how to measure quality performance. This is done on a daily basis; whereby quality performance is analysed during the daily Gemba in all manufacturing departments.

To determine whether the scoring patterns per statement were significantly different per option, a chi-square test was conducted to determine whether the scoring pattern for each statement was significantly different in comparison with other options in the same question. In terms of the null hypothesis, nearly the same number of respondents scored across each option for each statement. On the contrary, the alternative hypothesis states that there is a significant difference between the levels of strongly disagree and strongly agree. The aforementioned results are illustrated in Table 4.9. The highlighted significant values (p-values) are less than 0.05, which imply that the distributions were different, i.e., the differences in the manner in which respondents scored (strongly disagree, disagree, not sure, agree and strongly agree) were significant.

4.6.4 Section 5: Customer Satisfaction

This section deals with customer satisfaction within PISA.

Table 4.10 depicts the results on customer satisfaction.

Table 4.10: Responses to section on customer satisfaction

		Strongly Disagree		Disagree		Not Sure		Agree		Strongly Agree		Chi Square
Statement	Section	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	p-value
Customers' returned non-conforming products are studied for patterns and prevent the same problem reoccurring	Q5.1	4	4.3%	10	10.9%	15	16.3%	47	51.1%	16	17.4%	0.000
Customer returns are communicated to the entire organisation	Q5.2	8	8.7%	18	19.6%	17	18.5%	35	38.0%	14	15.2%	0.000
Customer returns are only handled by the quality department	Q5.3	6	6.5%	27	29.3%	13	14.1%	37	40.2%	9	9.8%	0.000
There are customers' returns every month due to quality problems with products	Q5.4	6	6.5%	27	29.3%	15	16.3%	30	32.6%	14	15.2%	0.000
Customers measure PISA on quality performance	Q5.5	0	0.0%	4	4.3%	12	13.0%	52	56.5%	24	26.1%	0.000

Figure 4.10 below graphs the results on customer satisfaction.

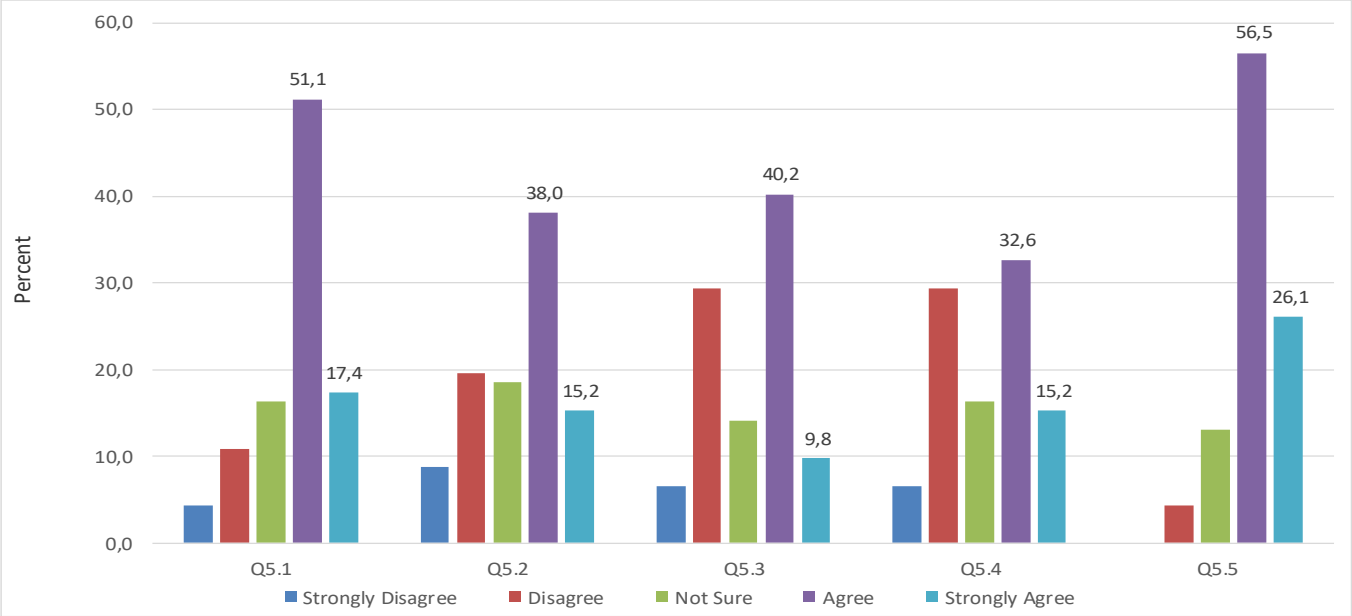


Figure 4.10: Responses to section on customer satisfaction

The following patterns were observed within the data:

All of the statements show (significantly) higher levels of agreement whilst other levels of agreement are lower (but still greater than levels of disagreement).

The significance of these differences is illustrated within in 4.10. Factor analysis shows that the following three statements form a sub-theme:

i. Employees throughout the organisation are aware of customer returns when they occur. A performance report is sent by the customers on a weekly basis, which is displayed on the Gemba boards throughout the organisation. The significant factor shows that all respondents have identified customer satisfaction as important;

ii. Respondents' have identified that quality non-conformances received from customers are only handled by the quality department; and

iii. Employees have noted that products are returned by customers on a monthly basis. It is evident that customer satisfaction is not being achieved. Customers provide feedback to the employees during their monthly visits and also submit performance reports. The production plan also contains information that all returned products must be remanufactured and sent back to the customer.

There are high levels of agreement in relation to the sub-theme “Product returns and customer satisfaction”. Respondents have an understanding of what these are and what they need to do so that these are achieved.

To determine whether the scoring patterns per statement were significantly different per option, a chi-square test was conducted to determine whether the scoring pattern for each statement was significantly different in comparison with other options in the same question. In terms of the null hypothesis, nearly the same number of respondents scored across each option for each statement. On the contrary, the alternate hypothesis states that there is a significant difference between the levels of strongly disagree and strongly agree. The aforementioned results are illustrated in Table 4.10. The highlighted significant values (p-values) are less than 0.05, which imply that the distributions were different, i.e., the differences in the manner in which respondents scored (strongly disagree, disagree, not sure, agree and strongly agree) were significant.

4.6.5 Section 6: Communication

This section deals with communication within PISA.

Table 4.11 depicts the results on communication.

Table 4.11: Responses to section on communication

		Strongly Disagree		Disagree		Not Sure		Agree		Strongly Agree		Chi Square
Statement	Section	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	p-value
The General Managers holds a communication meeting once a month	Q6.1	5	5.4%	12	13.0%	24	26.1%	38	41.3%	13	14.1%	0.000
The quality department communicates customer returns to all departments	Q6.2	2	2.2%	19	20.7%	6	6.5%	49	53.3%	16	17.4%	0.000
Quality performance is communicated to employees on a daily basis	Q6.3	3	3.3%	14	15.2%	14	15.2%	47	51.1%	14	15.2%	0.000
Quality improvements projects are communicated to employees	Q6.4	3	3.3%	9	9.8%	14	15.2%	50	54.3%	16	17.4%	0.000
Total quality management tools are used to communicate customer performance	Q6.5	1	1.1%	9	9.8%	32	34.8%	35	38.0%	15	16.3%	0.000

Figure 4.11 below graphs the results on communication.

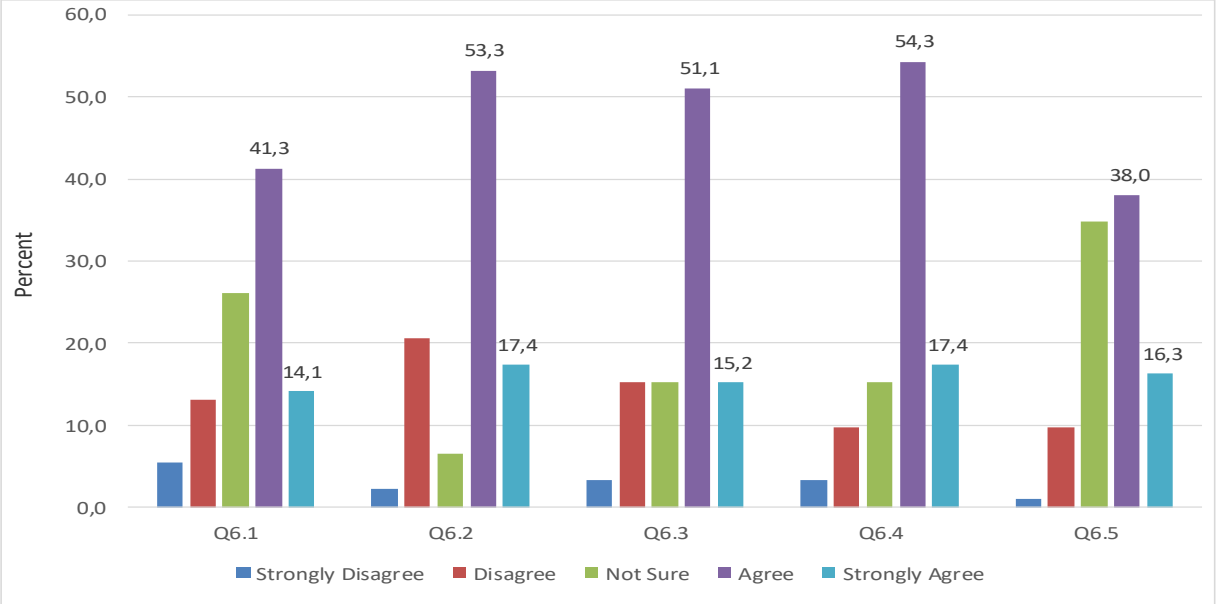


Figure 4.11: Responses to section on communication

The following patterns were observed within the data:

All of the statements show (significantly) higher levels of agreement whilst other levels of agreement are lower (but still greater than levels of disagreement)

The significance of these differences is illustrated within table 4.6. Factor analysis shows that the following three statements form a sub-theme:

i. Employees acknowledge the communication that takes place on a monthly basis, which is conducted by the General Manager of PISA. This communication is in the form of a meeting in the assembly area;
ii. Internal communication takes places by the quality department, whereby the information of customer returns and quality problems being experienced at the end user are transferred to all departments during the daily gemba; and
iii. It is noted that quality performance and quality projects being worked on is communicated internally. Quality performance and projects being worked on is displayed within the departments, on the gemba boards.
iv. This section shows all employees and management is aligned in terms of communication

There are high levels of agreement relation to this sub-theme “performance and communication”. Respondents have an understanding of what these are and what

they need to do so that these are achieved.

To determine whether the scoring patterns per statement were significantly different per option, a chi-square test was conducted to determine whether the scoring pattern for each statement was significantly different in comparison with other options in the same question. In terms of the null hypothesis, nearly the same number of respondents scored across each option for each statement. On the contrary, the alternate hypothesis states that there is significant differences between the levels of strongly disagree and strongly agree. The aforementioned results are illustrated in table 4.11. The highlighted significant values (p-values) are less than 0.05, which implies that the distributions were different, i.e., the differences in the manner in which respondents scored (strongly disagree, disagree, not sure, agree and strongly agree) were significant.

4.6.6 Section 7: Continuous Improvement

This section deals with continuous improvement within PISA.

Table 4.12 depicts the results on continuous improvement.

Table 4.12: Responses to section on continuous improvement

		Strongly Disagree		Disagree		Not Sure		Agree		Strongly Agree		Chi Square
Statement	Section	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	p-value
There is a quality improvement team of employees that drive quality improvement	Q7.1	2	2.2%	7	7.6%	12	13.0%	59	64.1%	12	13.0%	0.000
Quality improvement tools and techniques are widely used.	Q7.2	3	3.3%	20	21.7%	17	18.5%	37	40.2%	15	16.3%	0.000
PISA practices continuous improvement of all its products, services, and processes	Q7.3	0	0.0%	6	6.5%	15	16.3%	54	58.7%	17	18.5%	0.000
Continuous improvement initiatives are visually displayed	Q7.4	0	0.0%	12	13.0%	10	10.9%	57	62.0%	13	14.1%	0.000
All departments participate in quality improvement initiatives	Q7.5	1	1.1%	17	18.5%	10	10.9%	47	51.1%	17	18.5%	0.000

Figure 4.12 below graphs the results on continuous improvement

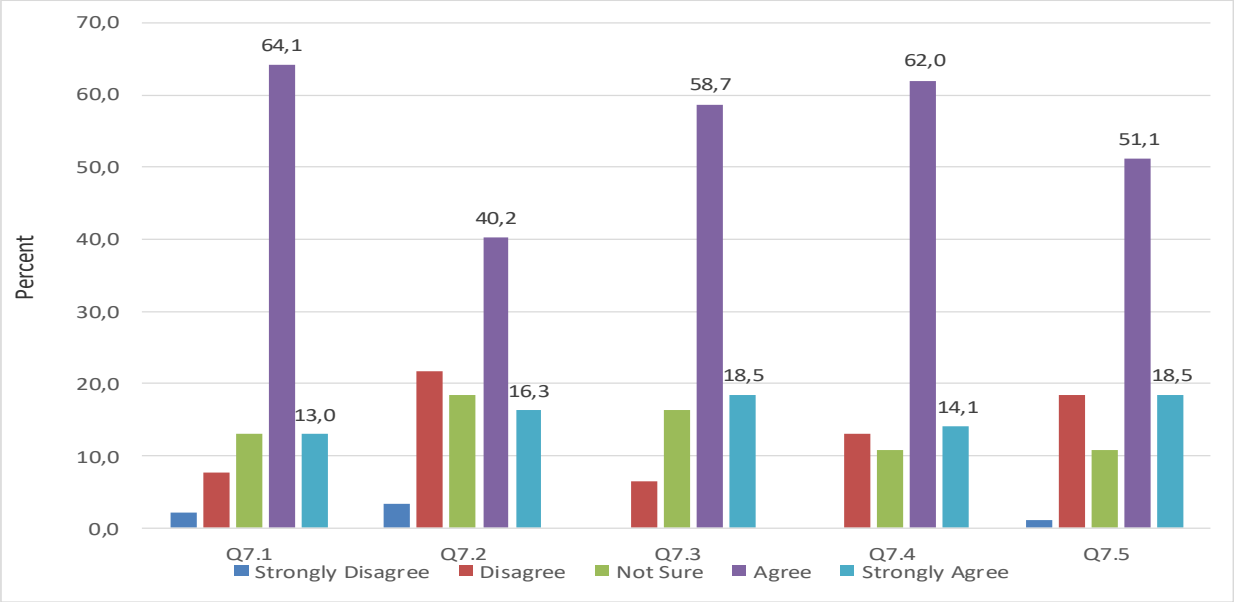


Figure 4.12: Responses to section on continuous improvement

The following patterns were observed within the data:

All of the statements demonstrate (significantly) higher levels of agreement whereas other levels of agreement are lower (but still superior than levels of disagreement)

The consequence of these differences is illustrated in table 4.12. Factor analysis displays that the following three statements form a sub-theme:

i. There is a quality improvement team of employees that drive quality improvement. This initiative is driven by the quality department, which involves the middle management, sewing machine mechanics, quality inspectors and top management;
ii. Quality improvement tools and techniques are widely used. This indicator would have come from a majority of top management and quality inspectors, as they are more involved in finding solutions than sewing machinists or mechanics; and
iii. Continuous improvement initiatives are visually displayed throughout the organisation and displayed on the departmental Gemba boards. These initiatives are discussed on a daily basis, during the Gemba.
iv. Continuous improvement is an area that respondents have identified as important and an area that management focuses on.

There are high levels of agreement relation to this sub-theme “quality improvement”.

Respondents have an understanding of what these are and what they need to do so that these are achieved.

To determine whether the scoring patterns per statement were significantly different per option, a chi-square test was conducted to determine whether the scoring pattern for each statement was significantly different in comparison with other options in the same question. In terms of the null hypothesis, nearly the same number of respondents scored across each option for each statement. On the contrary, the alternate hypothesis states that there is a significant difference between the levels of strongly disagree and strongly agree. The aforementioned results are illustrated in table 4.12. The highlighted significant values (p-values) are less than 0.05, which imply that the distributions were different, i.e., the differences in the manner in which respondents scored (strongly disagree, disagree, not sure, agree and strongly agree) were significant.

4.6.7 Section 8: Teamwork and Resource Management

This section deals with teamwork and resource management within PISA.

Table 4.13 depicts the results on teamwork and resource management.

Table 4.13: Responses to section on teamwork and resource management

		Strongly Disagree		Disagree		Not Sure		Agree		Strongly Agree		Chi Square
Statement	Section	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	p-value
PISA encourages teamwork	Q8.1	2	2.2%	4	4.3%	8	8.7%	41	44.6%	37	40.2%	0.000
Brainstorming sessions take place to get employees' ideas on quality improvement	Q8.2	4	4.3%	17	18.5%	11	12.0%	44	47.8%	16	17.4%	0.000
Sufficient financial resources are provided to support improvement activities	Q8.3	4	4.3%	24	26.1%	22	23.9%	33	35.9%	9	9.8%	0.000
Employee participation in teamwork initiatives are rewarded by management	Q8.4	5	5.4%	20	21.7%	20	21.7%	35	38.0%	12	13.0%	0.000
PISAs management is satisfied with the spirit of team work	Q8.5	4	4.3%	12	13.0%	25	27.2%	37	40.2%	14	15.2%	0.000

Figure 4.13 below graphs the results on teamwork and resource management.

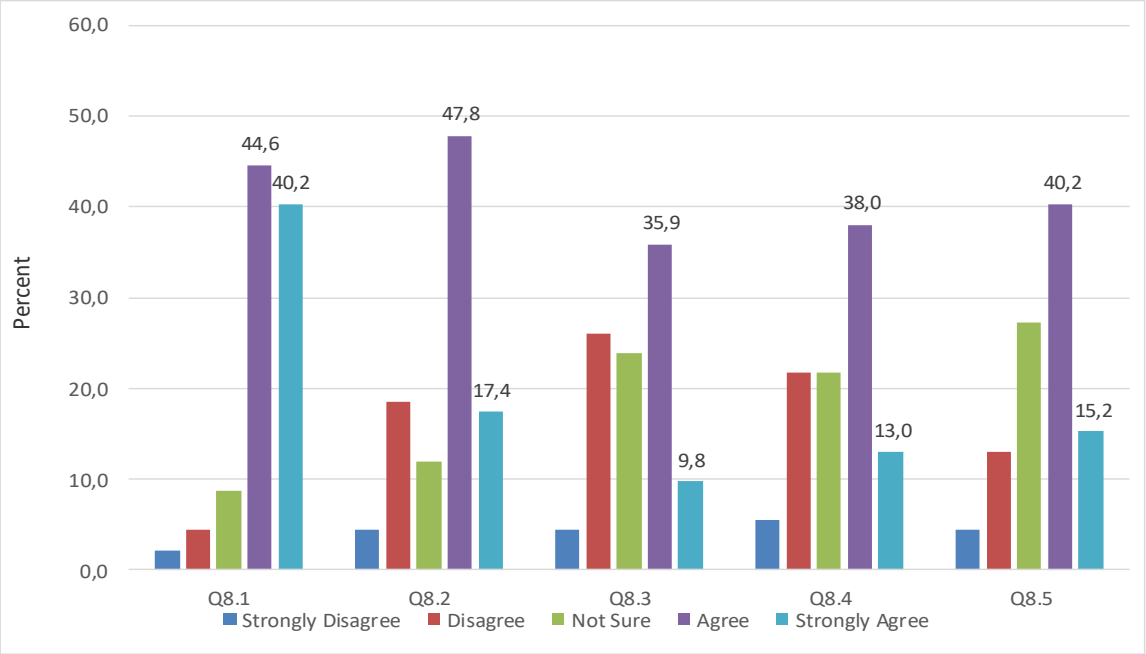


Figure 4.13: Responses to section on teamwork and resource management

The following patterns were observed within the data:

All of the statements demonstrate (significantly) higher levels of agreement whereas other levels of agreement are lower (but still superior than levels of disagreement)

The consequence of these differences is illustrated in table 4.13. Factor analysis displays that the following three statements form a sub-theme:

i. Brainstorming sessions take place to get employees' ideas on quality improvement. This takes place during a production meeting at the start of the work day, in all departments;
ii. Employee participation in teamwork initiatives is rewarded by management. In terms of teamwork initiatives, and safety initiatives, as employees put suggestions forward. Quality initiatives are not easily identified; and
iii. PISA's management is satisfied with the spirit of team work.

There are high levels of agreement in relation to the sub-theme "employee participation and teamwork". Respondents have an understanding of what these are and what they need to do so that these are achieved.

To determine whether the scoring patterns per statement were significantly different per option, a chi-square test was conducted to determine whether the scoring pattern

for each statement was significantly different in comparison with other options in the same question. In terms of the null hypothesis, nearly the same number of respondents scored across each option for each statement. On the contrary, the alternate hypothesis states that there is a significant difference between the levels of strongly disagree and strongly agree. The aforementioned results are illustrated in Table 4.13. The highlighted significant values (p-values) are less than 0.05, which imply that the distributions were different, i.e., the differences in the manner in which respondents scored (strongly disagree, disagree, not sure, agree and strongly agree) were significant.

4.6.8 Section 9: Employee Participation

This section deals with employee participation within PISA.

Table 4.14 depicts the results on employee participation.

Table 4.14: Responses to section on employee participation

		Strongly Disagree		Disagree		Not Sure		Agree		Strongly Agree		Chi Square
Statement	Section	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	p-value
Employees' thoughts have been taken into consideration to make quality decisions	Q9.1	11	12.0%	18	19.6%	18	19.6%	35	38.0%	10	10.9%	0.000
Employee awareness and feedback on status are recognised	Q9.2	3	3.3%	20	21.7%	26	28.3%	33	35.9%	10	10.9%	0.000
Employee involvement in quality initiatives demotivate employees	Q9.3	2	2.2%	33	35.9%	34	37.0%	20	21.7%	3	3.3%	0.000
Employee participation in industry's success reduces the turnover and therefore reduces the cost of hiring and training new employees	Q9.4	5	5.4%	16	17.4%	31	33.7%	35	38.0%	5	5.4%	0.000
Employee satisfaction can lead to customer satisfaction	Q9.5	0	0.0%	3	3.3%	9	9.8%	53	57.6%	27	29.3%	0.000

Figure 4.14 below graphs the results on employee participation.

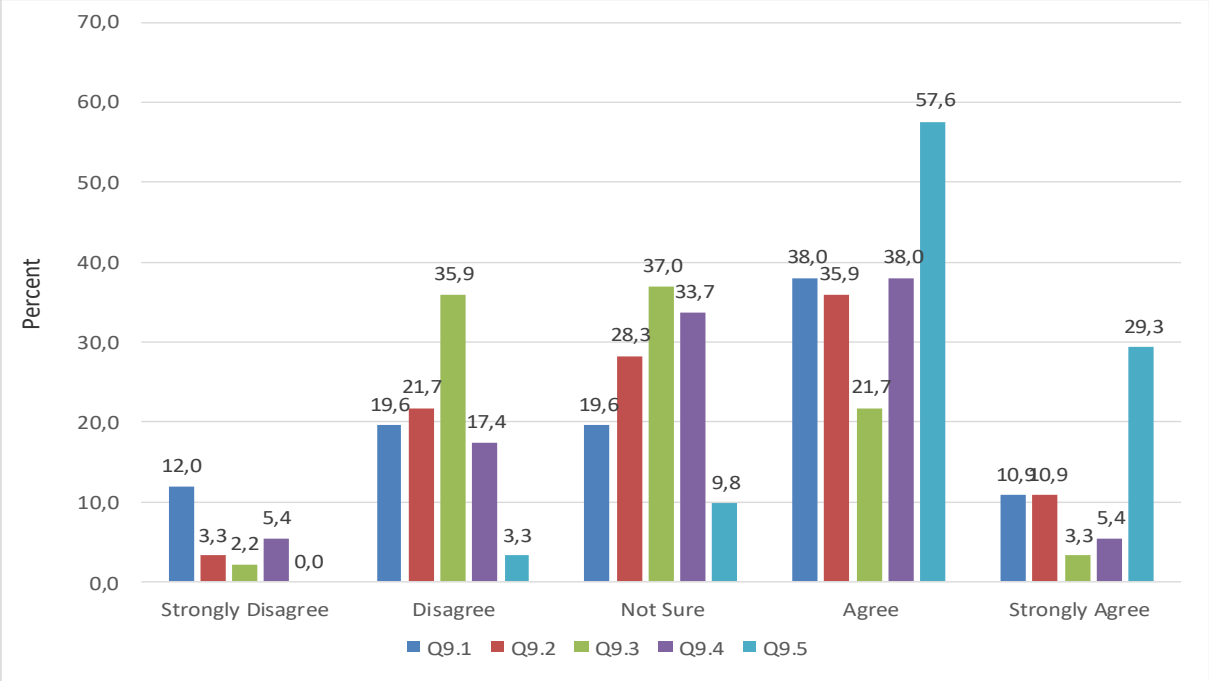


Figure 4.14: Responses to section on employee participation

The following patterns were observed within the data:

All of the statements show variation in terms of the levels of agreement, levels of being unsure and levels of disagreement.

The significance of these differences is illustrated in table 4.14.

i. Employee feedback and status are recognised;

ii. Respondents have noted employee involvement in industry's success decreases the turnover and, therefore, reduces the cost of hiring and training new employees; and

iii. Respondents have noted that employee satisfaction will lead to customer satisfaction.

To determine whether the scoring patterns per statement were significantly different per option, a chi-square test was conducted to determine whether the scoring pattern for each statement was significantly different in comparison with other options in the same question. In terms of the null hypothesis, nearly the same number of respondents scored across each option for each statement.

On the contrary, the alternate hypothesis states that there is significant differences between the levels of strongly disagree and strongly agree. The aforementioned results are illustrated in Table 4.14. The highlighted significant values (p-values) are less than 0.05, which imply that the distributions were different, i.e., the differences in the manner in which respondents scored (strongly disagree, disagree, not sure, agree and strongly agree) were significant.

4.6.9 Section 10: Work Environment and Culture

This section deals with the work environment and culture within PISA.

Table 4.15 depicts the results on work environment and culture.

Table 4.15: Responses to section on work environment and culture

		Strongly Disagree		Disagree		Not Sure		Agree		Strongly Agree		Chi Square
Statement		Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	p-value
All employees are committed to participate in total quality management initiatives	Q10.1	8	8,7%	16	17,4%	18	19,6%	41	44,6%	9	9,8%	0,000
Top management promotes a culture of employee participation	Q10.2	5	5,4%	21	22,8%	21	22,8%	37	40,2%	8	8,7%	0,000
Employees show interest in eliminating customer returns	Q10.3	7	7,6%	14	15,2%	10	10,9%	46	50,0%	15	16,3%	0,000
Teamwork and involvement are normal practices in the company	Q10.4	4	4,3%	11	12,0%	12	13,0%	48	52,2%	17	18,5%	0,000
A pleasant environment exists in all working areas	Q10.5	5	5,4%	22	23,9%	13	14,1%	32	34,8%	20	21,7%	0,000

Figure 4.15 below graphs the results on work environment and culture.

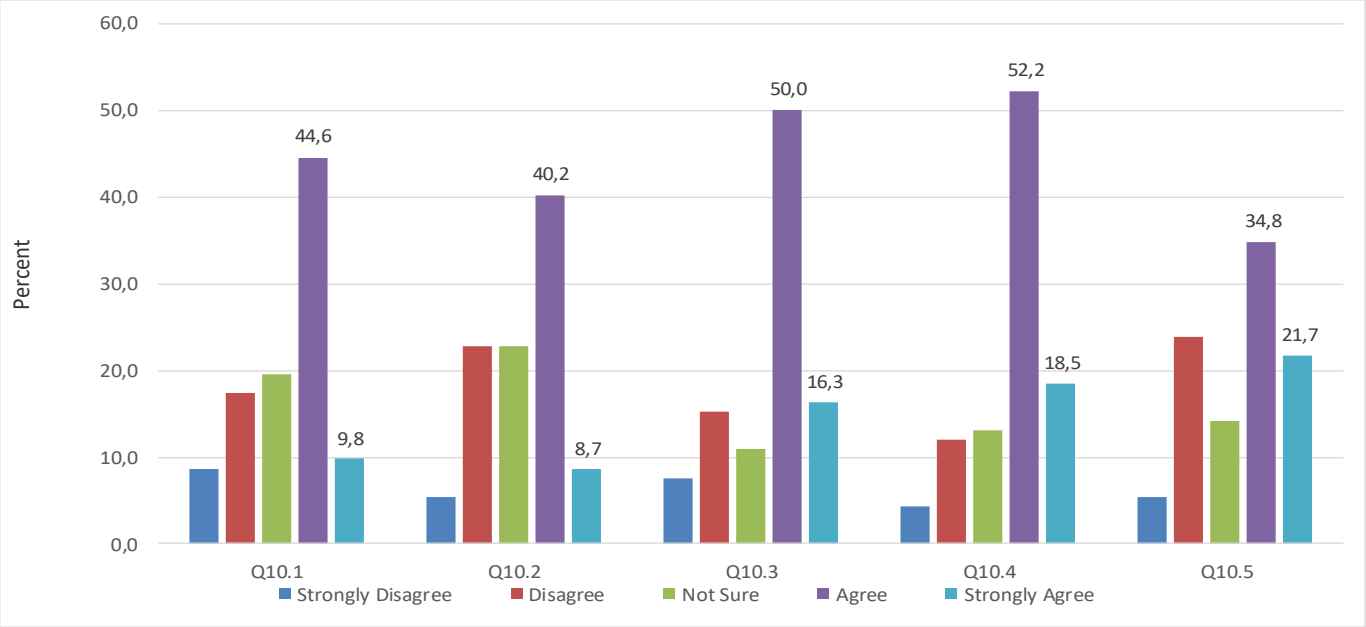


Figure 4.15: Responses to section on work environment and culture

The following patterns were observed within the data:

All of the statements demonstrate (significantly) higher levels of agreement whereas other levels of agreement are lower (but still superior than levels of disagreement)

The consequence of these differences is illustrated in table 4.15. Factor analysis displays that the following three statements form a sub-theme:

i. Employee commitment in terms of TQM shows that employees want to provide a quality product to the customer;
ii. Top management promotes employee involvement in TQM initiatives; and
iii. Teamwork and participation are normal practices in the company.

There are high levels of agreement in relation to the sub-theme “employee commitment and teamwork”. Respondents have an understanding of what these are and what they need to do so that these are achieved.

To determine whether the scoring patterns per statement were significantly different per option, a chi-square test was conducted to determine whether the scoring pattern for each statement was significantly different in comparison with other options in the same question. In terms of the null hypothesis, nearly the same number of respondents scored across each option for each statement.

On the contrary, the alternate hypothesis states that there is a significant difference between the levels of strongly disagree and strongly agree. The aforementioned results are illustrated in Table 4.15. The highlighted significant values (p-values) are less than 0.05, which imply that the distributions were different, i.e., the differences in the manner in which respondents scored (strongly disagree, disagree, not sure, agree and strongly agree) were significant.

4.6.10 Section 11: Supplier Quality Management

This section deals with supplier quality management within PISA.

Table 4.16 depicts the results on supplier quality management.

Table 4.16: Responses to section on supplier quality management

		Strongly Disagree		Disagree		Not Sure		Agree		Strongly Agree		Chi Square
Statement	Section	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	p-value
Suppliers are selected on the basis of having a quality accreditation	Q11.1	2	2.2%	10	10.9%	25	27.2%	43	46.7%	12	13.0%	0.000
Suppliers are regularly audited by PISA's quality department	Q11.2	3	3.3%	20	21.7%	25	27.2%	32	34.8%	12	13.0%	0.000
Suppliers provide relevant quality records and data	Q11.3	0	0.0%	4	4.3%	26	28.3%	50	54.3%	12	13.0%	0.000
PISA works closely with suppliers toward long-term partnership and improvement	Q11.4	2	2.2%	7	7.6%	21	22.8%	48	52.2%	14	15.2%	0.000
Quality issues with raw materials are identified, necessary action plans agreed and progress monitored by both parties	Q11.5	1	1.1%	12	13.0%	15	16.3%	45	48.9%	19	20.7%	0.000

Figure 4.16 below graphs the results on supplier quality management.

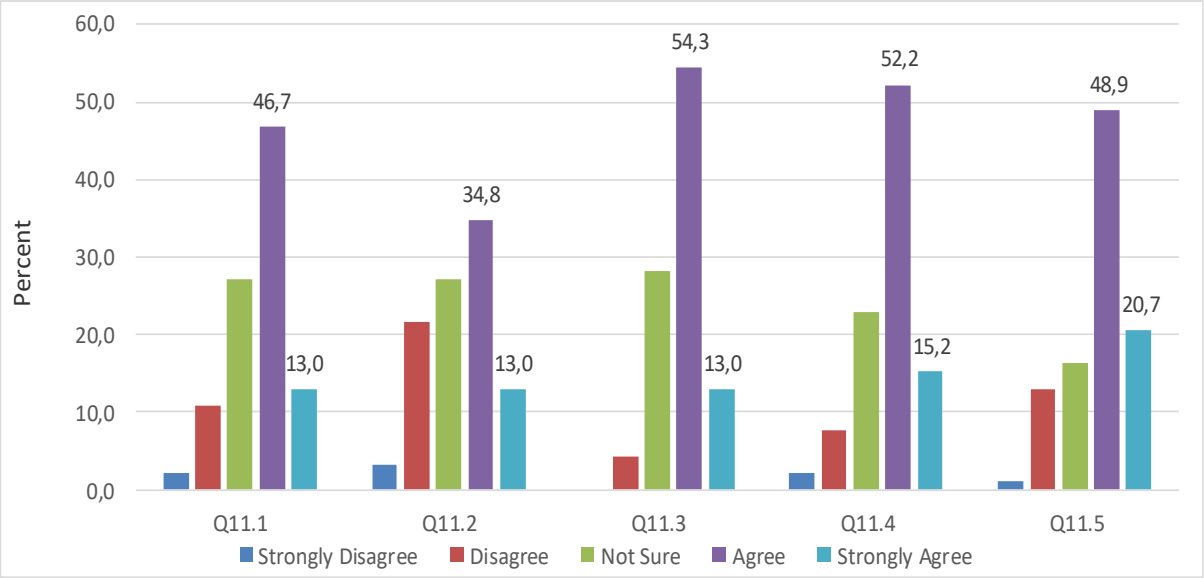


Figure 4.16: Responses to section on supplier quality management

The following patterns were observed within the data:

All of the statements demonstrate (significantly) higher levels of agreement whereas other levels of agreement are lower (but still superior than levels of disagreement)

The consequence of these differences is illustrated in table 4.16. Factor analysis displays that the following three statements form a sub-theme:

i. Suppliers are selected on the basis of having a quality accreditation;
ii. Suppliers are regularly audited by PISA's quality department; and
iii. Suppliers provide relevant quality records and data.

To determine whether the scoring patterns per statement were significantly different per option, a chi-square test was conducted to determine whether the scoring pattern for each statement was significantly different in comparison with other options in the same question. In terms of the null hypothesis, nearly the same number of respondents scored across each option for each statement. On the contrary, the alternate hypothesis states that there is a significant difference between the levels of strongly disagree and strongly agree. The aforementioned results are illustrated in Table 4.16. The highlighted significant values (p-values) are less than 0.05, which imply that the distributions were different, i.e., the difference in the manner in which respondents scored (strongly disagree, disagree, not sure, agree and strongly agree) were significant.

The matrix tables are preceded by a summarised table that reflects the results of KMO and Bartlett's Test. The requirement is that Kaiser-Meyer-Olkin Measure of Sampling Adequacy should be greater than 0.50 and Bartlett's Test of Sphericity less than 0.05. In all instances, the conditions are satisfied which allow for the factor analysis procedure.

Factor analysis is done only for the Likert scale items. Certain components divided into finer components. This is explained below in the rotated component matrix.

4.7 KMO and Bartlett's Test

Table 4.17 KMO and Bartlett's test analysis

		Kaiser-Meyer-Olkin Measure of Sampling Adequacy	Bartlett's Test of Sphericity		
Question	Section		Approx. Chi-Square	df	Sig.
2	General organisation	0.793	311.653	36	0.000
3	Leadership	0.830	182.550	10	0.000
4	Training	0.823	225.435	10	0.000
5	Customer satisfaction	0.447	58.334	10	0.000
6	Communication	0.722	109.280	10	0.000
7	Continuous improvement	0.721	154.366	10	0.000
8	Teamwork and resource management	0.754	122.865	10	0.000
9	Employee participation	0.578	111.513	10	0.000
10	Work environment and culture	0.773	121.586	10	0.000
11	Supplier quality management	0.828	228.673	10	0.000

All of the conditions are satisfied for factor analysis.

that is, the Kaiser-Meyer-Olkin Measure of Sampling Adequacy value should be greater than 0.500 and the Bartlett's Test of Sphericity sig. value should be less than 0.05.

4.8 Rotated Component Matrix

Factor analysis is a statistical technique whose main goal is data reduction. A typical use of factor analysis is in survey research, where a researcher wishes to represent a number of questions with a small number of hypothetical factors. As per Table 4.17:

- The principle component analysis was used as the extraction method, and the rotation method was Varimax with Kaiser Normalization. This is an orthogonal rotation method minimizes the number of variables that have high loadings on each factor. It simplifies the interpretation of the factors;

- Factor analysis/loading show inter-correlations between variables; and
- Items of questions that loaded similarly imply measurement along a similar factor. An examination of the content of items loading at or above 0.5 (and using the higher or highest loading in instances where items cross-loaded at greater than this value) effectively measured along the various components.

The statements that constituted Sections 3, 4, 7, 8, 10 and 11 loaded perfectly along a single component. These findings imply that the statements that constituted these sections perfectly measured what they set out to measure.

It is noted that the remaining sections loaded along 2 or 3 components (sub-themes). This means that respondents identified different trends within the section. Within the section, the splits are colour coded.

4.9 Reliability Statistics

The two most important aspects of precision are **reliability** and **validity**. Reliability is computed by taking several measurements on the same subjects. A reliability coefficient of 0.60 or higher is considered as “acceptable” for a newly developed construct (Nunnally: 1978).

Table 4.18 below reflects the Cronbach’s alpha score for all the items that constituted the questionnaire.

Table 4.18 Cronbach’s alpha score

Question	Section	Number of Items	Cronbach's Alpha
2	General organisation	10	0.690
3	Leadership	5	0.846
4	Training	5	0.861
5	Customer satisfaction	5	0.244
6	Communication	5	0.696
7	Continuous improvement	5	0.787
8	Teamwork and resource management	5	0.781
9	Employee participation	5	0.647
10	Work environment and culture	5	0.785
11	Supplier quality management	5	0.868

The reliability scores for all sections, except one, surpass the recommended Cronbach's alpha value of 0.600 for a newly developed construct. This indicates a degree of acceptable, consistent scoring for these sections of the research. The value for section 2 is lower than the standard. This degree of non - consistency was due to the interpretations amongst the various levels of the respondents.

4.10 Phase 2: Qualitative Data

Interviews were conducted with five of PISA's top management. The management that were included in the interview was the General Manager, Quality Products Manager, Lean Manager, Finance Manager and the Purchasing Manager. As part of the inclusion criteria, all interviewees were employed on a permanent basis and based in the Durban manufacturing facility. Interviews done with the General Manager were approximately 60 minutes long and interviews with the other managers were approximately 30 minutes to an hour long. Prior to the interview, participants were given the opportunity to view the interview schedule (Appendix 5) in order to gain familiarity with the questions in advance. This proved to be useful during the interview as participants had the opportunity to reflect on potential answers prior to the interview.

Through the use of qualitative data analysis procedures, the main themes were generated from the data after each interview was transcribed. Each of the questions used on the interview schedule was used to identify the individual managers' insight into the organisation's quality performance, both internally and externally, and how quality performance was contributing as a whole to the overall performance of the business

Interview questions and discussions follow below:

4.10.1 Interview feedback provided by the General Manager of PISA

Your view on quality performance internally and externally?

The quality performance internally is always under strain and at times very costly in terms of loses to the business. This is due to the skills for the manufacturing of parachutes is not readily available, training takes times and comes at a cost of paying wages and rejecting very expensive material. Also, the geographical location of PISA limits people to this isolated industrial area. The quality aspect over years has always been the responsibility of the quality department and this has been difficult to change in terms of everyone taking responsibility for quality. Quality performance externally is not consistent in terms of supplying a quality product all the time. Over the years products have been returned due to major non-conformances (product dimension is smaller than required, product is damaged, raw material defects) being detected. The problem is once the product is returned it has to be remade at PISA's cost, together with having to pay for transportation, which a majority of the time is based abroad.

The handling of customer complaints due to quality issues?

Customer complaints and claims (customer returns) is controlled and managed by the quality department. The product is returned and assessed by the quality management for reason of return. The quality department will open an in-depth investigation why the product was sent wrong to the customer. The quality products manager will look at all the supporting documents to produce the product and identify which process was not followed correctly, together with looking at the skills of the relevant people that produced the product and overall traceability. An assessment is made to either repair or remake the product. If a product is classified as repair or remake this is at the cost of PISA. A majority of the time the product has to be remade, due to a parachute and related equipment not being able to be repaired. Besides the cost of repairing or remaking the product, transportation is also the responsibility of PISA. The reason the quality department handles product claims is due to the quality inspectors being the last people to have handled the product. With dispatching a finished product to a customer, a certificate of conformance (coc) is created by the quality products managers, acknowledging that all processes were followed to produce the product.

Objectives set for the quality department?

The quality objective set for the quality department for the year 2017 – 2020 is that non-conformance rate must not exceed 1000 parts per million (ppm). This is a Zodiac wide requirement for all businesses to achieve. This is monitored on a monthly basis. Whenever the ppm level is above the requirement an action plan has to be put into place, on how to reduce the ppm level to the requirement. Zodiac is very stringent with achieving the required quality levels. The number one objective for the Zodiac Group is achieving zero safety incidences (for their employees) in the entire 100 organisations globally and the second objective is achieving customer satisfaction with zero non-conforming products being sent to customers. Besides Zodiac setting objectives to be achieved, objectives also set a target for the management and employees of PISA to achieve. It seems that beyond the year 2020, Zodiac would set a ppm level that would be lower than a 1000 ppm. This would be difficult to achieve, if the current target of 1000 ppm is not achievable.

Are you seeing signs of improvement by the staff and their involvement to improve quality?

Signs of improvement by PISAs employees are not clear or visible as the number of claims being received from customers are really quite high. The quality objectives set by Zodiac is 1000ppm per month. On average for a 12 month cycle the ppm level being achieved is at 10 000. Improvements are going to take time due to having a work force that is not totally literate. Due to manufacturing a safety critical product that is required seasonally PISA has a small management structure that cannot cope with the current workload and to also drive improvements. The mind-set of people within the production environment is that the quality inspectors are responsible for quality. They do not promote the term "auto – inspection". Auto inspection means that once you have finish done your sewing process, check if the product conforms to the requirement, if it does conform pass it on to the next process, if it does not conform to the requirement repair and re-check. The directors of the company do not want to hire more quality inspectors, as they want sewing machinist to be responsible for their own quality. Sewing machinists are considered as value adding employees, because they add value to a product and quality inspectors are considered as non-value adding employees, as they are checking what a sewing machinist is meant to be doing right the first time.

Due to customers receiving products that are not up to standard, how do we explain to customers the steps we are taking to improve our quality?

A corrective action process deployed by Zodiac called Quick Response Quality Control (QRQC) is under a trial and error process. This is whereby when a repetitive non-conformity is detected a group of employees from the various departments come together to analysis why this non-conformance came about and also to create actions on how to overcome repeating the same mistake. This is a very time-consuming process and employee have not been well trained on the initiative. The quality department personnel have been handed booklets on how to implement the corrective action initiative, but there is no indicator if this is the right method of doing it. Once the QRQC methodology has been complete a formal document is filled in and sent to the customer. This action is not monitored internally to see that the action has been effective. That is due to people not being disciplined in terms of following up on the actions put in place, which entails that the non-conformity could be repeated. Customers have also responded to the actions put in place in terms of non-conformity being found and have advised that the actions are not strong enough to eliminate repeating the mistake. This has led to the loss of customers. To gain the confidence from customers after detecting quality problems is very difficult, as they lose trust and confidence in PISA as a supplier of parachutes and related equipment.

Should a system be in place to better handle customer complaints or more emphasis/system should be in place to eliminate quality issues internally?

The existing quality claims is managed by the quality department, as the quality department is the last internal department to have any contact with the final product. The target would be to eliminate claims, instead of investing in an expensive customer complaints system. The way to go about eliminating claims being received is to put more emphasis on the sewing machinist being quality conscience, not to be target driven but quality driven. Also, all customer feedback should be shared with all the relevant employees and departments this would create an awareness not to repeat the mistake.

Is the quality department responsible for producing quality or should this be directed towards all departments?

Currently the quality department handles all customer complaints, because the quality department is the last department to have contact with the product. It has been a culture at PISA for many years that the quality department is responsible for quality. It has been difficult to change the mind-set of people as there are a lot of employees that have many years of service at PISA and getting them to change is a challenge. The responsibility of quality should be directed to all departments within the organisation. The new employees are more quality focused than long servicing employees, there needs to be a culture change in terms of being quality driven and not target driven. For quality to be seen as the main driver in terms of achieving customer satisfaction, the middle and top management need to drive this initiative. People need to be taught in terms of why quality is priority especially producing a product like parachutes and related equipment. Substandard quality of products being sent to customers would have an overall effect on the whole of PISA and not just the quality department. Departmental managers need to explain this to the subordinates' that if the required quality is not achieved and losses are made to the business then there would be no bonuses paid due to poor performance.

Is the costs that are being incurred due to poor quality internally and externally, having an effect on the profits of PISA?

Yes, it is having an impact on the profits of PISA. When a customer complaint is received, the product is also returned. Even if the product is remade or repaired this incurs labour and material costs. Due to the majority of PISA's customers being based abroad the returned products have to be transported back to PISA at PISA's cost. The exchange rate also plays a part in terms of purchasing material to repair or remake the product. A majority of the suppliers of raw material to PISA is based abroad, which means the exchange rate plays a major part in terms of the price that is paid for the material. This cost is not recovered as this has to be done at the cost of PISA. The directors based in France, set finance targets that need to be achieved within the financial year and due to unplanned customer returns, this affects the overall financial performance. If quality issues have an adverse effect on the financial targets for the year, then the directors recover the money from performance bonuses that were meant to be paid to the employees. Customer complaints could have a major effect on the profit margin if the customer decides to cancel a contract due to the poor quality of products being received. A profit margin or even the business could be at risk if a

skydiver has to die or have a critical injury with using a PISA product that malfunctions. This could lead to a liability law suit, which could lead to exorbitant costs.

What training is to take place for individuals on quality tools/ techniques?

The Zodiac Group has a dedicated quality and lean support departments that is dedicated to the implementation and maintenance of quality and lean principles within the entity. Zodiac deploys specialists in these fields to assist organisations that are not performing in these areas. The problem is that Zodiac priorities which organisations these specialised need to be involved in. PISA is the smallest of the 100+ companies globally. Personnel with the relevant skills internally need to be sent for training external on problem solving. Thereafter create mini workshops to teach staff internally on how to problem solve. It is also difficult to train personnel on improvements techniques due to having staff that is illiterate. The problem also comes about when people are trained in terms of quality tools and techniques and thereafter leave for better prospects. This leaves a gap whereby new personnel come in with new techniques and ideas and offset the ideas and methods that have already been implemented. Another situation that arises is when directors want production targets to be achieved, and do not want to stop production to train and develop problem solving skills, that are required to find solutions for non-conformances being detected both internally and externally. The training that is being looked at is simple tools that can be used for employees at all levels. This has not been confirmed as we still await feedback from Zodiac's quality and lean support departments.

Are quality objectives set for the quality department realistic or should more emphasis be placed on acquiring skills to achieve the objectives?

The quality objectives set on the quality department is not realistic. Due to PISA belonging to a group like Zodiac the quality objectives are set globally for all organisations to achieve the same targets. PISA experiences a lot of issues in terms designs not being consistent between the manufacturing and inspection file, which is the responsibility of the design entity based in Joue Les Tours, France.

Also, the quality of raw material received from suppliers in at times substandard and cannot be used to produce products. The quality acceptance criteria between the customer and PISA are not aligned, as PISA would accept some deviation from the

requirement and this would have no effect on the product, which is classified as a minor defect. Skills need to be obtained to achieve the required objectives. An aging work force cannot maintain the requirements that are set out by the directors and also new ideas and methods need to be introduced to fulfil customer expectations.

4.10.2 Interview feedback provided by the Quality Products Manager of PISA

In your opinion are your customers happy with the quality of products that is delivered from PISA?

Customers view on the quality is that PISA is not consistent in terms of maintaining the quality of products supplied. Products that manufactured from the product range at times defers from the specification. There are times whereby customers found major defects on products and these were returned. The problem comes in as customers lose confidence and trust in the products that PISA manufacturers. Customers have return products and also cancelled long term contracts due to not supplying a quality product. Reports are also received on a weekly basis from customers and thus far, PISA's quality performance has not been 100% first time right. Non-conformances are found every week. This is very concerning for the future of PISA to maintain customer satisfaction and also to maintain the business if we continue to produce products that are not to the customers' expectations.

Measuring of internal non-conformances

The Zodiac Group has a central data based that can be used by all of Zodiac companies globally, on this is database is a graphical measurement tool, called a 4 box. The 4 box is a graphical representation of how a production line is performing in terms of quality. This report details recurrent defects and trends of non-conforming areas. The 4 box depicts a clear and concise detail in terms of departmental performance. The 4 box also requires actions to be put in place to eliminate repeating the non-conformance. The area of concern is that the supervisors are not quality driven, but production and target driven. It is a culture that is difficult to change, with production supervisors. And it seems that with the production supervisors not being quality driven, the sewing machinists have adopted the same attitude. The feeling is that the quality department is fully responsible for achieving quality.

How do you measure your non-conformance rate to customers?

The Zodiac Group has key performance indicators (objectives) that need to be measured on a monthly and yearly basis called Zodiac Non-Conformance Rate (ZNCR).

This measure is an indicator to the Directors on quality performance at PISA. The data is calculated using the unit of measure called parts per million (ppm). The actual data is calculated by:

$$\frac{\text{Number of non-conforming products}}{\text{Number of units delivered}} \times 1\,000\,000 = \text{ppm}$$

The target for Zodiac for the next three years is not to exceed a 1000ppm per month. PISA has not been able to reach that target. The closest PISA has been to achieving the target is 5000ppm which is extremely high considering that parachutes and related equipment is considered a safety critical product. When the ppm levels are high an action plan is required to show what is causing the ppm levels to be high and how to eliminate the areas of concern. This is a time-consuming process and requires the assistance from support departments. Support departments are not helpful in terms of finding solutions to quality problems being experienced both internally and externally. This is a major contributor to why repetitive non-conformities are being experienced.

How do you communicate improvements to your customers?

Whenever a customer complaint is received a Quick Response Quality Control (QRQC) process takes place. This is whereby all the relevant departments of the organisation gather at one central point to discuss the quality issue that has been experienced at the customer. An action plan is drawn up and actions decided with responsibilities and due dates. This is then reported back to the customer. At times the customer responds that the actions are not strong enough to not repeat the same mistake. Also, action plans have been submitted to customers showing the actions put in place to eliminate the non-conformance and after a few months the non-conformance is recurrent, and this is questioned by customers.

By producing quality that is below customer expectations, do you think customers would move their business to other suppliers?

Yes. A parachute is a safety critical item. A parachute is a piece of equipment that is used to safely bring a person down to the ground. If quality issues are experienced that jeopardizes a skydiver's life, customers would not want to take that risk of purchasing products from PISA. PISA supplies militaries globally with parachutes and related equipment, by supplying a product that is substandard could lead to news

being sent to militaries about the quality performance of PISA, which could lead to not receiving any military contracts. This could also lead to tarnishing the Zodiac brand. PISA's competitors could also use the quality performance as a tactic to defer potentially customers from purchasing anymore products from PISA. Parachutes and related equipment failure could be catastrophic to a skydiver, which could lead to death or potentially disability. PISA could have a liability lawsuit being laid, which could lead to the demise of the business.

What quality tools are currently being used by your department?

Zodiac has tools that need to be applied by all entities when it comes to solving quality issues. These tools are stored on a central database, accessible by all Zodiac entities globally.

Some of the tools are:

- *Failure mode and effect analysis (FMEA);*
- *Safety, Quality, Cost, Delivery, People (SQCDP);*
- *Plan, Do, Check, Act (PDCA);*
- *Value stream mapping;*
- *Fishbone diagram; and*
- *Quick Response Quality Control (QRQC).*

The concern comes in is that the skills and knowledge to apply these tools at PISA are very rare. Not many employees know how to apply these tools effectively. The employees that used to previously use these tools to solve quality problems have left PISA for better prospects externally. Even when the tools are applied, there is no indicator that shows it is being applied correctly and effectively. The drawback to effectively applying the tools is that people within the production area are illiterate and cannot understand what is being asked. That is one of the reasons why people reluctantly shy away from driving problem solving initiatives. PISA's Human Resources department has taken the initiative to send people that are illiterate on a training cause called Audit Based Education (ABET), but people are reluctant to attend, as they feel this is not value adding to their lives.

What corrective action system do you have in place to handle customer claims/complaints?

Quick response quality control (QRQC) is a recently launched problem solving tool that is being tried by PISA. This is when a quality issue is picked up internally or externally a QRQC is launched. There is a set standard that needs to be applied with various questions being asked, together with allocating people responsibility and due dates for actions to be complete. The QRQC requires the input of all support departments to attend the meeting to provide insight and feedback. The QRQC is similar to a brainstorming session, with more structure in place. The disadvantages to the QRQC are that it is a very time-consuming process, requires the skills, knowledge, and support of all departments. Also no one in PISA has been formally trained on how to apply the method. Due to PISA being the smallest and only Zodiac entity in South Africa not much emphasis has been put on scheduling the required training. Training is being provided in only two countries (France and United States of America) and the focus is on the more profitable companies within Zodiac to first go through the training.

4.10.3 Interview feedback provided by the Lean Manager of PISA

Can lean tools and quality tools be used to improve internal non-conformances and customer returns?

Zodiac provides all entities tools to use to improve internal non-conformances. These tools are accessible to all organisations via a central database.

Some of the tools are:

- *Autonomous teams;*
- *First time right;*
- *A3 / 8D;*
- *PDCA; and*
- *Value stream mapping.*

Is Visual management in place?

Visual management is in place showing customer complaints and action plans to overcome internal and external quality issues. The problem these plans are put in place just to say that it is done, not done to effectively eliminate the problem at hand. People at PISA are more production driven than quality driven. That culture needs to be eliminated and trying to achieve that trait is taking time. The people that are long serving to the company have this mental thought process and it seems to be rubbing of onto new employees. Visual management for safety is well displayed showing all the safety regulations and signs that need to be abided by. Employees seem to focus a lot more on the safety regulations than on the quality issues being experienced both internally and externally. I guess people seem improving quality as an effort that they don't want to put in.

What is your opinion on the quality performance of PISA (Both internally and externally)?

The performance of quality both internally and externally is extremely bad, knowing that we are manufacturing a safety critical product like a parachute and related equipment. During management meetings on a monthly basis quality is discussed in terms of performance and the feedback providing by the quality department is alarming.

The ppm levels are always high and above the requirement set by Zodiac. This is having a negative effect on the profit margins of PISA and Zodiac. I have seen customer returns coming into our receiving stores. There is a claims store that is filled with customer returns, by looking into this store it is an indicator of poor-quality performance externally. During the daily gemba the 4 box report is discussed by the department team leader and supervisor and the trend continues to rise on products non-conforming internally. The actions being put in place does not seem to be well thought out. The directors of Zodiac divide the labour workforce into direct and indirect. The direct workforce is employees who are sewing and inspecting the actual product. The indirect workforce is employees that are supporting to the production departments and having no physical contact with the product. The directors want to limit the number of indirect people being employed and would rather invest in direct labour. By doing this employing people with the skills to problem solve is restricted. The directors advise that people that are currently employed need to be trained in handling many tasks at the same (multi skilled). By having this type of pressure being applied to function at your current job and also find time to problem solve is really difficult for people to achieve.

Do you think that using more lean improvement tools/techniques would improve the quality performance?

Yes, using lean improvement tools and techniques would improve the quality performance. The tools have a structure that needs to be followed, that would show what lead to the root cause of the problem. Tools also have a structure whereby actions need to be put in place with responsibilities and actions are monitored for effectiveness. Lean improvement tools have been around for years and are used by businesses around the world to solve problems and improve overall performance. When it comes to problem solving it is not about the product being manufactured but how the lean improvement tools are being applied.

Are quality tools/techniques adequate for improvement or should the training be improved on how to better understand the tools?

The applying of tools would seem simple if only people knew how to apply it. The tools are readily available the training on how to effectively apply the tools need investment from top management.

If you take a problem-solving tool and give it to employees to implement without the adequate training, people would shy away as they would be afraid of what could go wrong instead of what could go right. Training to use the tools is important for people but also the value of applying the tool also needs to be understood. Examples need to be done with shop floor employees and management to show that the tools can be effective and can add value to PISA if implemented and monitored effectively.

Are customer complaints visually displayed in various departments of PISA? Or only displayed in the department that sent the non-conformance?

The customer complaint is only displayed in the department that the non-conformance has been detected in. Which means other departments would not know the non-conformances being received in other production departments. This needs to improve, in terms of communication, ideas can be shared. Example if one department received non-conformances based on having stitches problems and actions were implemented and were effective, this action could be transferred to other departments to eliminate the non-conformance being repeated.

In your opinion is visual management a good way to communicate?

It is a good way to communicate. Employees that are illiterate maybe not able to relate to problems with words and would need pictures to better explain the situation. So visually displaying problems is a good way to communicate and to get the message across of what is needed. The visual management also creates awareness for employees not to repeat their mistakes. Visual management also demonstrates to customers that the organisation is taking quality promises seriously and wants to resolve these areas, to provide a better product and service. Having a lot of foreign visitors coming to PISA and English not being their first language can use the visual management to best explain what message is trying to be portrayed.

Did you consider benchmarking PISA against other parachute manufacturers globally?

Due to parachute manufacturing being very limited both locally and internationally it is not easy to benchmark the competition. Also due to competition, other parachute manufacturing organisations may not be willing to disclose information that could jeopardise their position in the parachute market.

In terms of benchmarking it can be considered to do an intercompany benchmarking between the three Zodiac entities (South Africa, France and the United States of America). The value and feasibility of such an exercise needs to be discussed with the directors of the various divisions.

4.10.4 Interview feedback provided by the Finance Manager of PISA

The costs incurred due to quality issues?

Labour and material variances together with transportation costs are incurred due to quality issues. Due to majority of PISA's customers being based overseas, the exchange rate plays apart on the price. Also, a majority of raw material supplies is purchased from overseas which means the exchange rate also plays a part on the price. PISA purchases raw materials from international suppliers using two types of foreign currencies, namely the Euro and US Dollar. Budgets are set on a yearly basis by the directors of Zodiac, and quality non-conformances are not part of the budget. This means when quality non-conformances are found externally at the customer and this has to be returned to PISA and remade. The profits are used to transport the products back to the manufacturing facility and returned to customer (a majority of the time is air transportation) and also to reproduce these products. Also, material is purchased for confirmed orders to customers, by repairing or remaking a product this depletes the material stock. By depleting the stock, would mean delaying customer deliveries, which could lead to customers cancelling orders and long-term contracts.

The costs not recovered due to quality issues?

The costs not recovered due to quality issues is a loss to the business. This affects the projected financial target and also interrupts the budget set for labour and material. The costs that are not recovered due to quality issues is threefold. Fold one - material, is lost due to scrapping and reproducing. Fold two - labour has to be paid to remake the product and a majority of the time overtime would need to be paid if the customer requires the product urgently. Fold three - is transportation (a majority of the time is air transportation), the non-conforming product has to pick up from the customer, returned to PISA, remade or repaired and transported back to the customer.

Budget for training and improvement of quality processes?.

The training budget for financial year 2016 – 2017 is set at R150 000. That is really not a lot set aside for training as there is a workforce of over 200 people. Government grants are applied for annually and these grants are only for R50 000. The government is giving this grant, but it would not be enough to cover the cost of over 200 employees training. The budget for improvements is set at R200 000. The reason the budget is set so low, is due to sales that are not guaranteed, which means the

sales are forecasted. As confirmed sales increase, budgets also increase. The budget for improvements could also decrease, if the money needs to be spent on areas that are considered to be more important.

Is customer returns having an impact on PISA's profits?

Customer returns are having a major impact on PISA's profits for numerous reasons. Customer returns are not budgeted for. Customer returns affect the overall business, because it impacts on more material being used, labour and transportation.

Are customers returns budgeted for?

Customer returns are not budgeted for. The key performance indicator (objective) is to achieve customer satisfaction by providing a quality product. The directors of Zodiac do not see the value in budgeting for customer returns. They would rather budget for training, improvements to the organisation and other areas that could be considered as value adding.

How do you report the costs incurred both internally and externally?

There is a central database that all Zodiac companies globally work on. On this database there is a template that needs to be filled in that details the requirements in terms of quality reporting. Internally quality reporting requires the cost of material rejections and the cost of labour. External quality costs are reported in the form of budget costs versus actual costs. When the budget cost is low an explanation is required, and this area would detail the customer return and the cost incurred due to this return.

How do you explain the cost of customer returns to the Directors (which are based in France) PISA?

The directors visit PISA on a monthly basis to view the performance of the business. The meeting takes place between the General Manager, Finance Manager and the directors. Customer quality issues are discussed as this would have an impact on the profit margins. The customer quality issues are also discussed as it would have an impact on the Zodiac brand that could tarnish the name. Action plans have to be explained to the directorship on what potentially could have gone wrong and what is being done not to repeat the mistake. At times the directors would advise the Sales Manager to visit the customer experiencing the non-conformance to re-assure the

customer that the problem is being worked on. This also incurs unbudgeted costs due to flights, accommodation and car hire and this affects the profit margin. But it has to be done to maintain supplier and customer relationship. This is an area that the production staff does not see, and how supplying a poor-quality product affects the financials of the business and also increases the risk of losing a customer.

4.10.5 Interview feedback provided by the Purchasing Manager of PISA

Scheduling audits of suppliers?

No supplier audits take place as a majority of suppliers are based overseas. Auditing of suppliers is seen as a non-value adding process by the directors of the company and is seen as a non-recoverable expense. Suppliers are based in countries like Korea, India, United Kingdom, United States of America and France. The skills of supplier auditing are also not readily available at PISA and the directors do not want to invest in training personnel on how to conduct supplier audits.

What is the evaluation process for accepting suppliers?

i. *The initial supplier selection is based mainly on the ability to provide a product that meets the requirements for a particular purpose, taking into account the end use of the intended product.;*

ii. *The potential supplier's product is sampled by the Configuration Manager / Quality Manager / General Manager and used to manufacture test pieces or completed items for evaluation.;*

iii. *The introduction of product from a new supplier, especially where the strength or performance of materials in use is critical, is to be carefully monitored.;*

iv. *All suppliers will be assessed on a 1-4 rating scale, 1- Very Good, 2- Good, 3 - Average, 4- Poor in the following categories, Certificate of conformity; specification; price; delivery; credit terms and lead times.;*

v. *Therefore, the suppliers who score the lowest point accumulation are the most suitable.;*

vi. *The supplier with the next lowest score becomes the first alternate supplier.;*

vii. *There are traditional suppliers who are in some cases sole suppliers. For these suppliers, their performances are monitored by the Purchasing Dept. If their performance deteriorates this fact is brought to the attention of the Purchasing Manager and General Manager for action.;*

viii. *In the case where a supplier is a sole supplier and does not perform, an intensive goods in inspection system will be set up, Quality and Purchasing will endeavour to assist the supplier in solving the common problems.;*

ix. *Records of the suppliers' test results are maintained by the Goods-In Inspector / Lab Technician.;*

x. *A list of preferred suppliers is maintained by the Purchasing Manager.;*

xi. *When a new supplier has to be added to the list or a low performance supplier has to be removed from the list the Purchasing Manager will then update the list.; and*

xii. *Should a supplier consistently fail to maintain their rating then the Purchasing Manager will decide if the next alternative supplier is to be used. The poor performance supplier is removed from the approved supplier's list.*

Do you think this process is adequate or should more criteria be set, as a parachute is a safety critical product?

The criteria set by the designers of the parachute. The specification and acceptance criterion are created between the designers and suppliers after years of testing. There would be an evaluation phase that takes place which entails testing the strength of the material, together with doing actual flight tests to check if the material can withstand its intended use.

What is the policy for returning suppliers non-conforming raw material?

i. *Non–conforming material shall be rejected by the goods in inspector / lab technician via a quality rejection note. A copy of this note shall be attached to the rejected material.;*

ii. *The Goods in-inspector / lab technician shall ensure that the rejected items are placed in the quarantine area for return to the supplier.;*

iii. *Arrangements are made with the supplier for collection and replacement. A corrective action plan is required from the supplier to show evidence of how this conformity will not happen again.; and*

iv. The purchasing manager will update his classification list with the suppliers performance if need be.

Are suppliers evaluated on their quality and delivery performance?

Yes, suppliers are evaluated on specific criteria, which is on time delivery and quality. The on-time delivery and quality performance of suppliers is measured by Zodiac on a monthly basis. For delivery the criteria set by Zodiac is called SOTD, which means Supplier on Time Delivery and SNCR, which means Supplier Non-Conformance Rate. The target that is set for financial year 2016-2017 is 95% on time and 98% for supplier conformance (delivering a quality product first time right). If delivery or supplier quality falls below the requirement an action plan must be put in place by the supplier that shows actions to be taken to overcome issues. Suppliers also visit PISA when a major non-conformance (deferring from specification) is detected on the quality of raw material.

Are their actions in place to delist a supplier that does not perform?

i. Suppliers are only de-listed if there is an economically viable replacement for that supplier.

ii. We will replace a supplier by an alternate supplier who already has that type of business expertise.

iii. We must be able to show document proof of returns of defective product of at least 3 products on a financial year, using the following documents as evidence.

a) Reject Notes;

b) Corrective Action Reports (CAR); and

c) No correspondence from supplier.

iv. We must be able to show that the supplier is unwilling or incapable of rectifying the QC problem i.e.

a) Supplier on time; and

b) Price.

v. *All suitable alternate suppliers must be interviewed as an alternate supplier. He/she must be supplied with the same supplier information regarding:*

a) Product identification;

b) Delivery lead times; and

c) Ballpark times (approximate times).

Do you accompany the quality department during supplier audits?

No supplier audits takes place. The directors of the company don't see this process as value adding and also not done due to financial constraints. A majority of PISA's suppliers are based abroad. Suppliers are based in countries like Korea, India, United Kingdom, United States of America and France. The skills of supplier auditing is also not readily available at PISA and the directors do not want to invest in training personnel on how to conduct supplier audits.

4.11 Summary

The research found that significant results were achieved in the understanding and perceptions that employees have of TQM and TQM tools and techniques. It found that employees had a comprehensive understanding of what was required for a manufacturing organisation like PISA to be seen as compliant with TQM principles. However, the organisation itself was found to be non-compliant with TQM tools and techniques and there is a serious lack of TQM manufacturing principle integration with the functions and processes involved in the manufacturing organisation.

The interviews held with individual managers show the seriousness of quality due to the type of product being manufactured, together with its intended use. Management understands the financial impact that non-quality is bringing to the business, together with the possibility of losing customers due to quality issues being experienced. It also shows that the directors of the company need to put more emphasis on improving quality both internally and externally, and this would have a positive impact on externally quality. PISA does not budget for quality issues experienced externally as the directors don't feel that this is value adding for the business. Directors need to invest in supplier auditing as this could potentially be a problem waiting to happen, if suppliers are not monitored in terms of providing quality raw material.

The next chapter will review the results of both qualitative and quantitative data and use the relevant literature to support and discuss points of interest that pertain to the study as a whole. The chapter will also focus on: the recommendations for future research; limitations of the study; answering the research questions; recommendations; and conclusions of the chapter and study.

CHAPTER FIVE

STATEMENT OF FINDINGS AND DISCUSSION

"Quality is not an act, it is a habit" – Aristotle

5.1 Introduction

The preceding chapter examined the results obtained from the data collected from the study and analysed them using a number of quantitative methods. This chapter will review each question and the result according to the context of the research questions of the study and will examine these results in relation to the support provided by previous literature.

This study is guided by the following research questions:

i. What is the extent of quality concerns at PISA?

ii. To what extent are quality tools being used at PISA?

iii. What are PISA's management and employees' perceptions of TQM?

iv. What are the challenges in adopting TQM principles at PISA?

The research objectives of the study were as follows:

i. To quantify the extent of quality concerns at PISA;

ii. To explore, the degree to which quality tools are employed at PISA;

iii. To capture the perceptions of PISA's management and employees on TQM; and

iv. To explore the challenges in adopting TQM principles at PISA.

This chapter concludes with recommendations for future research, limitations of the study, recommendations and conclusion.

5.2 Phase 1: Quantitative Data

5.2.1 General Organisation

An organisation's top management should show evidence of its obligation to the development and execution of the quality management system and repeatedly improve its effectiveness by communicating to the business the significance of

meeting customer as well as statutory and regulatory requirements; creating the quality policy; make certain that quality objectives are recognized; conducting management reviews and to make sure the availability of resources (ISO, 9001: 4).

Respondents were asked if top management shows commitment to quality (Q2.1) and the majority of the respondents either agreed or strongly agreed that this was so. Top management's commitment to achieving a quality product augurs well with manufacturing a safety critical product like a parachute, for which the required quality standards for the manufacturing of parachutes and related equipment is paramount. The death of a skydiver due to the parachute failing in use could potentially lead to a liability lawsuit that could close PISA.

Respondents were asked if PISA's management encourages teamwork (Q2.2). The majority of respondents either agreed or strongly agreed that it was so. Teamwork is encouraged in the form of daily meetings and discussions of issues being experienced in manufacturing. However it should be noted that this takes place internally and should not be interpreted to mean the type of team building that takes place at external venues.

Respondents were asked if PISA has a quality policy manual (Q2.3). Having a quality policy manual is a requirement for the ISO 9001 quality management standard, this falls under the section documented requirements. The quality management system documentation shall include a quality manual (ISO, 9001: 2). This policy is placed on the numerous notice boards throughout the organisation. While this is the case, problems may arise if employees cannot understand the requirements.

Respondents were asked if PISA's management communicates PISA's objective to staff on a yearly basis (Q2.4) and most indicated that this was being done. The objectives of the organisation are set by the directors which are based in France. This is done before the start of the financial year. The objectives detail the targets to be achieved in terms of on time delivery to customers and non-conformance rate (products sent to customers with quality problems being experienced). Objectives that are set on a yearly basis by the directors are communicated to all employees. The degree to which objectives are being achieved are reported to the directors on a monthly basis but this is not communicated to the employees. Targets that are not achieved must have an action plan on how to overcome problems being experienced.

By not communicating the performance, employees are not aware if the objectives are being achieved. PISA's management would need to find a medium to communicate monthly performance objectives to employees at all levels, with reasons for not achieving the objectives, together with action plans on how to overcome problems being experienced. Setting quality objectives is also a requirement for the ISO 9001:2008 standard. The quality management system documentation shall include documented statement of quality objectives (ISO, 9001: 2).

Respondents were asked if they have been informed of customer returns due to non-conformances (Q2.5). The responses, i.e., 3.3% (strongly disagree) and 9.8% (not sure) could potentially be those of sewing machine mechanics and administrative staff. These employees are not often linked directly with the manufacturing of products. The 50% (agree) and 37% (strongly agree) respondents could predominantly be sewing machinists and quality inspectors, as all customer complaints and customer returns are communicated immediately to the employees performing these functions.

Respondents were asked if, on a regular basis, customers visit PISA (Q2.6). The customers visiting are existing customers and also potential customers that want to see the manufacturing facility, before signing sales contracts. Existing customers and potential customers come from different countries around the world. Customers are in the form of military personnel, as PISA only supplies military parachutes and related equipment. Quality performance, both internally and externally, is monitored by customers and is also considered a "selling point" due to selling a safety critical product like a parachute and related equipment. Employees of PISA are informed before a customer visit takes place but there is no feedback session for employees once visitors have come and gone.

Respondents were asked if PISA has a high employee turnover (employees leaving for other jobs) (Q2.7). 33,7% of the respondents agreed with this statement. The manufacturing of parachutes and related equipment requires high technical skill. The most sophisticated process in the manufacture of parachutes could take an employee 6 months to master. During this time, employees are paid a full wage while training. Employees leave for better prospects, resulting in a loss of skill. This would entail re-hiring and re-training of employees. Consequently, it would be a loss to PISA as employees would be training and not adding value to the end product being sold.

Respondents were asked if customers will move to other parachute suppliers due to customers experiencing quality non-conformances with PISA (Q2.8). Customers have moved onto other suppliers due to non-conformances being experienced by customers. 40% of respondents agreed with this statement as PISA experienced a loss of customers due to non-conforming products being found by customers during inspection. Due to the nature of a parachute and related equipment being of a safety critical product, non-conformances are not acceptable. 10% of respondents have indicated as not being sure. These respondents could be employees that have not been at PISA long enough to have the experience of losing customers, due to non-conformances. The nonexistence of improvement in the manufacturing and quality inspection processes often affects the quality of the product unsafely as there is no improvement to the quality or function of the product which, in turn, leads to an absence of interest from customers and a loss of profit to the company. Employees need to be made aware by PISA's management that the loss of customers would mean loss of profits, which could lead to job losses and eventually the demise of the organisation.

Respondents were asked if, in the last 10 years, they had at least once participated in PISA's stock take (Q2.9). 40% of the respondents acknowledged that, in the last 10 years, they have participated in a stock take. A stock take, occurs once a year at PISA. During the period of the stock take, manufacturing of products does not take place due to no movements of raw materials and products. Stock take is done to confirm the value of raw materials being kept in the raw material stores and also to confirm the value of work-in-progress being held in the factory. The stock take of both raw materials and work-in-progress are financially analysed in terms of profits and losses.

Respondents were asked if PISA measures quality performance (Q2.10). 51% of the respondents acknowledged that quality performance is measured. Quality performance measured internally is only displayed in the relevant departments. The graphicals are created using information from non-conformances discovered during in-process and final inspection. To improve the quality performance internally, graphics need to be explained to employees in greater detail, together with action plans on how to overcome the areas of non-conformances. PISA's engineering department would need to look at ways of improving the display of graphics, in terms of showing if quality

performance is improving or deteriorating. This would give employees an indication if quality performance is improving due to putting actions in place. Quality performance externally comes in the form of graphics called First Time Right (FTR), which are sent by the customer. This is an indication that the product was received at the customer level with no non-conformances being found. To date, PISA has not achieved a 100% FTR. This is a very perturbing sign in terms of quality performance at the customer level and also delivery of a quality product as required by the customer. To improve the quality performance externally, employees need to look at the returned product and to create a brainstorming session driven by the production supervisor and quality auditor on how to eliminate the non-conformances and achieve customer satisfaction. This would also mean providing feedback to the customer on the root cause of the non-conformance and how to eliminate the non-conformance.

5.2.2 Leadership

Politis (2002) noted that leaders are essential in "providing the vision and oomph for knowledge sharing and to sustain effective knowledge management practice. Such leaders must add to the formation of a corporate knowledge philosophies and a managerial mind-set that promotes the flow of knowledge all through the organisation" (Politis, 2002: 194).

Respondents were asked if top management ensures that every employee knows PISA's objectives (Q3.1). 72.9% of the respondents agreed with this statement. It was found that the objectives are communicated on a yearly basis to the employees of PISA; this is done at the start of the financial year. This is also an ISO requirement whereby all employees must understand the objectives that need to be reached and the objectives need to be displayed within the organisation. The quality management system documentation shall include documented statement of quality objectives (ISO 9001: 2). Advising the employees on a yearly basis about the objectives is a good way to communicate what the target that needs to be achieved, but this process needs to be improved by giving employees a progress update on a monthly basis. Employees need to know the target in comparison with what is actually being achieved and what is limiting employees from reaching the objectives.

Respondents were asked if top management invests in developing employees on total quality improvement techniques/tools (Q3.2). 52% of the respondents agreed on with this statement. This percentage could mainly be made up of top management and

quality inspectors. A leader in TQM is a person who motivates, by suitable means, adequate capability to impact a group of individuals to become keen supporters in the achievement of organizational goals (Darling, 1992: 5). Consequently, top management and quality inspectors work with tools and techniques that are required by Zodiac. The quality inspectors are advised of non-conformances being experienced by the various customers, and also problem solving sessions are created to find solutions on how to eliminate repeating the non-conformance. All customer non-conformances must be reported to the Quality Department within Zodiac, and this is done using quality improvement tools and techniques.

Respondents were asked if middle management gets employee's involvement in quality continuous improvement projects (Q3.3). 51% of the respondents agreed with this statement. The category of employees who agreed with this statement could potentially be quality inspectors and middle management. Kisombe (2013) states that using employees in the improvement process offers a practical section to the improvements being made to the manufacturing process as personnel have valuable knowledge within the manufacturing processes and have an in-depth knowledge of the raw materials and components used that can be removed as waste to improve processes within the manufacturing of the product. Internal non-conformances need to have an action plan drawn up showing evidence of actions that are being put in place to eliminate repeating the non-conformance. These actions are discussed during the daily Gemba. The 4 box report is used to monitor the quality trends of products (if non-conformances are increasing or decreasing with action plans in place).

Respondents were asked if top management puts safety as priority above quality (Q3.4). 82.6% of the respondents agreed with this statement. Top management puts safety as a priority, which respondents have identified. All organisations within the Zodiac Group must focus on safety as a number one key performance indicator and objective. This is communicated on a daily basis during the Gemba at PISA, together with the presence of visual management throughout the organisation, explaining the safety rules and regulations. Safety reports containing safety incidents must be reported to Zodiac on a monthly basis. Any injuries, whether major or minor, must be reported immediately to the safety department of Zodiac. Akass (1994) is of the view that the more safety conscious businesses used their performance in safety aspects as a valuable indicator to determine organisational achievement.

Respondents were asked if top management gets involved in projects to improve quality (Q3.5). 73.9% of the respondents agreed with this statement. The directors of Zodiac require evidence of quality improvements taking place. Hedlund, *et al*. (2003) state that leadership appears out of a complex performance domain and requires a broad response repertoire from which to draw as well as the capability to learn to respond to an assortment of everyday interpersonal and organisational problems. This is to be consistent in terms of supplying a quality product to the customers. Projects are also required internally in terms of improving quality to eliminate unnecessary expenses in terms of material rejections and wasting of labour.

5.2.3 Training

Nikandrou et, al. (2009) state that the main goal of training is to deliver, attain and improve the required skills in order to help businesses accomplish their goals and to generate a competitive advantage by adding value to their key resources –, i.e., employees. Respondents were asked if employees are given training in how to identify and act on quality improvement opportunities (Q4.1). 63% of respondents agreed with this statement. The majority of respondents could potentially be quality inspectors and middle management. This level of employees are given training by production and quality management on how to focus on improving quality issues experienced within the production area. Training is likely to be used more frequently at lower levels of an organisation (Jones and George, 2008: 15). The quality inspectors record all defects that are found during the manufacturing process. This is done during in-process and final inspection.

Respondents were asked if employees are trained for job-related skills (Q4.2). 83.7% of the respondents agreed with this statement. Due to a majority of the respondents being sewing machinists and quality inspectors the response rate is 83.7%. All employees in the production facility are given on-the-job related training. Noe (2008) refers to training as a scheduled effort by an organisation to assist employees' learning of job related capabilities which contain knowledge, skills or behaviours that are necessary for successful job performance. Training is broken down into sewing machine training and quality inspection training. The training for sewing machinists is done using the different types of sewing machines (single needle, double needle, harness machine, bartack, zigzag, specialized automatic and walking foot) that are currently being used at PISA. The training starts with learning how to clean the sewing

machines before the work day; thereafter, the different parts of the machine are explained (by the production supervisor); the handling of the material through the machines are taught and, finally, the sewing machinists are taught to look at a drawing and sew the required process. To improve this method of training, the sewing machine mechanics should train sewing machinists on the different parts of the machine and how they function. Training should also be provided on minor repairs that could be done by the sewing machinists. Such training would limit the down time and waiting time for mechanics to attend to machine breakdowns. Quality inspectors are trained to inspect the products using inspection documents, together with measuring tools (rulers, measuring tapes and vernier calipers). At the end of training, training documents are completed in by the production supervisors to keep record of the training that was conducted. This training record is required as per ISO requirements (Document control and record keeping). The training document is also used as part of the traceability for employees' skills which are used as evidence to show that the person conducting the process is competent.

Respondents were asked if employees are trained on TQM concepts (Q4.3). The respondents rated this statement as follows: 46.7% agreed; 25% were unsure; and 28.2% disagreed. This rate of response shows that the latter two groups of respondents share close opinions on this statement. Chaneski (2014) found that organisations that did not train and use employees to manage and supervise the manufacturing process faced the risk of an inconsistent level of quality in their products and manufacturing line. An area of improvement for management is to improve the level of communication and training on quality management concepts. This is to create alignment between all employees, to work and achieve the required goal of TQM. This would relieve the strain on the quality department to not only work on TQM concepts, because all manufacturing personnel would be focused to achieve the same goals.

Respondents were asked if employees have been trained to use quality improvement tools, for example, Ishikawa diagram (Q4.4). The respondents rated this statement is as follows: 41.3% agreed; 29.3% were not sure and 29.3% disagreed. This response rate shows that employees are not aligned in terms of working or identifying quality improvement tools. In order to attain successful training transfer and information to the place of work, the training programme must be applicable to the job (Axtell *et al*.,

1997: 201; Kontoghiorghes, 2002: 114; Rouiller and Goldstein, 1993: 377). The reason for the above responses is that middle management works on customer complaints using basic quality improvement tools, like Ishikawa. The 29.3% of respondents who were unsure could be employees that were promoted from contract employees to permanent employees and were not trained to perform any improvements. This response is alarming as it shows that there is no alignment between employees in terms of using quality improvement tools. The 29.3% that disagreed to using quality improvement tools could be middle management who would have worked in the administrative area since this level of employees are not involved in using quality improvement tools. This skill needs to be improved by training all personnel in PISA in quality improvement tools. This would create alignment amongst all employees who could work in teams using quality improvement tools.

Respondents were asked if employees are given training on how to measure quality performance (Q4.5). 63.1% of the respondents agreed with this statement. This is response by the majority of the production staff (sewing machinist, quality inspectors and sewing machine mechanics). The reason production staff is aligned with quality performance is that it is discussed in the Gemba on a daily basis. Also, quality inspectors record all defects found during the manufacturing process. This data then generate a graphical illustration called a 4 box report which shows the quality performance of the manufacturing department. According to Van Dyk *et al*. (2001), every organisation ought to base its training and growth values on a combination of work content training with management skills and leadership training in line with career levels.

5.2.4 Customer Satisfaction

The term satisfaction has been essential to the marketing notion for over thirty years (Parker and Mathews, 2001: 38). Keith (1960) views marketing as “satisfying the desires and requirements of the consumer”. “As soon as I use a word”, Humpty Dumpty would say in a somewhat scornful manner, ``it means just what I choose it to mean ± neither more nor less'' (Carroll, 1865). At this time, the most extensively implemented description of customer satisfaction is that of a method; an assessment between what was received and what was expected (Oliver, 1977: 480, 1981: 25; Olson and Dover, 1979: 179; Tse and Wilton, 1988: 204).

Respondents were asked if customers' returned non-conforming products are studied for patterns and prevent the same problem reoccurring (Q5.1). 68.5% of the respondents agreed with this statement. This response was expected due to customer non-conformances being placed onto the Gemba boards in the department when non-conformance was detected. Chapman and Khawaldeh (2002) stress the importance for embracing customer satisfaction component in businesses that practised the TQM beliefs and they considered it as a significant section for fixing and solving customers' problems and complaints. A non-conformance list is managed by the quality department, monitoring individual part numbers for non-conformance. Trends are looked at if the same non-conformance was repeated. At times, non-conformances yield no actions as PISA is not resourced enough to action all customer non-conformances. Lewis *et al*. (2006) state that businesses ought to understand and determine customer wants and expectations by accomplishing their requirements and striving to surpass their expectations. Employees are informed during the daily Gemba that a non-conformance was detected by a customer and the process considered as non-conforming needs to be improved and not repeated. Sureshchander *et al.* (2001) define customer importance and fulfilment is considered as an important factor of the TQM movement because, by addressing customers' requirements and expectations, and anticipating and responding to their growing interests and desires, organisations can outlast their competitors. Non-conformances considered as major non-conformances (parts missing or damage to the product) have action plans raised immediately, as the use of the product during a major non-conformance could lead to a fatality or even disability.

Respondents were asked if customer returns are communicated to the entire organisation (Q5.2). 53.2% of the respondents agreed with this statement. An external customer service plan must provide customers with timely information, a quick response to problems and uphold a business objective to reduce the quantity of complaints. The plan must show evidence that improvement has been made and where improvement is possible, and be more than just observing people's work (Motwani, 2011: 292). This plan is communicated during the daily Gemba by the quality auditor. In order to increase customer satisfaction, customer complaints must be treated with high priority (Zhang et al., 2005: 730). A photograph is received via email from customers showing the non-conformance discovered. This photograph is displayed on the Gemba boards.

Respondents were asked if customer returns are only handled by the quality department (Q5.3). 50% of the respondents agreed with this statement and 35.8% disagreed with this statement. The 50% that, agreed could be top management, middle management and quality inspectors. All customer returns are handled by the quality department. The reason this is done, is that the quality department is the last department to have had contact or seen the product. Also, the quality department generates the certificate of conformance (coc) that is used as traceability to show that all the required processes were followed according to the manufacturing and inspection specifications. When employees know what they are supposed to be achieving on-the-job and how well they are doing are precise, they perform more efficiently (Wagner and Hollenbeck, 1998: 37).

Respondents were asked if there are customer returns every month due to quality problems with products. (Q5.4). 47.8% of the respondents have agreed; 16.3% were unsure and 35.8% disagreed with this statement. The response rate percentage to this statement shows there is misalignment in terms of communicating customer returns. With the ppm level not going below the required ppm levels show that the quality performance in not within the 1000ppm required by Zodiac. Due to the number of customer returns employees are overwhelmed and cannot focus on what needs to be improved. This requires an in-depth training session with individual manufacturing departments to explain the customer returns, together with a root cause analysis of why it went wrong to the customer and the actions that need to be put in place to eliminate this non-conformance being repeated. For this brainstorming and action plan session to take place, production and support departments (configuration, purchasing and engineering) need to be present to give their insight and opinion. Evans (2005) states that the most putative ways to gather information about customers are surveys service assessment cards, focus groups and pay attention to what customers say during business transactions, particularly when they complain.

Respondents were asked if customers measure PISA on quality performance (Q5.5). 82.6% of the respondents agreed with this statement. A weekly quality performance report is sent from customers. Customers measure PISA by using the parts per million (ppm) units of measure. This report is placed on the departmental Gemba boards.

The actual data are calculated by the following formula:

Number of non-conforming products / Number of units delivered	X	1 000 000 = ppm

Quality performance externally comes in the form of graphicals called First Time Right (FTR), which are sent by the customer. This is an indication that the product was received by the customer with no non-conformances being found. Thus far, PISA has not achieved a 100% FTR. This is a very perturbing sign in terms of quality performance to the customer and also delivering a quality product as required by the customer. To improve the quality performance externally, employees need to look at the returned product and to create a brainstorming session driven by the production supervisor and quality auditor on how to eliminate the non-conformances and achieve customer satisfaction. Deming (1986) mentions that customer satisfaction is the reason for TQM beliefs and execution. This would mean also providing feedback to the customer on the root cause of the non-conformance and how to eliminate the non-conformance being discovered again by the customer.

5.2.5 Communication

Schermerhorn *et al*. (2004: 285) describe organisational communication as the precise process through which information flows and is shared throughout a company.

Respondents were asked if the General Manager holds a communication meeting once a month (Q6.1). 55.4% of the respondents agreed with this statement. This communication meeting does not take place once a month. This communication meeting has no set time or date to take place. Sinha (2012) agrees that good quality, and recurrent communication that endorses employee participation may provide a platform for employees to better their job satisfaction levels by feeling important. The meeting takes place when there is a need to communicate important information to employees. Quality is not discussed during the meeting. The discussion at the meeting is about production targets, company losses, visitors that could be coming to PISA, safety aspects and absenteeism. The General Manager needs to create an agenda in terms of what needs to be discussed and including quality performance as one of the vital performance indicators. The agenda needs to be circulated to all employees or displayed in the numerous notice boards throughout the organisation.

Respondents were asked if the quality department communicates customer returns to all departments (Q6.2). 70.7% of the respondents agreed and 22.9% disagreed with

this statement. The employees within the production area would acknowledge this statement, as evidence is displayed within the individual manufacturing departments. The department's customer returns would not be communicated to departments like human resources, configuration and logistics. Ross (1999) states that effective communication perceptions can afford businesses with a practical method for communicating about quality. The communication needs to be improved, whereby the non-conformance is communicated to all departments and personnel. This can either be done by displaying the information on the notice boards or sent via email to personnel that have a company email account.

Respondents were asked if the quality performance is communicated to employees on a daily basis (Q6.3). 66.3% of the respondents agreed and 18.8% disagreed with this statement. The quality inspectors record all defects found during the manufacturing process. This data then generate a graphical illustration called a 4 box report which shows the quality performance of the manufacturing department. This is displayed in individual manufacturing departments. The production supervisor, team leaders and quality auditors need to generate an action plan that would eliminate the non-conformances that are being detected. The 4 box monitors the performance of individual part numbers and the actions put in place would be monitored for effectiveness in terms of eliminating the non-conformance. Makhomu (2012) states that not including employees in decisions has a negative impact on the manufacturing process, and can have affect employee morale in a negative way, which, in turn, upsets the working performance of employees and negatively impacts on their ability to work at peak efficiency.

Respondents were asked if quality improvement projects are communicated to employees (Q6.4). 71.7% of the respondents agreed with this statement. The quality improvement projects are communicated by the production supervisor to employees of individual production departments. This is done in line with the 4 box reports. Once the 4 box report is generated by the engineering department, it is given to departmental supervisors to create action plans. Projects would need to create a structured problem solving routine. The project charters would need to be displayed in the individual manufacturing departments showing evidence of projects and problem solving. This is monitored by top management and directors during their monthly visits. Besterfield *et al*. (2011) state that communication brings about the businesses values, opportunities,

directions and effective communication necessitates feedback.

Respondents were asked if TQM tools are used to communicate customer performance (Q6.5). 54.3% of the respondents agreed and 34.8% were unsure about this statement. The 54.3% of the respondents must be employees from the quality department and top management. Respondents could be confused or do not understand about what is considered as TQM tools. Besterfield *et al*. (2011) found that improving quality will be vulnerable if ineffective communication obstructs the flow of information to and from the employees. The reporting of customer performance is done using Zodiac reporting methods. These are tools that Zodiac requires all entities to use when reporting. There is no link between TQM tools and Zodiac's reporting requirements.

5.2.6 Continuous Improvement

Total quality management, described by Spector and Beer (1994) as "the continuous improvement of work methods to improve the organization's capability to deliver high-quality products or services in a profitable manner," is one of the most important research themes in operations management (Nair, 2006: 948). Continuous improvement, which is the continuing improvement of products, programmes, services, or processes (Blazey, 2006), plays a vital role in a TQM environment (Anderson *et al*., 1994: 472), and previous studies have found that continuous improvement is one of the most significant quality management concepts that lead straight to organizational performance (Olson *et al*., 2008: 178, Yeung *et al*., 2005: 189).

Respondents were asked if there is a quality improvement team of employees that drive quality improvement (Q7.1). 77.1% of the respondents agreed with this statement. The majority of quality improvement initiatives are created by the quality department. The production departments don't feel that quality is their responsibility. The quality department takes full control of handling the quality initiatives because customers demand answers and actions to eliminate receiving non-conforming products. The initiatives of quality improvements needs the buy in and drive from all departments. Achieving the required quality levels for the parachuting manufacturing companies is critical as it is a safety critical product and failure of the product during use can be catastrophic for the user as it could lead to death or even disability. Death or disability to a skydiver could lead to a lawsuit against PISA and Zodiac. It is the

responsibility of top management to see that the quality drive is performed by all employees at all levels and also should promote the involvement of employees from all departments and not just the quality department. Bhuiyan and Baghel (2005) encourage the change of continuous improvement from the production floor to the whole business.

Respondents were asked if quality improvement tools and techniques are widely used (Q7.2). 56.5% of the respondents agreed and 25% disagreed with this statement. Quality improvement tools, need to be explained more clearly and concisely to PISA's top management. The tools and techniques that are used by PISA are information that are required from Zodiac in terms of reporting. The employees of PISA are not aware if this is quality improvement tools and techniques or information that is required for reporting purposes. The skill in terms of quality improvement tools and techniques is very limited. The directors of Zodiac do not want to invest in employing indirect staff, as they feel this would increase their overhead costs. In an organisation that has employees that are illiterate, it is not easy to promote using tools by people who have not received training. Moreover, handing down tools and techniques to middle management is this going to be effective as they are not trained to use these tools and monitor their effectiveness. Baird et al. (2011) state that an organization's ethos, such as whether or not the organizational culture puts emphasis on teamwork and respect for people, was linked with the use of a number of TQM practices, such as quality data and reporting, supplier quality and management, and product and service design.

Respondents were asked if PISA practices continuous improvement of all its products, services, and processes (Q7.3). 77.2% of the respondents agreed with this statement. The reason for the agreement is due to the fact that many French designs come from the design entity in Joue Les Tours, France. The designers introduce new designs that need to be manufactured at PISA. Sewing machinists, quality inspectors and middle management are heavily involved in the transfers of new products. The design of new products requires the development of new processes. Lam (1997) found that the success of a TQM programme is determined by employee commitment, and having the knowledge of which strategies are effective in imploring employee dedication to continuous improvement projects. The device for applying TQM, is particularly significant in a TQM environment.

Respondents were asked if continuous improvement initiatives are visually displayed (Q7.4). 76.1% of the respondents agreed and 10.9% were unsure about this statement. The visual management of a place of work refers to the neat and strategic organization of an employee's work area to make sure that there is no untidiness or unwanted items that will play a part in hindering the progression and rate at which an employee is able to accomplish his or her responsibilities (Mund, 2011: 17). When it comes to customers that receive a major non-conformance and this is reported to PISA, an action plan is required. The customer complaint must be displayed in the department that passed this non-conformance for people to be aware and also to show what actions are being put in place to eliminate repeating this non-conformance. During the directors' monthly visit, these actions are examined. Vermaak (2008) found that an alternative way to introduce visual management tactics is by means of graphs that show defects that occurred within an exact workstation in the production process, and this creates an alert for the teams accountable for repairs within the production process of the defect, which needs to be addressed.

Respondents were asked if all departments participate in quality improvement initiatives (Q7.5). 69.6% of the respondents agreed and 19.6% disagreed with this statement. The reason that the majority of respondents agreed with this statement is that all departments are involved in quality initiatives since all departments manufacture products that are sent to the customer with non-conformances. There is not a single production department that achieved the acceptable quality levels in terms of design. PISA, in the last 5 years, has not achieved the First Time Right at 100%. Burrill and Ledolter (1999) mention that persistent improvement can bring positive results, such as lower defect rates, a reduced cost of quality and an improved financial view, as well as imperceptible results, such as job satisfaction.

5.2.7 Teamwork and Resource Management

Teamwork in organisations is controlled and the teams have a team leader, objectives, responsibility, agendas, targets and other features of task forces (Nurmi 1996: 9). Teams are prepared as top management teams, functional teams, project teams, boards, quality assurance teams, and production teams (Nurmi, 1996: 9). Nurmi states (1996) that, in order to get added value, teamwork has to be resourced correctly, managed appropriately, it must be built on a trust and responsibility-based organization, simple rules of conduct and expertise in teamwork.

Respondents were asked if PISA encourages teamwork (Q8.1). 84.8% of the respondents agreed with this statement. This is due to the daily Gemba attended by top management and middle management. Middle management thereafter communicates the outcome of the daily Gemba to sewing machinists and quality inspectors. Moreover, top management encourages teamwork to achieve the objectives set out by Zodiac. Management support is an important concept essential for successful TQM implementation, and this promotes employee participation (Ahire *et al*., 1996: 1, Cua *et al*., 2001: 675, de Menezes, 2012: 308). The success of a TQM programme depends on employee commitment (Lam, 1997: 21), and understanding which influence strategies are effective in imploring employee dedication to continuous improvement projects. The system for applying TQM, is particularly important in a TQM environment.

Respondents were asked if brainstorming sessions take place to get employees ideas on quality improvement (Q8.2). 65.2% of the respondents agreed and 22.8% disagreed with this statement. Prior to the Gemba taking place by top and middle management, a 10-minute meeting takes place at the start of the work day. This meeting is called the “TOP 10 MEETING”, since the meeting must last for 10-minutes. It is during this 10 minute meeting that supervisors promote employees suggest quality improvement ideas. This has not been a very successful initiative as people do not give ideas in terms of improving quality. Seaker and Waller (1996) state that not only is brainstorming a significant aspect amongst modern management methods, but it is also imperative that it takes origin in the organisation’s culture, and it is essential that employees feel free to speak their opinions without fear of consequences.

Respondents were asked if sufficient financial resources are provided to support improvement activities (Q8.3). 45.7% respondents agreed with this statement; 23.9% were unsure and 30.4% disagreed. The resources that are provided for improvement initiatives are not enough for this type of industry, whereby producing a quality product is key due to it being a safety critical product. The directors want the overheads of the organisation to be maintained and financial targets met. The directors of Zodiac divide the labour into direct and indirect workforces. The direct workforce is employees who are sewing and inspecting the actual product. The indirect workforce is employees that are supporting the production departments and have no physical contact with the product. The directors want to limit the number of indirect people being employed and

would rather invest in direct labour.

Consequently, employing people with the skills to problem solving is restricted. The directors advise that people that are currently employed need to be trained in handling many tasks at the same time (multi-skilled). Another reason is that money can only be invested in improvements if the organisation is profitable. Alexander, *et al*. (2006) state that the implementation of quality improvement practices and strategies may be a function of organizational performance. By having this type of pressure being applied, to function at the current job and also find time to problem solve are really difficult tasks for people.

Respondents were asked if employee participation in teamwork initiatives are rewarded by management (Q8.4). 51% of the respondents agreed; 21.7% were unsure and 27.1% disagreed with this statement. In terms of rewards, only safety initiatives are rewarded. Zodiac's number one objective is safety. The key performance indicator is zero injuries for employees. Rewards are given in the form of money for ideas that are given by employees to improve the work environment with safety initiatives. Moodaliyar (2010) states that extrinsic rewards could be in the form of monetary incentives for enhancement in quality of output while intrinsic rewards could be linked with providing employees with the expertise required for multi-skilling and improved autonomy in executing their jobs, thereby, leading to greater than before job satisfaction. Due to manufacturing a safety critical product like a parachute and related equipment, a reward scheme should be in place for employees that reach the required quality levels. This scheme will motivate all employees to achieve the quality targets.

Respondents were asked if PISA's management is satisfied with the spirit of team work (Q8.5). 55.4% of the respondents agreed; 27.2% were unsure and 17.3% disagreed with this statement. The spirit of teamwork is not something that can be measured to show how it is performing. Lagrosen and Lagrosen (2005) found that businesses adapting to key values, as well as widespread employee involvement, connected to successful quality management. The spirit of teamwork can only be promoted by top management and through participation in initiatives with employees that show interest and the value of teamwork. Employee involvement is important for implementing quality management initiatives successfully; minimal research in operations management is available that explores which management actions and

behaviours lead to commitment (Gattiker and Carter, 2010: 72).

5.2.8 Employee Participation

According to Harber *et al*. (1991), employee participation is seen as a significant component in the adoption of new management approaches and plays an imperative role in defining the degree of job satisfaction. Employees' participation had been recognized as a management resolution to growing employees' satisfaction (Cotton et al., 1988: 8). According to a classic meaning, participation is defined as involvement (Vroom, 1974: 47).

Respondents were asked if employees' thoughts had been taken into consideration to make quality decisions (Q9.1). 48.9% of the respondents agreed; 31.6% disagreed and 19.6% were unsure to this statement. Employees' thoughts are taken into account in terms of making quality decisions. Experience plays an important role in making value-added decisions in this type of industry. Employees who are new and still developing skill and experience seldom make decisions as they are afraid of the outcome. Chaneski (2014) found that organisations that did not train and use employees to be able to oversee the manufacturing process faced the risk of an unpredictable level of quality in their products and production lines. Employees who have been in the industry for many years are mostly likely to make quality decisions. It is the responsibility of the quality department to make quality decisions for a complete product. It is a requirement from the Head of Quality in Zodiac that promotes this kind of decision making.

Respondents were asked if employee awareness and feedback on status are recognised (Q9.2). 46.8% of the respondents agreed; 28.3% were unsure and 25% disagreed with this statement. Awareness and feedback are provided to employees in the top 10 meeting and also discussed during the daily Gemba. At times, customers do not provide feedback in terms of performance and actions put in place for non-conformances. Therefore, feedback is not provided to employees. Goeldner and Powell (2011) found that clienteles, who make regular visits to the manufacturing facilities and are in direct connection with the production processes, are able to offer in-depth and clear insight into developments that can be made to the production process in its entirety.

Respondents were asked if employee involvement in quality initiatives demotivates employees (Q9.3). 25% of the respondents agreed; 37% were unsure and 38.1% disagreed with this statement. The involvement of employees in quality initiatives is positive in terms of employee feedback. Employees are more likely to be demotivated when a customer complaint is received. It seems that their hard work was in vain. Complaints involve additional costs to the company. Employees also shy away from quality initiatives as they feel they could be victimised for airing their views on why the required quality levels are not being achieved. Hook and Stehn (2001) found that permitting employees to be enthusiastically involved in quality initiative tasks are essential for the accomplishment of the production process since they encourage initiative from employees and permit them to be actively involved in efforts to further improve the production process.

Respondents were asked if employee participation in industry's success reduces the turnover and, therefore, reduces the cost of hiring and training new employees (Q9.4). 43.4% of the respondents agreed; 33.7% were unsure and 22.8% respondents disagreed with this statement. This is made evident by top management. Once every two weeks a meeting takes place between the General Manager and PISA's Works Committee (Similar to union representatives). The works committee is made up of employees from the manufacturing facility. The works committee members are nominated by their fellow employees. Six employees are nominated every year. It is during this meeting with the General Manager that the industries' success is discussed in terms of value for the employees and the sustenance of the business in the long-term. Higgins (1982) states that participation is a psychological and sensitive image that will lead to the completion of individual and business goals, particularly if embraced by the companies' culture (Ardichvili *et al*., 2003: 64).

Respondents were asked if employee satisfaction can lead to customer satisfaction (Q9.5). 86.9% of the respondents agreed with this statement. If employees are focused on their individual processes in terms of meeting targets, customers will be satisfied since they will be no non-conformance of products and products will be delivered on time. TQM philosophies are implemented to inspire organisation members' contribution, encourage empowerment, know that employees play a crucial role in accomplishing the business goals and treat the work force as primary resources (Karia, 2006: 30). Employees are continuously being pushed by middle

management to produce faster, which results in the production of poor quality products.

5.2.9 Work Environment and Culture

Robbins and Judge (2007) define organisational culture as an arrangement of plain assumptions, created, discovered or established by a given group. Robbins and Judge (2007) states that an organisations culture includes employee views of an organisation concerning designs of beliefs, values and opportunities of an organisation.

Respondents were asked if all employees are committed to participate in TQM initiatives (Q10.1). 54.4% of the respondents agreed; 19.6% were unsure and 26.1% disagreed with this statement. Employees are committed to participate in TQM initiatives when the individual departments are not performing to achieve the required quality targets. Starbird and Cavanagh (2011) found that the pre-eminent way to drive performance development is to include the work force that do the real work within the manufacturing process and they recommend that involving employees in the process and performance improvement drive, will result in improved change acceptance from the whole organisation. Employees want to play an active role in terms of improving the quality of products which will improve customer satisfaction. It sometimes becomes too cumbersome for employees when they have to balance their workload and also participate in TQM initiative. PISA's management needs to promote TQM initiatives as the way of life by creating systems and routines for employees.

Respondents were asked if top management promotes a culture of employee participation (Q10.2). 48.9% of the respondents agreed; 22.8% were unsure and 28.2% disagreed with this statement. Basu (2004) advocates a TQM culture where top management create the visualisation which is transferred all through the organisation. Once the quality culture has been entrenched, quality will be driven from the bottom up, i.e., from the production operator rather than being directed or controlled by top management. The promoting of employee participation needs to be monitored for routines in terms of achieving the philosophy of TQM. Top management needs to be disciplined in terms of promoting and participating in the culture of employee participation. This system should be considered by top management for employee participation and this system could also be seen by employees as a way to gain from rewards, work towards achieving customer satisfaction and achieve the quality standards expected by customers.

Respondents were asked if employees show interest in eliminating customer returns (Q10.3). 66.3% of the respondents agreed and 22.8% disagreed with this statement. Employees have shown interest in eliminating customer claims by participating in discussions during the top 10 meeting and also providing feedback in the daily Gemba on non-conformances customer. The problem is that it is difficult to maintain a constant level of quality. The quality of the product sent to the customer for the first time and the quality of the product sent to the customer for the second time around are not the same. The problem could also arise about with employees doing the same job day in and day out. Employees have created their own routine in terms of what they do, that when a mistake is made by them it is not evident. Gryna (2001) refers to an organisations quality culture as the workers' sentiments, views, ethnicities and practices regarding quality and believes that it is critical to recognize this quality culture as it has a great influence on quality performance and can also recognize barriers to change and enable an action plan to be established based on this evaluation of the quality culture. PISA's management would need to look at job rotation and how it could benefit the worker from not having to do the same job day in and day out. Job rotation would also benefit the company by multi-skilling employees, which will result in greater flexibility in the production areas.

Respondents were asked if teamwork and involvement are normal practices in the company (Q10.4). 70.7% of the respondents agreed and 16.3% disagreed with this statement. The reason that respondents scored highly for this statement is due to the quality department handling and promoting teamwork to achieve the quality levels of customers. The majority of the respondents could be quality inspectors and quality management. It is not normal for routines to be in place. There is also no constant promotion of teamwork and involvement of employees by management. Besterfield *et al*. (2011) states that management must bring about cultural change so that employees will change to fulfil their own requirements. When they are ready, people will engage in behaviours that contribute to the organisation's mission. To ensure that change is recognised, employees must be enthused from a state of reluctance to a state of trust. The involvement of teamwork needs to be defined and explained to employees.

Respondents were asked if a pleasant environment exists in all working areas (Q10.5). 56.5% of the respondents agreed; 14.1% were unsure and 29.3% disagreed

with this statement. The 29.3% of the employees that disagreed could be from the quality department. This is due to sewing machinists who, at times, do not accept the feedback provided by the quality inspectors, whereby products are sent back to the production line when a repair is detected. A pleasant work environment is not evident is when customers returns products due to quality issues. The production departments would blame the quality department for passing the product and the quality department would blame the production department for not sewing the product correctly. Evans (2008) states that, as a replacement for responding to a crisis, a quality attitude must be able to imitate a willingness to modernize, to enlist change agents within the business, and inspire leadership and creative resolutions to a problem. It is the responsibility of PISA's management to promote a pleasant work environment and promote quality as the responsibility of all employees. The consequences of sending a poor quality product to customers need to be explained in terms of the skydivers using the product and how it affects the business in terms of profits and losses.

5.2.10 Supplier Quality Management

Suppliers are those businesses that provide the organisation with raw materials and services that support them to gratify the needs and desires of their own consumers (Evans, 2005 and Al-Qudah, 2006).

Respondents were asked if suppliers are selected on the basis of having a quality accreditation (Q11.1). 59.7% of the respondents agreed; 27.2% were unsure and 13.1% disagreed with this statement. Top and middle management are involved in the selection of raw materials from suppliers. There is also a criterion that needs to be met by PISA in order for a company to be listed as a supplier of raw materials.

The criterion is as follows:

i. The initial supplier selection is based mainly on the capability to provide a product that meets the requirements for a particular purpose, taking into account the end use of the intended product.;

ii. The potential supplier's product is sampled by the Configuration Manager / Quality Manager / General Manager and used to manufacture test pieces or completed items for evaluation.;

iii. The introduction of product from a new supplier, especially where the strength or performance of materials in use is critical, is to be carefully monitored.;

iv. All suppliers will be assessed on a 1-4 rating scale, 1- Very Good, 2- Good, 3- Average, 4- Poor in the following categories, Certificate of conformance; specification; price; delivery; credit terms and lead times.;

v. Therefore, the suppliers who score the lowest point accumulation are the most suitable.;

vi. The supplier with the next lowest score becomes the first alternate supplier.;

vii. There are traditional suppliers who are in some cases sole suppliers. For these suppliers, their performances are monitored by the Purchasing Dept. If their performance deteriorates this fact is brought to the attention of the Purchasing Manager and General Manager for action.;

viii. In the case where a supplier is a sole supplier and does not perform, an intensive goods in inspection system will be set up, Quality and Purchasing will endeavour to assist the supplier in solving the common problems.;

ix. Records of the suppliers' test results are maintained by the Goods-In Inspector / Lab Technician.;

x. A list of preferred suppliers is maintained by the Purchasing Manager.;

xi. When a new supplier has to be added to the list or a low performance supplier has to be removed from the list the Purchasing Manager will then update the list.; and

xii. Should a supplier consistently fail to maintain their rating then the Purchasing Manager will decide if the next alternative supplier is to be used. The poor performance supplier is removed from the approved supplier's list.;

This demonstrates a rigorous selection process which warrants that the quality of resources used by the manufacturing facility is of the paramount quality so that the end product is of the best quality (MacDuffie and Helper, 1997: 118). There is no interaction with suppliers from sewing machinist and quality inspectors. The problem with creating this level of interaction with suppliers is that the transfer of information is only known by a few individuals. If an individual leaves PISA for a better prospect or any other reason, the skill and knowledge that the person has gained has not been

shared with anyone within the organisation. Consequently, dealing with suppliers would come to a standstill. Management needs to expand the interaction with suppliers so that there is continuous interaction with suppliers even in the absence of one skilled individual.

Respondents were asked if suppliers are regularly audited by PISA's quality department (Q11.2). 47.8% of the respondents agreed; 27.2% were unsure and 25% disagreed with this statement. No supplier audits take place as a majority of suppliers are based overseas. The directors of the company view the auditing of suppliers as a non-value adding process and a non-recoverable expense to the company. Suppliers are based in countries like Korea, India, United Kingdom, United States of America and France. The skills of supplier auditing is also not readily available at PISA and the directors do not want to invest in training personnel on how to conduct supplier audits. Ferencikova and Bris (2013) believe that suppliers' participations are valued and suppliers can contribute by confirming specification standards. Customer audits must highlight possible risks that can arise in the supply chain. According to Ferencikova and Bris (2013) the main function of supplier auditing was to steadily extend to become a valuable management tool for driving the performance of a business.

Respondents were asked if suppliers provide relevant quality records and data (Q11.3). 67.3% of the respondents agreed; 28.3% were unsure and 4.3% disagreed with this statement. The majority of the respondents that agreed with this statement are from top and middle management. Due to PISA being an ISO certified company, documents and records keeping are vital to the traceability system. One requirement is that the organization shall evaluate and choose suppliers built on their capability to supply product in terms of the organization's requirements and criterion for selection, assessment and reassessment shall be established (ISO, 9001: 10). Records of the results of assessments and any required actions arising from the assessment shall be retained (ISO, 9001: 10). PISA will not accept raw material in its store if the relevant documents are not supplied with the raw material.

Respondents were asked if PISA works closely with suppliers toward a long-term partnership and improvement (Q11.4). 67.4% of the respondents agreed; 22.8% were unsure and 9.8% disagreed with this statement. PISA creates a long partnership with suppliers. Due to the nature of manufacturing parachutes and related equipment, finding raw material suppliers that have the accreditation to supply aeronautical

equipment is limited. PISA has built a relationship with its suppliers, in terms of quality, delivery lead times and payments. Crosby (1989), states that the connection between supplier and purchaser is well-thought-out as one of the most critical parts of the quality improvement process, and the supplier partnership consists of supplier selection, supplier evaluation, conferences, combined planning and suppliers' quality control. Moreover, when new designs are created by the design entity in Joue Les Tours, France, new raw material needs to be designed to fulfil the functional requirement of the product.

Respondents were asked if quality issues with raw materials are identified, necessary action plans agreed and progress monitored by both parties (Q11.5). 69.6% of the respondents agreed; 16.3% were unsure and 14.1% disagreed with the statement. The quality of raw material is just as important as a completed product being supplied to a customer. Quality issues experienced with raw material are communicated to suppliers immediately. Actions plans are required, for eliminating the quality problem being repeated. To show evidence of its action plan to customers, PISA is working with suppliers to achieve the required quality levels. Richardson (1997) states that the organisations have faith in that the supplier must meet precise objectives like continuous improvement in quality and productivity; waste eradication; process control; production adjustments; standardisation and defect anticipation. It is also a requirement from ISO to show evidence of the interaction with suppliers.

5.3 Phase 2: Qualitative Data

The interview findings show opinions that are more or less aligned in terms of the functionality of the business. PISA's management view on achieving customers' satisfaction is evident. This view relates to producing a quality product that fulfils the customers' requirements.

The interview feedback from the different managers in terms of quality performance internally and externally is aligned in terms of the directors' requirements. Quality performance internally is impacting the quality performance externally. Since products are not being manufactured first time right by sewing machinists. Products are sewn by machinists, sent for inspection and then returned to the production line due to the product not being produced correctly the first time. A process defined as auto inspection is meant to be conducted by all sewing machinists before passing the

product onto final inspection. Auto inspection is whereby a sewing machinist checks that the product was sewn correctly according to the manufacturing requirements and then passes onto the quality inspection for verification. Quality inspectors are pressurised to work to achieve targets instead of achieving the required quality.

External quality performance is made evident to all top management at PISA during the daily Gemba. The quality performance externally is understood on how it impacts the companies' profits substantially. This is due to transportation costs to return the product (globally), the quality department to re-assess and the cost to re-manufacture or repair. To re-manufacture or repair would cost PISA labour time and also material. This information needs to be cascaded down to all employees of PISA by top management for them to understand why it is vital to get the quality right both internally and externally. Employees also need to understand the impact that poor quality would have on a skydiver if the product fails in use and how it affects the overall financial performance of the business.

Claims are being received in small quantities on a weekly basis by international customers. The quality department is the first department to see the non–conforming product when it arrives at PISA. Since it was, the last department to have any physical contact with the product. Moreover, the quality department creates a certificate of conformance (coc) when the product is being dispatched to customers.

Quality objectives are communicated to all employees at the start of every work year. The objectives are set by the directors of Zodiac. The problem is that objectives are set on a yearly basis, but the performance on a monthly basis is not shown to all employees in terms of the target versus what was actually achieved.

Improvements are only done by the quality department. This is due to customers expecting corrective actions and evidence to show that non-conforming products won't be dispatched again to the different militaries. Due to PISA being an ISO certified company, the standard requires evidence of improvements during external and internal audits. Another reason why the quality department is the department that handles improvements is due to other departments lacking the skills and knowledge on how to deploy and use improvements tools and techniques. Management is also responsible for the lack of improvements in production, as production personnel are more target driven than quality and improvement driven. This is a major area of

concern in terms of moving the business forward. The quality department cannot handle the full deployment of improvements. It needs to be actioned and supported by all departments. Feedback needs to be provided to customers when a product is non-conforming. Such feedback is necessary to build the customer-supplier relationship and also to show that, as a manufacturer, PISA has the customers' best interest in mind. This is also due to PISA manufacturing a safety critical product like a parachute and related equipment. Failure of the product's use can be catastrophic to both the skydiver and PISA as a business.

It is also evident that the viewpoint from production staff is that the quality department is fully responsible for achieving the quality expected by customers. The directors promote quality to be the responsibility of all employees at PISA, irrelevant of the department or job title. This is a culture that has been difficult to change in terms of the mindset of PISA's personnel. Production personnel are always target driven and not quality driven. It is the responsibility of middle and top management to drive the culture change in terms of making all personnel responsible for quality.

It was evident during the interview that the poor quality performance internally and externally is negatively impacting the business financially. This is due to the fact that a budget is not allocated for non-conformances. Customer returns are costing the business financial losses due to products being returned. PISA has to cover the cost in terms of transporting the products back to the factory from anywhere in the world, re-assess the non-conformity, and repair or remanufacture the product. Repair or remanufacture would require additional material and labour costs. PISA will also incur the cost to return the product to the customer. A majority of PISA's suppliers are based internationally, which means raw materials have to be purchased in terms of the exchange rate. Goods are returned by air at exorbitant costs which are based on weight. Internal quality problems also impact the business by rejecting material and paying labour to reproduce or repair the product. Overtime also has to be paid if the product is not going to be delivered on time, as the militaries charge penalties for late deliveries.

Training on quality tools and techniques is done by the quality department at PISA. All Zodiac companies globally have access to a central database called ZA (Zodiac Aerospace) Standards. This database consists of quality improvement and lean tools and techniques that can be used to solve internal and external quality issues. The

problem is that no formal training is given in terms of how to use the quality tools and techniques. There is a manual procedure that needs to be downloaded, read and thereafter implemented. By following this method of implementation on the use of the quality tools, people create opinions of what is right and what is wrong.

A weekly quality performance report is sent from customers. Customers measure PISA by using the ppm units of measure. This report is placed on the departmental Gemba boards.

The actual data is calculated by the following formula:

$$\frac{\text{Number of non-conforming products}}{\text{Number of units delivered}} \times 1\,000\,000 = \text{ppm}$$

Quality performance externally comes in the form of graphicals called First Time Right (FTR), which is sent by the customer. This is an indication that the product was received by the customer without non-conformances. To date, PISA has not achieved a 100% FTR. This is a very perturbing sign in terms of quality performance. Lean and TQM tools and techniques can be used to improve internal non-conformances and effectively solve quality problems experienced by customers.

Lean tools can be used to improve the internal manufacturing process and implement the 5s (set, sort, shine, simplify and standardise) for the manufacturing environment to be more organised. Employees from the different departments and levels need to be trained on the quality and lean philosophies. Zodiac must provide this training as there are internal quality and lean departments that provide this service. Thereafter, quality and lean manufacturing need to be monitored for their effectiveness in terms of reducing internal non-conformances and eliminating external non-conformances.

Visual management is in place at different areas of the manufacturing facility. The visual management represents the different departments' information that needs to be displayed. The human resources department represents all the labour laws required by the South African government. The production department displays production plans. The safety department displays all the safety rules and regulations required by PISA and the South African government.

Due to parachute manufacturing being very limited both locally and internationally it is not easy to benchmark the competition. Also due to competition, other parachute

manufacturing organisations may not be willing to disclose information that could jeopardise their position in the parachute market. It will be useful to perform intercompany benchmarking between the three Zodiac entities (South Africa, France and the United States of America). The value and feasibility of such an exercise needs to be discussed with the directors of the various divisions.

No supplier audits take place as a majority of suppliers are based overseas. Auditing of suppliers is seen as a non-value adding process by the directors of the company and is seen as a non-recoverable expense. Suppliers are based in countries like Korea, India, United Kingdom, United States of America and France. The skills of supplier auditing is also not readily available at PISA and the directors do not want to invest in training personnel on how to conduct supplier audits.

The initial supplier selection is built mainly on the ability to provide a product that meets the requirements for a particular purpose, taking into account the end use of the intended product. The potential supplier's product is sampled by the Configuration Manager / Quality Manager / General Manager and used to manufacture test pieces or completed items for evaluation. The introduction of a product from a new supplier, especially where the strength or performance of materials in use is critical, is to be carefully monitored. All suppliers will be assessed on a 1-4 rating scale, 1- Very Good, 2- Good, 3- Average, 4- Poor in the following categories: certificate of conformance; specification; price; delivery; credit terms and lead times (See WP-016).

Therefore, the suppliers who score the lowest point accumulation are the most suitable. The supplier with the next lowest score becomes the first alternate supplier. There are traditional suppliers who are, in some cases, sole suppliers. For these suppliers, their performances are monitored by the Purchasing Department. If their performance deteriorates, these suppliers are referred to the Purchasing Manager and General Manager for action. In the case where a supplier is a sole supplier and does not perform, intensive goods inspection, an inspection system will need to be set up before becoming a supplier. The Quality and Purchasing will endeavour to assist the supplier in solving the common problems. Records of the suppliers' test results are maintained by the Goods-In Inspector/Lab Technician. A list of preferred suppliers is maintained by the Purchasing Manager. When a new supplier has to be added to the list or a low performance supplier has to be removed from the list, the Purchasing Manager will then update the list. Should a supplier consistently fail to maintain its

rating, then the Purchasing Manager will decide if the next alternative supplier is to be used. The poor performance supplier is removed from the approved supplier's list.

Suppliers are evaluated on specific criteria, which are on time delivery and quality. The on time delivery and quality performance of suppliers are measured by Zodiac on a monthly basis. For on time delivery, the criterion defined by Zodiac is called SOTD, which means Supplier on Time Delivery, and SNCR, which means Supplier Non-Conformance Rate. The target that was set for the financial year 2016-2017 was 95% on time and 98% for supplier conformance (delivering a quality product first time right). If delivery or supplier quality falls below the requirement, an action plan must be put in place by the supplier that shows actions to be taken to overcome issues. Suppliers also visit PISA when a major non-conformance (deferring from specification) is detected on the quality of raw material.

5.4 Thematic Analysis of Qualitative Data

Thematic analysis of qualitative data is used to recognize themes or key concepts in a document or set of documents (Federay and Muir-Cochrone 2006: 1). It is a method of pattern acknowledgment contained within the data, where developing themes turn out to be the categories or codes for analysis. The data collected were examined using content analysis. Data were characterized as per each objective and guideline questions. By studying the data, key themes and common trends emanated through the interviewer's key findings.

5.4.1 Identification of Themes

From the coding process themes appeared from the text recognized then in the same time sub-themes, will be merged in the discussion. The themes that developed from observations and perceptions conveyed by respondents, showed the challenges the Durban based parachute manufacturing facility experienced to achieve customer satisfaction through TQM.

5.4.2 Reviewing Themes

The reviewing of themes in thematic analysis displays the different frameworks in which words appear. The words are organized in a table format which exposes recurrent expressions and themes.

The words that were most frequently used were expense, cost, customer, repair, remake, objectives, as illustrated in Table 5.1. These findings are not surprising given the topic under study.

Table 5.1 Themes

PISA's top management was interviewed (N=5).

Quality performance	Number of interviewees that used the theme	Percentage of interviewees who used this term
Rejecting	3	60
Costly	1	20
Claims	3	60
Repair	3	60
Remake	3	60
Tools	1	20
Train	4	80
Objectives	3	60
Customers	3	60
Designs	3	60
Confidence	1	20

5.5 Summary

The chapter was divided into two sections, namely, quantitative data analysis and qualitative data analysis. The quantitative data was coded under the headings general, organisation; leadership; training; customer satisfaction; communication; continuous improvement; team and resource management; employee participation; work environment and culture and supplier quality management. This chapter provided the feedback by all respondents in terms of the questionnaire. The feedback showed employees understood the different functioning aspects of PISA.

The qualitative data analysis focused on the feedback provided by PISA's top management. The feedback showed that management is aligned in terms of the

quality performance of the business and also the areas of concern that need to be addressed to fulfil customer satisfaction.

The next chapter reviews the research questions, recommendations for future research, limitations of the study, recommendations and conclusion.

CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATIONS

"There is a direct relationship between quality and sales, quality and productivity, quality and profit, quality and competitive position. Good quality will lead to good things, such as increased profits, improved productivity, lower cost, and loyal customers. Quality is the responsibility of management" – Charles H Schmauch

6.1 Introduction

In this chapter, the findings from chapter five are discussed. The discussion is grouped into four sections, namely: research questions; recommendations for future research; limitations of the study; recommendations of the study and conclusion. The chapter ends with the summary which highlights the key points discussed.

6.2 Research Objectives

The research objectives of the study were as follows:

i. To quantify the extent of quality concerns at PISA.;

ii. To explore, the degree to which quality tools are employed at PISA.;

iii. To capture the perceptions of PISA's management and employees on TQM.; and

iv. To explore the challenges in adopting TQM principles at PISA.

6.3 Conclusion and Recommendations

The first research objective was to quantify the extent of quality concerns at PISA. The data collection methodologies used by the researcher to serve this objective were the quantitative and qualitative approaches. These approaches were employed during the completion of the questionnaire and during the interview session with the individual managers. Based on the number of customer returns and producing a safety critical product like a parachute and related equipment, there are quality concerns at PISA. The concerns are based on customer returns; which equate to loss of profits, loss of the customers, and even worse, the failure of the product could lead to death or disability of the end user. The interviews with top management revealed that it will be

difficult to sustain PISA as a profitable organisation in the long-term. The survey results conclude that employees recognize the quality concerns and the impact they can have on the current business and in the long-term. The recommendation would be to improve the inspection method using technology; such as microscopes linked to a computer screen, whereby small details that cannot be seen with the human eye can see, with the microscope.

The second research objective examined the degree to which quality tools are employed at PISA. The data collection methodologies employed by the researcher to serve this objective were the quantitative and qualitative methods. It has been identified that quality tools are not being used effectively even though they are available. This is due to the limited number of employees with the relevant skills to execute and maintain the quality tools. There are also restrictions such as the low literacy levels of employees. Employees are not able to read and understand how to execute the quality tools deployed by Zodiac. Zodiac also deploys quality tools, but does not initiate training on how to apply the tools. The quality tools are stored on a central database for all Zodiac companies to use, but the database does not permit employees to ask questions pertaining to training. The recommendation would be to send PISA's top management on training, to learn and to deploy the relevant quality tools. This would improve the quality performance internally, by eliminating the rework and rejection costs. Also, by eliminating internal quality concerns, quality products can be sent to customers.

The third research objective captured the perceptions of PISA's management and employees on TQM. The data collection methodologies employed by the researcher to serve this objective were the quantitative and qualitative methods. The perception from top management is that there are quality concerns in terms of TQM at PISA. This is due to employees not able to execute 100% customer delivery with no returns. During the interview process, top management recognised the concerns in terms of profit and losses and maintenance of customers due to quality concerns. Quality tools cannot be used easily since the skills are not available. Employees recognised the quality concerns and the consequences if customers received a poor quality of products continuously. The recommendation would be for PISA's top management to be sent on training on TQM and also on the ISO 9001 training. The knowledge gained through the training could be shared with the employees at a lower level, and

employees would buy into TQM and the ISO 9001 QMS, because top management would be driving the initiative.

The fourth and final objective explored the challenges in adopting TQM principles at PISA. The data collection methodologies employed by the researcher to serve this objective were the quantitative and qualitative methods. The challenge experienced at PISA to achieve TQM is the lack of skills to use quality tools. There is also a concern in terms of the number of people that are available to use quality tools. Another challenge is the myth of the production personnel that the quality department is fully responsible for quality in the company. A final challenge is the limited number of raw material suppliers available, due to the limited number of suppliers available in the parachute industry. The recommendation would be for non-quality personnel to be sent on TQM training externally and to spend more time with the quality inspectors internally analysis the quality problems being experienced to eliminate repeating the mistake.

6.4 Recommendation for Future Research

For future research, it is recommended that the same questionnaire should be administered with contract workers that have been employed for more than one year and include personnel from the head office in Paris, France. It was eminent that respondents for this study were mainly from the production and quality departments with limited management involvement. This recommended survey will provide vision into employees' perception of quality at all levels of the organisation.

Future research can be further conducted in the 2 other parachute manufacturing entities within Zodiac. The France and American-based parachute manufacturing organisations can use a similar questionnaire or similar research method to compare employees' perception of quality. The results should be benchmarked. The parachute manufacturing companies should provide the results to executive management to analyse their strengths and weaknesses and note similar trends, if any.

PISA should also consider the viability of conducting research with a nominated group of key customers globally to acquire their perception of the Durban-based manufacturing facility's effectiveness to fulfil customers' quality requirements and the effectiveness of QMS.

6.5 Limitations of the Study

The following limitations could have an influence on this study:

i. Data collection. This was done by means of a questionnaire that was completed by employees of the organisation. This was a closed-response questionnaire with no control on the response rate;

ii. Respondents might not have given their honest feedback due to victimisation, although anonymity was guaranteed;

iii. The details of the study were explained to all respondents, but they could be of the opinion that the feedback will not influence outcomes; and

iv. The questionnaire did not look at the respondents' length of service in the organisation. This could have an impact as respondents who were new and would have been unsure in their responses to certain questions.

6.6 Recommendations

Based on the research findings, the following recommendations are proposed:

- An active awareness programme should be developed and implemented to educate all employees at all levels of the organisation that quality is everyone's responsibility.;
- Top management must reveal all errors made and corrective actions taken in the relevant support departments, so that everyone understands that errors and remedies are not being ignored.;
- Teamwork should be considered externally by PISA's management in forums like team building.
- Visual management must display customer complaints and actions.;
- Zodiac's business-wide operational procedures should be implemented.;
- PISA should be benchmarked against other parachute manufacturing companies within the Zodiac Group, and, if possible, globally.;
- To send employees that illiterate for training on how to read and write, in South Africa the training is called Adults Based Education Training (ABET).

- Develop a training centre for employees to be sent for refresher training every 6 months. A training centre should also train new employees and develop the skills of existing employees.;
- PISA's management needs to define a feedback session for employees once visitors have come and gone
- To improve the quality performance internally, graphicals need to be explained to employees in greater detail, together with action plans on how to overcome the areas of non-conformances.
- To improve this method of training, the sewing machine mechanics should train sewing machinists on the different parts of the machine and how they function.
- Train and involve more personnel in terms of internal auditing. Such training should identify non-conforming areas, and actions should be implemented to avoid the repeat of non-conformity.;
- Top Management should address the staff on a weekly basis in terms of both internal and external performance, together with quality targets.;
- Management should be assigned departments which they mentor. This would create awareness that management is committed to achieving the quality requirements, together with wanting to achieve customer satisfaction.;
- The quality, production and procurement departments should have quarterly meetings with suppliers to discuss targets and problems being experienced. Supplier performance should be measured on a weekly basis and data should be presented during the quarterly meeting, together with action plans.;
- The quality department should present to the directors of PISA the benefits of auditing suppliers on an annual basis.;
- A rewards programme should be suggested for employee performance and achieving quality targets.;
- Retired personnel should be given short term contracts to train new and existing employees.; and

- All employees need to be trained on the requirements of the QMS and the value it will bring if the rules are applied correctly.

In conclusion, it is suggested that regular assessments (surveys or employee suggestion box with a card that can be completed) of employee insights should be conducted by the human resources department and the quality department. Feedback should be discussed during monthly management meetings. Management should provide feedback to employees via a monthly communication meeting and post the feedback on the communication notice boards. Management's role of creating the awareness of customer complaints and employees' involvement in finding solutions should be key to maintain customer satisfaction.

6.7 Conclusion

This study was conducted to determine employee perceptions of TQM at the Durban-based parachute manufacturing facility. The data acquired from the research study will be used to offer guidance into the current quality beliefs and provide insight towards the attainment of an enhanced, active and employee-maintained quality culture.

The projected business gain is a decrease in defects in products supplied to the customer. This decrease will result in customer satisfaction and higher profit margins. The arrangement of the study engaged on clear and broad review of linked literature on quality and linked behavioural patterns.

The research methodology included the use of qualitative and quantitative research methods. Statistical techniques were used to examine the data and the research findings were interpreted in line with the literature review and research objective.

All the objectives of this study were achieved. In concluding, recommendations and scope for future research were presented. The study indicated that the majority of the employees who had partaken in this research had positive perceptions of overall quality. A number of recommendations have been suggested to PISA's management to consider in order to address the adverse insights of quality yet at the same time maintain the positive insights of quality voiced by the employees.

This chapter looked at the results for each section of the questionnaire, together with interviews, and placed them within the context of the research questions. The interviews with PISA's top management, show that internal and external quality issues

are evident. Customer satisfaction is the key target. If customer target is not achieved, it could have a financial strain on the business and a potential loss of customers, which could lead to the demise of the business. The chapter discussed the results achieved within the context of the research questions and used previous literature to support and explain the results that were achieved. Finally, recommendations were offered to improve the implementation of TQM within the organisation.

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LIST OF APPENDICES

APPENDIX 1 – Letter of permission to conduct the research

PARACHUTES INDUSTRIES OF SOUTHERN AFRICA PTY
AEROSAFETY & TECHNOLOGY

ZODIAC AEROSPACE

17 December 2015

Attention: Dr Manduth Ramchander
Department of Operations and Quality Management
Durban University of Technology
41/43 ML Sultan Road
Durban
4000

PO Box 1334
Durban
4001

Dear Sir

LETTER OF CONSENT TO UNDERTAKE RESEARCH IN THE PARACHUTE MANUFACTURING INDUSTRY FOR A MASTERS DEGREE (MASTER OF PHILOSOPHY (MPHIL)) IN QUALITY

Parachute Industries of Southern Africa (a company belonging to the Zodiac Group) do hereby grant Mr Bradley Naidoo permission to conduct research, on the parachute manufacturer in South Africa, for a Masters Degree in Quality

Parachute Industries would kindly request that any sensitive information be treated confidential. Parachute Industries supports this research, as the contribution to the body of knowledge and society will be beneficial to improve South Africa's presence in the global market

We wish Mr Naidoo every success in his research.

Yours Faithfully

_____

Dr Dhanesh Rampersad
General Manager

PARACHUTE INDUSTRIES OF SOUTHERN AFRICA (PTY) LTD
29, Duiker Road, Canelands – Po Box 1616 – South Africa – Tel : +27 32 533 333 – Fax : +27 32 533 0262
Directors: Geraud de Riberolles, John O'Donnell, Cyril Jean Christophe Abegg
www.zodiacaerospace.com

APPENDIX 2 - Covering letter for the filling in of the questionnaire

Faculty of Management Sciences

Department of Operations and Quality Management

Date: 27 December 2015

Dear Participant

My name is Bradley Naidoo, I am currently pursuing my Masters Degree at the Durban University of Technology (DUT). My research is based on Quality improvement within the parachute manufacturing industry. The name of the organisation the research is being conducted on is Parachute Industries of Southern Africa (PISA).

Please could you kindly fill /complete the attached questionnaire. All details/data of this questionnaire will be private and confidential. If you are not comfortable with completing the questionnaire please hand the blank or partial filled in questionnaire back to your supervisor.

The questions are multiple choices.

Please put an X in the box that is appropriate to your department

Department	
Sewing Machinist	
Quality Inspectors	
Sewing Mechanics	
Middle Management	
Senior Management	

APPENDIX 3 – Questionnaire

Section 1 (General Organisation)

In this section, we would like to know more about PISA in general. Please mark an X in the appropriate boxes

Questions	Options	Please mark an X in the appropriate box
I. Number of permanent employees at PISA	200	
	170	
	120	
	150	
II. How long has PISA been associated with Zodiac?	10	
	5	
	4	
	1	
III. What audit is conducted annually by PISA's French customer (AERAZUR, JT)	Quality Check	
	Quality Assurance Policy (QAP)	
	Customer Check	
	None of the above	
IV. What quality management system does PISA have?	ISO 9001:2008	
	Six Sigma	
	Total Quality Management	
	Other	
V. Excluding over time, how many hours a week do you work?	40	
	60	
	25	
	15	
VI. To implement the quality management system was it:	Easy	
	Difficult	
	Extremely difficult	
	Don't know	
VII. How often does the Gemba take place	Once a week	
	Every day	
	4 Days a week	
	Never heard of it	
VIII. What is the status of the ownership of your company	Local	
	Fully Foreign	
	Joint Venture	

		None of the above	
IX.	Do you know how many products were returned from AERAZUR (France customer) due to customer non-conformance from the year 2010 to the year 2014	3519	
		4090	
		5075	
		1567	
X.	Which Zodiac's awards has PISA won?	Zodiac's Quality Award	
		Zodiac's Financial Award	
		Zodiac's Design Award	
		None	

Section 2 (General Organisation)

Please place a circle (RING) around the answer that best describes the statement.

No	Statement	Strongly Disagree (1)	Disagree (2)	Not Sure (3)	Agree (4)	Strongly Agree (5)
1.	Top management shows commitment to quality	SD	D	NS	A	SA
2.	PISA's management encourages team work	SD	D	NS	A	SA
3.	PISA has a quality policy manual	SD	D	NS	A	SA
4.	PISA's management communicates PISA's objective to staff?	SD	D	NS	A	SA
5.	You been notified of customer returns due to non-conformances?	SD	D	NS	A	SA
6.	Customers visit PISA	SD	D	NS	A	SA
7.	PISA has a high employee turnover (employees leaving for other jobs)	SD	D	NS	A	SA
8.	Customers will move to other parachute suppliers due to customers experiencing quality non - conformances with PISA	SD	D	NS	A	SA
9.	In the last 10 years you have at least one participated in PISA's stock take	SD	D	NS	A	SA
10.	PISA measures quality performance	SD	D	NS	A	SA

Section 3 (Leadership)

Please place a circle (RING) around the answer that best describes the statement.

No	Statement	Strongly Disagree (1)	Disagree (2)	Not Sure (3)	Agree (4)	Strongly Agree (5)
1.	Top management ensures that every employee knows PISA's objectives	SD	D	NS	A	SA
2.	Top management invests in developing employees on total quality improvement techniques / tools	SD	D	NS	A	SA
3.	Middle management gets employees involved in quality continuous improvement projects	SD	D	NS	A	SA
4.	Top management puts safety as priority above quality	SD	D	NS	A	SA
5.	Top management gets involved in projects to improve quality	SD	D	NS	A	SA

Section 4 (Training)

Please place a circle (RING) around the answer that best describes the statement.

No	Statement	Strongly Disagree (1)	Disagree (2)	Not Sure (3)	Agree (4)	Strongly Agree (5)
1.	Employees are given training in how to identify and act on quality improvement opportunities	SD	D	NS	A	SA
2.	Employees are trained for job related skills	SD	D	NS	A	SA
3.	Employees are trained on total quality management concepts	SD	D	NS	A	SA
4.	Employees have been trained to use quality improvement tools example Ishikawa diagram	SD	D	NS	A	SA
5.	Employees are given training on how to measure quality performance	SD	D	NS	A	SA

Section 5 (Customer Satisfaction)

Please place a circle (RING) around the answer that best describes the statement.

No	Statement	Strongly Disagree (1)	Disagree (2)	Not Sure (3)	Agree (4)	Strongly Agree (5)
1.	Customers' returned non-conforming products are studied for patterns and prevent the same problem reoccurring	SD	D	NS	A	SA
2.	Customer returns are communicated to the entire organisation	SD	D	NS	A	SA
3.	Customer returns are only handled by the quality department	SD	D	NS	A	SA
4.	There are customers returns every month due to quality problems with products	SD	D	NS	A	SA
5.	Customers measure PISA on quality performance	SD	D	NS	A	SA

Section 6 (Communication)

Please place a circle (RING) around the answer that best describes the statement.

No	Statement	Strongly Disagree (1)	Disagree (2)	Not Sure (3)	Agree (4)	Strongly Agree (5)
1.	The General Managers holds a communication meeting once a month	SD	D	NS	A	SA
2.	The quality department communicates customer returns to all departments	SD	D	NS	A	SA
3.	Quality performance is communicated to employees on a daily basis	SD	D	NS	A	SA
4.	Quality improvements projects are communicated to employees	SD	D	NS	A	SA
5.	Total quality management tools are used to communicate customer performance	SD	D	NS	A	SA

Section 7 (Continuous Improvement)

Please place a circle (RING) around the answer that best describes the statement.

No	Statement	Strongly Disagree (1)	Disagree (2)	Not Sure (3)	Agree (4)	Strongly Agree (5)

1.	There is a quality improvement team of employees that drive quality improvement	SD	D	NS	A	SA
2.	Quality improvement tools and techniques are widely used.	SD	D	NS	A	SA
3.	PISA practices continuous improvement of all its products, services, and processes	SD	D	NS	A	SA
4.	Continuous improvement initiates are visually displayed	SD	D	NS	A	SA
5.	All departments participate in quality improvement initiatives	SD	D	NS	A	SA

Section 8 (Teamwork and Resource Management)

Please place a circle (RING) around the answer that best describes the statement.

No	Statement	Strongly Disagree (1)	Disagree (2)	Not Sure (3)	Agree (4)	Strongly Agree (5)
1.	PISA encourages teamwork	SD	D	NS	A	SA
2.	Brainstorming sessions take place to get employees ideas on quality improvement	SD	D	NS	A	SA
3.	Sufficient financial resources are provided to support improvement activities	SD	D	NS	A	SA
4.	Employee participation in teamwork initiatives are rewarded by management	SD	D	NS	A	SA
5.	PISAs management is satisfied with the spirit of team work	SD	D	NS	A	SA

Section 9 (Employee Participation)

Please place a circle (RING) around the answer that best describes the statement.

No	Statement	Strongly Disagree (1)	Disagree (2)	Not Sure (3)	Agree (4)	Strongly Agree (5)
1.	Employee's thoughts has been taken into consideration to make quality decisions	SD	D	NS	A	SA
2.	Employee awareness and feedback on status are recognised	SD	D	NS	A	SA
3.	Employee involvement in quality initiatives demotivate employees	SD	D	NS	A	SA
4.	Employee participation in industry's success reduces the turnover and therefore reduces the cost of hiring and training new employees	SD	D	NS	A	SA
5.	Employee satisfaction can lead to customer satisfaction	SD	D	NS	A	SA

Section 10 (Work Environment and Culture)

Please place a circle (RING) around the answer that best describes the statement.

No	Statement	Strongly Disagree (1)	Disagree (2)	Not Sure (3)	Agree (4)	Strongly Agree (5)
1.	All employees are committed to participate in total quality management initiatives	SD	D	NS	A	SA
2.	Top management promotes a culture of employee participation	SD	D	NS	A	SA

3.	Employees show interest in eliminating customer returns	SD	D	NS	A	SA
4.	Teamwork and involvement are normal practices in the company	SD	D	NS	A	SA
5.	A pleasant environment exists in all working areas	SD	D	NS	A	SA

Section 11 (Supplier Quality Management)

Please place a circle (RING) around the answer that best describes the statement.

No	Statement	Strongly Disagree (1)	Disagree (2)	Not Sure (3)	Agree (4)	Strongly Agree (5)
1.	Suppliers are selected on the basis of having a quality accreditation	SD	D	NS	A	SA
2.	Suppliers are regularly audited by PISA's quality department	SD	D	NS	A	SA
3.	Suppliers provide relevant quality records and data	SD	D	NS	A	SA
4.	PISA works closely with suppliers toward long term partnership and improvement.	SD	D	NS	A	SA
5.	Quality issues with raw materials are identified, necessary action plans agreed and progress monitored by both parties	SD	D	NS	A	SA

MANAGEMENT QUALITY POLICY STATEMENT

By nature, there is a total quality requirement on the products we manufacture. No compromise can be tolerated when the life of our customers is dependent on the correct functioning of our products. From the design to the production of parachutes, it must be our commitment to ensure that no process is ever overlooked.

Quality is by essence the foundation of PISA's customer satisfaction and this manual is its cornerstone. Here are the rules applicable to our processes. They ensure that the products we deliver conform to the expectations of our customers. It is my and every manager's responsibility to ensure that these works procedures are being known and complied with by PISA's employees.

Our future relies on our capacity to enhance PISA's customer service level. The road to an improved competitiveness can only be built on increasing quality levels and on time deliveries respectively measured by ZNCR (Zodiac Non Conformance Rate) and ZOTD (Zodiac on Time Delivery).

More than enforcing and maintaining this quality manual, our collective goal must be improving its policies and procedures. Our quality manual must be dynamic and an integral part of the improvement journey we have set for ourselves. Ensuring employees Safety, Lean principles (5S, Visual Management etc..), team work, Gemba must constantly be applied in an effort to add value to customer service. Internal leading indicators such as First Time Right for ZNCR and productivity for ZOTD will regularly be reviewed and communicated to ensure dynamic feedback.

I will work in close collaboration with PISA's quality team to ensure that this quality manual is known, understood and adhered to by all, at all levels of the company. I will also ensure that everybody in the organisation considers quality as a foundation of their activity that cannot be altered. Finally, I am committed to lead a culture of continuous improvement together with all employees in order to make PISA a world class parachute manufacturing facility. Quality is the journey on which PISA's future relies.

APPENDIX 5 - Interview Schedule

Position	Rationale	Location	Date	Duration
General Manager	I. Your view on quality performance internally and externally? II. The handling of customer complaints due to quality issues III. Objectives set for the quality department IV. Are you seeing signs of improvement by the staff and their involvement to improve quality? V. Due to customers receiving products that are not up to standard, how do we explain to customers the steps we are taking to improve our quality? VI. Should a system be in place to better handle customer complaints or more emphasis / system should be in place to eliminate quality issues internally? VII. Is the quality department responsible for producing quality or should this be directed towards all departments? VIII. Is the costs that are being incurred due to poor quality internally and customer complaints, is this having an effect on the profits of PISA? IX. What training is to take place for individuals on quality tools/ techniques? X. Are quality objectives set for the quality department realistic or should more emphasis be placed on acquiring skills to achieve the objectives?	General managers' office	7 May 2016	60 Minutes

Position	Rationale	Location	Date	Duration
Quality Products Manager	I. In your opinion are your customers happy with the quality of products that is delivered from PISA? II. Measuring of internal non - conformances III. How do you measure your non -conformance rate to customers? IV. How do you communicate improvements to your customers? V. By producing quality that is below customer expectations, do you think customers would move their business to other suppliers? VI. What quality tools are currently being used by your department? VII. What corrective action system do you have in place to handle customer claims / complaints?	Boardroom	7 May 2016	30 Minutes

Position	Rationale	Location	Date	Duration
Lean Manager	I. Can lean tools and quality tools be used to improve internal non - conformances and customer returns? II. Is Visual management in place? III. What is your opinion on the quality performance of PISA (Both internally and externally)? IV. Do you think that using more lean improvement tools/techniques would improve the quality performance? V. Are quality tools / techniques adequate for improvement or should the training be improved on how to better understand the tools? VI. Are customer complaints visually displayed in various departments of PISA? Or only displayed in the department that sent the non -conformance? VII. In your opinion is visual management a good way to communicate? VIII. Did you consider benchmarking PISA against other parachute manufacturers globally?	Boardroom	8 May 2016	30 Minutes

Position	Rationale	Location	Date	Duration
Finance Manager	I. The costs incurred due to quality issues II. The costs not recovered due to quality issues III. Budget for training and improvement of quality processes IV. Is customer returns having an impact on PISA's profits? V. Is customers returns budgeted for? VI. How do you report the costs incurred both internally and externally? VII. How do you explain the cost of customer returns to the Directors (which are based in France) PISA?	Boardroom	8 May 2016	30 Minutes

Position	Rationale	Location	Date	Duration
Purchasing Manager	I. Scheduling audits of suppliers II. What is the evaluation process for accepting suppliers? III. Do you think this process is adequate or should more criteria be set, as a parachute is a safety critical product? IV. Are suppliers evaluated on their quality and delivery performance? V. Are their actions in place to delist a supplier that does not perform? VI. Do you accompany the quality department during supplier audits?	Boardroom	9 May 2016	30 Minutes

APPENDIX 6 - Rotated component matrix

Question 2	Component		
	1	2	3
Top management shows commitment to quality	0.824	0.298	-0.025
PISA's management encourages team work	0.755	0.388	-0.125
PISA has a quality policy manual	0.332	0.745	-0.151
PISA's management communicates PISA's objective to staff	0.445	0.738	-0.052
You been notified of customer returns due to non-conformances	0.048	0.854	0.237
Customers visit PISA	0.764	-0.095	0.388
PISA has a high employee turnover (employees leaving for other jobs)	-0.032	-0.161	0.797
In the last 10 years you have at least one participated in PISA's stock take	0.070	0.363	0.568
PISA measures quality performance	0.604	0.494	-0.088

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 9 iterations.

Question 3	Component
	1
Top management ensures that every employee knows PISA's objectives	0.876
Top management invests in developing employees on total quality improvement techniques / tools	0.809
Middle management gets employees involvement in quality continuous improvement projects	0.775
Top management puts safety as priority above quality	0.664
Top management gets involved in projects to improve quality	0.798

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

Question 4	Component
	1
Employees are given training in how to identify and act on quality improvement opportunities	0.857
Employees are trained for job related skills	0.654
Employees are trained on total quality management concepts	0.903
Employees have been trained to use quality improvement tools example Ishikawa diagram	0.727
Employees are given training on how to measure quality performance	0.850

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

Question 5	Component		
	1	2	3
Customers' returned non-conforming products are studied for patterns and prevent the same problem reoccurring	0.856	0.017	0.282
Customer returns are communicated to the entire organisation	0.858	-0.022	-0.276
Customer returns are only handled by the quality department	-0.332	0.656	0.413
There are customers returns every month due to quality problems with products	0.151	0.888	-0.162
Customers measure PISA on quality performance	0.035	-0.020	0.919

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 5 iterations.

Question 6	Component	
	1	2
The General Managers holds a communication meeting once a month	0.003	0.944
The quality department communicates customer returns to all departments	0.606	0.436
Quality performance is communicated to employees on a daily basis	0.858	-0.123
Quality improvements projects are communicated to employees	0.869	0.028
Total quality management tools are used to communicate customer performance	0.695	0.200

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.

Question 7	Component
	1
There is a quality improvement team of employees that drive quality improvement	0.548
Quality improvement tools and techniques are widely used.	0.856
PISA practices continuous improvement of all its products, services, and processes	0.840
Continuous improvement initiates are visually displayed	0.744
All departments participate in quality improvement initiatives	0.692

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

Question 8	Component
	1
PISA encourages teamwork	0.646
Brainstorming sessions take place to get employees ideas on quality improvement	0.794
Sufficient financial resources are provided to support improvement activities	0.803
Employee participation in teamwork initiatives are rewarded by management	0.688
PISAs management is satisfied with the spirit of team work	0.715

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Question 9	Component	
	1	2
Employee's thoughts has been taken into consideration to make quality decisions	0.817	0.156
Employee awareness and feedback on status are recognised	0.875	0.098
Employee involvement in quality initiatives demotivate employees	-0.063	0.898
Employee participation in industry's success reduces the turnover and therefore reduces the cost of hiring and training new employees	0.185	0.850
Employee satisfaction can lead to customer satisfaction	0.721	-0.068

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

Question 10	Component
	1
All employees are committed to participate in total quality management initiatives	0.799
Top management promotes a culture of employee participation	0.742
Employees show interest in eliminating customer returns	0.729
Teamwork and involvement are normal practices in the company	0.671
A pleasant environment exists in all working areas	0.724

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Question 11	Component
	1
Suppliers are selected on the basis of having a quality accreditation	0.813
Suppliers are regularly audited by PISA's quality department	0.784
Suppliers provide relevant quality records and data	0.751
PISA works closely with suppliers toward long term partnership and improvement	0.904
Quality issues with raw materials are identified, necessary action plans agreed and progress monitored by both parties	0.809

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

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PARACHUTE INDUSTRIES OF SOUTHERN AFRICA (PTY) LTD		PROCEDURE NO	QM-002
ZODIAC AEROSPACE	P O BOX 1616 VERULAM 4340 REG.NO.2005/038410/07 / 29 DUIKER ROAD CANELANDS VERULAM 4340	REVISION NO	03
		DATE	18 DEC 2013

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WP-002	CONTROL OF RECORDS PROCEDURE	4.2.4
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WP-004	MANAGEMENT REVIEW PROCEDURE	5.1 / 5.6
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WP-006	INFRASTRUCTURE AND ENVIRONMENT	6.3 / 6.4
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Issued By:	Date:	Approved By:	Date:

APPENDIX 8 – Statutory and regulatory requirements

1. Parachute Related Products:

Military Parachute Products are designed and certified by PISA through the Technical Department. At that point, the products are issued with an official PISA Part Number. When a new product is introduced to the Defence Authorities, in South Africa, they in-turn add their own acceptance standards to it. Once approved into the Defence inventory, the products are then issued a National Stock Number (based on the PISA Part Number). The National Stock Number (N.S.N.) is controlled by the National Codification Bureau of the Republic of South Africa in Pretoria. PISA is then allocated a Commercial and Government Entity Number (CAGE Code), to which our reference is V6507.

In addition to the National Codification System, PISA Parachutes are then participants with The North Atlantic Treaty Organisation's (N.A.T.O.) Military non N.A.T.O. sponsored nations Logistical supply processes. Parachutes are listed as 1670, followed by the country code 18 for South Africa, followed by an Identification Number of the individual product.

Export customers either follow their own acceptance procedures or accept the South African Defence procedures couple with The N.S.N. / NATO Codification System.

Sport parachutes follow a similar procedure, but receive approval through the South African Civil Aviation Authority ZA-T.S.O. System (an approval testing standard) or in the situation of international customers accept the United States Federal Aviation Administration's T.S.O. (Technical Standard Order) approval which is administered on behalf of The FAA by the South African CAA. These Sport Parachutes are certified for the Reserve parachute and Harness / Container System and not for the main parachute through a series of performance live jump tests.

Strength and performance related textile products incorporated into parachutes hold generally approved USA Military Specifications (Mil Spec's) Parachute Industry Association Standards or commonly accepted commercial standards, within The International Parachute Industry. The key areas of control for textile products are the parachute cloth, suspension line, webbing, reinforcing tapes, container fabrics and then the steel load bearing hardware components.

2. Other Legal Requirements:

PISA. complies with the following legal requirements:

a) *Occupational Health and Safety Act 85 of 1993.*
b) *Employment Equity Act.*
c) *Basic Conditions of Employment Act.*
d) *Skills Development Act.*
e) *Labour Relations Act.*