

AN INVESTIGATION ON THE IMPACT OF PROCUREMENT QUALITY
MANAGEMENT IN A NUCLEAR POWER STATION

GUIMEDE NOMFUSI LETICIA

 CAPE PENINSULA
UNIVERSITY OF TECHNOLOGY
LIBRARIES

Dewey No. ARC 658.72 Gum

CAPE PENINSULA
UNIVERSITY OF TECHNOLOGY



20132042

CPT ARC 658.72 Gum
(Green) Not for loan



**AN INVESTIGATION ON THE IMPACT OF PROCUREMENT QUALITY
MANAGEMENT IN A NUCLEAR POWER STATION**

by

Gumede Nomfusi Leticia

**Dissertation submitted in fulfilment of the requirements for the
degree**

Master of Technology: Quality

in the Faculty of Engineering

at the Cape Peninsula University of Technology

**Supervisor: Prof. Dr. J A Watkins
Co-supervisor: Mr A Bester**

Bellville

November 2011

DECLARATION

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

Name: Nomfusi Gumede

Signature: 

Date: November 2011

ACKNOWLEDGEMENTS

The author of this dissertation wishes to acknowledge the contributions of the following people in the completion of this research:

- My Saviour, King Jesus, for His grace and mercy He has afforded me throughout my life.
- My loving husband, who patiently and consistently supported me through all the late nights.
- My two beautiful daughters, Lindi and Unathi, for being patient and understanding, and also Phindile Radebe for her support.
- My helper (child-minder) who patiently supported me during my studies. Thank you, Buli.
- My Lecturer; Mr Bester, and Professor Andre Watkins, without whom I would not have been able to complete this research.

ABSTRACT

This research project in Procurement Quality Engineering was conducted at a Nuclear Power Generation Company in the Western Cape, South Africa. During the past decade, quality management has become increasingly recognised as highly desirable for all organisations at all levels. All organisations, to varied degrees, can benefit from the application of quality management skills in some parts of their daily operations.

The research project will investigate the impact or effect of late deliveries of spares on the operational cost of the organisation. The organisation is not aware what impact the delivery of spares has on operating costs. Against the above background, the problem to be researched within the ambit of this dissertation reads as follows: “Poor product and / or service delivery from Vendors and / or Suppliers have an adverse impact on the output of the Procurement Quality Department”.

The primary research objectives of this study are the following:

- To emphasise the importance of quality within the supply chain.
- To investigate the impact of non-conforming items delivered to a Nuclear Power Plant.
- To determine measures which can be put in place to improve communication between suppliers, vendors, buyers and procurement quality engineering.
- To determine or investigate the cost of poor quality in the organisation.
- To improve the quality of goods and services through the application of a quality management system within the supply chain.

The research method used in this research project involved both qualitative and quantitative research processes. Questionnaires and statistical techniques were used to analyse the data, and to draw conclusions and recommend possible areas for improvement. The research methodology falls within the ambit of a case study.

GLOSSARY OF TERMS

Non-conformance:	Non-fulfilment of a requirement or the failure of a product to meet a specified requirement. (ISO 9000, 2005:13).
Requirement:	A need or expectation that is used, generally implied or obligatory. (ISO 9000, 2005:7).
Supplier (Contractor):	A supply chain management term referring to anyone who provides goods or services to a company. A vendor often manufactures items, and sells those items to a customer. (Gitlow & Gitlow, 1987:159).
Supply Chain Management:	The simultaneous integration of customer requirements, internal processes, and upstream supplier performance. (Ghosh, Kannan & Tan, 1998:1035).
Total Quality Management:	Ensures that management is responsible for developing the organisation's vision, establishing guiding principles (Code of Conduct), and setting the strategy and tactics for achieving the vision, within the constraints of the guiding principles. (Goetsch & Davis, 2002:312).
Project:	A unique process consisting of a set of coordinated and controlled activities with start and finish dates, undertaken to achieve an objective conforming to specified requirements, including constraints of time, cost and resources. (ISO 10006, 2003:2).
Process:	A set of interrelated or interacting activities which transform inputs into output. (ISO 9000, 2005:7).

TABLE OF CONTENTS	PAGE
DECLARATION OF THE COPYRIGHT	(i)
ACKNOWLEDGEMENTS	(ii)
ABSTRACT	(iii)
GLOSSARY OF TERMS	(iv)
LIST OF ANNEXURES	(ix)
TABLE OF FIGURES	(x)
LIST OF TABLES	(xi)
CHAPTER 1: SCOPE OF THE RESEARCH	
1.1 INTRODUCTION AND MOTIVATION	1
1.2 BACKGROUND TO THE RESEARCH PROBLEM	2
1.2.1 Statement of the research problem	2
1.3 THE RESEARCH QUESTION STATEMENT	3
1.3.1 Investigative sub-questions	3
1.4 PRIMARY RESEARCH OBJECTIVES	3
1.5 THE RESEARCH PROCESS	4
1.6 THE RESEARCH DESIGN AND METHODOLOGY	5
1.7 DATA COLLECTION DESIGN AND METHODOLOGY	6
1.8 DATA VALIDITY AND RELIABILITY	6
1.9 ETHICS	8
1.10 RESEARCH ASSUMPTIONS	8
1.11 RESEARCH CONSTRAINTS	9
1.12 CHAPTER AND CONTENT ANALYSIS	9
CHAPTER 2: BACKGROUND TO RESEARCH ENVIRONMENT	
2.1 THE NATURE OF ESKOM BUSINESS	11
2.2 HISTORY OF ESKOM	11
2.3 ROLE OF ESKOM IN SOUTH AFRICA	12

2.4	ESKOM'S COMMUNITY / SOCIAL INVOLVEMENT (DEVELOPMENT PROGRAMMES)	13
2.4.1	Eskom mathematics, science and technology programme and winter school	14
2.4.2	Tertiary education support programme (TESP)	14
2.4.3	National Science and Technology Forum	14
2.4.4	Water Conservation Programme	15
2.5	KOEBERG NUCLEAR POWER STATION	15
2.5.1	Nuclear Power Origination	16
2.5.2	Advantages of the nuclear power	16
2.5.3	Disadvantages of the nuclear power	17
2.6	MANAGEMENT SYSTEMS AT KOEBERG	17
2.6.1	Quality Management Systems	17
2.6.2	Environmental Management Systems	18
2.6.3	Safety Management Systems / Safety Culture	18
2.6.4	Training and development	19
2.7	PROCUREMENT DEPARTMENT AT KOEBERG	20
2.7.1	Procurement Quality Engineering (PQE)	20
	CHAPTER 3: SUPPLY CHAIN AND QUALITY MANAGEMENT	
3.1	INTRODUCTION	22
3.2	PROCUREMENT MANAGEMENT	23
3.2.1	Procurement Planning	25
3.2.2	Control of Procurement Documents	26
3.3	QUALITY MANAGEMENT	27
3.3.1	Human Resources: Training	30
3.4	SUPPLY CHAIN MANAGEMENT (SCM)	31
3.4.1	Supply Chain Quality Management (SCQM)	33
3.4.2	The Quality Concept in Purchasing and S. Chain Management	33
3.4.3	Supply Chain Management and Internal Service Quality	33

3.5	BUYER - SUPPLIER RELATIONSHIP	34
3.5.1	Team Relationships	36
3.6	PARTNERSHIPS	38
3.7	RISK AND SUPPLY CHAIN MANAGEMENT	39
3.7.1	Risk Management	38
3.7.2	Consequences of failing to manage risk	41
3.8	CONTROL OF NON-CONFORMING PRODUCTS	42
3.9	QUALITY COSTING	44
3.10	CATEGORIES / MODELS OF QUALITY COST	45
3.11	COST OF POOR QUALITY (COPQ)	47
3.12	REDUCING THE COST OF POOR QUALITY	48
3.13	IMPROVEMENT TOOLS FOR MANAGEMENT	49
3.13.1	Continuous Process Improvement (CPI)	50
3.13.2	Quality Management Control Tools	52
	CHAPTER 4: THE SURVEY ENVIRONMENT	
4.1	THE SURVEY ENVIRONMENT	55
4.2	AIM OF THIS CHAPTER	55
4.3	CHOICE OF SAMPLING METHOD	55
4.4	THE TARGET POPULATION	56
4.5	DATA COLLECTION	56
4.6	MEASUREMENT SCALES	57
4.7	THE DEMAND FOR A QUALITATIVE RESEARCH STRATEGY	58
4.8	SURVEY SENSITIVITY	58
4.9	SURVEY DESIGN	59
4.10	THE VALIDATION SURVEY QUESTIONS	60
4.11	THE RESEARCH QUESTIONNAIRE	60
4.11.1	BUYERS QUESTIONNAIRES	61
4.11.2	MATERIALS MANAGEMENT QUESTIONNAIRES	63
4.12	CONCLUSION	65
	CHAPTER 5: DATA ANALYSIS	
5.1	INTRODUCTION	66
5.2	METHOD OF ANALYSIS	67

5.2.1	VALIDATION OF SURVEY RESULTS	67
5.2.2	DATA FORMAT	68
5.2.3	PRELIMINARY ANALYSIS	68
5.2.4	INFERENTIAL STATISTICS	68
5.2.5	ASSISTANCE TO RESEARCHER	70
5.2.6	SAMPLE	70
5.3	ANALYSIS	70
5.3.1	RELIABILITY TESTING	71
5.3.2	DESCRIPTIVE STATISTICS	75
5.3.3	UNI-VARIATE GRAPHS	76
5.3.4	INFERENTIAL STATISTICS	80
5.3.4.1	Comparisons with regard to the difference in proportions who agreed and who disagreed	81
5.3.4.2	Comparisons with regard to whether the two independent groups differed in respect of their perceptions	86
5.3.4.3	Analysis of Variance and Mann-Whitney U tests	92
	CHAPTER 6:RECOMMENDATIONS AND CONCLUSION	
6.1	INTRODUCTION	94
6.2	THE RESEARCH PROBLEM REVISITED	94
6.3	THE RESEARCH QUESTIONS REVISITED	94
6.4	THE INVESTIGATIVE QUESTIONS REVISITED	94
6.5	KEY RESEARCH OBJECTIVES REVISITED	95
6.6	FINDINGS AND CONCLUSIONS	96
6.7	RECOMMENDATIONS	97
	BIBLIOGRAPHY	99

LIST OF ANNEXURES

ANNEXURE A: Cronbach Alpha Coefficients for all the items in the Questionnaire	105
ANNEXURE B: Descriptive statistics: Frequency tables	110
ANNEXURE C: Descriptive statistics: Uni-variate with means & standard deviations where appropriate	115
ANNEXURE D: Comparison of proportions	124
ANNEXURE E: Chi-square test for comparisons	128
ANNEXURE F: ANOVA & Man Whitney test	137
ANNEXURE G: Cronbach's Alpha Coefficient for all the items forming the measuring instrument in this survey for the total sample	138
ANNEXURE H: Cronbach's Alpha Coefficient for each scale forming the measurement of impact of non -conformances	140
ANNEXURE I: Cronbach's Alpha Coefficient for each scale forming the measurement of the importance of quality in the supply chain management for the total sample	145

TABLE OF FIGURES

Figure 3.1:	Risk management	40
Figure 3.2:	Core risk analysis	41
Figure 3.3:	Components of the cost of quality	48
Figure 3.4:	The Deming (PDCA) Cycle	50
Figure 5.1:	Survey distribution.	76
Figure 5.2:	The impact of non-conformances.	76
Figure 5.3:	The importance of quality in the supply chain management.	77
Figure 5.4:	Quality Management tools to measure the reduction of non-conformances.	78
Figure 5.5:	Mechanisms to be deployed to reduce non-conformances.	78
Figure 5.6:	Improvement of quality of goods and services through the application of QMS within the supply chain.	79
Figure 5.7:	The impact of non-conformances.	83
Figure 5.8:	The importance of quality in the supply chain management.	83
Figure 5.9:	Quality Management tools to measure the reduction of non-conformances.	84
Figure 5.10:	Mechanisms to be deployed to reduce non-conformances.	85
Figure 5.11:	Improvement of quality of goods and services through the application of QMS within the supply chain.	85
Figure 5.12:	The impact of non-conformances.	87
Figure 5.13:	The impact of non-conformances.	88
Figure 5.14:	The impact of non-conformances.	89

Figure 5.15:	The impact of non-conformances.	90
Figure 5.16:	The impact of non-conformances.	91
Figure 5.17:	The impact of non-conformances.	92

LIST OF TABLES

Table 5.1:	Cronbach's Alpha Coefficient for all the items forming the measuring instrument in this survey for the total sample.	140
Table 5.2:	Cronbach's Alpha Coefficient for each scale forming the measurement of impact of non-conformances.	72
Table 5.3:	Cronbach's Alpha Coefficient for each scale forming the measurement of the importance of quality in the supply chain management for the total sample.	73
Table 5.4:	Cronbach's Alpha Coefficient for each scale forming the measurement of quality management tool that reduces non-conformances.	73
Table 5.5:	Cronbach's Alpha Coefficient for each scale forming the measurement of the mechanisms to be deployed to reduce non-conformances.	74
Table 5.6:	Cronbach's Alpha Coefficient for each scale forming the measurement of quality of goods and services.	75
Table 5.7:	Descriptive statistics for all the variables.	142
Table 5.8:	Descriptive statistics-mean, median, standard deviation and range.	147
Table 5.9:	Statistically significant Chi-square test for equal proportions.	81
Table 5.10:	Contingency table for Respondent group vs Q3.	87
Table 5.11:	Chi-square test for Respondent group vs Q3.	87

Table 5.12:	Contingency table for Respondent group vs Q7.	88
Table 5.13:	Chi-square test for Respondent group vs Q7.	88
Table 5.14:	Contingency table for Respondent group vs Q9.	89
Table 5.15:	Chi-square test for Respondent group vs Q9.	89
Table 5.16:	Contingency table for Respondent group vs Q20.	90
Table 5.17:	Chi-square test for Respondent group vs Q20.	90
Table 5.18:	Contingency table for Respondent group vs Q22.	91
Table 5.19:	Chi-square test for Respondent group vs Q22.	91
Table 5.20:	Contingency table for Respondent group vs Q24.	92
Table 5.21:	Chi-square test for Respondent group vs Q24.	92

CHAPTER 1: SCOPE OF THE RESEARCH

1. INTRODUCTION AND MOTIVATION

South Africa is the only country in Africa that uses nuclear energy to generate electricity. Koeberg ensures a reliable supply of electricity to the Western Cape, which is one of the fastest growing regions in South Africa. It has operated safely for more than 21 years and has a further active life of 30 - 40 years. The station's two reactors supply 1 800 MW, or 6%, of South Africa's electricity needs. Koeberg has produced more than 81 000 million KWh of electricity since 1984, using seven and a half tonnes of Uranium. Seawater is used to cool the condenser on the secondary side. Koeberg makes a small contribution to the electricity mix to South Africa. For instance, in 1998 Koeberg generated 13,6bKWh (Kilowatt hour) of electricity, accounting for about 7 % of the country's total electricity generation. (Eskom, 2002:**Online**).

One important contribution to the successful operation of this facility is the steady supply of spares and the award of contracts in accordance with the respective Nuclear Standards and Specifications. Due to the nature of the requirements for spares for the facility, the procurement of the spares, and awards of contracts, equates a major percentage of the operating cost of the organisation. Non-conformance with requirements by suppliers, and late delivery of spares has a significant impact on the organisation and its operations, and causes disruptions such as planning delays, paperwork delays and reworking. The power station will benefit from this research project because:

- The research will address areas of improvement.
- The research will focus, in addition, on the processes that will be implemented and maintained in order to reduce non-conformance issues.
- The research will identify which quality management tools should to be implemented and used in order to measure and reduce non-conformance issues.

1.2 BACKGROUND TO THE RESEARCH PROBLEM

The purpose of this research is to investigate the impact of procurement quality management at a Nuclear Power Plant. The research project will be carried out within the Procurement Department under the Procurement Quality Engineering Group (PQE). The Procurement Department consists of local and international buyers and senior advisors, who are responsible for purchasing spares and placing contracts with vendors or suppliers. The PQE group consists of approximately eight Quality Advisors who are responsible for the following:

- Perform quality engineering and surveillance on all activities related to procurement of equipment, tools and services for the jobs assigned.
- Review and accept: Material requisitions (MR), Purchase requisitions (PR), quality control plans (QCP), tenders, bids, purchase orders, inspection or source verifications and test plans, inspections and test procedures, acceptances.
- The procurement quality assurance group has the lead role in defining the procurement quality programme, and performing, monitoring and verifying activities to ensure their effective compliance with the requirements.
- The group controls and/or monitors the effectiveness of the quality programme of the supply chain, and the quality of the products through source verifications and documents and record reviews.

The research investigated the impact of non-conformances in the supply chain.

1.2.1 Statement of the research problem

According to Watkins (2008:35), (citing Cooper and Schindler 2006), the statement of the research problem pertains to a problem within the research environment, and will form the primary focus of the research. Against the above background the research problem to be researched within the ambit of this dissertation reads as follows: "Poor product and/or service delivery from vendors and/or suppliers have an adverse impact on the output of the Procurement Quality Department".

1.3 THE RESEARCH QUESTION STATEMENT

The research question to be searched within the ambit of this dissertation, reads as follows: “Which mechanisms and/or processes can be used to reduce non-conformances of vendors and/or suppliers to culminate in improved delivery and overall efficiency”?

1.3.1 Investigative sub-questions

The investigative sub-questions to be researched in support of the research question are as follows:

- What is the impact of poor quality or non-conformance?
- How can non-conformance be prevented in future?
- What are the quality management tools that can be used to analyse and prevent non-conformance?
- What alternative mechanisms can be deployed to minimise non-conformance?
- What processes do the suppliers and/or vendors have in place in order to address non-conformance?

1.4 PRIMARY RESEARCH OBJECTIVES

The research objectives to be considered in this research project are the following:

- To investigate the impact of non-conforming items delivered to the Nuclear Power Plant.
- To emphasize the importance of quality within the Supply Chain Management.
- To determine which measures should be put in place in order to improve communication between suppliers or vendors, buyers, and the procurement Quality Engineering Department.
- To investigate mechanisms to be deployed in order to reduce non-conformance.

- To improve the quality of goods and services through the application of a quality management system within the supply chain.

1.5 THE RESEARCH PROCESS

According to Watkins (2008:39), the research process provides an insight into the process of 'how' the research will be conducted, from formulating the research proposal to final submission of the thesis or dissertation.

According to Watkins (2008:39), (citing Remenyi, Williams, Money, and Swartz 2002), explain the research process as consisting of eight specific phases, namely:

- Reviewing the literature.
- Formalising a research question.
- Establishing the methodology.
- Collecting evidence.
- Analysing the evidence.
- Developing conclusions.
- Understanding the limitations of the research.
- Producing management guidelines or recommendations.

According to Watkins (2008:40), (citing Collis and Hussey 2003), there are six fundamental stages of the research process, namely:

- The identification of the research topic.
- Definition of the research problem.
- Determining how the research is going to be conducted.
- Collection of the research data.
- Analysis and interpretation of the research data.
- Writing up of the dissertation or thesis.

After detailed considerations of the diverse types of processes, the researcher will adopt the Collis and Hussey research process.

1.6 THE RESEARCH DESIGN AND METHODOLOGY

According to Watkins (2008:42), (citing Yin 1994), a research design can be defined as "...the logical sequence that connects the empirical data to study's initial research question, and ultimately, to its conclusion". Colloquially, a research design is an action plan from getting here to there where 'here' may be defined as the initial set of questions to be answered, and 'there' is some set of conclusions (answers) to these questions.

Case study research will serve as a research method. A case study is an empirical enquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. Furthermore:

- Case study research aims not only to explore certain phenomena, but also to understand them in a particular context.
- "How" and "why" questions are explanatory, and likely to be used in case study research.
- A case study illuminates a decision or set of decisions - why they were taken, how they were implemented, and with what result.
- The case study as a research strategy comprises an all-encompassing method - with the logic of design incorporating specific approaches to data collection and data analysis. In this sense, the case study is not either data collection or merely a design feature alone, but "a comprehensive research strategy".
- A case study is typically used when contextual conditions are the subject of research.

According to Watkins (2008:47), (citing Collis and Hussey 2003), case studies are often described as exploratory research used in areas where there are few theories or a deficient body of knowledge. In addition, the following types of case studies can be identified:

- **Descriptive case studies:** Where the objective restricted to describing current practice.
- **Illustrative case studies:** Where the research attempts to illustrate new and possibly innovative practices adopted by particular companies.

- **Experimental case studies:** Where the research examines the difficulties in implementing new procedures and techniques in an organisation and evaluating the benefits.
- **Explanatory case studies:** Where existing theory is used to understand and explain what is happening.

1.7 DATA COLLECTION DESIGN AND METHODOLOGY

The data collection methodology to be used within the ambit of this research will be questionnaires. Questionnaires fall within the ambit of a broader definition of 'survey research' or descriptive survey'. The concept of 'survey' is defined by Watkins (2008:67), (citing Remenyi *et al* 2002), as: "...the collection of a large quantity of evidence, usually numeric, or evidence that will be converted to numbers, normally by means of a questionnaire". A questionnaire is a list of carefully structured questions, chosen after considerable testing, with a view to eliciting reliable responses from a chosen sample. The aim is to establish what a selected group of participants do, think or feel. A positivistic approach suggests structured close ended' questions, while a phenomenological approach suggests unstructured 'open-ended' questions. In this research, different questionnaires will be designed for Senior Buyers and Materials Management.

1.8 DATA VALIDITY AND RELIABILITY

According to Watkins (2008:67), (citing Collis and Hussey 2003), 'validity' is concerned with the extent to which the research findings accurately represent what is happening. More specific, whether the data is a true picture of what is being studied. According to Watkins (2008:67), (citing Cooper and Schindler 2006), three major forms of validity can be identified, namely 'content validity', 'criterion-related validity' and 'construct validity', which are expanded upon below to provide a holistic perspective of each of the concepts:

- **Content validity:** The content of the measuring instrument is the extent to which it provides adequate coverage of the investigative (sub-) questions guiding the study. If the instrument contains a representative sample of the universe of subject matter of interest, then content validity is good.

- **Criterion-related validity:** This reflects the success of measures used for prediction or estimation. Any criterion measure must be judged in terms of the following four qualities:
 - **Criterion is relevant:** The criterion must be defined and scored in the terms with which we judge the proper measures of success.
 - **Freedom from bias:** The criterion must allow each respondent the opportunity to score well.
 - **Reliability:** A reliable criterion is stable and responsible.
 - **Availability:** The information specified by the criterion must be available.
- **Construct validity:** In attempting to evaluate construct validity, both the theory and the measuring instrument being used should be considered.

Construct validity relates to the problem that there are a number of phenomena which are not directly observable, such as motivation, satisfaction, ambition and anxiety, Watkins (2008:68), (citing Collis and Hussey 2003).

Reliability, (also referred to as 'trustworthiness'), is concerned with the findings of the research, Watkins (2008:68), (citing Collis & Hussey 2003). The findings can be said to be reliable if you, or anyone else, repeated the research and obtained the same results. There are three common ways of estimating the reliability of the responses to questions in questionnaires or interviews, namely, the 'test re-test method', the 'split-halves method', and the 'internal consistency method':

- **Test re-test method:** The questions are asked of the same people, but on separate occasions. Responses on the two occasions are correlated and the correlation coefficient of the two sets of data computed, thus providing an index of reliability.
- **Split-halves method:** The questionnaires or interviews record sheets are divided equally into two halves. The two piles are then correlated and the correlation coefficient of the two sets of data computed, thus providing an index of reliability.

- **Internal consistency method:** Every item is correlated with every other item across the entire sample, and the average inter-item correlation is taken as the index of reliability.

The test re-test method will be applied to this research study.

1.9 ETHICS

In the context of research, according to Watkins (2008:69), (citing Saunders, Lewis and Thornhill 2001), "... ethics refer to the appropriateness of your behaviour in relation to the rights of those who become the subject of your work, or are affected by it". The following ethical issues will be observed during this research study:

- **Informed consent:** Participants should be given the choice to participate or not to participate, and furthermore be informed in advance about the nature of the study.
- **Right to privacy:** The nature and quality of participants' performances will be kept strictly confidential.
- **Honesty with professional colleagues:** Findings will be reported in a complete and honest fashion, without misrepresentation.
- **Confidentiality/anonymity:** Confidentiality and anonymity will apply to questionnaires, as this will lead to participants giving more open and honest responses.

1.10 RESEARCH ASSUMPTIONS

According to Watkins (2008:71), (citing Leedy and Ormrod 2001), "...assumptions are what the researcher takes for granted. But taking things for granted may cause misunderstandings. What we may tacitly assume, others may have never considered. If we act on our assumptions, and in the final result such actions make a big difference to the outcome, we may face a situation we are totally unprepared to accept. In research, we try to leave nothing to chance in the hope of preventing misunderstandings". The Researcher assumed that there would

be no travelling involved since the research was conducted with the organisation and the Buyers and Materials Management personnel were office based.

1.11 RESEARCH CONSTRAINTS

Research constraints (limitations or de-limitations); pertain to any inhibiting factor which would in any way constrain the research student's ability to conduct research in a normal way. According to Watkins (2008:73), (citing Collis and Hussey 2003), 'limitations' identify weaknesses in the research, while 'de-limitations' explain how the scope of the study was focused on one particular area or entity, as opposed to say wider or holistic approach.

The research constraints are as follows:

- **De-limitations:** The research will be confined to a nuclear power plant, and the questionnaires will be sent to various departments, namely:
 - Procurement department.
 - Materials management.

1.12 CHAPTER AND CONTENT ANALYSIS

The chapter and content analysis pertaining to this dissertation is as follows:

- **Chapter 1: The scope of the research:** This chapter will provide a brief introduction to, and background for the research. The research process will be explained, followed by the formulation of the research problem, the research question and supporting investigative questions. The research assumptions and constraints will be listed, feeding into the overall research design and methodology. The chapter will further provide details of the chapter and content analysis of the dissertation, including key research objectives.
- **Chapter 2: A holistic perspective of the research environment:** This chapter will provide a background to, and holistic overview of Eskom Koeberg Nuclear Power Station.
- **Chapter 3: Literature review:** In this chapter, a literature review on the supply chain will be conducted. The research methodology to be used in this

research study will be discussed, and various aspects that impact on the study will be explained.

- **Chapter 4: Data collection design and methodology:** This chapter will include research and interviewing participants at Koeberg Nuclear Power Station.
- **Chapter 5: Data analysis and interpretation of results:** The data gleaned from Chapter 4 will be analysed, and the results interpreted.
- **Chapter 6: Conclusion:** In this chapter, the research will be concluded and recommendations will be made to mitigate the research problem.

CHAPTER 2: BACKGROUND TO RESEARCH ENVIRONMENT

2.1 THE NATURE OF ESKOM BUSINESS

Eskom generates 95% of the electricity used in South Africa. Eskom is a vertically integrated operation that generates, transmits and distributes electricity to industrial, mining, commercial, agricultural and residential customers, and to redistributors. (Eskom, 2002:**Online**).

Eskom Enterprises, the wholly owned subsidiary of Eskom, together with its subsidiaries, serves as a means by which all the non-regulated activities of Eskom, both inside and outside South Africa, are carried out. Eskom Enterprises' core lines of business are infrastructure development, energy business operations, specialised energy services and the pursuit of key opportunities in related or strategic businesses, such as information technology and telecommunications.

2.2 HISTORY OF ESKOM

Since establishing the Electricity Supply Commission in 1923, the organisation has grown tremendously. The ownership of Eskom vests in the South African government. The operations of Eskom are located in South Africa. Eskom Enterprises has operations on the African continent, with its head office being located in Johannesburg, South Africa, and other offices in Uganda, Nigeria and Mali. (Eskom, 2002:**Online**).

Additional power stations and major power lines are being built to meet the rising electricity demand in South Africa. Eskom is regulated under subject licences granted by the National Energy Regulator of South Africa (NERSA), originally under the Electricity Act (41 of 1987) – and lately under the Electricity Regulation Act (4 of 2006) – and by the National Nuclear Regulator in terms of the National Nuclear Regulatory Act (47 of 1999).

Between 1950 and 1970 Eskom increased its capacity by 130%, extending existing Power stations and building new ones. Another major milestone was the building of Koeberg, Africa's first nuclear power station, in 1984. Electrification on a massive scale kicked off in 1990, and a major highlight was winning the Global Power Company of the Year award in 2001. (Eskom, 2002:**Online**).

Eskom is integrally linked to the economic development of South Africa. Over the years, Eskom has established a record of excellence in many aspects of its business, from engineering and people development to social and environmental innovation. Eskom is currently the largest single supplier of electrical energy on the African continent, supplying more than 45% of the electricity consumed. It is among the largest utilities in the world. For the purpose of this research, the research project will be conducted at Koeberg Nuclear Power Station. (Eskom, 2002:**Online**).

2.3 ROLE OF ESKOM IN SOUTH AFRICA

Eskom, as a state-owned enterprise, has a greater role to play, in addition to the supply of electricity. It also supports South Africa's growth and development aspirations. Eskom's value proposition to the country can be summarised as follows:

- **Providing electricity to all South Africans:** Electricity is a necessary and important input to all economic activity, and, in particular, is important for realising national socio-economic objectives. Investment in electricity generation infrastructure is a necessary precondition for sustained economic growth. Fundamentally, new investments in other sectors can only proceed if the future supply of electricity is secure.
- **Supporting other industries:** Over and above supplying electricity, the size of the organisation's current operations and expansion makes Eskom an important economic stimulant. For example, as electricity generation uses approximately 50% of the country's coal production, the continued operation of Eskom is therefore an integral part in ensuring sustainability of the coal mining sector and related industries – sectors that provide substantial employment. (Eskom, 2002:**Online**).

- **Driving transformation:** Eskom's affirmative procurement strategy has a direct bearing on redistributing wealth and income in society. Eskom continues to support procurement with BEE and BWO suppliers, thereby channelling significant amounts of money into these sectors.
- **Creating jobs and new industries:** Over five years (to March 2013) Eskom will spend R385 billion on capital expenditure. This is the biggest build programme in the country and will have large spin-offs through the awarding of contracts, investment by suppliers and the purchasing of goods and services sourced from South Africa. This will help to create approximately 40 000 direct and indirect new jobs, with the related skills development benefits. (Eskom, 2002:Online).
- **Providing a reliable electricity infrastructure:** For direct foreign investment, a secure and reliable electricity supply is a prerequisite. Eskom ensures that South Africa remains an attractive investment destination.

2.4 ESKOM'S COMMUNITY / SOCIAL INVOLVEMENT (DEVELOPMENT PROGRAMMES)

Eskom is committed to ploughing back to the community. Prior to the 2009 academic year Eskom supported government's national Department of Education's Dinaledi schools programme, for six years. This commitment to support 18 schools concluded at the end of 2008. A total of six schools were selected for the 2009 academic year. (Eskom, 2002:Online).

Several national programmes are executed by Eskom's Human Resources division and these are:

- Eskom maths, science and technology programme and winter school.
- Tertiary education support programme (TESP).
- National science and technology forum (NSTF).
- Water conversation programme.

2.4.1 Eskom mathematics, science and technology programme and winter school

The programme objectives are to increase the number of learners who pass Grade 12, with university exemption in mathematics and physical science. The objectives are as follows:

- To serve as resource centres for surrounding schools.
- To act as a pilot for potential input to the national Department of Education's Dinaledi schools programme.

Koeberg supports two schools in the Western Cape namely, Atlantis High School and Nkwenkwezi High School in Dunoon. (Eskom, 2002:**Online**).

2.4.2 Tertiary education support programme (TESP)

Eskom supports higher education institutions, so as to attract and develop the appropriate skills required. Higher education institutions are constrained to provide the required skills to support South African industry.

The objectives of TESP are as follows:

- To develop students with increased knowledge of science, engineering, and technology.
- To retain and increase the knowledge base, and lecturing staff, at higher education institutions.
- To develop the capacity to conduct research.
- To increase the pool of potential Eskom employees.
- To create the capacity to provide a transfer of knowledge to the Eskom skills pipeline and professionals in industry. (Eskom, 2002:**Online**).

2.4.3 National Science and Technology Forum

A memorandum of understanding was entered into between the national science and technology forum (NSTF), the National Research Foundation, and Eskom for the NSTF awards in the capacity development category, which focuses on the

recognition of academics and researchers for their achievements in the development of black, post-graduate students, and degree undergraduate students. (Eskom, 2002:**Online**).

2.4.4 Water Conservation Programme

Eskom is one of the largest consumers of freshwater in South Africa, accounting for approximately 2% of the country's total annual consumption. (Eskom, 2002:**Online**).

Due to the role of water in the electricity generation process, water resources are an important input into Eskom's value chain. Eskom encourages people to save water, and also encourages its employees to participate in various activities, especially during "Water Week" which is held in March every year.

Water management and sewage plant reviews are conducted at all coal-fired power stations to assess the status and effectiveness of water management practices, and to promote water conservation and water demand management. The management reviews revealed various deficiencies, such as unaccounted water losses, water leaks, ageing plant, poor coal quality leading to load losses, and higher demineralised water consumption, and opportunities to reduce water consumption.

2.5 KOEBERG NUCLEAR POWER STATION

Koeberg Power Station is the only nuclear power station on the African continent. It is situated at Duynefontein, 30km northwest of Cape Town in South Africa, on the Atlantic coast. Koeberg ensures a reliable supply of electricity to the Western Cape - one of the fastest growing regions in South Africa. It has operated safely for more than 21 years, and efficiently for a decade, and has a further active life of 30 - 40 years. The station's two reactors supply 1 800 MW, or 6%, of South Africa's electricity needs. Koeberg has produced more than 81 000 million kWh of electricity since 1984, using seven and a half tonnes of Uranium. The construction of Koeberg Nuclear Power Station, which started in 1976, was

preceded by ten years of investigations and exhaustive studies. This was done, even though the lifespan of the Koeberg Power Station is only 40 years, taking it to the year 2024. It is possible to extend this to 50-60 years, based on global experience of similar power reactors. Koeberg has two units, each having a three-loop Framatome Pressurised Water Reactor (PWR) with a rating of 965 Mwe. However, the combined output of the two units is 1840 Mwe. Units 1 and 2 were started up in 1984 and 1985 respectively. Seawater is used to cool the condenser on the secondary side. Koeberg makes a small contribution to the electricity mix to South Africa. For instance, in 1998 Koeberg generated 13,6 bKWh (Kilowatt hour) of electricity, accounting for about 7 % of the country's total electricity generation. (Eskom, 2002:**Online**).

2.5.1 Nuclear Power Origination

In a nuclear power station, the energy comes from the splitting of atoms of uranium - a process known as fission. Uranium has the highest atomic mass of all the known natural elements. It is also the most readily fissionable material, especially when it has been enriched to contain slightly more Uranium 235 than naturally occurs. When a source of neutrons is introduced to the Uranium 235 atom, the neutrons split the uranium nucleus, releasing energy in the form of heat and further neutrons, which in turn, split other Uranium nuclei. Considerable heat is generated from this fission reaction, and this becomes the energy source that converts boiling water to steam. The steam ultimately drives the power station's turbines. (Eskom, 2002:**Online**).

2.5.2 Advantages of the nuclear power

According to Scott (2011:**Online**), nuclear power is safe. Generating electricity from nuclear power does not lead to carbon dioxide emissions and other 'greenhouse' gases that can damage the environment. The process produces small volumes of waste for disposal.

2.5.3 Disadvantages of the nuclear power

There are some negative public perceptions about nuclear energy because of its association with nuclear weapons, and concerns about nuclear waste and safety. Nuclear stations with engineering safety systems are expensive, mainly because of the need to ensure their safety. Waste disposal is also expensive.

2.6 MANAGEMENT SYSTEMS AT KOEBERG

Koeberg has successfully retained its compliance with the following international management systems:

- A quality management system ISO 9001:2008.
- An environmental management system ISO 14001:2004.
- A safety management system ISO 18000:2007.

2.6.1 Quality Management Systems

Koeberg Nuclear Power station complies with a quality management system, ISO 9001: 2008. It also complies with various nuclear codes and standards, namely: American Standard of Mechanical Engineers – Nuclear Quality Assurance (ASME-NQA 1), International Atomic Energy Agency (IAEA). According to IAEA (1996), quality management encompasses all decisions and activities that aim at maintaining or at improving an already achieved level of quality. The quality of nuclear plants, or nuclear fuel fabrication facilities, refers to its future performance with respect to safety and profitability. IAEA points out that a nuclear installation is of high quality, if these three conditions are fulfilled:

- Safety of the operation is assured as a necessary condition during the entire lifetime of the installation.
- Maximum profitability of the installation during its entire lifetime should be achieved.
- The disposal of nuclear waste is organized in a way that at no time will radioactivity harm the environment.

In short, a tight quality management of a nuclear installation is of crucial importance.

2.6.2 Environmental Management Systems

One of the organisation's focuses is on re-enforcing environmental controls and decision making, emissions control and water management practices, and driving continual improvement by taking a systems approach to environmental management.

Koeberg Nuclear Power Station is committed to the following:

- Implementing and integrating Safety, Health, Environment and Quality (SHEQ).
- Ensuring the health and safety of employees.
- Ensuring compliance to nuclear standards and codes.
- Ensuring procedure adherence.

In summary, Safety, Health, Environment and Quality Management Systems are implemented throughout the organisation, in accordance with the requirements of international and national regulatory requirements.

2.6.3 Safety Management Systems / Safety Culture

Safety culture (2002:**Online**) (cited Davies, Grote, and Kunzler, 2002), describe safety culture as a manifestation of internalized assumptions or understandings that are shared by an organisation's members on such matters as the interactions between humans, institutions, and their environment. Furthermore, these assumptions enable them to find common ways of making sense of situations - of finding meaning in one's professional and personal existence. The author further elaborates that safety culture is said to be at the very heart of an organisation. It is one of the most stable and substantial forces within organisations, shaping the way employees think, behave, and approach their work. In short, safety culture represents an organisation's unique style of operation.

Scott (2011:**Online**), points out that South Africa has nuclear safety culture because of the Koeberg Nuclear Power Station. Scott (2011:**Online**), further mentions that "Nuclear power is certainly complex... It requires management depending on the level of risk, but the level of risk in nuclear is low." Furthermore, Scott (2011:**Online**) asks; "How many people are killed on the roads every day, compared to people killed in the nuclear industry?... obviously if something does go wrong in nuclear the consequences are enormous." Scott (2011:**Online**), elaborates that Japan was using boiling water reactors, whereas Koeberg uses pressurised water reactors, and about 70 % of all new nuclear stations in the world use the pressurised system. Furthermore, Eskom was familiar with pressurised water reactors and would want to stick with that design for future nuclear power stations in the country.

2.6.4 Training and development

Training of personnel forms an integral part of Eskom Koeberg Nuclear Power Station. Induction and orientation training, as well as SHEQ (i.e. Safety, Health, Environment & Quality) training, is conducted for new employees on a regular basis. Refresher training is also conducted for all the experienced staff.

ISO 9001: (2008:6) dictates that the organisation shall:

- Determine necessary competence for personnel performing work affecting product quality.
- Provide training, or take other action, to satisfy these needs.
- Evaluate effectiveness of the action taken.
- Ensure personnel are aware of the relevance of their activities and how they contribute to the achievement of quality objectives.
- Maintain appropriate records of education, training, skills and experience.

Competence and training of personnel performing work-affecting quality is also applicable in the supply chain management.

2.7 PROCUREMENT DEPARTMENT AT KOEBERG

The Procurement Department consists of local and international Buyers, and Senior Advisors who are responsible for purchasing spares and placing contracts with Vendors or Suppliers. The Procurement Department is involved in evaluating prospective tenders or contractors, in consultation with the relevant departments, in terms of their compliance with applicable commercial, financial, quality, technical, environmental, legal, safety capability/capacity and human resources requirements, as well as performance ratings (where applicable), as determined by the specific functional areas within Koeberg Nuclear Power Station, in relation to the specific contract. Consultation is needed with the necessary role players e.g. Health and Safety Management, Finance Department, Design Engineering Support, Procurement Quality Engineering etc. in order to establish the competency of the contractor or supplier, before a contract is awarded, and to ensure that the specifications of the contract and the project will be met during the execution of the contract or project.

The Health and Safety Plan is evaluated against the Health and Safety Specification, and it is verified that the cost of health and safety has been incorporated in the tender application. Regular strategic meetings are established and conducted, and all stakeholders are invited to participate, e.g. Health and Safety Department, Procurement Quality Engineering, Finance Department and Project Management, to provide an opportunity to share information with vendors, thereby ensuring that the vendors are in possession of, and are familiar with, the latest requirements, standards, procedures and processes.

2.7.1 Procurement Quality Engineering (PQE)

The PQE department is a group within the Procurement department, consisting of Quality Advisors who are responsible for the following:

- Performing Quality Engineering and Surveillance, Assessments and Audits on all activities related to the procurement of Equipment, Tools and Services for the jobs assigned.

- Reviewing and accepting: Material Requisition (MR), Purchase Requisition (PR), Quality Control Plans (QCP), Tenders, Bids, Purchase Orders, Inspection or source verification and Test Plan, Inspection and Test Procedures.
- The procurement quality assurance group has the lead role in defining the procurement quality programme, and performing, monitoring and verifying activities to ensure effective compliance to the requirements.
- The group controls and monitors the effectiveness of the quality programme of the supply chain, and the quality of the products, through source verifications and reviews of documents and records.

The research project investigated the impact, or the effect, of late deliveries of spares, on the operational cost of the organisation.

One important contribution to the successful operation of this facility is the steady supply of spares and award of contracts, in accordance with the respective Nuclear Standards and Specifications. Due to the nature of the spares requirements for the facility, the procurement of the spares and awards of contracts carries a major percentage of the operating cost of the organisation. Non-conformances of suppliers and late delivery of spares has a great impact on the organisation and its operations, and causes delays, such as planning delays, paperwork delays and reworking. The Company will benefit from this research project because:

- It will also address areas of improvement.
- It also focuses on the processes that will be implemented and maintained in order to reduce non-conformances.
- It will identify which quality management tools are going to be implemented and used in order to measure and reduce non-conformances.

CHAPTER 3: SUPPLY CHAIN AND QUALITY MANAGEMENT

3.1 INTRODUCTION

Procurement is an activity that can involve many groups in organisations. It is important that activities are planned so that the activities of all the groups and individuals involved are adequately co-ordinated, and fully developed, before work on any systems or structures commences.

Currently, quality is more important than ever, and especially so in the nuclear industry, where it is synonymous with safety and efficiency in all phases of the fuel cycle. Poor performance in controlling suppliers can result in re-work, cost over-runs, lost output, accidents or reductions in safety margins. It is evident that the need to include quality and safety as an integral part of any item or service supplied to a nuclear installation is well recognized. However, the means of achieving appropriate results by applying systematic controls may not be as well understood or well developed throughout suppliers.

In this literature review the following critical areas will be the focus of the discussion:

- Procurement Management.
- Quality Management.
- Supply Chain Management (SCM).
- Buyer -Supplier Relationship.
- Partnerships.
- Risk and Supply Chain Management.
- Control of Non-Conforming Products.
- Quality Costing
- Categories / Models of Quality Cost.
- Cost of Poor Quality (COPQ).
- Reducing the Cost of Poor Quality.
- Improvement Tools for Management.

3.2 PROCUREMENT MANAGEMENT

According to Zack (2002:6), "...procurement management is the process necessary to obtain goods and services from outside the organisation for the execution of the project".

Van Weele (2010:6), points out that "...procurement includes all activities required in order to get the product from the supplier to its final destination". Furthermore, the author mentions that procurement encompasses the purchasing function, stores, traffic and transportation, incoming inspection and quality control and assurance, which allows companies to make supplier selection decisions based on the total cost of ownership (TCO), rather than price. This is supported by Van Weele (2000:11), who states that procurement relates to the function of the purchasing input used in the firm's value chain. These may include:

- Raw materials.
- Supplies.
- Consumable items, as well as assets, such as machinery, laboratory equipment, office equipment and buildings.

Kerzner (2006:804), defines procurement (and contracting) as a process that involves two parties with different objectives who interact in a given market segment. Kerzner further avow that "good procurement practices can increase corporate profitability by taking advantage of quantity discounts, minimizing cash flow problems, and seeking out quality suppliers". Furthermore, procurement planning, according to Kerzner, usually involves the selection of one of the following as the primary objectives:

- Procuring all goods/services from a single source.
- Procuring all goods/services from multiple sources.
- Procuring only a small portion of the goods/services.
- Procuring none of the goods/services.

Kerzner (2006:805), explains that another factor is the environment in which procurement must take place. The two environments include:

- **Macro environment:** Includes the general external variables that can influence how and when one does procurement. These include recession, inflation, cost of borrowing money, and unemployment.
- **Micro environment:** Includes the internal environment of the firm, especially the policies and procedures imposed by the firm, project, or client in the way that procurement will take place.

According to Kerzner (2006:805), the procurement, or contracting system, involves four cycles, namely:

- **The requirement cycle:** Definition of the boundaries of the project.
- **The requisition cycle:** Analysis of the resources.
- **The solicitation cycle:** The bidding process.
- **The award cycle:** Contractor selection and contract award.

According to the International Atomic Energy Agency (IAEA), IAEA (1996:13), states that "...procurement is an activity that can involve many groups in the nuclear installation and many separate organisations outside it". Furthermore, the author mentions that it is important that activities are planned so that the activities of all the groups and individuals involved are adequately co-ordinated, and fully developed before work on any systems or structures starts. The author further elaborates that inadequate planning, from the very beginning of any proposed procurement work, can cause significant problems at later stages of the work. Typical problems may include:

- Late identification of true costs or small benefits leading to wasted effort.
- New plans or proposals being developed, which conflict with established strategies or long term plans.
- Developing plans or proposals that ignore the needs of other parts of the customer organization.
- Finding that the proposed work clashes with the established plans of other groups.

- Late alteration of work because of late identification of a constraint known to other groups.
- Delays due to conflict with other work in the same are, but controlled by a different group.
- Late identification of material deficiencies, or poor progress, due to inadequate monitoring.

3.2.1 Procurement Planning

IAEA (1996:13), points out that procurement planning should take place to address three distinct aspects of managing procurement:

- **Priorities for allocating resources:** These include the use of money and time in a way that is consistent with the overall strategy for the installation, taking account of aspects, such as the remaining operational life and regulatory expectations.
- **Advanced planning to take account of:** The necessary completion date, availability of key personnel, manufacturers' or suppliers' capability and commitments.
- **Integration with operating requirements and other concurrent work on the installation:** Include harmonizing work with available outage periods, co-ordination between working parties on different tasks, access to facilities or resources controlled by the nuclear installation, for instance radiological protection, decontamination.

In terms of IAEA (1996:14), "...senior management should define the policies and strategies that will influence the way that all procurement activities are initiated, planned and co-ordinated to ensure that they are:

- Decided, and priorities defined, for procurement that meet the plans and strategies for the nuclear installation.
- Identified in adequate detail, together with acceptance standards and criteria.
- Adequately developed to take account of expectations from the customer group in the nuclear installation.
- Communicated to all people involved in an appropriate level of detail.
- Supported by adequate resources of all types.

- Monitored for acceptability.
- Reviewed for adequacy and any areas of improvement.
- Arranged to involve the regulatory authority in clearance or acceptance of the proposals and plans as necessary.
- Agreed with relevant groups in the nuclear installation, including finance and quality sections.

3.2.2 Control of Procurement Documents

ISO 9001 (2008:3), dictates that: "...documents required by the quality management system shall be controlled, and a documented procedure shall be established". Control of documents is vital in an organisation.

IAEA (1996:40-42), specifies that procurement documents should be controlled, reviewed and approved before issue, to ensure that all requirements have been included and that they are in accordance with the specified requirements, the nuclear installation procedures and the regulatory requirements. Changes to procurement documents should be undertaken in a controlled manner, and the supplier or prospective supplier should be notified of approved changes. Changes to procurement documents should be subjected to the same level of control as the original documents, to ensure that consistent information is provided.

Typical problems that are encountered in the controlling of procurement documents include:

- Inadequate or defective specifications that do not adequately identify all requirements; inconsistent levels of detail being provided; following changes to the documents; changes that is inconsistent with the intent of the originator and the needs of the customer.
- Failure by prospective suppliers to comply with administrative requirements, leading to invalid or rejected bids.
- Information being made available to only one prospective supplier, following a question or clarification.

3.3 QUALITY MANAGEMENT

Van Weele (2010:238), defines quality management as; "...making sure that the requirements are met, and being able to demonstrate this objectively". This implies that, for every transaction between customer and supplier, they need to agree on the following:

- The basic requirements of the transaction.
- The way in which the requirements are to be realised.
- How to check that the requirements are (being) fulfilled.
- The measures to be taken when the requirements / expectations are not met.

To sum up, quality management relates to all activities and decisions aimed at taking the organisation's products and services to the desired quality level, and to maintain that level.

Curren (2007:**Online**), mentions that Quality Management (QM), also referred to as Total Quality Management (TQM), evolved from many different management practices and improvement processes. Furthermore, quality management is not specific to managing people, but is rather related to improving the quality of goods and services that are produced, in order to satisfy customer demands. Quality management permeates the entire organization as it is being implemented.

According to Kerzner (2006:880), there is no explicit definition of TQM. Furthermore, some people define it as "providing the customer with quality products at the right time and at the right place." Others define it as ..."meeting or exceeding customer requirements". The author points out the primary strategies of TQM which are as follows:

- Solicit ideas for improvement from employees.
- Encourage and develop teams to identify and solve problems.
- Encourage team development for performing operations and service activities, resulting in participative leadership.
- Benchmark every major activity in the organisation to ensure that it is done in the most efficient and effective way.

- Utilise process management techniques to improve customer service and reduce cycle time.
- Develop and train customer staff to be entrepreneurial and innovative in order to find ways to improve customer service.
- Implement improvements so that the organisation can qualify as an ISO 9000 supplier.

The author further mentions that there are secondary categories, as follows:

- Maintain continuous contact with customers; understand and anticipate their needs.
- Develop loyal customers by not only pleasing them, but by exceeding their expectations.
- Work closely with suppliers to improve their product or service quality and productivity.
- Utilise information and communication technology to improve customer service.

Burke (1999:6) and Kerzner (2006:833-835), are of the view that project quality management is a subset of project management, which includes the processes required to ensure that the project will satisfy the needs for which it was undertaken. It consists of:

- **Quality planning:** Identify the quality standards relevant to the project and determine how to satisfy them.
- **Quality assurance:** Evaluate the overall project performance on a regular basis to provide confidence that the project will satisfy the applicable quality standards.
- **Quality control:** Monitor specific project results and determine if they satisfy quality requirements. Determine the means to eliminate unsatisfactory performance.

According to Goetsch and Davis (2002:312), TQM ensures that management is responsible for developing the organisation's vision, establishing guiding principles (Code of Conduct), and setting the strategy and tactics for achieving the vision within the constraints of the guiding principles. This statement can also be

applied to procurement quality management. All projects or departments need a vision, a clear picture, where everyone in the team unites to achieve one goal. TQM principles consist of the following elements:

- **Leadership:** Drives the quality system in terms of commitment and resources.
- **Customer focus:** Presents the customer as the foremost aim for all processes.
- **Involvement of people (employees):** Communication and participation. People at all levels are the essence of an organisation and their full involvement enables their abilities to be appropriately used. They must be trained, and must be competent to do their jobs.
- **Process approach:** Input, process and output in flowchart form.
- **System approach:** Documentation must enable the process approach.
- **Continuous improvement:** Moving from lower to higher levels of quality excellence. All organisations must continuously improve their processes in order to provide a more effective and efficient quality system.
- **Factual approach to decision-making:** Data and statistics must be used effectively.
- **Mutually beneficial supplier relationships:** Understanding raw material and commodity suppliers as partners in the process. An organisation and its suppliers are interdependent, and a good partnership approach will enhance the ability of both to create value. This means working closely with suppliers to understand their needs and requirements; communicating well with them; working jointly on improvement; and seeing their needs as being closely linked to that of the organisation (Crawford, 2006:40-41).

Burtonshaw-Gunn (2008:212), describes that the implementation of a formal TQM system offers advantages such as: better planning of activities, correct interpretation of customer requirements, early resolution of problems, reduced levels of remedial work and wastage, and feedback of customer problems. Furthermore, Burtonshaw-Gunn (2008:218), lists the following as the four levels of quality:

- **Inspection:** Includes sorting, grading, reblending, corrective actions, and identifying sources of non-conformances.

- **Quality Control:** Includes product testing, paperwork controls, process performance data, and the use of basic statistics.
- **Quality Assurance:** Includes the use of quality costs, developing systems, and involvement of non-production operations.
- **Total quality management:** Includes employee involvement, teamwork, improved suppliers and customers, policy development and process management.

3.3.1 Human resources: Training

According to Day (2003:5-10), human resources refer to resources required by employers in order to perform work of a high quality. This is supported by Tricker and Sherring-Lucas (2001:121), who are of the view that personnel whose work affects quality, should be assigned work, based on their competency, skills, education and experience.

Goetsch and Davis (2002:110), point out some one of the aspects on which ISO places emphasis, are human resources, work environment and customer relations, which are critical to ensure quality in the delivering of procurement quality management.

ISO 9001: (2008:6), dictates that an organisation shall:

- Determine the necessary competence for personnel performing work which affects the quality of products.
- Provide training or take other actions to satisfy these needs.
- Evaluate the effectiveness of actions taken.
- Ensure personnel are aware of the relevance of their activities and how they contribute to the achievement of quality objectives.
- Maintain appropriate records of education, training, skills and experience.

Competence and training of personnel performing work-affecting quality, is also applicable in the supply chain management.

3.4 SUPPLY CHAIN MANAGEMENT (SCM)

Van Weele (2010:18), found that supply chain management includes the management of all activities, information, knowledge and financial resources associated with the flow and transformation of goods and services, starting from raw materials, suppliers, component suppliers and other suppliers, in such a way that the expectations of the end users of the company are met or surpassed.

Gryna (2001:404), defines the supply chain as the tasks, activities, events, processes, and interactions undertaken by all suppliers and all end users in the development, procurement, production, delivery, and consumption of a specific good or service. Furthermore, the purchasing function has the primary role of managing the supply chain to achieve high quality and value throughout the supply chain. Gryna (2001:404), mention further that, under supply chain management, mechanisms must be put in place to assure adequate related planes among parties in the supply chain. Such mechanisms include:

- Clear contractual requirements.
- Continuous feedback.
- Communication.

Handfield and Nichols (2002) (cited Handfield and Bechtel 2002:367), describe that supply chain encompasses all activities associated with the flow and transformation of goods from the raw materials stage (extraction), through to the end user, as well as the associated flows of information. The authors further elaborate that manufacturers need to position themselves so that they have more flexibility and reduced lead time in their supply chain processes, and less obsolete inventories.

Burtonshaw-Gunn (2008:264), expresses the view that "...the relative power of the supplier, in relation to the buyer's business,, and vice versa needs to be considered, as the performance of one another has a direct impact on the other's business". Many companies will not wish to have a plethora of small suppliers with all of the associated administration that this necessitates. Equally, they will

be reluctant to be reliant on a sole source supplier arrangement. As a compromise, organisations often select a small number of suppliers with which they will develop a close relationship. Furthermore, the author found that the changes made from a simple purchasing function in supply chain management have resulted in a cultural change where much closer cooperation is seen between the supplier and the buyer. This dispensation is very evident in the UK's retail, manufacturing, and - to a lesser extent - construction sectors. The latter has previously been known for its adverse relationships. However, over the last 15 years there have been dramatic changes, resulting in more collaboration through 'partnering', where both parties commence their business relationship by agreeing to a set of mutual objectives, and have an agreed process for problem resolution and decision making, and a joint commitment to continuous improvement in performance measures.

Burtonshaw-Gunn (2008:264), points out that well-established supply chains provide many parties in this arrangement with a security of future work, and confidence to invest in staff development through training, namely in plant and equipment, and finally, in business processes, to support the supply chain management relationship.

Burtonshaw-Gunn (2008:264), explains that supply chain management continues to grow in importance with the globalization of business operations and the use of world-wide suppliers. As such, it is an important feature that needs to be considered by those companies seeking growth through international operations. Burtonshaw-Gunn (2008:264), is, furthermore, explaining that, as with many management topics, supply chain management is not an isolated discipline. It can, indeed, be seen to have many links with other sections, such as in customer relationship management, decision making, risk management, project management and, finally, people-focused performance management, which itself covers team working, trust and conflict resolution.

Garvin (1983) (cited Robinson and Malhotra 2004:316), mentions that SCM involves challenges, such as developing trust and collaboration among supply chain partners, identifying best practices that can facilitate supply chain process alignment and integration, and successfully implementing the latest collaborative

information systems and Internet technologies that drive efficiency, performance, and quality throughout the supply chain.

3.4.1 Supply Chain Quality Management (SCQM)

Ross (1997) (cited Robinson and Malhotra 2004:319), defines SCQM as, "... the formal coordination and integration of business processes involving all partner organizations in the supply channel to measure, analyze and continually improve products, services, and processes, in order to create value and achieve satisfaction of intermediate and final customers in the marketplace".

3.4.2 The Quality Concept in Purchasing and Supply Chain Management

Buying the right quality is important for the ultimate customer, because the quality of the firm's own product is largely determined by the quality of goods and services purchased. However, quality is equally important for the internal customer of the supply function, since it contributes towards efficiency and total cost. Managing the quality of purchased goods and services, therefore, is a contributing factor in delivering the required service level to the customer.

3.4.3 Supply chain management and internal service quality

According to Hugo, Badenhorst-Weiss and van Biljon (2006:126), internal service quality is of crucial importance for the following reasons:

- The level of internal service quality is important because it impacts on an organisation's ability to meet external customer needs.
- Purchasing is a boundary-spanning position between the firm and its external customers, yet it is also an internal customer and an internal relationship. Consequently it plays a pivotal role in delivering quality.
- Internal customers determine, to a large degree, the quality of products and services delivered to the external customer.
- The internal quality of the workplace is the biggest contributor to employee satisfaction. Each employee in supply management, therefore, has a

potentially key role to play in the quality of goods and services delivered to internal and external customers.

Hugo, Badenhorst-Weiss and van Biljon (2006:130), point out the elements of internal service quality as follows:

- Responsiveness to customers' needs.
- Quality of delivered products or services.
- Meeting customers' expectations.
- Flexibility in meeting customers' changing needs.
- Delivering information on time (to internal suppliers and customers).
- Delivering products or services on time.
- Delivering reliable information.
- Explaining products or service delivery problems.
- Communication level.

3.5 BUYER -SUPPLIER RELATIONSHIP

According to Gitlow and Gitlow (1987:159), a supplier is the organisation that provides a product to the customer. In a contractual situation, the supplier may be called the contractor. The supplier may also, for example, be the producer, distributor, importer, assembler or service organisation. The supplier may be either external or internal to the organisation. Shapiro (1985) (cited Carter and Ellram 1994:15), defines 'buyer-supplier relationship' as "...the ability to work together closely in redesigning components". Ellram (1991) (cited Carter and Ellram 1991:38-44), found that that high levels of trust and communication are required for buying and selling firms to work together effectively on sensitive design issues. Such trust and communication are also necessary for the sharing of technology and personnel. The author further adds that, "...previous research supports the need for close working relationships, open communications, and trust, in order to bridge sensitive issues and go beyond routine supplier relationships". Ellram (1991:2-8), mentions that, "...relationships exhibiting such characteristics are referred to, in the operations literature, as "partnering" or "strategic alliance" relationships".

Sandras (1989), (cited Narasimhan and Nair 2004:302), points out that buyer–supplier relationship architecture describes mechanisms for building relationships, the role of the buyer and the supplier, and the relationship protocol between a buyer and supplier. The authors further elaborate that, specifically, buyer–supplier relationship architecture comprises those aspects of just-in-time (JIT), which are related to “link to suppliers” and “link to customers”.

Furthermore, the author conceptualizes buyer–supplier relationship architecture to be composed of quality expectations in a buyer–supplier relationship, information sharing, and trust between buyer and supplier, and aspects related to centralized planning in JIT, termed as “supply chain proximity”.

Handfield and Nichols (2002), (cited Handfield and Bechtel 2002:368), avow that buyer–supplier relationships identify the drivers such as:

- **Globalization:** The rise of global competition and the fast pace of technological change convinced many firms that neither vertical integration, open market bargaining, nor equity sharing were effective mechanisms for tackling supply uncertainty and poor material quality. Managers today realize that a new form of supply chain relationship is required for suppliers to respond more quickly to global supply chain customers.
- **Information technology:** This means that organizations are moving towards a concept known as e-commerce, where transactions are completed via a variety of electronic media, including the World Wide Web. These technologies are supply chain “enablers,” in that they can substantially reduce paperwork, improve communication, and reduce supply chain cycle times, if properly implemented. A primary requirement is that buyers develop relationships with suppliers, characterized by a willingness to share and receive information and work in a collaborative manner to improve efficiency and reduce cycle time.
- **Customer requirements:** Partnering occurred as firms sought to take advantage of market opportunities through a synergistic combination of strategic core competencies. This typically led to a reduction in the number of suppliers of a particular part or service, as buyers identified those suppliers with the greatest potential for partnering, a process often described

as “supply base optimization”. Conversely, suppliers are limiting the number of customers they do business with, to focus only on their “best” customers.

Handfield, Trent and Monczka (2002) (cited Handfield and Bechtel(2002:368), avow that a requirement for supplier/ customer optimization is that supply chain participants have a solid mutual understanding of the underlying business processes and capabilities of their selected partners.

Handfield and Krause (2002) (cited Handfield and Bechtel 2002:368), researched that buyers should share information with their suppliers, and also provide suppliers with guarantees of future volumes and prices, resources, and creativity, which may be tied to suppliers’ cost reduction and quality improvement efforts. Furthermore, such relationships between buyers and suppliers, are characterized by mutual interdependence, close organizational cooperation, increased levels of trust, and a strong tendency towards information sharing.

3.5.1 Team relationships

Pryke (2009:59-60), defines a team as, “...two or more people who are collaborating in pursuit of a common objective or goal, which distinguishes a team from a group”.

Emmett and Crocker (2006:77), maintain that teams involve a small number of people who have a common shared and accepted goal. Furthermore, the goal is the 'performance purpose', and the team players, the people, have a complementary contribution with mutual accountability. Emmett and Crocker (2006:77), researched that commitment to teams involves putting the team before individuals; however, teams require the right blend of unique individual strengths. The following can be said about teams:

- Individual success is dependent on others.
- Teams work out problems together; individual blame is banished.
- The whole is more than the sum of the parts.
- Teams require individuals to connect to something bigger than themselves.

- Each member needs to be awake, aware and in tune with others.
- United we stand but divided we fall.
- There is none of us as strong as all of us.

Effective teams will communicate and understand each other whilst motivating and supporting each other. Team work requires hard work, commitment, clear communication and good understanding. Emmett and Crocker (2006:79), mention that “in building teams, then, the following stages and emotions are involved”:

- **Forming:** Is when a team comes together with a sense of anticipation, optimism, excitement and commitment. The teams attempt to define the task and decide how it will be accomplished, and decide what information needs to be gathered.
- **Storming:** As the team begins to work together, they find that they have differences about the best way of achieving the task’s objectives. The teams are resistant to the task and to quality improvement approaches different from what each individual member is comfortable using. The following behaviours can be observed:
 - Arguing among members, even when they agree on the real issue.
 - Defensiveness and competition.
 - Factions choosing sides.
- **Norming:** At this stage, teams have a new ability to express criticism constructively. Team members begin to accept and understand each other. Foster (2004:320), describe that norming is where the teams become a cohesive unit, and interdependence, trust and cooperation develop. The following behaviours can be observed:
 - An attempt to achieve harmony by avoiding conflict.
 - More friendliness, confiding in each other and sharing of personal problems.
 - Discussing the team's dynamics.
 - A sense of team cohesion, a common spirit and goals.
 - Establishing and maintaining team ground rules and boundaries.
- **Performing:** Emmett & Crocker (2006:79), point out that members having insights into personal and group processes, and a better understanding of each other’s strengths and weakness and satisfaction at the team's progress.

The team can work together effectively and work closely. All members understand one another's responsibilities and have the ability to prevent or work through group problems

- **Mourning or ending:** Teams members regret the ending of the project and the breaking up of the team (Foster 2004:320). Teams have a sense of loss and sadness; wondering what happens next; and have high and low emotions (Emmett & Crocker, 2006:79).

3.6 PARTNERSHIPS

Gryna (2001:415), defines partnership as the wave of the future which involves not just quality but also other business issues. Teamwork and training of suppliers in quality techniques is very important in forming good partnerships. In an organisation, buyers are the single point of contact between the organisation and the suppliers, emphasising the importance of the training of buyers.

Van Renen (2009:32), explains that, for an organisation to strengthen and develop capabilities within its supply chain, considerable investment would be needed before benefits can be gleaned. To protect such an investment, a protective transactional framework is required. Partnership agreements between suppliers and customers are examples of such frameworks.

According to Maya (2010:48), Management should consider the potential benefits of establishing partnerships with suppliers to the organisation, in order to create value for both parties. Furthermore, the author elaborates that "... a partnership should be based on a joint strategy, sharing knowledge as well as gains and losses". When establishing partnerships, an organisation in terms of ISO (9004:2009:8), should:

- Identify key suppliers, and other organisations, as potential partners.
- Jointly establish a clear understanding of customers' needs and expectations.
- Jointly establish a clear understanding of the partners' needs and expectations.
- Set goals to secure opportunities for continuing partnerships.

3.7 RISK AND SUPPLY CHAIN MANAGEMENT

3.7.1 Risk Management

According to Kerzner (2006:709-711), risk management is a systematic process of identifying, analysing and responding to project risks. It includes maximising the probability and consequences of positive events and minimising the probability and consequences of adverse events leading to project objectives. According to Kerzner (2006:718-742), the following are remedial actions which should be instituted:

- **Risk management planning:** Deciding how to approach and plan the risk management activities for a project.
- **Risk identification:** Determining which risks may affect the project, and documenting their characteristics.
- **Qualitative risk analysis:** Performing a qualitative analysis of risks and conditions to prioritise their effects on project objectives.
- **Quantitative risk analysis:** Measuring the probability and consequences of risks, and estimating their implications for project objectives.
- **Risk monitoring and control:** Monitoring residual risks, identifying new risks, executing risk reduction plans and evaluating their effectiveness throughout the life cycle of the project.

Zack (2002:5), defines risk management as “...the process of identifying, analyzing and responding to project risk events”. Some of the risks which can be identified include layout risks, resource overloading, activity interferences, coordination of subcontractors and vendors, and documentation reviews.

Burtonshaw-Gunn (2008: 266), mentions that establishing good, close and strong supply chain relationships, should be the objectives for any company. This is not without risk, however, and the risks of supply chain management and collaborative working are shown in this model these cover the main features of environmental risks, competitive risks, client and supplier relationship and project attractiveness. Burtonshaw-Gunn (2008: 266), further adds that “...understanding these risks can be used to develop the relationships within the supply chain,

whether at the client, lead consultant or specialist contractor positions, as each party can have an appreciation of the risks that the other supply chain partners face and have to deal with” refer to figure 3.1 below.

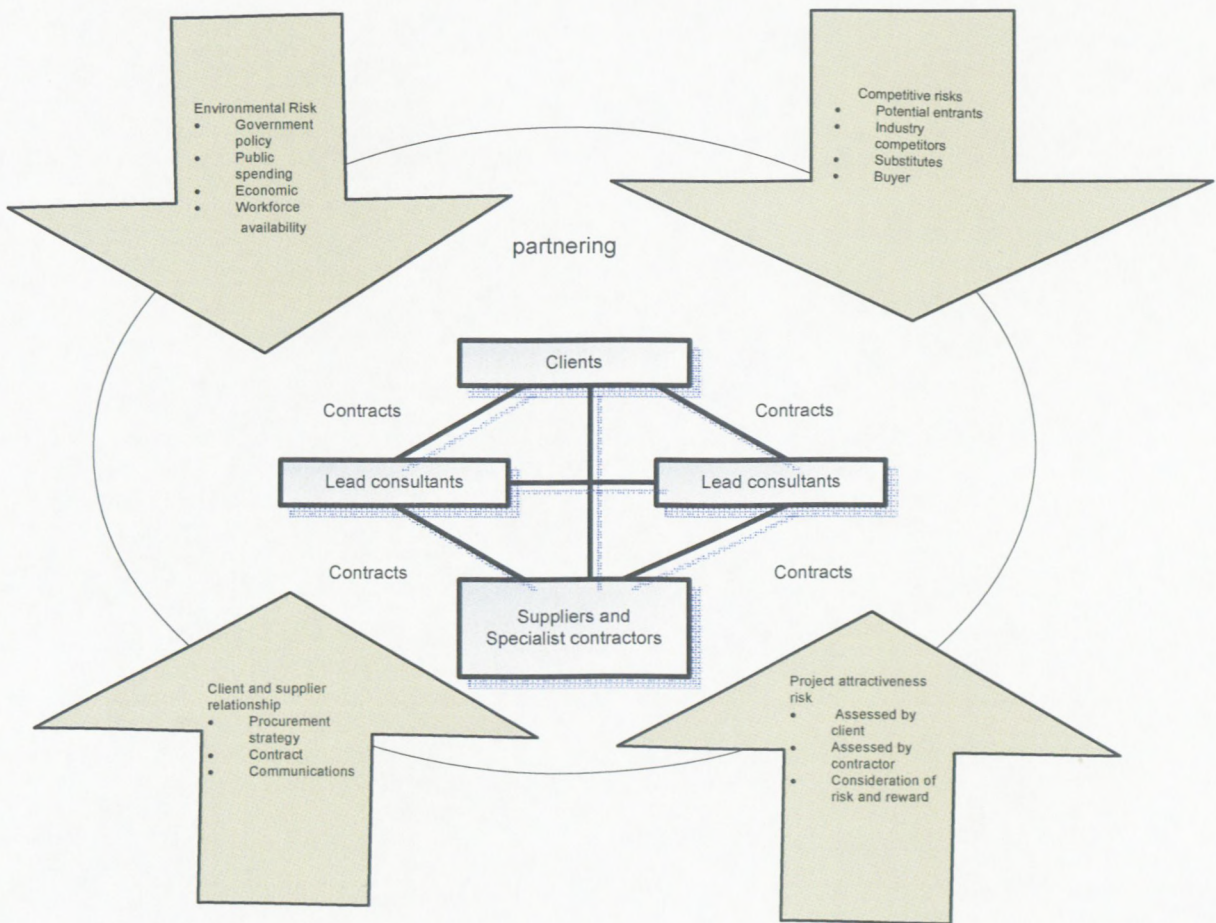


Figure 3.1: Risk Management (Source: Burtonshaw-Gunn, 2008:266)

According to Burtonshaw-Gunn (2008:229), risk management offers three inter-related questions, and the processes that facilitate the answers to these are the core of risk analysis, refer to figure 3.2 below.

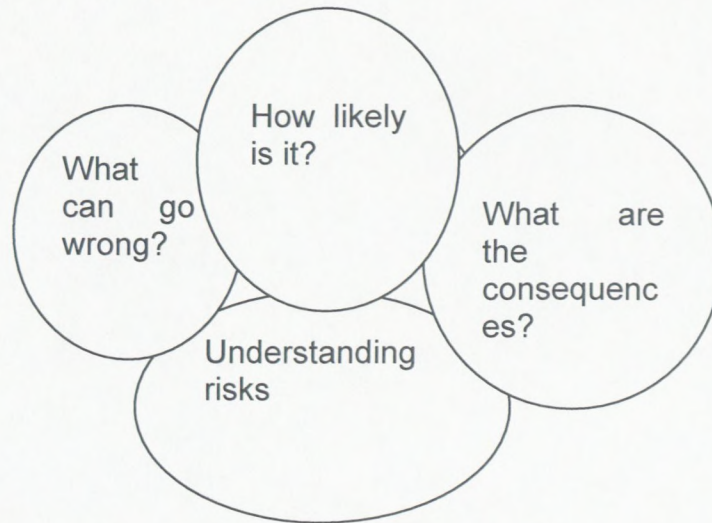


Figure 3.2: Core risk analysis (Source: Burtonshaw-Gunn, 2008:229)

3.7.2 Consequences of failing to manage risk

Burtonshaw-Gunn (2008:230), suggests that, the consequences of failing to manage risk have an impact, not only on the project and the organisation, but also on the project manager as an individual. It includes:

- Significant overruns.
- Schedule delays.
- Inability to achieve stated technical objectives in terms of delivery, functionality, cost etc.
- Project de-scoping.
- Project cancellation.
- Penalties and fines.
- Personal and or organizational liability.
- Loss of credibility for company and for individuals as project managers.

3.8 CONTROL OF NON-CONFORMING PRODUCTS

Organisations should have a documented method of dealing with non-conformities or non-conforming products, and non-conformance should be recorded.

According to Goetsch and Davis (2002:160), the organisation should deal with non-conforming product by one or more of the following ways:

- By taking action to eliminate the detected con-conformity.
- By authorising its use, release or acceptance under concession by a relevant authority and, where applicable, by the customer.
- By taking action to preclude its original intended use or application.

Goetsch and Davis (2002:160), state that, “...records of the nature of non-conformities and subsequent actions taken, including concession obtained, shall be maintained”. Furthermore, the author is of the view that “...when a non-conforming product is corrected, it shall be subject to re-verification to demonstrate conformity of the requirement”.

Foster (2004:255), points out that “...when non-conforming products are produced, one of the following things can happen”:

- The non-conforming products can be reworked to meet specified requirements.
- They can be accepted with or without repair or concessions.
- They can be considered for alternative applications.
- They can be rejected and scrapped.

According to Goetsch and Davis (2002:161), the organisation must identify and control any non-conforming product. Identification must be visible to anyone, and should be in a medium that is not easily removed or separated from the product.

IAEA (2008:12), point out that, the causes of non-conformances should be determined and remedial actions should be taken to prevent their recurrence

Products and processes that do not conform to the specified requirements should be identified, segregated, controlled, recorded and reported to an appropriate level of management within the organization. Furthermore, the impact of non-conformances shall be evaluated and non-conforming products or processes should be either:

- Accepted.
- Reworked or corrected within a specified time period.
- Rejected.
- Discarded or destroyed to prevent their inadvertent use.

IAEA (2008:12), further mentions that “...Concessions granted to allow acceptance of a non-conforming product or process shall be subject to authorization”. Furthermore, when nonconforming products or processes are reworked or corrected, they should be subject to inspection to demonstrate their conformity with requirements or expected results. Corrective actions for eliminating non-conformances should be determined and implemented. Preventive actions to eliminate the causes of potential non-conformances shall be determined and taken. The status and effectiveness of all corrective and preventive actions should be monitored and reported to management at an appropriate level in the organization. Potential non-conformances that could detract from the organization’s performance should be identified. This should be done by using feedback from:

- Other organizations.
- Both internal and external reports.
- Through the use of technical advances and research.
- Through the sharing of knowledge and experience.
- Through the use of techniques that identify the best practices.

IAEA (2008:14-15), point out that a procedure should be established to control non-conforming items and processes, which should include:

- Segregation of non-conforming items to prevent them from being used or transferred to another organization before the non-conformance is resolved;

- Positive identification of non-conforming items and process equipment (e.g. tagging, labelling, stickers, marking);
- Resolution of the non-conformance (e.g. rework, repair, use as is or reject) and determination of the causes for the non-conformance so that corrective actions can be taken to prevent the non-conformance from recurring. (IAEA, 2008:14-17).

Non-conformance data should be periodically analysed to identify quality trends, and should be reported to the responsible manager for review and corrective action to remove the underlying causes of the non-conformances.

3.9 QUALITY COSTING

According to Crosby (1979), (cited Goulden and Rawlins 1997: 200), the cost of quality is not an absolute performance measurement: it is an indication of where corrective action will be profitable for a company.

Machowski and Dale (1998), (cited Schiffauerova and Thomson 2006:647), avow that there is no general agreement on a single broad definition of quality costs (CoQ). However, CoQ is usually understood as the sum of conformance plus non-conformance costs, where cost of conformance is the price paid for prevention of poor quality (for example, inspection and quality appraisal) and cost of non-conformance is the cost of poor quality caused by product and service failure (for example, rework and returns).

According to Dale and Plunkett (1995) (cited Schiffauerova and Thomson 2006:647), it is now widely accepted that quality costs are:

- The costs incurred in the design, implementation, operation and maintenance of a quality management system.
- The cost of resources committed to continuous improvement.
- The costs of system, product and service failures, and all other necessary costs and non-value added activities required to achieve a quality product or service.

Crosby (1979), (cited Schiffauerova and Thomson 2006:651), views quality as “conformance to requirements” and therefore, defines the CoQ as the sum of price of conformance and price of non-conformance. Furthermore, the authors elaborate that the price of conformance is the cost involved in making certain that things are done right the first time, which include the following:

- Actual prevention and appraisal costs.
- The price of non-conformance, which is the money wasted when work fails to conform to customer requirements, usually calculated by quantifying the cost of correcting, reworking or scrapping, which corresponds to actual failure costs.

The model is used in companies that measure quality costs; however, most of the time it is only a different terminology describing a Prevention, Appraisal , Failure (P-A-F) model (Goulden and Rawlins, 1995) (cited Schiffauerova and Thomson (2006:651).

According to Feigenbaum (1991) and Crosby (1997), (cited Goulden and Rawlins 1997:200), explain that “quality costs are an essential part of quality improvement programmes, because they present quality programmes and activities in a way which management understands – money.” Other authors, namely Munro-Faure and Munro-Faure (1992) and Stevenson (1993), (cited Goulden and Rawlins 1997: 200), make the following claims:

- The objective of continuous improvement is to meet customer requirements at the lowest cost, which can only be achieved by eliminating the cost of rejects and rework.
- As these can only be eliminated once they have been identified, any serious attempt to deal with quality issues must take into account the costs associated with quality.

3.10 CATEGORIES / MODELS OF QUALITY COST

Gryna (2001:20), mentions that many organisations summarise the costs associated with quality into four categories, namely:

- **Internal failure costs:** These are the costs of deficiencies discovered before delivery that are associated with the failure to meet explicit requirements or the implicit needs of customers. Internal failures costs consist of cost of failure to meet customer requirements and cost of inefficient processes. The examples of failure to meet customer requirements include scrap and rework because of non-conforming products received from suppliers. This area also includes the costs to the buyer, of resolving supplier quality problems.
- **External failure costs:** These are costs associated with deficiencies that are found after production is received by the customer. It consists of lost opportunities for sales revenue. The examples are: warranty charges, returned material.
- **Appraisal costs:** These are costs incurred to determine the degree of non-conformance to quality requirements. Examples are incoming inspection and test, in-process inspection and test, final inspection and test, document review and product quality audits.
- **Preventive costs:** These are costs incurred to keep failure and appraisal costs to a minimum. Examples are quality planning, new products review, process planning, process control, quality audits and training (Gryna 2001:19-21) and (Juran and Godfrey 1999:8); Van Weele (2010: 240-241) and Van Weele (2000:179-180).

According to Kerzner (2006:848-849), prevention cost are expected to rise as more time is spent on prevention activities throughout the organisation. Furthermore, the author elaborates that..."as processes improve over the long run, appraisal costs will go down as the need to inspect the quality decreases". Kerzner (2006:849), believes that the biggest savings will come from the internal failure areas of rework, scrap, re-engineering and redo. The author further mentions that ..."prevention costs actually decrease, without sacrificing the purpose of

prevention, if the cost associated with waste can be identified and eliminated. The author points out the cost associated with waste, as follows:

- Rejection of completed work.
- Design flaws.
- Work in progress.
- Improperly instructed manpower.
- Excess or non-contributing management (who still charge time to the project).
- Improperly assigned manpower.
- Improper utilisation of facilities.
- Excessive expenses that do not necessary contribute to the project (i.e. unnecessary meetings, travel, lodgings).

3.11 COST OF POOR QUALITY (COPQ)

The Carpenter Group LLC (2007:**Online**), defines the cost of poor quality as all the costs that would disappear if your manufacturing process was perfect. This includes all appraisal, prevention, and failure costs. Anyone running a company knows these costs exist, but what they may not realize is how much of their expenses are directly tied to COPQ.

According to the Carpenter Group LLC (2007:**Online**), determining the cost of poor quality is a key ingredient for the success of any improvement initiative. Whether you need to engage top management, obtain resources, or inspire your team, placing a monetary value on the costs of a problem helps to accomplish all of the above.

Gryna (2001:19), defines the cost of poor quality as the annual monetary loss of products and processes that are not achieving their quality objectives. Gryna (2001:20), further mentions that companies estimate the cost of poor quality for several reasons, namely:

- Quantifying the size of the quality problem, in the language of money, improves communication between middle managers and upper managers.

- Major opportunities for cost reduction can be identified. Cost of poor quality does not exist as a homogenous mass.
- Opportunities for reducing customer dissection and associated threats to product saleability can be identified. Some costs of poor quality are the result of product failures that take place after a sale. In part, these costs are paid by the manufacturer in the form of warranty charges, claims etc. But whether the costs are paid by the manufacturer or not, the failures add to customers' costs because of downtime and other forms of disturbance.
- Measuring the cost of poor quality provides a means of evaluating the progress of quality improvement activities and spotlighting obstacles to improvements.
- Knowing the cost of poor quality leads to the development of a strategic quality plan that is consistent with overall organization goals.

Gryna (2001:20), further mentions that “the main components of the cost of poor quality (which apply to both manufacturing and service organizations) are shown in Figure 3.3. Gryna (2001), also mentions that “note that this framework reflects, not only the cost of non-conformities (sometimes called ‘quality costs’), but also process inefficiencies and the impact of quality on sales revenue.

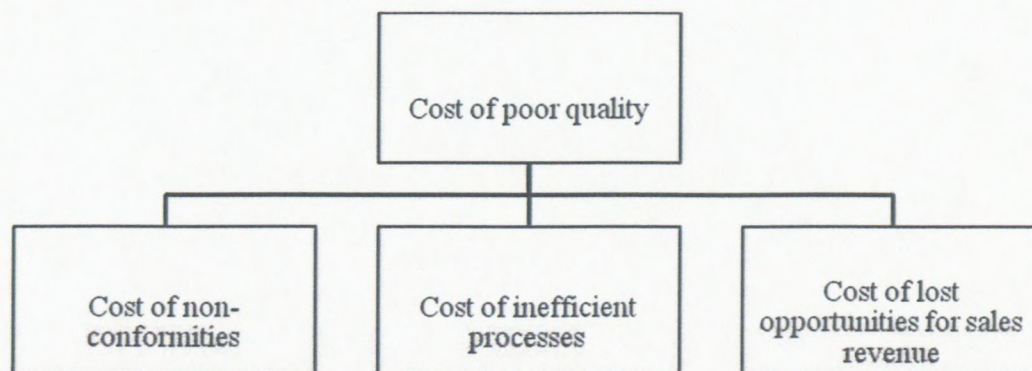


Figure 3.3: Components of the cost of quality (Source: Gryna 2001:19-20)

3.12 REDUCING THE COST OF POOR QUALITY

The Carpenter Group LLC (2007:**Online**), describes that systematic reductions in the cost of poor quality can be attained by implementing a Quality Management System (QMS) that provides an integrated and closed loop corrective action process. In a manufacturing organization, when deviations, non-conformance, out of specifications, quality incidents or customer complaints occur, corrective and preventive actions need to be initiated to remedy the problems.

The Carpenter Group LLC (2007:**Online**), further elaborates “once a quality problem has been identified, the first step is to initiate an investigation and to properly identify the root cause of the problem. After the root cause has been identified, Corrective Action (CAPA) items are created and routed for approval. When approved, appropriate changes are implemented in the environment and then the CAPA is closed out. These changes may include amendments to a documented procedure, upgrading the skill set of an employee through a training and certification process, or recalibrating the manufacturing equipment”. In addition, the system may capture COPQ associated with that non-conformance and use that information to initiate and complete a cost recovery process with a supplier.

3.13 IMPROVEMENT TOOLS FOR MANAGEMENT

When the performance measures are established and implemented the senior management should review the performance measures on a regular basis.

According to Foster (2007:328), an important measurement tool to assist management is the balanced scorecard. The balanced scorecard is usually a spreadsheet that is used to communicate to management, on a regular basis (Foster, 2007:328). Foster (2007:328), furthermore mentions that the balanced scorecard includes financial measures of business and non-financial measures.

Neely (2008:1018), describes that “measurement is all about understanding what is happening inside the organisation, and working out how to introduce

improvement”. Considering Neely’s view, any management reviews are likely to improve the performance management process. The organisation should start with the focus on internal and external benchmarking to identify areas for improvement. Any improvement initiative should have senior management commitment (Basu, 2001:11).

Basu (2001:11), suggest that “the self-assessment process should exist for an organisation to attain excellence in a collaborated supply chain; this process should include periodic audits of the process and its effectiveness”.

Basu (2001:11-12), identifies these key features of such an assessment process as:

- A comprehensive checklist which is customized to the company structure for any proven process.
- Establishing the checklist and the assessment process by ‘pilot’ assessments and education.
- Self assessment by each site / group / department.
- Periodic audits by a team from other sites / groups / departments and the corporate offices.

The structure for knowledge sharing should include best practice forums to learn from others, internal and external benchmarking to assess targets and gaps, continuous communication through newsletters, videos, and websites (Basu 2001:12).

3.13.1 Continuous Process Improvement (CPI)

According to Goetsch and Davis (2002:104), one of the most common tools for improvement is the Deming (or Shewhart) Cycle. This method is also known as Plan-Do-Check-Act (PDCA) or Plan-Do-Study-Act (PDSA) and it is well suited for many improvement projects. Figure 1.1 below illustrates the Deming’s Cycle.

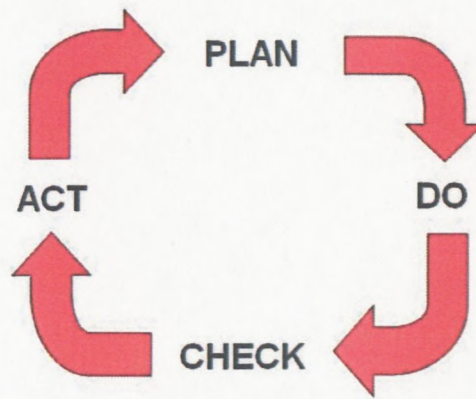


Figure 3.4: The Deming (PDCA) Cycle (Source: Goetsch & Davis 2002:104-105)

The Deming's cycle consists of the following stages:

- **Plan:** Includes planning of the improvement. Prior to implementing a change one must understand both the nature of the current problem, and how your process failed to meet a customer requirement. The problem solving team determines the following :
 - Which process needs improved.
 - How much improvement is required.
 - The change to be implemented.
 - When the change is, to be implemented.
 - How you plan to measure the effect of the change.
 - What will be affected by this change (documents, procedures, etc.).
- **Do:** Includes the implementation of the change. The change must be monitored after implementation to make sure no backsliding occurs.
- **Check:** Includes checking the results to determine whether the anticipated improvement occurred. The check stage is where analysis of the data collected during the Do stage will be performed, and it includes the following:
 - Did the process improve?
 - By how much?
 - Was the objective for the improvement met?
 - Was the process more difficult to use with the new methods?
- **Act:** Includes acting on the improvement based on the check results, and going through the cycle again.

IAEA (2008:16-17) believes that opportunities for the improvement of the management system should be identified, and actions to improve the processes selected, planned and recorded. Furthermore, Improvement plans should include plans for the provision of adequate resources. Actions for improvement should be monitored through to their completion and the effectiveness of the improvement checked. Experience and lessons learned from incidents and events and from accumulated knowledge should be reviewed periodically, and be used for deciding on improvements to the management system and the waste management activities themselves. Benchmarking by interaction with other operators regionally, nationally and internationally, as appropriate and practicable, may also give rise to ideas for improvements that warrant consideration. Action plans should be developed, that identify how, where and when improvements may be made to the management system. These plans should specify how the improvements will be evaluated, to demonstrate that they have been achieved.

3.13.2 Quality Management Control Tools

According to Kerzner (2006:851), statistical methods have become prevalent throughout business, industry and science. The author points out the benefits of using statistical process control (SPC), as follows:

- Improved process information.
- Better communication.
- Discussion based on facts
- Consensus for action.
- Information for process changes.

Kerzner (2006:851), further mentions that, "...SPC takes advantage of the natural characteristics of any process", and gives the following basic tools of SPC:

- **Data figures:** They provide a systematic method for collecting and displaying data. In most cases, data tables are forms designed for the purpose of collecting specific data.
- **Pareto analysis:** This is a special type of histogram that helps to identify and prioritise problem areas. The construction of a Pareto diagram may involve data collected from data figures, maintenance data, repair data, parts,

scrap rates or other sources. By identifying types of nonconformity from any of these data sources, the Pareto diagram directs attention to the most frequently occurring elements. It is sometimes called the 80:20 rule, and is used to determine the effect of corrective action, or to analyse the difference between two or more processes and methods.

- **Cause and effect analysis:** Also known as fishbone diagrams. After identifying a problem, it is necessary to determine its cause. Cause and effect analysis uses diagramming techniques to identify the relationship between an effect and its causes. It consists of the following steps:
 - **Identify the problem:** This step often involves the use of other statistical process control tools, such as a Pareto analysis, histogram and control charts.
 - **Select interdisciplinary brainstorming team:** Select an interdisciplinary team based on the technical, analytical and management knowledge required for determining the causes of the problem.
 - **Draw problem box and prime arrow:** The problem contains the problem statement being evaluated for cause and effect. The prime arrow functions as the foundation for their major categories.
 - **Specify major categories:** Identify the major categories contributing to the problem stated in the problem box. The six basic categories for the primary cause of the problems are most frequently: personnel, method, materials, machinery, measurements and environment.
 - **Identify effect causes:** Identify the major causes contributing to the problem and determine the causes related to each of the major categories.
 - **Identify corrective action:** The corrective action analysis is performed in the same manner as the cause and effect analysis. The cause and effect diagram is simply reversed so that the problem box becomes the corrective action box.
- **Trend analysis:** Is a statistical method for determining the equation that fits the data in a scatter plot. It quantifies the relationships of the data,

determines the equation and measures the fit of the equation to the data. This method is also known as curve fitting, or least squares.

- **Histograms:** It is a graphical representation of data as a frequency distribution. This tool is valuable in evaluating both attribute (pass/fail) and variable (measurement) data. They offer a quick look at the data at a single point in time, and they do not display variance or trends over time.
- **Scatter diagrams:** Organise data, using two variables, namely; an independent variable and a dependent variable
- **Process control charts:** The use of control charts focuses on the prevention of defects rather than their detection and rejection. It costs much more to produce an unsatisfactory product or service than it does to produce a satisfactory one. There are many costs associated with producing unsatisfactory goods and services. These costs are: labour, materials, facilities and the loss of customers. The cost of producing a proper product can be significantly reduced by the application of statistical process control charts.

These basic tools provide for the efficient collection of data, identification of patterns in the data, and measurement of variability (Kerzner, 2006:851-855).

CHAPTER 4: THE SURVEY ENVIRONMENT

4.1 THE SURVEY ENVIRONMENT

Koeberg Nuclear Power Station (KNPS), one of Eskom's power generation stations, consists of various functional or departmental areas, each with a unique role in the service delivery. The various functional areas, which will serve as the research survey environment, include the following:

- Procurement Department which consists of the following:
 - Procurement Quality Engineering Department.
 - Contract Administration, local and international buyers.
 - Materials Management Department.

4.2 AIM OF THIS CHAPTER

The aim of this chapter, and the survey contained therein is to determine what the key factors are for poor service or product delivery within the Nuclear Generation. The ultimate objective is to solve the research problem, as defined in Chapter 1, Paragraph 1.2.1, which reads as follows: "Poor product / service delivery from vendors/suppliers have an adverse impact on the output of the Procurement Quality Engineering Department".

4.3 CHOICE OF SAMPLING METHOD

The various functional areas, listed in paragraph 4.1 above, will serve as the individual strata for the research survey. The above is to ensure that all identifiable strata of the population were taken into account (Watkins 2008:54) cited by (Collis & Hussey 2003).

4.4 THE TARGET POPULATION

Watkins (2008:54), (citing Collis and Hussey 2003) define population as: “A population is any precisely defined set of people or collection of items, which is under consideration”. With any survey, it is necessary to clearly define the target population.

The ‘sampling frame’ is defined by Watkins (2008:54) cited by (Collis and Hussey 2003), as ‘a list or record of the population from which all the sampling units are drawn.’ For this survey, 51 employees, randomly selected from Koeberg Nuclear Power Station at various functional areas, represent the sampling frame. This transposes into different numbers of employees from different functional areas being randomly selected from the following identified research strata:

4.5 DATA COLLECTION

According to Watkins (2008:53), (citing Emory and Cooper 1995), three primary types of data collection (survey) methods can be distinguished, namely:

- Personal interviewing.
- Telephone interviewing.
- Self-administered questionnaires/surveys.

Self administered questionnaires served as the primary data collection method in this dissertation.

Interviews, according to Watkins (2008:60), (citing Collis and Hussey 2003), are associated with both positivist and phenomenological methodologies. In this data collection exercise, participants were asked questions, in order to determine what they think or feel. The use of personal interviews as an additional element to the data collection process is important. This allows for the identification of issues within the target environment, which may not be readily identifiable using a pure survey questionnaire. Furthermore, according to Watkins (2008:61), (citing Hussey and Hussey 2003), interviews are associated with both positivist and

phenomenological methodologies, as employed within the ambit of this dissertation.

The data collection method used in the survey, falls within the context of a survey, defined as: “A sample of subjects being drawn from a population and studied to make inferences about the population” Watkins (2008:59) cited by Hussey and Hussey (2003).

More specific, the survey conducted in this dissertation falls within the ambit of a ‘descriptive survey’ as defined by Ghauri, Grønhaug and Kristianslund (1995:64).

The data collection method used falls within the ambit of both the definitions attributed to the concepts ‘survey’ and ‘field study’. ‘Survey’, according to Gay and Diebl (1992:238), is an attempt to collect data from members of a population in order to determine the current status of that population with respect to one or more variables. Kerlinger (1986:372), defines ‘field study’ as non-experimental scientific inquiries aimed at discovering the relations and interactions among...variables in real...structures. As in the case of most academic research, the collection of data forms an important part of the overall dissertation content.

4.6 MEASUREMENT SCALES

In the survey, the respondents were asked to respond to questions or statements based on the well-known Lickert scale (Parasuraman 1991:410). The reason for choosing the Lickert scale, was the fact that the scale can be used in both respondent-centred (how responses differ between people) and stimulus-centred. (how responses differ between various stimuli) studies. It was most appropriate to glean data in support of the research problem in question (Emory and Cooper 1995:180-181). The advantages in using the popular Lickert scale, according to Watkins (2008:140), (citing Emory and Cooper 1995) are:

- Easy and quick to construct.
- Each item meets an empirical test for discriminating ability.

- The Lickert scale is probably more reliable than the Thurston scale, and it provides a greater volume of data than the Thurston differential scale.
- The Lickert scale is also treated as an interval scale.

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

4.7 THE DEMAND FOR A QUALITATIVE RESEARCH STRATEGY

While the Researcher acknowledges that a number of strategies can be applied in similar research projects, the well-known concepts of objectivity, reliability, etcetera, inherited from the empirical analytical paradigm, are suggested for business research in more or less the traditional way. Quoting Thorndike and Hagen, these concepts are defined by Emory & Cooper (1995:156), as follows:

- **Practicality:** Practicality is concerned with a wide range of factors of economy, convenience and interpretability.
- **Validity:** Validity refers to the extent to which a test measures what we actually wish to measure. Watkins (2008:43), (citing Yin 2003), identifies 3 subsets to the concept of validity, namely: Construct validity, internal validity and external validity.
- **Reliability:** Reliability has to do with the accuracy and precision of a measurement procedure.

4.8 SURVEY SENSITIVITY

There are particular challenges to the researcher, especially in research conducted in areas of a sensitive nature. The following guidelines from various academics serve to illustrate the mitigation process, which can be deployed in an instance where research is conducted in areas of a sensitive nature:

- A qualitative investigation of a particularly sensitive nature conducted by Oskowitz and Meulenberg-Buskens (1997:83), qualified the importance of handling mission critical issues as identified above, when the authors stated: “Thus any type of qualitative investigation could benefit from the

researchers being skilled and prepared, and the sensitive nature of an investigation into a stigmatizing condition made the need for such an undertaking even more imperative in the current study”.

- The sensitivity of certain issues, and issues identified as impacting the research negatively in the environments being evaluated, not only demand intimate personal involvement, but also demand the ‘personal and practical experience’ of the researcher. This view was upheld by Oskowitz and Meulenberg-Buskens (1997:83), as being imperative to assure quality in qualitative research being undertaken. Checkland (1989:152), supports this view, but extends the concept with the view that: “The researcher becomes a participant in the action, and the process of change itself becomes the subject of research”.

4.9 SURVEY DESIGN

Watkins (2008:140), (citing Collis and Hussey 2003), are avow that “if research is to be conducted in an efficient manner and make the best of opportunities and resources available, it must be organised”. Furthermore, if it is to provide a coherent and logical route to a reliable outcome, it must be conducted systematically, using appropriate methods to collect and analyse the data. A survey should be designed in accordance with the following stages:

- **Stage one:** Identify the topic and set some objectives.
- **Stage two:** Pilot a questionnaire to find out what people know and what they see as the important issues.
- **Stage three:** List the areas of information needed and refine the objectives.
- **Stage four:** Review the responses to the pilot.
- **Stage five:** Finalise the objectives.
- **Stage six:** Write the questionnaire.
- **Stage seven:** Re-pilot the questionnaire.
- **Stage eight:** Finalise the questionnaire.
- **Stage nine:** Code the questionnaire.

In this research project, the descriptive survey design was used, and not the analytical survey. The descriptive survey, according to Watkins (2008:140), (citing Collis and Hussey 2003), is frequently used in business research in the form of attitude surveys. The descriptive survey as defined by Ghauri, Grønhaug and Kristianslund (1995:60), has furthermore the characteristics to indicate how many members of a particular population have a certain characteristic. Particular care was taken to avoid bias in the formulation of the questions.

The statements within the survey have been designed with the following principles in mind (Watkins, 2008:143):

- Avoidance of double-barrelled statements.
- Avoidance of double-negative statements.
- Avoidance of prestige bias.
- Avoidance of leading statements.
- Avoidance of the assumption of prior knowledge.

Statements were so formulated as to allow the same respondents to respond to each of the two questionnaires, and to determine the impact of non-conforming products / services delivered in the nuclear power plant.

4.10 THE VALIDATION SURVEY QUESTIONS

The author has developed two separate survey questionnaires to measure non-conformance from suppliers. According to Watkins 2008:8), (citing Babbie 2005) due to the fact that face-to-face interviews are highly structured, questions were prepared and piloted to ensure that they reflected a high degree of ‘validity’.

4.11 THE RESEARCH QUESTIONNAIRE

In the opinion of Sammy (2008:85), a questionnaire is a quantitative data collection method which has several advantages, namely:

- It is relatively economical.
- It can ensure anonymity.
- It contains questions to cover specific considerations.

- Existing questionnaires can be modified.

The objective of these surveys is to determine the opinions of the role players in procurement and materials management in this industry. The questionnaires in this research study are divided into two sections, namely:

- Buyers questionnaire.
- Materials management questionnaire.

A list of the questions in the research questionnaire is given below.

4.11.1 BUYERS QUESTIONNAIRES

A. IMPACT OF NON-CONFORMANCES

The following question applies to the entire questionnaire. To what extent do you agree or disagree with the following statements?

Question 1: Poor service delivery and products are often received from suppliers.

Question 2: There are sufficient measures in place to reduce wastage due to poor quality.

Question 3: Surveillances are conducted with suppliers.

Question 4: There are proper procedures that govern non-conformances.

Question 5: There are proper corrective procedures that deal with non-conformances.

B. THE IMPORTANCE OF QUALITY IN THE SUPPLY CHAIN MANAGEMENT

Question 6: There are proper preventive procedures that deal with non-conformances.

Question 7: There are proper preventive procedures that deal with the prevention of non-conformances.

Question 8: Proper records of non-conformances are kept.

Question 9: Preventive measures are communicated to suppliers.

Question 10: Preventive measures are communicated to end-users.

C. QUALITY MANAGEMENT TOOLS TO MEASURE THE REDUCTION OF NON-CONFORMANCES

Question 11: Quality Management tools are often used to analyse non-conformances.

Question 12: I often use Quality Management tools to analyse non-conformances.

Question 13: I have been trained to use Quality Management tools to analyse non-conformances.

Question 14: There are proper procedures that govern the use of Quality Management tools.

Question 15: I work in accordance with a Quality Management System.

D. MECHANISMS TO BE DEPLOYED TO REDUCE NON-CONFORMANCES

Question 16: Sound procedures are in place in order to identify non-conformances.

Question 17: Sound procedures are in place in order to correct non-conformances.

Question 18: Records of root causes for non-conformances are kept.

Question 19: Problem notification is raised to address non-conformances.

E. IMPROVEMENT OF QUALITY OF GOODS AND SERVICES THROUGH THE APPLICATION OF QMS WITHIN THE SUPPLY CHAIN

Question 20: Awareness and training is conducted.

Question 21: Suppliers use different quality standards.

Question 22: Receipt inspections and surveillances are conducted by the client organisation.

Question 23: The supplier database is updated regularly.

Question 24: Buyers always send correct information to suppliers when purchasing items.

Question 25: There is adequate communication between buyers & suppliers.

4.11.2 MATERIALS MANAGEMENT QUESTIONNAIRES

A. IMPACT OF NON-CONFORMANCES

The following question applies to the entire questionnaire. To what extent do you agree or disagree with the following statements?

Question 1: Poor service delivery and products are often received from suppliers.

Question 2: There are sufficient measures in place to reduce wastage due to poor quality.

Question 3: Surveillances are conducted with suppliers.

Question 4: There are proper procedures that govern non-conformances.

Question 5: There are proper corrective procedures that deal with non-conformances.

B. THE IMPORTANCE OF QUALITY IN THE SUPPLY CHAIN MANAGEMENT

Question 6: There are proper preventive procedures that deal with non-conformances.

Question 7: There are proper preventive procedures that deal with prevention of non-conformances.

Question 8: Proper records of non-conformances are kept.

Question 9: Preventive measures are communicated with suppliers.

Question 10: Preventive measures are communicated with end-users.

C. QUALITY MANAGEMENT TOOLS TO MEASURE THE REDUCTION OF NON-CONFORMANCES

Question 11: Quality Management tools are often used to analyse non-conformances.

Question 12: I often use Quality Management tools to analyse non-conformances.

Question 13: I have been trained to use Quality Management tools to analyse non-conformances.

Question 14: There are proper procedures that govern the use of Quality Management tools.

Question 15: I work in accordance with a Quality Management System.

D. MECHANISMS TO BE DEPLOYED TO REDUCE NON-CONFORMANCES

Question 16: Sound procedures are in place in order to identify non-conformances.

Question 17: Sound procedures are in place in order to correct non-conformances.

Question 18: Records of root causes for non-conformances are kept.

Question 19: Problem notification is raised to address non-conformances.

E. IMPROVEMENT OF QUALITY OF GOODS AND SERVICES THROUGH THE APPLICATION OF QMS WITHIN THE SUPPLY CHAIN

Question 20: Awareness and training is conducted.

Question 21: Suppliers use different quality standards.

Question 22: Receipt inspections and surveillances are conducted by the client organisation.

Question 23: The supplier database is updated regularly.

Question 24: Buyers always send correct information to suppliers when purchasing items.

Question 25: There is adequate communication between buyers & suppliers.

4.12 CONCLUSION

In this chapter, the ‘knowledge management’ survey design and methodology was addressed under the following functional headings:

- Survey environment.
- Aim of the chapter.
- Choice of sampling method.
- Target population.
- Data collection.
- Measurement scales.
- Demand for a qualitative research strategy.
- Survey sensitivity.
- Survey design.
- Survey questions.

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

CHAPTER 5: DATA ANALYSIS

5.1 INTRODUCTION

De Vos (2002: 339), defines data analysis as “the process of bringing order, structure and meaning to the mass of collected data” This chapter discusses the statistical analysis of the questionnaire compiled by the researcher, for the purpose of obtaining Magister Technologiae: Quality in the Faculty of Engineering at the Cape Peninsula University of Technology. The aim of this study is to determine whether poor product or service delivery from vendors or suppliers have an adverse impact on the output of the Procurement Quality Department. In this chapter the data obtained from the completed questionnaires will be presented and analysed.

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

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

The following responses to the questionnaire developed by the researcher for the purpose of obtaining information regarding: the impact of poor quality or non-conformances; whether non-conformance can be prevented in future; the quality management tools that can be used to analyse and prevent non-conformances; alternative mechanisms that can be deployed to minimise non-conformances; and what processes the suppliers or vendors have in place in order to address non-conformances, have been analysed by using SAS® software.

5.2 METHOD OF ANALYSIS

5.2.1 VALIDATION OF SURVEY RESULTS

A descriptive analysis of the survey results returned by the research questionnaire respondents is reflected below. The responses to the questions obtained through the questionnaires are indicated in table format for ease of reference. Data validation is the process of ensuring that a programme operates on clean, correct and useful data. The construct validation, however, can only be taken to the point where the questionnaire measures what it is supposed to measure. Construct validation should be addressed in the planning phases of the survey, and when the questionnaire is developed. This questionnaire is supposed to measure mechanisms or processes that can be used to reduce non-conformances of vendors or suppliers of a nuclear power plant in the Western Cape. The departments which will form part of this survey will be the Procurement department and the Materials Management department of the nuclear power plant.

5.2.2 DATA FORMAT

The data was received in questionnaires, which were coded and captured on a database developed on Microsoft Access, for this purpose. These questionnaires were captured twice and then the two datasets were compared to minimise mistakes in capturing. When the database had been developed, use was made of rules, with respect to the questionnaire, that set boundaries for the different variables (questions). For instance, if the Likert scale is used, as follows:

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

A boundary is set on Microsoft Access as less than 6. This means if the 6 or more than 6, are captured, an error will show until a number less than 6 is captured. It

was then imported into SAS-format through the SAS ACCESS module. This information, which had been double-checked for correctness, was then analysed by the custodian of this document.

5.2.3 PRELIMINARY ANALYSIS

The reliability of the statements in the questionnaire posed to the respondents in the nuclear facility is measured by using the Cronbach Alpha test. (Refer to 5.3.1). A Uni-variate descriptive analysis is performed on all the original variables; displaying frequencies, percentages, cumulative frequencies, cumulative percentages, means, standard deviations, range, median, mode etc. These descriptive statistics are discussed in paragraphs 5.3.2 and 5.3.3. (Refer to computer printouts in Annexure B & C).

5.2.4 INFERENCE STATISTICS

Inferential statistics that will be used are:

- **The Cronbach Alpha test:** Cronbach's Alpha is an index of reliability associated with the variation accounted for by the true score of the "underlying construct". Construct is the hypothetical variables that are being measured **Watkins (2008:44), (citing Cooper & Schindler 2001)**. Another way to put it would be that Cronbach's Alpha measures how well a set of items (or variables) measures a single uni-dimensional latent construct. When data has a multidimensional structure, Cronbach's Alpha will usually be low.
- **The Chi-square tests for nominal data:** The Chi-square (two-sample) tests are probably the most widely used nonparametric tests of significance that are useful for tests involving nominal data, but which can be used for higher scales as well, like cases where persons, events or objects are grouped in two or more nominal categories such as 'yes-no', or cases A, B, C or D. The technique is used to test for significant differences between the observed distribution of data among categories and the expected distribution based on the null hypothesis. It has to be calculated with actual counts, rather than percentages **Watkins (2008:44) cited by (Cooper & Schindler 2001)**.

- **The Mann-Whitney U test, or Wilcoxon rank-sum test:** Is used for ordinal data with two independent samples. The Mann-Whitney *U* test (also called the Mann-Whitney-Wilcoxon (MWW), Wilcoxon rank-sum test, or Wilcoxon-Mann-Whitney test), is a non-parametric test for assessing whether two samples of observations come from the same distribution. The null hypothesis is that the two samples are drawn from a single population, and therefore, that their probability distributions are equal. It requires the two samples to be independent, and the observations to be ordinal or continuous measurements, i.e. one can at least say, of any two observations, which is the greater. In a less general formulation, the Wilcoxon-Mann-Whitney two-sample test may be thought of as testing the null hypothesis that the probability of an observation from one population exceeding an observation from the second population is 0.05.
- **A One-way ANOVA:** Is used to test for differences among two or more independent groups (means).
- **The computation of a *p*-value (Probability value):** It measures statistical significance when comparing variables with each other, determining relationships between variables or determining associations between variables. Results will be regarded as significant if the *p*-values are smaller than 0.05, because this value presents an acceptable level on a 95% confidence interval ($p \leq 0.05$). The *p*-value is the probability of observing a sample value as extreme as, or more extreme than, the value actually observed, given that the null hypothesis is true. This area represents the probability of a Type 1 error that must be assumed if the null hypothesis is rejected (Watkins 2008:44) cited by (Cooper & Schindler 2001).
- **The *p*-value is compared to the significance level (α):** The basis of the null hypothesis is either rejected or not rejected. If the *p* value is less than the significance level, the null hypothesis is rejected (if *p* value $< \alpha$, reject null). If the *p* value is greater than, or equal to, the significance level, the null hypothesis is not rejected (if *p* value $\geq \alpha$, do not reject null). Thus with $\alpha=0.05$, if the *p* value is less than 0.05, the null hypothesis will be rejected. The *p* value is determined by using the standard normal

distribution. The small *p value* represents the risk of rejecting the null hypothesis.

- **A statistical significance of difference:** If there is good reason to believe the difference does not represent random sampling fluctuations only. Results will be regarded as significant if the *p-values* are smaller than 0.05, because this value is used as the cut-off point in most behavioural science research.

5.2.5 ASSISTANCE TO RESEARCHER

The conclusions made by the researcher, were validated by the statistical report. Help was given to interpret the outcome of the data. The final report written by the researcher was validated and checked by the statistician, to exclude any misleading interpretations.

All inferential statistics are discussed in paragraphs 5.3.4.

5.2.6 SAMPLE

The target population is employees at the Procurement and Material Management departments in a nuclear power station in the Western Cape; South Africa. A random sample of 51 was drawn in the target population of 70 and the sample realization was 51.

5.3 ANALYSIS

In total, 51 respondents from a nuclear power station in the Western Cape completed the questionnaire. Descriptive statistics will be given for each variable and only the respondents who completed the entire questionnaire will be utilized in the inferential statistics.

5.3.1 RELIABILITY TESTING

Reliability tests (Cronbach's Alpha Coefficient) will be conducted on the questions/statements (which is the measuring instrument in this case) posed to the respondents of the nuclear facility. As Q1 and Q23 are negatively correlated with the other variables (statements) it might suggest that some reversal issues are present, i.e., some questions are phrased as a negative, thus should be recoded. For instance, Q1 which states "Poor Service delivery and products are often received from suppliers", has a negative meaning. Thus, if a respondent agrees with statement Q1 they will disagree with "Good Service delivery and products are often received from suppliers. It is thus necessary to recode Q1 and it is achieved by creating a new variable NQ1 that is the reverse of the original variable and the transformation is as follows:

NQ1 = 1 if Q1 = 5;

NQ1 = 2 if Q1 = 4;

NQ1 = 4 if Q1 = 2;

NQ1 = 5 if Q1 = 1;

The same transformation is done to Q23 as it was negatively correlated with the rest of the items in the questionnaire, and again some reversal issues may be present, although the question was not negatively phrased.

The result is that the Cronbach's Alpha Coefficients for each item are more than 0.70 (the acceptable level according to Nunnally, 1978: 245), and thus these items (statements) in the questionnaire, prove to be reliable and consistent, for all the items in the scale.

The results of the Cronbach Alpha tests for all the raw variables of items in the questionnaire are shown in Table 5.1 and in Annexure A. Table 5.1 shows the correlation between the respective item and the total sum score (without the respective item) and the internal consistency of the scale (coefficient alpha) if the respective item were to be deleted. By deleting the items (statements) one by one, each time, with the statement with the highest Cronbach Alpha value, the Alpha value will increase. In the right-most column of Table 5.1 refer to Annexure G, it

shows that the reliability of the scale could be higher if some of these statements were to be deleted.

For instance, if statement Q24 is deleted from this measuring scale then the Cronbach Alpha Coefficient will increase to 0.8667. This, however, is not needed, as the alpha for each item is greater than 0.70. The Cronbach Alpha Coefficient indicates that the overall measuring instrument (all the items/statements) that determines whether the impact of non-conformance of goods and services delivered at a nuclear power station is consistent. This, however, does not indicate that the measuring instrument is uni-dimensional. Due to the voluminous nature of Table 5.1, the table is contained within the ambit of Annexure G.

In the original questionnaires the questions/statements are grouped into 5 scales, where each of the scales indicates a different measurement with respect to the impact of non-conformance of goods and services delivered at a nuclear power station. These subscales will also be tested for consistency and the results are shown in Tables 5.2 to 5.6 and in Annexure A.

TABLE 5.22: Cronbach's Alpha Coefficient for each scale forming the measurement of impact of non-conformances

Statements (Test all statements without current one's input)	Variable nr.	Correlation with total	Cronbach's Alpha Coefficient
IMPACT OF NON-CONFORMANCES			
1. Poor service delivery and products are often received from suppliers.	Q1	0.0568	0.5601
2. There are sufficient measures in place to reduce wastage due to poor quality.	Q2	0.2505	0.4489
3. Surveillances are conducted with suppliers.	Q3	0.3319	0.3788
4. There are proper procedures that govern non-conformances.	Q4	0.2197	0.4519
5. There are proper corrective procedures that deal with non-conformances.	Q5	0.2386	0.2386
Cronbach's Coefficient Alpha for standardized variables			0.5105
Cronbach's Coefficient Alpha for raw variables			0.4795

Table 5.2 shows that the impact for non-conformance measurement is inconsistent. If the statement Q1 is left out of the scale, in this case the Cronbach Alpha will improve to 0.5601, which still does not imply consistency.

TABLE 5.3: Cronbach’s Alpha Coefficient for each scale forming the measurement of the importance of quality in the supply chain management for the total sample

Statements (Test all statements without current one’s input)	Variable nr.	Correlation with total	Cronbach’s Alpha Coefficient
THE IMPORTANCE OF QUALITY IN THE SUPPLY CHAIN MANAGEMENT			
6. There are proper preventative procedures that deal with non-conformances.	Q6	0.6027	0.7883
7. There are proper preventative procedures that deal with prevention of non-conformances.	Q7	0.6501	0.7770
8. Proper records of non-conformances are kept.	Q8	0.5352	0.8067
9. Preventative measures are communicated with suppliers.	Q9	0.5591	0.8010
10. Preventative measures are communicated with end-users.	Q10	0.7366	0.7458
Cronbach’s Coefficient Alpha for standardized variables			0.8206
Cronbach’s Coefficient Alpha for raw variables			0.8206

The measuring scale for measuring the importance in the supply chain management is consistent.

TABLE 5.4: Cronbach’s Alpha Coefficient for each scale forming the measurement of quality management tool that reduces non-conformances

Statements (Test all statements without current one’s input)	Variable nr.	Correlation with total	Cronbach’s Alpha Coefficient
QUALITY MANAGEMENT TOOLS TO MEASURE THE REDUCTION OF NON-CONFORMANCES			
11. Quality Management tools are often used to analyse non-conformances.	Q11	0.6974	0.7802
12. I often use Quality Management tools to analyse non-conformances.	Q12	0.7786	0.7541
13. I have been trained to use Quality	Q13	0.6578	0.7926

Statements (Test all statements without current one's input)	Variable nr.	Correlation with total	Cronbach's Alpha Coefficient
Management tools to analyse non-conformances.			
14. There are proper procedures that govern the use of Quality Management tools.	Q14	0.6356	0.7981
15. I work in accordance with a Quality Management System.	Q15	0.4074	0.8507
Cronbach's Coefficient Alpha for standardized variables			0.8288
Cronbach's Coefficient Alpha for raw variables			0.8322

The measuring scale for measuring quality management tools to reduce non-conformances is consistent.

TABLE 5.5: Cronbach's Alpha Coefficient for each scale forming the measurement of the mechanisms to be deployed to reduce non-conformances

Statements (Test all statements without current one's input)	Variable nr.	Correlation with total	Cronbach's Alpha Coefficient
MECHANISMS TO BE DEPLOYED TO REDUCE NON-CONFORMANCES			
16. Sound procedures are in place in order to identify non-conformances.	Q16	0.2583	0.6255
17. Sound procedures are in place in order to correct non-conformances.	Q17	0.5630	0.3754
18. Records of root causes for non-conformances are kept.	Q18	0.4586	0.4559
19. Problem notification is raised to address non-conformances.	Q19	0.2594	0.6014
Cronbach's Coefficient Alpha for standardized variables			0.6045
Cronbach's Coefficient Alpha for raw variables			0.4811

Table 5.5 shows that the measurement scale which measures the mechanisms to be deployed in order to reduce non-conformances, is not consistent.

TABLE 5.6: Cronbach's Alpha Coefficient for each scale forming the measurement of quality of goods and services

Statements (Test all statements without current one's input)	Variable nr.	Correlation with total	Cronbach's Alpha Coefficient
IMPROVEMENT OF QUALITY OF GOODS AND SERVICES THROUGH THE APPLICATION OF QMS WITHIN THE SUPPLY CHAIN			
20. Awareness and training is conducted.	Q20	0.2708	0.3880
21. Suppliers use different Quality standards.	Q21	-0.0381	0.5229
22. Receipt inspections and surveillances are conducted by the client organisation.	Q22	0.0315	0.4993
23. The supplier database is updated regularly.	Q23	0.1536	0.4479
24. Buyers always send correct information to suppliers when purchasing items.	Q24	0.3096	0.3576
25. There is adequate communication between buyers and suppliers.	Q25	0.6494	0.1332
Cronbach's Coefficient Alpha for standardized variables			0.4087
Cronbach's Coefficient Alpha for raw variables			0.4580

Table 5.6 shows that the measurement scale which measures the improvement of quality of goods and services, is not consistent. A higher Cronbach Alpha (0.5229) can be achieved by deleting Q21; but it will still not prove to be consistent.

Due to the fact that Q6-Q10, which measures the importance in the supply chain management, and Q11-Q15 which measures quality management tools to reduce non-conformances, are consistent and that it represents one construct (Latent variable) each, the scale can be summarised, and thus statistical tests that can be performed on the interval data.

5.3.2 DESCRIPTIVE STATISTICS

In Table 5.7 (Refer to Annexure H) shows the descriptive statistics for all the categorical variables with the frequencies in each category and the percentage out of the total number of questionnaires. Take note that the descriptive statistics are based on the total sample. These descriptive statistics are also shown in Annexure

B & C. Due to the voluminous nature of Tables 5.7 and 5.8; the tables are contained within the ambit of Annexure H & I.

5.3.3 UNI-VARIATE GRAPHS

This paragraph will illustrate the distribution of the responses for each statement in the survey refers to Figure 5.1 below.

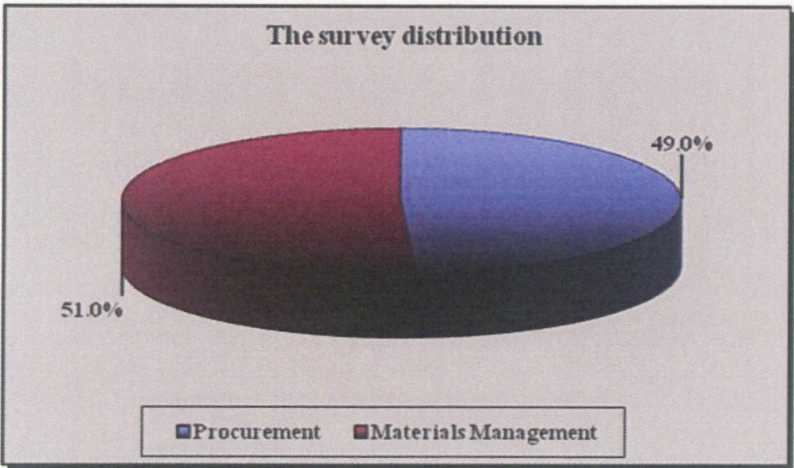


FIGURE 5.1: Survey distribution

The respondents that took part in this survey were equally distributed between the Procurement and Materials Management departments.

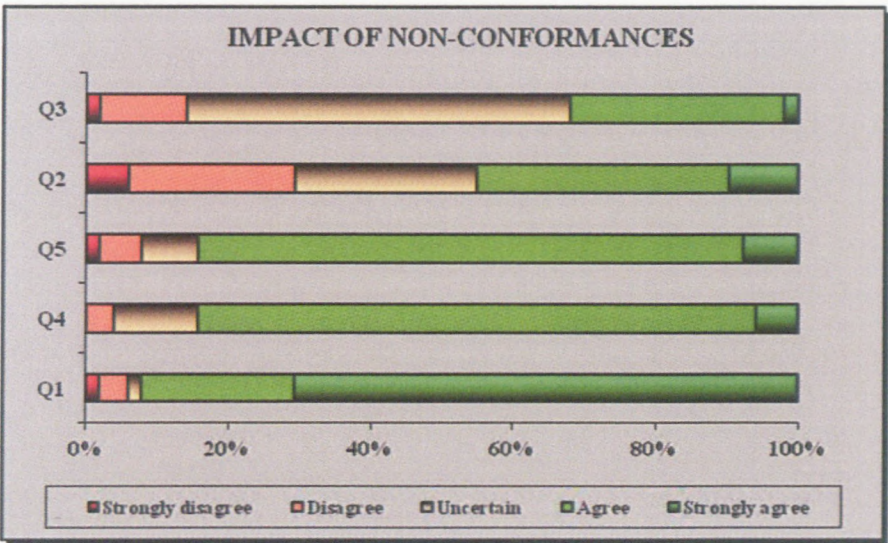


FIGURE 5.2: The impact of non-conformances

The statements as in Figure 5.2 were sorted from the statement which the respondents mostly agree with, to the statement that they least agree with. The respondents mostly agree with the following statements:

- Poor service delivery and products are often received from suppliers. (92.2% agree, to strongly agree).
- There are proper procedures that govern non-conformances. (84.3% agree, to strongly agree).
- There are proper corrective procedures that deal with non-conformances. (84.3% agree, to strongly agree).

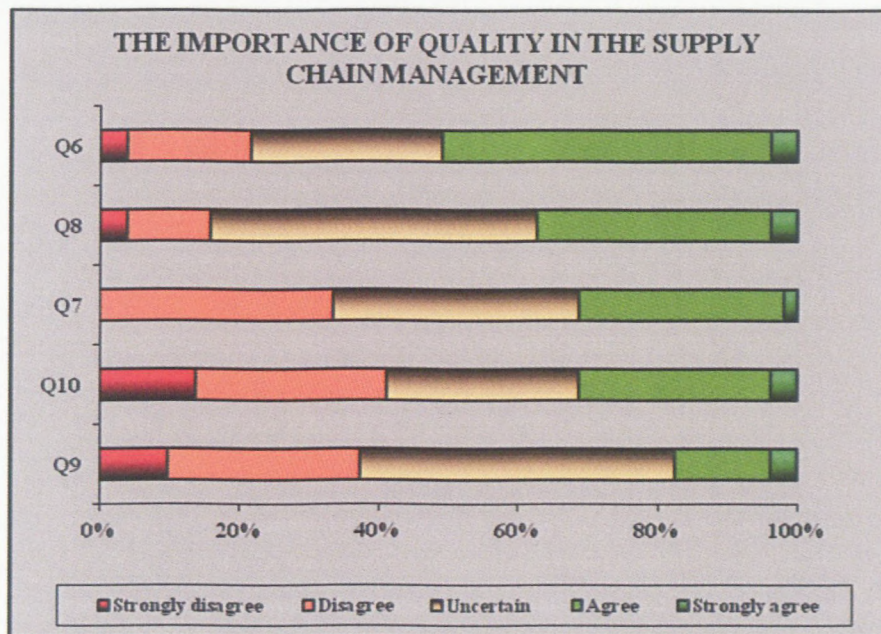


FIGURE 5.3: The importance of quality in the supply chain management

The statements as in Figure 5.3 were sorted from the statement which the respondents mostly agree with, to the statement that they least agree with. The respondents agreed more with the following statements:

- There are proper preventative procedures that deal with non-conformances. (51.0% agree, to strongly agree and 21.6% disagree, to strongly disagree).
- Proper records of non-conformances are kept. (37.2% agree, to strongly agree and 15.7% disagree, to strongly disagree).

Note should be taken of the high percentages of respondents who were undecided (27.4%-47.1% were undecided).

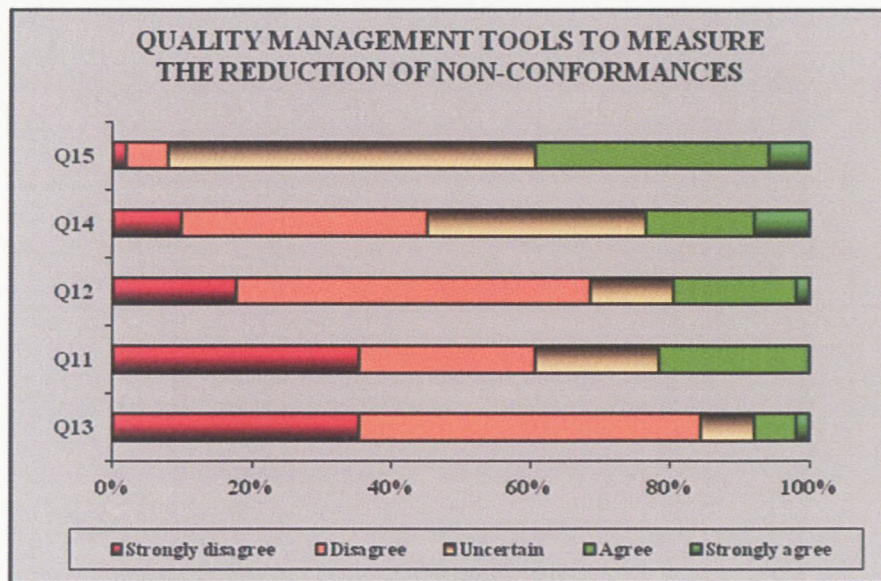


FIGURE 5.4: Quality Management tools to measure the reduction of non-conformances

The statements as in Figure 5.4 were sorted from the statement which the respondents mostly agree with to the statement that they least agree with. The respondents least agreed with the following statements:

- I have been trained to use quality management tools to analyse non-conformances. (84.3% disagree, to strongly disagree).
- Quality Management tools are often used to analyse non-conformances. (60.8% disagree, to strongly disagree).
- I often use quality management tools to analyse non-conformances. (68.6% disagree, to strongly disagree).

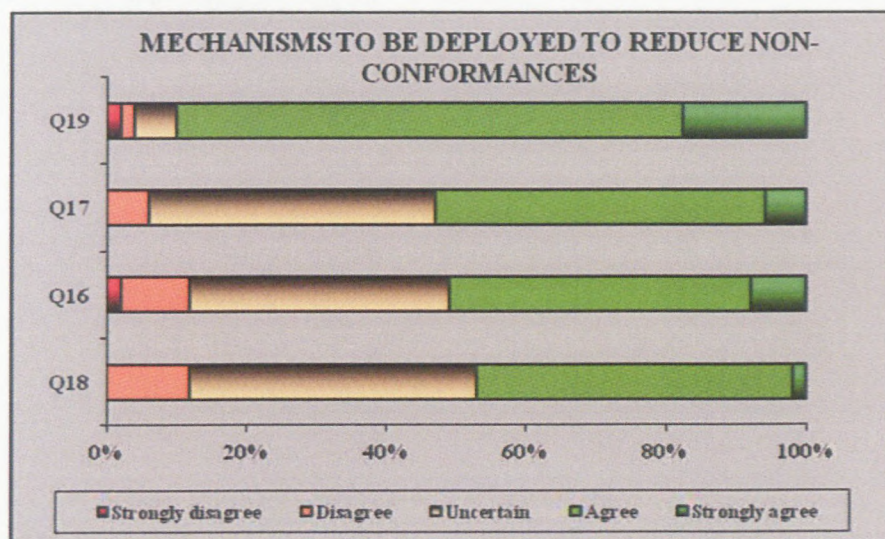


FIGURE 5.5: Mechanisms to be deployed to reduce non-conformances

The statements as in Figure 5.5 were sorted from the statement which the respondents mostly agree with to the statement that they least agree with. The respondents mostly agreed with the following statements:

- Problem notification is raised to address non-conformances. (90.2% agree, to strongly agree).
- Sound procedures are in place in order to correct non-conformances. (52.9% agree, to strongly agree).
- Sound procedures are in place in order to identify non-conformances. (51.0% agree, to strongly agree).
- Records of root causes for non-conformance are kept. (47.1% agree, to strongly agree).

Note should be taken of the high percentage of respondents who were undecided for questions 16 to 18.

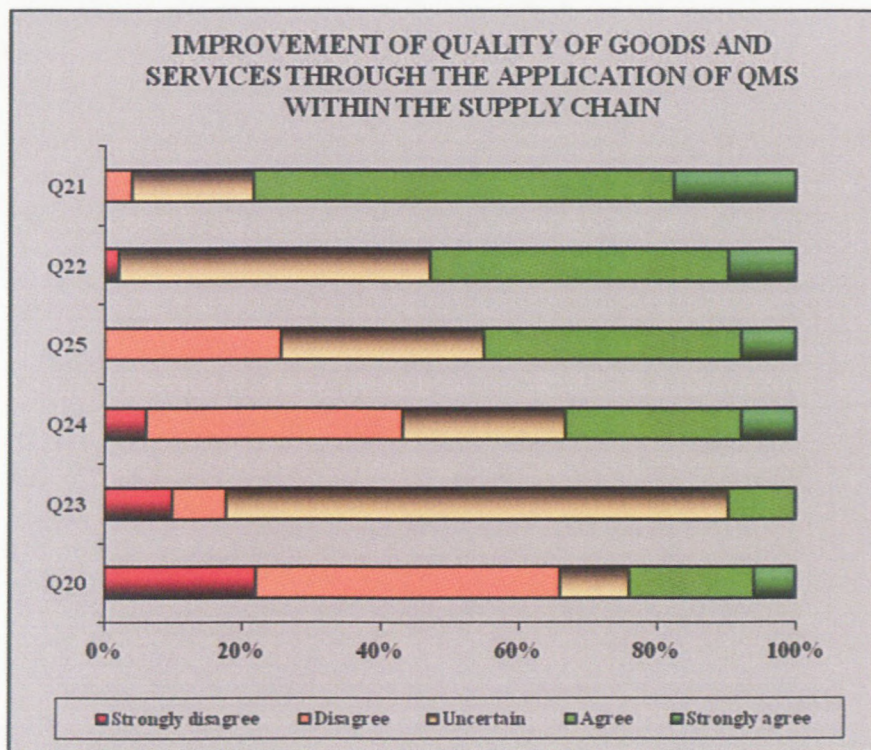


FIGURE 5.6: Improvement of quality of goods and services through the application of QMS within the supply chain

The statements were sorted from the statement which the respondents mostly agree with to the statement that they least agree with. The respondents mostly agreed with the following statements:

- Suppliers use different quality standards. (78.4% agree, to strongly agree).

- Receipt inspections and surveillance are conducted by the client organisation. (52.9% agree, to strongly agree).

The respondents agreed least with the statement “Awareness and training is conducted” (64.7% disagree, to strongly disagree).

5.3.4 INFERENCE STATISTICS

The following inferential statistics will be reflected on the survey data:

1. For all the statements in the survey, a comparison will be made between the proportions of respondents who agreed, to strongly agree and the proportions of respondents who disagree, to strongly disagree with the statements. This is done to serve as statistical evidence when the results are discussed.
2. A comparison will be made between the respondents who fall in the procurement group and the respondents who fall in the material management group, to see whether their perceptions are the same.

Comparative statistics for the abovementioned comparisons that were used, are discussed in Paragraphs 5.3.4.1 and 5.3.4.2; and the computer printouts are shown in Annexure D and E.

The hypotheses being tested for the comparisons under point 1 will be as follows:

- H_0 = The proportion of respondents who agree, to strongly agree is not different from the proportion of respondents who disagree, to strongly disagree.
- H_1 = The proportion of respondents who agree, to strongly agree is different from the proportion of respondents who disagree, to strongly disagree.

The hypotheses being tested for the comparisons under point 2 will be as follows:

- H_0 = The two independent groups (Procurement and Material Management) do not differ with respect to their perceptions in this survey.
- H_1 = The two independent groups (Procurement and Material Management) differ with respect to their perceptions in this survey.

5.3.4.1 Comparisons with regard to the difference in proportions of who agreed and who disagreed

Chi-square tests were performed to determine whether the proportion of respondents who agreed is equal to the proportion of respondents who disagreed for each question (statement).

The results for only the statistically significant differences are shown in Table 5.9; but all the results will be shown in Annexure D.

TABLE 5.9: Statistically significant Chi-square test for equal proportions

Question / Statement	Sample Size	Chi-Square	DF	P-Value
IMPACT OF NON-CONFORMANCES				
1. Poor service delivery and products are often received from suppliers.	51	79.5294	2	<0.0001***
3. Surveillances are conducted with suppliers.	50	12.0400	2	0.0024**
4. There are proper procedures that govern non-conformances.	51	60.1176	2	<0.0001***
5. There are proper corrective procedures that deal with non-conformances.	51	59.6471	2	<0.0001***
THE IMPORTANCE OF QUALITY IN THE SUPPLY CHAIN MANAGEMENT				
6. There are proper preventative procedures that deal with non-conformances.	51	7.4118	2	0.0246*
8. Proper records of non-conformances are kept.	51	7.8824	2	0.0194*
9. Preventative measures are communicated with suppliers.	51	6.1176	2	0.0469*
QUALITY MANAGEMENT TOOLS TO MEASURE THE REDUCTION OF NON-CONFORMANCES				
11. Quality Management tools are often used to analyse non-conformances.	51	17.4118	2	0.0002***
12. I often use Quality Management tools to analyse non-conformances.	51	29.0588	2	<0.0001***
13. I have been trained to use Quality Management tools to analyse non-	51	59.6471	2	<0.0001***

Question / Statement	Sample Size	Chi-Square	DF	P-Value
conformances.				
15. I work in accordance with a Quality Management System.	51	16.3529	2	0.0003***
MECHANISMS TO BE DEPLOYED TO REDUCE NON-CONFORMANCES				
16. Sound procedures are in place in order to identify non-conformances.	51	12.1176	2	0.0023**
17. Sound procedures are in place in order to correct non-conformances.	51	18.3529	2	0.0001***
18. Records of root causes for non-conformances are kept.	51	10.9412	2	0.0042**
19. Problem notification is raised to address non-conformances.	51	74.2353	2	<0.0001***
IMPROVEMENT OF QUALITY OF GOODS AND SERVICES THROUGH THE APPLICATION OF QMS WITHIN THE SUPPLY CHAIN				
20. Awareness and training is conducted.	51	25.4800	2	<0.0001***
21. Suppliers use different quality standards.	51	48.1176	2	<0.0001***
22. Receipt inspections and surveillances are conducted by the client organisation.	51	23.0588	2	<0.0001***
23. The supplier database is updated regularly.	51	35.7647	2	<0.0001***

* Statistically significant at level 0.05

** Statistically significant at level 0.01

*** Statistically significant at level 0.001

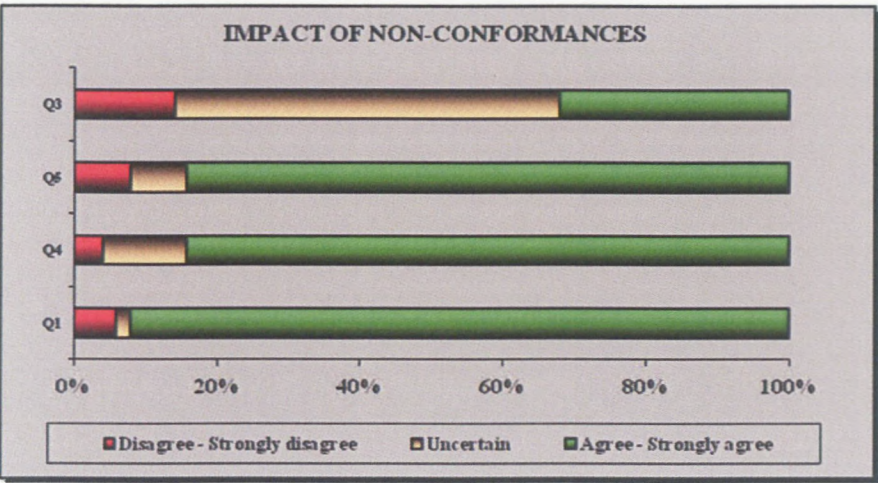


FIGURE 5.7: The impact of non-conformances

According to Table 5.9, there were statistically significant differences between the proportions of respondents who agree, to strongly agree, the proportions of the respondents who were undecided, and the proportions of the respondents who disagree, to strongly disagree. It can be seen in Figure 5.7 that for the statements Q1; Q4 and Q5 there were statistically significantly more respondents who agree, to strongly agree than respondents who were undecided or respondents who disagree, to strongly disagree. For Q3, however, statistically significantly more respondents were undecided compared to the other two responses.

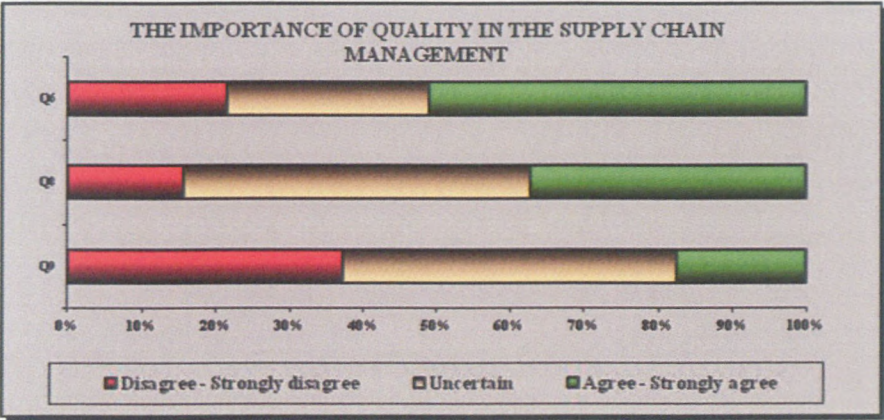


FIGURE 5.8: The importance of quality in the supply chain management

According to Table 5.9 there were statistically significant differences between the proportions of respondents who agree, to strongly agree, the proportions of the respondents who were undecided and the proportions of the respondents who disagree, to strongly disagree. It can be seen in Figure 5.8 that for the statement Q6 there were statistically significantly more respondents who agree, to strongly

agree than respondents who were undecided or respondents who disagree, to strongly disagree. For Q8 however there were statistically significantly more respondents who were undecided and who agree, to strongly agree than disagree, to strongly disagree. For Q9 however there were statistically significantly more respondents who were undecided and who disagree, to strongly disagree than agree, to strongly agree.

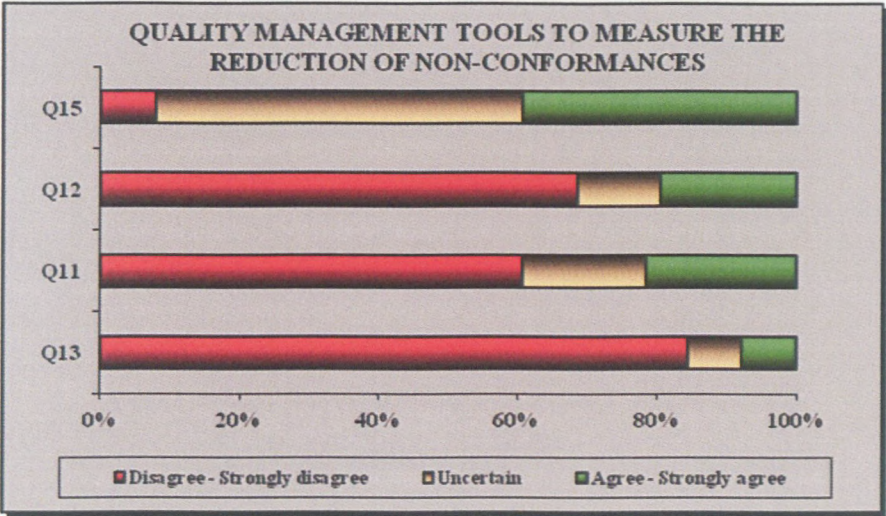


FIGURE 5.9: Quality Management tools to measure the reduction of non-conformances

According to Table 5.9 there were statistically significant differences between the proportions of respondents who agree, to strongly agree, the proportions of the respondents who were undecided and the proportions of the respondents who disagree, to strongly disagree. It can be seen in Figure 5.9 that for the statements Q11, Q12 and Q13 there were statistically significantly more respondents who disagree, to strongly disagree than respondents who were undecided or respondents who agree, to strongly agree. For Q15 however there were statistically significantly more respondents who were undecided and who agree, to strongly agree than disagree, to strongly disagree.

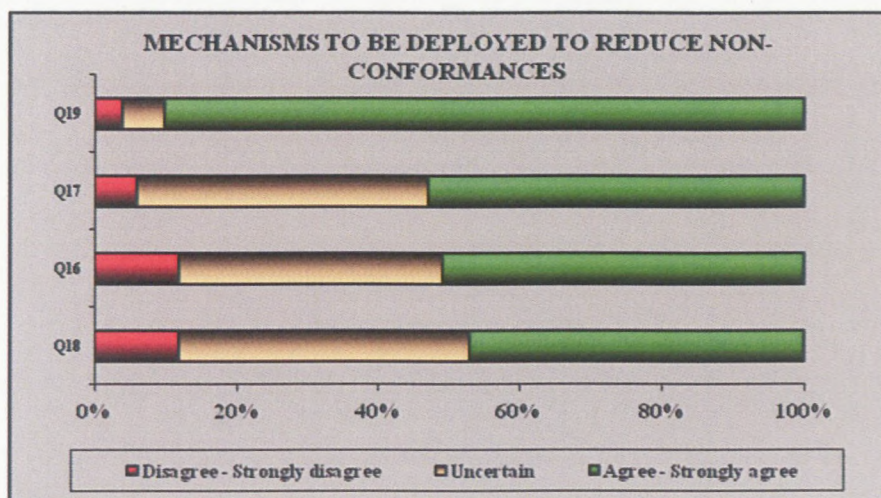


FIGURE 5.10: Mechanisms to be deployed to reduce non-conformances

According to Table 5.9 there were statistically significant differences between the proportions of respondents who agree, to strongly agree, the proportions of the respondents who were undecided and the proportions of the respondents who disagree, to strongly disagree. It can be seen in Figure 5.10 that for the statement Q19 there were statistically significantly more respondents who agree, to strongly agree than respondents who were undecided or respondents who disagree, to strongly disagree. For Q16, Q17 and Q18 however there were statistically significantly more respondents who were undecided and who agree, to strongly agree than disagree, to strongly disagree.

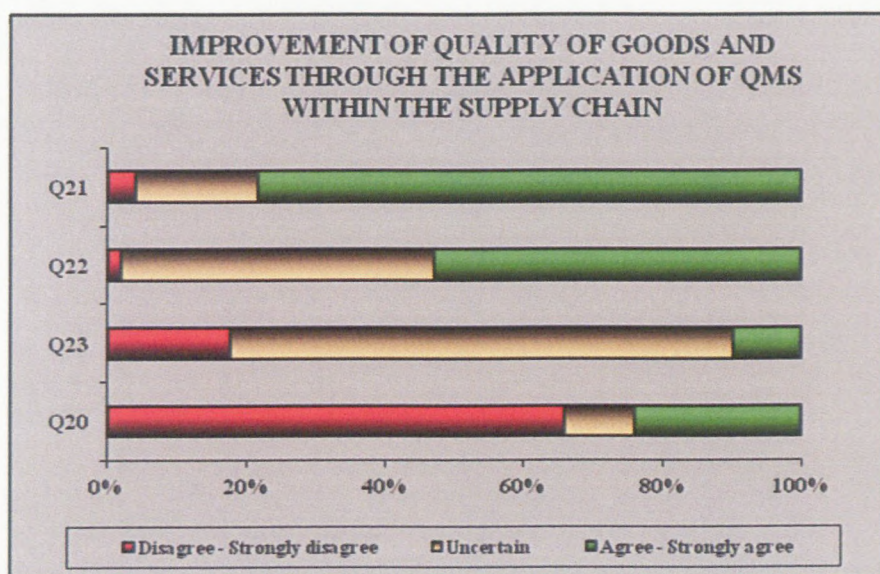


FIGURE 5.11: Improvement of quality of goods and services through the application of QMS within the supply chain

According to Table 5.9 there were statistically significant differences between the proportions of respondents who agree, to strongly agree, the proportions of the respondents who were undecided and the proportions of the respondents who disagree, to strongly disagree. It can be seen in Figure 5.11 that for the statement Q21 there were statistically significantly more respondents who agree, to strongly agree than respondents who were undecided or respondents who disagree, to strongly disagree. For the statement Q20 there were statistically significantly more respondents who disagree, to strongly disagree than respondents who were undecided or respondents who agree, to strongly agree. For Q22 however there were statistically significantly more respondents who were undecided and who agree, to strongly agree than disagree, to strongly disagree. For Q23 there were statistically significantly more respondents who were undecided than respondents who agree, to strongly agree and disagree, to strongly disagree.

5.3.4.2 Comparisons with regard to whether the two independent groups differed in respect of their perceptions

A comparison is made between the two groups of respondents (Procurement and Materials Management) to see whether there is a difference in their perceptions with respect to the statements that were made. Firstly the two groups are compared with respect to each statement by using Chi-square tests and then the two latent questions are compared by using an Analysis of Variance for 2 samples which compares the two means of the summarised variables A1 and A2. The Mann-Whitney test for two samples was also used, as doubt existed whether the data was normally distributed.

The two latent variables consist out of the following:

$A1 = Q6 + Q7 + Q8 + Q9 + Q10$; and

$A2 = Q11 + Q12 + Q13 + Q14 + Q15$.

All the statistically significant results will be discussed in this paragraph, with the supporting statistical analysis in Annexure E.

Table 5.10 and Table 5.11 below show the chi-squared test that was performed between two groups (Procurement and Materials Management). Analysis of variation was used from question Q6-Q10 and Q11-Q15 versus question three (Q3).

TABLE 5.10: Contingency table for Respondent group vs Q3

Frequency / Row percentage	Agree- Strongly Agree	Undecided	Disagree - Strongly Disagree	TOTAL
Buyers	11 45.8%	12 50.0%	1 4.2%	24 48.0%
Materials Management	5 19.2%	15 57.7%	6 23.1%	26 52.0%
TOTAL	16 32.0%	27 54.0%	7 14.0%	50

TABLE 5.11: Chi-Square test for Respondent group vs Q3

Question / Statement	Sample Size	Chi-Square	DF	P-Value
3. Surveillances are conducted with suppliers.	50	6.0845	2	0.0477*

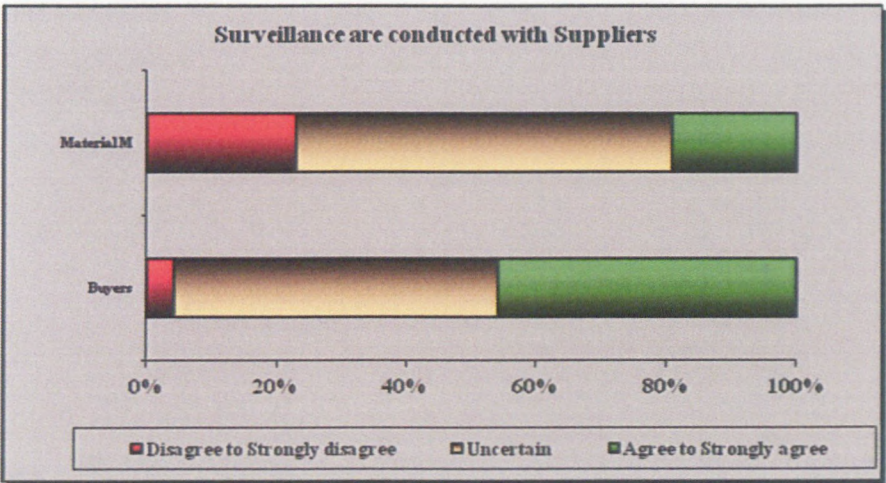


FIGURE 5.12: The impact of non-conformances

Although there are a high percentage of undecided respondents, there were statistically more buyers that agreed, to strongly agree with this statement.

Table 5.12 and Table 5.13 below show the chi-squared test that was performed between two groups (Procurement and Materials Management). Analysis of variation was used from question Q6-Q10 and Q11-Q15 versus question seven (Q7).

TABLE 5.12: Contingency table for Respondent group vs Q7

Frequency / Row percentage	Agree- Strongly Agree	Undecide d	Disagree -Strongly Disagree	TOTAL
Buyers	7 28.0%	13 52.0%	7 20.0%	25 49.0%
Administration	9 34.6%	5 19.2%	12 46.2%	26 51.0%
TOTAL	16 31.4%	18 35.3%	17 33.3%	51

TABLE 5.13: Chi-Square test for Respondent group vs Q7

Question / Statement	Sample Size	Chi-Square	DF	P-Value
7. There are proper preventative procedures that deal with prevention of non-conformances.	50	6.6709	2	0.0356*

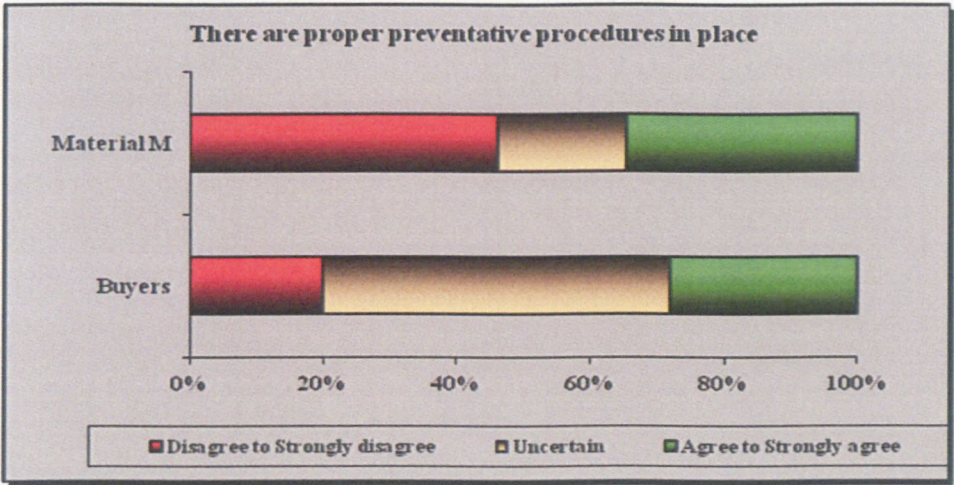


FIGURE 5.13: The impact of non-conformances

There were statistically significantly more buyers that were undecided whether there were proper preventative procedures that deal with prevention of non-

conformances. Thus, more respondents from the materials department disagree to strongly disagree, than buyers.

Table 5.14 and Table 5.15 below show the chi-squared test that was performed between two groups (Procurement and Materials Management). Analysis of variation was used from question Q6-Q10 and Q11-Q15 versus question nine (Q9).

TABLE 5.14: Contingency table for Respondent group vs Q9

Frequency / Row percentage	Agree- Strongly Agree	Undecide d	Disagree -Strongly Disagree	TOTAL
Buyers	3 12.0%	16 64.0%	6 24.0%	25 49.0%
Administration	6 23.1%	7 26.9%	13 50.0%	26 51.0%
TOTAL	9 17.6%	23 45.1%	19 37.2%	51

TABLE 5.15: Chi-Square test for Respondent group vs Q9

Question / Statement	Sample Size	Chi-Square	DF	P-Value
9. Preventative measures are communicated with Suppliers.	51	7.0838	2	0.0290*

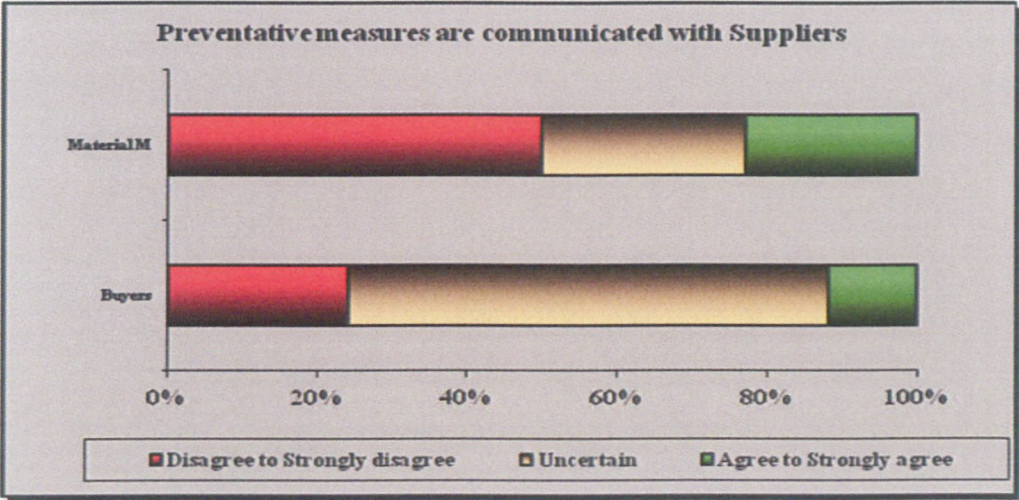


FIGURE 5.14: The impact of non-conformances

There were statistically significantly more buyers that were undecided whether preventative measures are communicated with suppliers. Thus, more respondents from the materials department disagree, to strongly disagree than buyers.

Table 5.16 and Table 5.17 below show the chi-squared test that was performed between two groups (Procurement and Materials Management). Analysis of variation was used from question Q6-Q10 and Q11-Q15 versus question twenty (Q20).

TABLE 5.16: Contingency table for Respondent group vs Q20

Frequency / Row percentage	Agree- Strongly Agree	Undecide d	Disagree -Strongly Disagree	TOTAL
Buyers	5 20.8%	0 0.0%	19 19.2%	24 48.0%
Administration	7 26.9%	5 19.2%	14 53.8%	26 52.0%
TOTAL	12 24.0%	5 10.0%	33 66.0%	50

TABLE 5.17: Chi-Square test for Respondent group vs Q20

Question / Statement	Sample Size	Chi-Square	DF	P-Value
20. Awareness and training is conducted.	50	6.0205	2	0.0493*

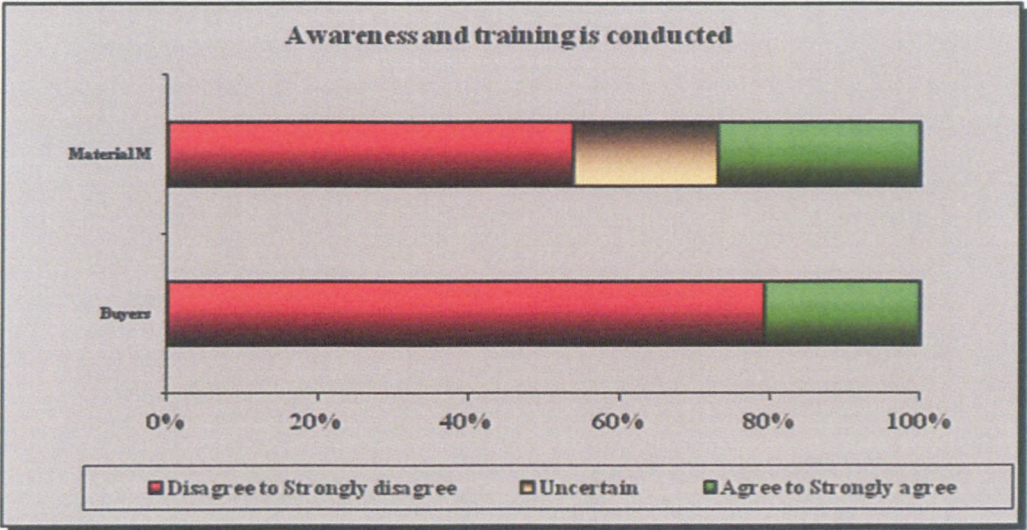


FIGURE 5.15: The impact of non-conformances

Statistically significantly more buyers do not agree, to strongly disagree that awareness and training is conducted, than the respondents from material management.

Table 5.18 and Table 5.19 below show the chi-squared test that was performed between two groups (Procurement and Materials Management). Analysis of variation was used from question Q6-Q10 and Q11-Q15 versus question twenty two (Q22).

TABLE 5.18: Contingency table for Respondent group vs Q22

Frequency / Row percentage	Agree- Strongly Agree	Undecide d	Disagree -Strongly Disagree	TOTAL
Buyers	7 28.0%	18 72.0%	0 0.0%	25 49.0%
Administration	20 76.9%	5 19.2%	1 3.8%	26 51.0%
TOTAL	27 52.9%	23 45.0%	1 2.0%	51

TABLE 5.19: Chi-Square test for Respondent group vs Q22

Question / Statement	Sample Size	Chi-Square	DF	P-Value
22. Receipt inspections and surveillance are conducted by the client organisation.	51	14.5931	2	0.0007***

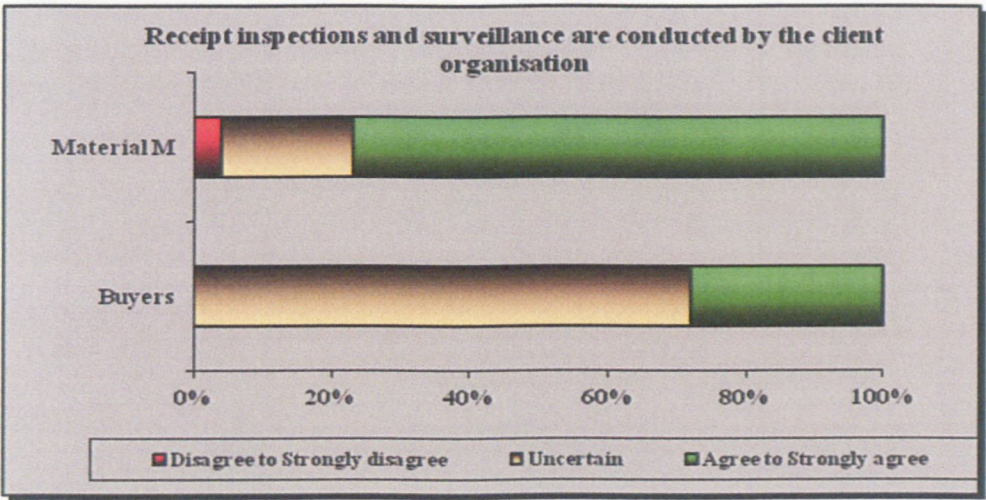


FIGURE 5.16: The impact of non-conformances

Statistically, significantly more respondents from the Material Management Department agree, to strongly agree than the buyers. Note should be taken that 72% of the buyers were undecided.

Table 5.10 and Table 5.11 below show the chi-squared test that was performed between two groups (Procurement and Materials Management). Analysis of variation was used from question Q6-Q10 and Q11-Q15 versus question twenty four (Q24).

TABLE 5.20: Contingency table for Respondent group vs Q24

Frequency / Row percentage	Agree-Strongly Agree	Undecided	Disagree -Strongly Disagree	TOTAL
Buyers	13 52.0%	3 12.0%	9 36.0%	25 49.0%
Administration	4 15.4%	9 34.6%	13 50.0%	26 51.0%
TOTAL	17 33.3%	12 23.5%	22 43.1%	51

TABLE 5.21: Chi-Square test for Respondent group vs Q24

Question / Statement	Sample Size	Chi-Square	DF	P-Value
24. Buyers always send correct information to suppliers when purchasing items.	51	8.4756	2	0.0144*

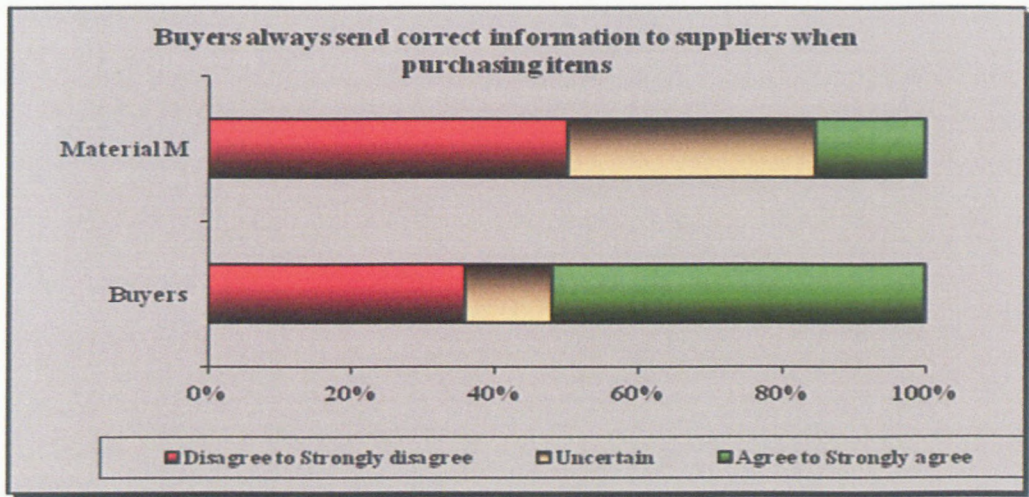


FIGURE 5.17: The impact of non-conformances

Statistically, significantly more buyers agree, to strongly agree that buyers send correct information to suppliers, than from the material management department.

5.3.4.3 Analysis of Variance and Mann-Whitney U tests

With respect to the two latent variables that measure the importance of quality in the supply chain management and quality management tools to measure the reduction of non-conformance, there were no differences between the mean scores of the buyers and the material management respondents. The non-parametric Mann-Whitney U test was used, as well as an ANOVA (Analysis of Variance), in order to test whether these two groups differed. See Annexure F for the statistical underpinning of the above.

In Chapter 6, recommendations and conclusions will be made.

CHAPTER 6: RECOMMENDATIONS AND CONCLUSION

6.1 INTRODUCTION

The research thus far indicates that quality management plays a vital role in the supply chain management. In this research the mechanisms / processes that can be used to reduce non-conformances of vendors and / or suppliers to culminate in improved delivery and overall efficiency was investigated. The impact that the poor product and / or service delivery from vendors / suppliers has on the plant performance has been elaborated on.

6.2 THE RESEARCH PROBLEM REVISITED

The research problem which has been researched within the ambit of this dissertation, reads as follows: “Poor product and / or service delivery from vendors and / or suppliers have an adverse impact on the output of the Procurement Quality Department”.

6.3 THE RESEARCH QUESTION REVISITED

The research question which has been researched within the ambit of this dissertation, reads: “Which mechanisms and / or processes can be used to reduce non-conformances of vendors and / or suppliers to culminate in improved delivery and overall efficiency”?

6.4 THE INVESTIGATIVE QUESTIONS REVISITED

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

- What is the impact of poor quality or non-conformances? Table 5.1 of Chapter 5 shows that the impact of non-conformance of goods and services delivered at a nuclear power station is consistent.

- How can non-conformances be prevented in future? The researcher believes that non-conformances can be prevented by providing training to all personnel, at planned intervals.
- What are the quality management tools that can be used to analyse and prevent non-conformances? The researcher support that quality management tools like Pareto analysis, Histograms, and Failure Mode Effect Analysis can be used to analyse non-conformances. The results of the research show that quality management tools are not used.
- What alternative mechanisms can be deployed to minimise non-conformances? The researcher avows that regular suppliers' visits can help in order to prevent the occurrence of non-conformances.
- What processes do the suppliers / vendors have in place in order to address non-conformances? The research indicated that awareness and training of the suppliers are not conducted. There is mainly indecision about whether the supplier database is regularly updated.

6.5 KEY RESEARCH OBJECTIVES REVISITED

The following are the key research objectives of this dissertation.

- To investigate the impact of non-conforming items delivered to the Nuclear Power Plant. Table 5.1 of Chapter 5 shows that the impact of non-conformance of goods and services delivered at a nuclear power station is consistent. Poor service delivery and products are often received from suppliers (92.2% agree, to strongly agree).
- To emphasize the importance of quality within the Supply Chain Management.
- To determine which measures should be put in place in order to improve communication between suppliers or vendors, buyers and the procurement Quality Engineering Department.
- To investigate mechanisms to be deployed in order to reduce non-conformances.
- To improve the quality of goods and services through the application of a quality management system within the supply chain.

6.6 FINDINGS AND CONCLUSIONS

From the results obtained through this survey on the impact of non-conformances, the following analogies can be drawn:

- Poor service delivery and products are often received from suppliers.
- There are proper procedures that govern non-conformances.
- There are proper corrective procedures that deal with non-conformances.
- There is indecision about whether surveillances are conducted with suppliers.

From the results obtained through this survey on the importance of quality for supply chain management the following analogies can be drawn:

- There are proper preventative procedures that deal with non-conformances.
- Proper records of non-conformances are kept.
- Preventative measures are not communicated to suppliers.

From the results obtained through this survey on quality management tools to measure the reduction of non-conformances the following analogies can be drawn:

- Most of the respondents have not been trained to use quality management tools to analyse non-conformances.
- Quality Management tools are not often used to analyse non-conformances.
- Although there is indecision about whether work is done in accordance with a QMS, there is still a larger part of the employees who think that work is done in accordance with a QMS.

From the results obtained through this survey on mechanisms to be deployed to reduce non-conformances the following analogies can be drawn:

- The main mechanism is that problem notification is raised to address non-conformances
- Sound procedures are in place in order to correct non-conformances.
- Sound procedures are in place in order to identify non-conformances.
- Records of root causes for non-conformance are kept.

From the results obtained through this survey on improvement of goods and services through the application of QMS within the supply chain, the following analogies can be drawn:

- Suppliers use different quality standards
- Receipt inspections and surveillance are conducted by the client organisation.
- There is mainly indecision about whether the supplier database is regularly updated.
- Awareness is not encouraged, and training is not conducted

The procurement department perceives that surveillance is conducted with suppliers, and that buyers always send correct information to suppliers when purchasing items, more so than respondents from the material management department perceive. They are also of the view that awareness and training are not conducted, more so than the material management department. The procurement department is also more undecided whether there are proper preventative procedures in place and whether preventative measures are communicated to suppliers. The material management department is more of the view that receipt inspections and surveillance are conducted by the client organisation whilst more of the procurement departments' respondents are undecided.

The two departments had the same opinion with regard to the importance of the supply chain management and the quality management tools, to measure the reduction of non-conformances.

6.7 RECOMMENDATIONS

The following recommendations are made to mitigate the research problem and provide answers to the research problem:

- Preventative measures must be communicated to suppliers.
- The supplier database must be regularly updated, and records of the updated information must be available to everyone within the organisation.
- Personnel must be made aware, and trained, especially in ways to reduce and prevent non-conformances.
- The research shows that most of the respondents have not been trained to use quality management tools to analyse non-conformances. Training of personnel

on quality management must be done in order to assist the organisation in reducing non-conformances, and also of preventing them.

- Quality Management tools are not often used to analyse non-conformances. Once the training of personnel is conducted, then all personnel must be encouraged to use the quality management tools when reporting non-conformances to Senior Management.
- Although there is indecision about whether work is done in accordance with a QMS, there is still a large number of the employees who think that work is done in accordance with a QMS. Training of personnel in QMS must be conducted for all employees.

BIBLIOGRAPHY

- Babbie, E. 2005. *The basis of social research*. Belmont: Thomson.
- Basu, R. 2001. New Criteria of Performance Management. *Measuring Business Excellence* 5,4.
- Burke, R. 1999. *Project Management Planning & Control Techniques*. Third Edition. Cape Town: Promatec International.
- Burtonshaw-Gunn, S.A. 2008. *The Essential management ToolBox, Tools, Models and Notes for Managers and Consultants*, John Wiley & Sons Ltd.
- Carpenter Group LLC, 2007. Process Improvement, Problem Solving Strategies & Cost of Poor Quality. H Available from: <http://www.quality-improvement-matters.com/> [Accessed 12/04/2011].
- Checkland, P. 1989. *Systems Thinking, Systems Practice*. John Wiley & Sons. Chichester. New York. Brisbane. Toronto.
- Carter, J.R. & Ellram, L.M. 1994. The Impact of interorganizational Alliances in Improving Supplier Quality. *International Journal of Physical Distribution & Logistics Management*. Vol.24 No. 5, pp15-23.
- Crawford, D. 2006. Managing in a Quality Way: *Training for Continuous Improvement*. Business Excellence Southern Africa. pages 40-41).
- Curren, G. 2007. Quality Management [Online]. Available from: <http://find.galegroup.com/gvrl/retrieve.do?content>. [Accessed 15/02/2011].
- Davies, H, Grote, G & Kunzler C. 2002. Organizational culture and quality of health care. *Quality in Health Care, safety culture*.

Available from: www.safetyculture.com.au [Accessed: 2011/03/24]

Day, J. 2003. *A Framework for Project Leadership*. Ph.D. Thesis. Graduate School of Business, University of Cape Town, South Africa.

De Vos, A.S. 2002. Scientific theory and professional research. in de Vos, A.S. Strydom, H. Fouché, C.S.L. & Delport, C.S.L. (eds) *Research at grass roots: for the social sciences and human service professions*. 2nd edition. Pretoria: Van Schaik.

Ellram, L.M, 1991. Key Success Factors and Barriers in International Purchasing Partnerships. *Management Decision*, Vol. 29 No. 7, 1991, pp. 38-44.

Emmett, S. & Crocker, B. 2006. *The Relationship-driven Supply Chain. Creating a culture of collaboration throughout the chain*. Gower Publishing.

Eskom Holdings Limited. 2002. Company information – Understanding generation of electricity. [Online]. Available from: <http://www.eskom.co.za/c/article/201/nuclear-power> (intranet – internal information). Available from: <http://www.eskom.co.za/c/article/40/company-information>. [Accessed 01/03/2011].

Foster, S.T. 2004. *Managing Quality: An Integrated Approach*, Second Edition. Pearson Prentice Hall.

Foster, S.T. 2007. *Managing Quality: Integrating the Supply Chain*, Third Edition. Pearson Prentice Hall.

Gay, L. R. and Diebl, P. L. 1992. *Research methods for business and management*. MacMillan Publishing Company. New York.

Ghauri, P. Grønhaug, K. & Kristianslund, I. 1995. *Research methods in business studies*. Prentice Hall: New York.

Gitlouw, H.S. & Gitlouw, S.J. 1987. The Deming Guide to Quality and Competitive Position. New Jersey, Prentice-Hall, Inc.

Goetsch, D. L. & Davis, S. B. 2002. *Understanding and Implementing ISO 9000: 2000*. Second Edition. New Jersey, Columbus, Ohio: Prentice Hall.

Goulden, C. and Rawlins, L. 1997. Quality Costing: the application of the process model within a manufacturing environment. *International Journal of Operations & Production Management*. Vol. 17 No.2.

Gosh, S, Handfield, R.B., Kannan, V.R. & Tan K. 1999. Supply Chain Management: An empirical study of its impact on performance. *International Journal of Operations & Production Management*, Vol. 19 No. 10 1999, 1034-1052.

Gryna, F.M. 2001. Quality Planning and Analysis. Fourth Edition. McGraw-Hill International Edition.

Handfield, R.B & Bechtel, C. 2002. The role of trust and relationship structure in improving supply chain responsiveness. *Industrial Marketing Management*.

Hugo, W.H.J. Badenhorst-Weiss, J.A & van Biljon, E.B.H. 2006. Purchasing & Supply Management. Fifth Edition. Van Schaik.

Juran, J.M. & Godfrey, A. B. 1999. *Juran's Quality Handbook, Fifth Edition*. McGraw-Hill International Edition.

IAEA, 1996. *Management of procurement activities in a nuclear installation*: IAEA-TECDOC-919.

IAEA, 2008. The Management System for the Processing, Handling and Storage of Radioactive Waste Safety Guide International Atomic Energy Agency Vienna. Safety Standards Series No. GS-G-3.3

ISO 10006: 2003. 2003. Guidelines for quality management in projects. Standards South Africa: Pretoria.

ISO 9001: 2008, 2008. Quality management system – Requirements. Standards South Africa: Pretoria.

ISO 9004:2009, 2009. Managing for the sustained success of an organization- A quality management approach Standards South Africa: Pretoria.

ISO 14001: 2005, 2005. Environmental management systems - Requirements with guidance for use. Standards South Africa: Pretoria.

Kerzner, H. 2006. *Project Management*. Ninth Edition. USA: John Wiley & Sons, Inc.

Kerlinger, F. N. 1986. *Foundations of behavioural research*. CBS College Publishing. New York.

Maya, N.M. 2010. *An Integrated Approach to improve quality in the Construction of Electrical Networks*. A thesis submitted in partial fulfilment of the requirements for the degree of Masters in the Faculty of Engineering at the Cape Peninsula University of Technology.

Meulenberg-Buskens, I. 1997. *Turtles all the way down? – On a quest for quality in qualitative research*. South African Journal of Psychology. Vol. 27, No. 2, June.

Narasimhan, R. & Nair, A. 2004. The Antecedent role of quality information sharing and supply chain proximity on strategic alliance formation and performance. *International journal of production economics*. Available online at www.sciencedirect.com

Neely, A. 2004. The Challenges of Performance Measurement. *Management Decision*.

Ntlokombini, N.N. 2010. *Project Management as a catalyst for improved quality within organisations*. A thesis submitted in partial fulfilment of the requirements for the degree of Masters in the Faculty of Engineering at the Cape Peninsula University of Technology.

Nunnally, J.C. 1978. *Psychometric theory* (2nd ed.). New York. McGraw-Hill.

Oskowitz, B. & Meulenbergh-Buskens, I. 1997. *Preparing researchers for qualitative investigation of a particularly sensitive nature: Reflections from the field*. South African Journal of Psychology. Vol. 27, No. 2, June.

Parasuraman, A. 1991. *Market Research*. 2nd Edition, Addison-Wesley.

Pryke, S. 2009. *Construction Supply Chain Management. Concepts and case studies*. Innovation in the Built Environment. Wiley-Blackwell.

Remenyi, D. Money, A. Twite, A. 1995. *Effective Measurement & Management of IT Costs & Benefits*. Butterworth-Heinemann Ltd. Linacre House, Jordan Hill, Oxford. OX2 8DP.

Robinson, C.R & Malhotra, M.K (2004). Defining the concept of supply chain; quality management and its relevance to academic and industrial practice. International Journal of production economics. Available online at www.sciencedirect.com

Sammy, N.R. 2008. *Research into the impact of Total Quality management on customer satisfaction at Telkom SA*. A dissertation submitted in partial fulfilment for a Masters Degree in Business Administration at the Business School, Tshwane University of Technology.

SA has 'nuclear safety culture' 2011. Safety Culture Business Live. Available from: www.timeslive.co.za/article [Accessed: 2011-03-24].

Scott, T. 2011. *SA has 'nuclear safety culture'*. [Online]. Available from www.timeslive.co.za/article [Accessed: 2011-03-24].

Schniffaurova, A & Thomson, V. 2006. A review of research on Cost of Quality models. *International Journal of Quality & Reliability Management*. Vol.23 No. 6. www.emeraldinsight.com/0265-671X.htm

Tricker, R. & Sherring-Lucas, B. 2001. *ISO 9001: 2000 in brief*. Butterworth:Heinemann.

Van Renen, O, 2009. *Eskom nuclear generation: Risk mitigation through quality management development of small suppliers*. A thesis submitted in partial fulfilment of the requirements for the degree of Masters in the Faculty of Engineering at the Cape Peninsula University of Technology.

Van Weele, A.J. 2000. Purchasing and Supply Chain Management. *Analysis, Planning and Practice*. Second Edition. Business Press, Thomson Learning.

Van Weele, A.J. 2010. Purchasing and Supply Chain Management. *Analysis, Strategy, Planning and Practice*. Fifth Edition. Cengage Learning.

Vogt, W. P. 1993. *Dictionary of statistics and methodology*. Newbury Park: Sage

Watkins, J. A. 2008. Thesis/Dissertations/Research Reports: A Practical guide for Students of Academic Research. Cape Town: Content Solutions.

Zack, J.G. 2002. *Project Management in Crisis*: Fluor Corporation, Aliso Viejo, California.

Annexure A :

Cronbach Alpha Coefficients for all the items in the Questionnaire

Variable	N	Simple Statistics		Sum	Minimum	Maximum	Label
		Mean	Std Dev				
nQ1	51	4.54902	0.87895	232.00000	1.00000	5.00000	
Q2	51	2.80392	1.09580	143.00000	1.00000	5.00000	Q2
Q3	50	2.82000	0.74751	141.00000	1.00000	5.00000	Q3
Q4	51	2.13725	0.56638	109.00000	1.00000	4.00000	Q4
Q5	51	2.17647	0.74043	111.00000	1.00000	5.00000	Q5
Q6	51	2.70588	0.94433	138.00000	1.00000	5.00000	Q6
Q7	51	3.00000	0.84853	153.00000	1.00000	4.00000	Q7
Q8	51	2.78431	0.85589	142.00000	1.00000	5.00000	Q8
Q9	51	3.25490	0.95589	166.00000	1.00000	5.00000	Q9
Q10	51	3.19608	1.11390	163.00000	1.00000	5.00000	Q10
Q11	51	3.74510	1.16350	191.00000	2.00000	5.00000	Q11
Q12	51	3.64706	1.03583	186.00000	1.00000	5.00000	Q12
Q13	51	4.09804	0.92206	209.00000	1.00000	5.00000	Q13
Q14	51	3.23529	1.08790	165.00000	1.00000	5.00000	Q14
Q15	51	2.64706	0.77003	135.00000	1.00000	5.00000	Q15
Q16	51	2.54902	0.85589	130.00000	1.00000	5.00000	Q16
Q17	51	2.47059	0.70294	126.00000	1.00000	4.00000	Q17
Q18	51	2.62745	0.72002	134.00000	1.00000	4.00000	Q18
Q19	51	1.98039	0.70683	101.00000	1.00000	5.00000	Q19
Q20	50	3.58000	1.19676	179.00000	1.00000	5.00000	Q20
Q21	51	2.07843	0.71675	106.00000	1.00000	4.00000	Q21
Q22	51	2.41176	0.75303	123.00000	1.00000	5.00000	Q22
nQ23	51	2.82353	0.74043	144.00000	1.00000	4.00000	
Q24	51	3.07843	1.09258	157.00000	1.00000	5.00000	Q24
Q25	51	2.72549	0.93975	139.00000	1.00000	4.00000	Q25

Cronbach Coefficient Alpha
 Variables Alpha
 Raw 0.857854
 Standardized 0.842689

Deleted Variable	Cronbach Coefficient Alpha with Deleted Variable		Alpha	Label
	Raw Variables	Standardized Variables		
Variable	Correlation with Total	Correlation with Total		
////////////////////////////////////				
nQ1	0.475220	0.850667	0.439076	0.835213
Q2	0.441959	0.851778	0.462911	0.834340
Q3	0.066603	0.861852	0.068391	0.848326
Q4	0.113359	0.859555	0.126827	0.846314
Q5	0.006276	0.863297	0.055794	0.848757
Q6	0.512836	0.849232	0.492955	0.833236
Q7	0.538368	0.848825	0.518289	0.832300
Q8	0.450358	0.851503	0.441700	0.835117
Q9	0.568031	0.847273	0.541771	0.831429
Q10	0.700778	0.841207	0.662916	0.826879
Q11	0.585972	0.845874	0.574603	0.830205
Q12	0.671425	0.842963	0.653103	0.827251
Q13	0.611257	0.845987	0.598716	0.829302
Q14	0.748366	0.839435	0.737279	0.824039
Q15	0.408454	0.852920	0.412151	0.836194
Q16	0.602253	0.846785	0.597978	0.829329
Q17	0.440225	0.852316	0.454806	0.834637
Q18	0.321248	0.855274	0.332174	0.839081
Q19	0.077838	0.861225	0.094853	0.847418
Q20	0.646391	0.843137	0.617359	0.828601
Q21	0.216255	0.857900	0.225426	0.842874
Q22	0.079718	0.861567	0.090124	0.847580
nQ23	0.066954	0.861779	0.060034	0.848612
Q24	0.044741	0.866730	0.043951	0.849161
Q25	0.434258	0.851909	0.415317	0.836079

Cronbach Alpha Coefficients for all the items in each scale of the Questionnaire

Variable	N	Simple Statistics		Sum	Minimum	Maximum	Label
		Mean	Std Dev				
nQ1	51	4.54902	0.87895	232.00000	1.00000	5.00000	
Q2	51	2.80392	1.09580	143.00000	1.00000	5.00000	Q2
Q3	50	2.82000	0.74751	141.00000	1.00000	5.00000	Q3
Q4	51	2.13725	0.56638	109.00000	1.00000	4.00000	Q4
Q5	51	2.17647	0.74043	111.00000	1.00000	5.00000	Q5

Cronbach Coefficient Alpha
Variables Alpha
Raw 0.415143
Standardized 0.434560

Deleted Variable	Cronbach Coefficient Alpha with Deleted Variable		Label
	Raw Variables	Standardized Variables	
Variable	Correlation with Total	Alpha	Label
nQ1	-0.056802	0.560065	
Q2	0.449960	0.096814	Q2
Q3	0.256748	0.332505	Q3
Q4	0.349378	0.301878	Q4
Q5	0.182033	0.383485	Q5

Pearson Correlation Coefficients					
Prob > r under H0: Rho=0					
Number of Observations					
nQ1	Q2	Q3	Q4	Q5	
1.00000	0.13477	-0.09138	0.12683	-0.36697	
	0.3457	0.5279	0.3751	0.0081	
51	51	50	51	51	
Q2	1.00000	0.40001	0.17313	0.24070	
	0.3457	0.0040	0.2244	0.0889	
51	51	50	51	51	
Q3	-0.09138	0.40001	1.00000	0.02192	0.17990
	0.5279	0.0040	0.8799	0.2112	
50	50	50	50	50	
Q4	0.12683	0.17313	0.02192	1.00000	0.51338
	0.3751	0.2244	0.8799	0.0001	
51	51	50	51	51	
Q5	-0.36697	0.24070	0.17990	0.51338	1.00000
	0.0081	0.0889	0.2112	0.0001	
51	51	50	51	51	

Variable	N	Simple Statistics		Sum	Minimum	Maximum	Label
		Mean	Std Dev				
Q1	51	1.45098	0.87895	74.00000	1.00000	5.00000	Q1
Q2	51	2.80392	1.09580	143.00000	1.00000	5.00000	Q2
Q3	50	2.82000	0.74751	141.00000	1.00000	5.00000	Q3
Q4	51	2.13725	0.56638	109.00000	1.00000	4.00000	Q4
Q5	51	2.17647	0.74043	111.00000	1.00000	5.00000	Q5

Cronbach Coefficient Alpha
Variables Alpha
Raw 0.479474
Standardized 0.510494

Deleted Variable	Cronbach Coefficient Alpha with Deleted Variable		Label
	Raw Variables	Standardized Variables	
Variable	Correlation with Total	Alpha	Label
Q1	0.056802	0.560065	Q1
Q2	0.250473	0.448861	Q2
Q3	0.331859	0.378770	Q3
Q4	0.219688	0.451897	Q4
Q5	0.541505	0.238561	Q5

Pearson Correlation Coefficients					
Prob > r under H0: Rho=0					
Number of Observations					
Q1	Q2	Q3	Q4	Q5	
1.00000	-0.13477	0.09138	-0.12683	0.36697	
	0.3457	0.5279	0.3751	0.0081	
51	51	50	51	51	
Q2	-0.13477	1.00000	0.40001	0.17313	0.24070
	0.3457	0.0040	0.2244	0.0889	
51	51	50	51	51	
Q3	0.09138	0.40001	1.00000	0.02192	0.17990
	0.5279	0.0040	0.8799	0.2112	
50	50	50	50	50	
Q4	-0.12683	0.17313	0.02192	1.00000	0.51338
	0.3751	0.2244	0.8799	0.0001	
51	51	50	51	51	
Q5	0.36697	0.24070	0.17990	0.51338	1.00000
	0.0081	0.0889	0.2112	0.0001	
51	51	50	51	51	

Variable	N	Simple Statistics		Sum	Minimum	Maximum	Label
		Mean	Std Dev				
Q6	51	2.70588	0.94433	138.00000	1.00000	5.00000	Q6

Q7	51	3.00000	0.84853	153.00000	1.00000	4.00000	Q7
Q8	51	2.78431	0.85589	142.00000	1.00000	5.00000	Q8
Q9	51	3.25490	0.95589	166.00000	1.00000	5.00000	Q9
Q10	51	3.19608	1.11390	163.00000	1.00000	5.00000	Q10

Cronbach Coefficient Alpha
Variables Alpha
Raw 0.820607
Standardized 0.820654

Cronbach Coefficient Alpha with Deleted Variable					
Raw Variables		Standardized Variables			
Deleted Variable	Correlation with Total	Alpha	Correlation with Total	Alpha	Label
Q6	0.602687	0.788267	0.605888	0.787416	Q6
Q7	0.650073	0.776998	0.651954	0.773783	Q7
Q8	0.535217	0.806668	0.533990	0.808083	Q8
Q9	0.559125	0.801002	0.545327	0.804873	Q9
Q10	0.736573	0.745801	0.733793	0.748797	Q10

Pearson Correlation Coefficients, N = 51					
Prob > r under H0: Rho=0					
Q6	Q7	Q8	Q9	Q10	
Q6	1.00000	0.67391	0.31586	0.37275	0.53125
Q7	<.0001	1.00000	0.46816	0.32055	0.55016
Q8	0.67391	0.0005	1.00000	0.41078	0.50676
Q9	<.0001	0.0005	0.0028	1.00000	0.62832
Q10	0.31586	0.46816	0.41078	0.62832	1.00000
Q10	0.0071	0.0218	0.0028	<.0001	
Q10	<.0001	<.0001	0.0001	<.0001	

Simple Statistics							
Variable	N	Mean	Std Dev	Sum	Minimum	Maximum	Label
Q11	51	3.74510	1.16350	191.00000	2.00000	5.00000	Q11
Q12	51	3.64706	1.03583	186.00000	1.00000	5.00000	Q12
Q13	51	4.09804	0.92206	209.00000	1.00000	5.00000	Q13
Q14	51	3.23529	1.08790	165.00000	1.00000	5.00000	Q14
Q15	51	2.64706	0.77003	135.00000	1.00000	5.00000	Q15

Cronbach Coefficient Alpha
Variables Alpha
Raw 0.832188
Standardized 0.828846

Cronbach Coefficient Alpha with Deleted Variable					
Raw Variables		Standardized Variables			
Deleted Variable	Correlation with Total	Alpha	Correlation with Total	Alpha	Label
Q11	0.697378	0.780230	0.675847	0.780243	Q11
Q12	0.778555	0.754144	0.761633	0.754623	Q12
Q13	0.657804	0.792553	0.664808	0.783464	Q13
Q14	0.635621	0.798134	0.628565	0.793918	Q14
Q15	0.407371	0.850730	0.415397	0.851782	Q15

Pearson Correlation Coefficients, N = 51					
Prob > r under H0: Rho=0					
Q11	Q12	Q13	Q14	Q15	
Q11	1.00000	0.75361	0.52711	0.58555	0.23243
Q12	<.0001	1.00000	0.64422	0.57212	0.34220
Q13	0.75361	<.0001	1.00000	0.45505	0.44407
Q14	<.0001	<.0001	0.0008	1.00000	0.36374
Q15	0.58555	0.57212	0.45505	0.36374	1.00000
Q15	<.0001	<.0001	0.0008	0.0087	
Q15	0.23243	0.34220	0.44407	0.36374	
Q15	0.1007	0.0140	0.0011	0.0087	

Simple Statistics							
Variable	N	Mean	Std Dev	Sum	Minimum	Maximum	Label
Q16	51	2.54902	0.85589	130.00000	1.00000	5.00000	Q16
Q17	51	2.47059	0.70294	126.00000	1.00000	4.00000	Q17
Q18	51	2.62745	0.72002	134.00000	1.00000	4.00000	Q18
Q19	51	1.98039	0.70683	101.00000	1.00000	5.00000	Q19

Cronbach Coefficient Alpha
Variables Alpha
Raw 0.592219
Standardized 0.604496

Cronbach Coefficient Alpha with Deleted Variable					
Raw Variables		Standardized Variables			
Deleted Variable	Correlation with Total	Alpha	Correlation with Total	Alpha	Label
Q16	0.258324	0.625491	0.259143	0.624905	Q16
Q17	0.562982	0.375378	0.554077	0.396896	Q17
Q18	0.458598	0.455882	0.473553	0.464013	Q18
Q19	0.259407	0.601373	0.277085	0.612393	Q19

Pearson Correlation Coefficients, N = 51						
Prob > r under H0: Rho=0						
	Q16	Q17	Q18	Q19		
Q16	1.00000	0.42629	0.17627	-0.01491		
Q16		0.0018	0.2160	0.9173		
Q17	0.42629	1.00000	0.43235	0.26046		
Q17		0.0018	0.0015	0.0649		
Q18	0.17627	0.43235	1.00000	0.37834		
Q18		0.2160	0.0015	0.0062		
Q19	-0.01491	0.26046	0.37834	1.00000		
Q19		0.9173	0.0649	0.0062		

Simple Statistics						
Variable	N	Mean	Std Dev	Sum	Minimum	Maximum Label
Q20	50	3.58000	1.19676	179.00000	1.00000	5.00000 Q20
Q21	51	2.07843	0.71675	106.00000	1.00000	4.00000 Q21
Q22	51	2.41176	0.75303	123.00000	1.00000	5.00000 Q22
nQ23	51	2.82353	0.74043	144.00000	1.00000	4.00000
Q24	51	3.07843	1.09258	157.00000	1.00000	5.00000 Q24
Q25	51	2.72549	0.93975	139.00000	1.00000	4.00000 Q25

Cronbach Coefficient Alpha	
Variables	Alpha
Raw	0.330655
Standardized	0.273637

Cronbach Coefficient Alpha with Deleted Variable					
Raw Variables		Standardized Variables			
Deleted Variable	Correlation with Total	Alpha	Correlation with Total	Alpha	Label
Q20	0.236111	0.212724	0.227043	0.151436	Q20
Q21	0.107136	0.317118	0.131693	0.228878	Q21
Q22	-0.013600	0.381357	-0.021022	0.341917	Q22
nQ23	-0.153620	0.447861	-0.121594	0.409433	
Q24	0.172411	0.274030	0.127860	0.231877	Q24
Q25	0.566478	-0.059022	0.443939	-0.046000	Q25

Pearson Correlation Coefficients						
Prob > r under H0: Rho=0						
	Q20	Q21	Q22	nQ23	Q24	Q25
Q20	1.00000	0.03957	0.12182	-0.08623	0.05074	0.41565
Q20		0.7850	0.3994	0.5515	0.7264	0.0027
Q20	50	50	50	50	50	
Q21	0.03957	1.00000	0.01308	0.25272	0.01753	0.00291
Q21		0.7850	0.9274	0.0736	0.9028	0.9838
Q21	50	51	51	51	51	
Q22	0.12182	0.01308	1.00000	-0.08229	-0.18589	0.07814
Q22		0.3994	0.9274	0.5659	0.1915	0.5858
Q22	50	51	51	51	51	
nQ23	-0.08623	0.25272	-0.08229	1.00000	-0.22977	-0.18598
nQ23		0.5515	0.0736	0.5659	0.1048	0.1913
nQ23	50	51	51	51	51	
Q24	0.05074	0.01753	-0.18589	-0.22977	1.00000	0.66419
Q24		0.7264	0.9028	0.1048		<.0001
Q24	50	51	51	51	51	
Q25	0.41565	0.00291	0.07814	-0.18598	0.66419	1.00000
Q25		0.0027	0.9838	0.5858	0.1913	<.0001
Q25	50	51	51	51	51	

Simple Statistics						
Variable	N	Mean	Std Dev	Sum	Minimum	Maximum Label
Q20	50	3.58000	1.19676	179.00000	1.00000	5.00000 Q20
Q21	51	2.07843	0.71675	106.00000	1.00000	4.00000 Q21
Q22	51	2.41176	0.75303	123.00000	1.00000	5.00000 Q22
Q23	51	3.17647	0.74043	162.00000	2.00000	5.00000 Q23
Q24	51	3.07843	1.09258	157.00000	1.00000	5.00000 Q24
Q25	51	2.72549	0.93975	139.00000	1.00000	4.00000 Q25

Cronbach Coefficient Alpha	
Variables	Alpha
Raw	0.457962
Standardized	0.408668

Cronbach Coefficient Alpha with Deleted Variable					
Raw Variables		Standardized Variables			
Deleted Variable	Correlation with Total	Alpha	Correlation with Total	Alpha	Label
Q20	0.270848	0.388025	0.276454	0.313048	Q20
Q21	-0.038145	0.522862	-0.061765	0.511041	Q21
Q22	0.031528	0.499282	0.038984	0.456825	Q22
Q23	0.153620	0.447861	0.121594	0.409433	Q23
Q24	0.309619	0.357630	0.303437	0.295204	Q24
Q25	0.649452	0.133157	0.579340	0.093631	Q25

Pearson Correlation Coefficients						
Prob > r under H0: Rho=0						
	Q20	Q21	Q22	Q23	Q24	Q25
Q20	1.00000	0.03957	0.12182	0.08623	0.05074	0.41565
Q20		0.7850	0.3994	0.5515	0.7264	0.0027
Q20	50	50	50	50	50	
Q21	0.03957	1.00000	0.01308	-0.25272	0.01753	0.00291
Q21		0.7850	0.9274	0.0736	0.9028	0.9838
Q21	50	51	51	51	51	

Q22	0.12182	0.01308	1.00000	0.08229	-0.18589	0.07814
Q22	0.3994	0.9274		0.5659	0.1915	0.5858
	50	51	51	51	51	
Q23	0.08623	-0.25272	0.08229	1.00000	0.22977	0.18598
Q23	0.5515	0.0736	0.5659		0.1048	0.1913
	50	51	51	51	51	
Q24	0.05074	0.01753	-0.18589	0.22977	1.00000	0.66419
Q24	0.7264	0.9028	0.1915	0.1048		<.0001
	50	51	51	51	51	
Q25	0.41565	0.00291	0.07814	0.18598	0.66419	1.00000
Q25	0.0027	0.9838	0.5858	0.1913	<.0001	
	50	51	51	51	51	

Annexure B :

Descriptive statistics: Frequency tables

TOTAL The FREQ Procedure				
Q1	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly Agree	36	70.59	36	70.59
Agree	11	21.57	47	92.16
Undecided	1	1.96	48	94.12
Disagree	2	3.92	50	98.04
Strongly Disagree	1	1.96	51	100.00

Chi-Square Test
for Equal Proportions
 ffffffffffffffffff
 Chi-Square 88.5098
 DF 4
 Pr > ChiSq <.0001
 Sample Size = 51

Q2	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly Agree	5	9.80	5	9.80
Agree	18	35.29	23	45.10
Undecided	13	25.49	36	70.59
Disagree	12	23.53	48	94.12
Strongly Disagree	3	5.88	51	100.00

Chi-Square Test
for Equal Proportions
 ffffffffffffffffff
 Chi-Square 14.7843
 DF 4
 Pr > ChiSq 0.0052
 Sample Size = 51

Q3	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	1	1.96	1	1.96
Strongly Agree	1	1.96	2	3.92
Agree	15	29.41	17	33.33
Undecided	27	52.94	44	86.27
Disagree	6	11.76	50	98.04
Strongly Disagree	1	1.96	51	100.00

Chi-Square Test
for Equal Proportions
 ffffffffffffffffff
 Chi-Square 65.8235
 DF 5
 Pr > ChiSq <.0001
 Sample Size = 51

Q4	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly Agree	3	5.88	3	5.88
Agree	40	78.43	43	84.31
Undecided	6	11.76	49	96.08
Disagree	2	3.92	51	100.00

Chi-Square Test
for Equal Proportions
 ffffffffffffffffff
 Chi-Square 78.3333
 DF 3
 Pr > ChiSq <.0001
 Sample Size = 51

Q5	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly Agree	4	7.84	4	7.84
Agree	39	76.47	43	84.31
Undecided	4	7.84	47	92.16
Disagree	3	5.88	50	98.04
Strongly Disagree	1	1.96	51	100.00

Chi-Square Test
for Equal Proportions
 ffffffffffffffffff
 Chi-Square 102.2353
 DF 4
 Pr > ChiSq <.0001
 Sample Size = 51

Q6	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly Agree	2	3.92	2	3.92

Agree	24	47.06	26	50.98
Undecided	14	27.45	40	78.43
Disagree	9	17.65	49	96.08
Strongly Disagree	2	3.92	51	100.00

Chi-Square Test
for Equal Proportions
////////////////////
Chi-Square 33.4118
DF 4
Pr > ChiSq <.0001
Sample Size = 51

	Q7 Frequency	Cumulative Percent	Cumulative Frequency	Percent
Strongly Agree	1	1.96	1	1.96
Agree	15	29.41	16	31.37
Undecided	18	35.29	34	66.67
Disagree	17	33.33	51	100.00

Chi-Square Test
for Equal Proportions
////////////////////
Chi-Square 14.8039
DF 3
Pr > ChiSq 0.0020
Sample Size = 51

	Q8 Frequency	Cumulative Percent	Cumulative Frequency	Percent
Strongly Agree	2	3.92	2	3.92
Agree	17	33.33	19	37.25
Undecided	24	47.06	43	84.31
Disagree	6	11.76	49	96.08
Strongly Disagree	2	3.92	51	100.00

Chi-Square Test
for Equal Proportions
////////////////////
Chi-Square 38.1176
DF 4
Pr > ChiSq <.0001
Sample Size = 51

	Q9 Frequency	Cumulative Percent	Cumulative Frequency	Percent
Strongly Agree	2	3.92	2	3.92
Agree	7	13.73	9	17.65
Undecided	23	45.10	32	62.75
Disagree	14	27.45	46	90.20
Strongly Disagree	5	9.80	51	100.00

Chi-Square Test
for Equal Proportions
////////////////////
Chi-Square 27.7255
DF 4
Pr > ChiSq <.0001
Sample Size = 51

	Q10 Frequency	Cumulative Percent	Cumulative Frequency	Percent
Strongly Agree	2	3.92	2	3.92
Agree	14	27.45	16	31.37
Undecided	14	27.45	30	58.82
Disagree	14	27.45	44	86.27
Strongly Disagree	7	13.73	51	100.00

Chi-Square Test
for Equal Proportions
////////////////////
Chi-Square 11.8431
DF 4
Pr > ChiSq 0.0186
Sample Size = 51

	Q11 Frequency	Cumulative Percent	Cumulative Frequency	Percent
Agree	11	21.57	11	21.57
Undecided	9	17.65	20	39.22
Disagree	13	25.49	33	64.71
Strongly Disagree	18	35.29	51	100.00

Chi-Square Test
for Equal Proportions
////////////////////
Chi-Square 3.5098
DF 3
Pr > ChiSq 0.3195
Sample Size = 51

Q12	Frequency	Cumulative Percent	Cumulative Frequency	Cumulative Percent
Strongly Agree	1	1.96	1	1.96
Agree	9	17.65	10	19.61
Undecided	6	11.76	16	31.37
Disagree	26	50.98	42	82.35
Strongly Disagree	9	17.65	51	100.00

Chi-Square Test
for Equal Proportions
Chi-Square 34.7843
DF 4
Pr > ChiSq <.0001
Sample Size = 51

Q13	Frequency	Cumulative Percent	Cumulative Frequency	Cumulative Percent
Strongly Agree	1	1.96	1	1.96
Agree	3	5.88	4	7.84
Undecided	4	7.84	8	15.69
Disagree	25	49.02	33	64.71
Strongly Disagree	18	35.29	51	100.00

Chi-Square Test
for Equal Proportions
Chi-Square 44.5882
DF 4
Pr > ChiSq <.0001
Sample Size = 51

Q14	Frequency	Cumulative Percent	Cumulative Frequency	Cumulative Percent
Strongly Agree	4	7.84	4	7.84
Agree	8	15.69	12	23.53
Undecided	16	31.37	28	54.90
Disagree	18	35.29	46	90.20
Strongly Disagree	5	9.80	51	100.00

Chi-Square Test
for Equal Proportions
Chi-Square 16.1569
DF 4
Pr > ChiSq 0.0028
Sample Size = 51

Q15	Frequency	Cumulative Percent	Cumulative Frequency	Cumulative Percent
Strongly Agree	3	5.88	3	5.88
Agree	17	33.33	20	39.22
Undecided	27	52.94	47	92.16
Disagree	3	5.88	50	98.04
Strongly Disagree	1	1.96	51	100.00

Chi-Square Test
for Equal Proportions
Chi-Square 50.6667
DF 4
Pr > ChiSq <.0001
Sample Size = 51

Q16	Frequency	Cumulative Percent	Cumulative Frequency	Cumulative Percent
Strongly Agree	4	7.84	4	7.84
Agree	22	43.14	26	50.98
Undecided	19	37.25	45	88.24
Disagree	5	9.80	50	98.04
Strongly Disagree	1	1.96	51	100.00

Chi-Square Test
for Equal Proportions
Chi-Square 35.9608
DF 4
Pr > ChiSq <.0001
Sample Size = 51

Q17	Frequency	Cumulative Percent	Cumulative Frequency	Cumulative Percent
Strongly Agree	3	5.88	3	5.88
Agree	24	47.06	27	52.94
Undecided	21	41.18	48	94.12
Disagree	3	5.88	51	100.00

Chi-Square Test
for Equal Proportions


```

////////////////////
Chi-Square 30.1765
DF 3
Pr > ChiSq <.0001
Sample Size = 51

```

	Q18	Frequency	Cumulative Percent	Cumulative Frequency	Percent
Strongly Agree		1	1.96	1	1.96
Agree		23	45.10	24	47.06
Undecided		21	41.18	45	88.24
Disagree		6	11.76	51	100.00

```

Chi-Square Test
for Equal Proportions
////////////////////
Chi-Square 27.9804
DF 3
Pr > ChiSq <.0001
Sample Size = 51

```

	Q19	Frequency	Cumulative Percent	Cumulative Frequency	Percent
Strongly Agree		9	17.65	9	17.65
Agree		37	72.55	46	90.20
Undecided		3	5.88	49	96.08
Disagree		1	1.96	50	98.04
Strongly Disagree		1	1.96	51	100.00

```

Chi-Square Test
for Equal Proportions
////////////////////
Chi-Square 92.2353
DF 4
Pr > ChiSq <.0001
Sample Size = 51

```

	Q20	Frequency	Cumulative Percent	Cumulative Frequency	Percent
Strongly Agree	0	1	1.96	1	1.96
Agree		9	17.65	13	25.49
Undecided		5	9.80	18	35.29
Disagree		22	43.14	40	78.43
Strongly Disagree		11	21.57	51	100.00

```

Chi-Square Test
for Equal Proportions
////////////////////
Chi-Square 33.8235
DF 5
Pr > ChiSq <.0001
Sample Size = 51

```

	Q21	Frequency	Cumulative Percent	Cumulative Frequency	Percent
Strongly Agree		9	17.65	9	17.65
Agree		31	60.78	40	78.43
Undecided		9	17.65	49	96.08
Disagree		2	3.92	51	100.00

```

Chi-Square Test
for Equal Proportions
////////////////////
Chi-Square 37.3922
DF 3
Pr > ChiSq <.0001
Sample Size = 51

```

	Q22	Frequency	Cumulative Percent	Cumulative Frequency	Percent
Strongly Agree		5	9.80	5	9.80
Agree		22	43.14	27	52.94
Undecided		23	45.10	50	98.04
Strongly Disagree		1	1.96	51	100.00

```

Chi-Square Test
for Equal Proportions
////////////////////
Chi-Square 30.4902
DF 3
Pr > ChiSq <.0001
Sample Size = 51

```

	Q23	Frequency	Cumulative Percent	Cumulative Frequency	Percent
Agree		5	9.80	5	9.80
Undecided		37	72.55	42	82.35
Disagree		4	7.84	46	90.20

Strongly Disagree 5 9.80 51 100.00

Chi-Square Test
for Equal Proportions
/////////////////
Chi-Square 61.5490
DF 3
Pr > ChiSq <.0001
Sample Size = 51

	Q24	Frequency	Cumulative Percent	Cumulative Frequency	Cumulative Percent
Strongly Agree		4	7.84	4	7.84
Agree		13	25.49	17	33.33
Undecided		12	23.53	29	56.86
Disagree		19	37.25	48	94.12
Strongly Disagree		3	5.88	51	100.00

Chi-Square Test
for Equal Proportions
/////////////////
Chi-Square 17.5294
DF 4
Pr > ChiSq 0.0015
Sample Size = 51

	Q25	Frequency	Cumulative Percent	Cumulative Frequency	Cumulative Percent
Strongly Agree		4	7.84	4	7.84
Agree		19	37.25	23	45.10
Undecided		15	29.41	38	74.51
Disagree		13	25.49	51	100.00

Chi-Square Test
for Equal Proportions
/////////////////
Chi-Square 9.4706
DF 3
Pr > ChiSq 0.0236
Sample Size = 51

Annexure C :

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

TOTAL

The UNIVARIATE Procedure

Variable: Q1 (Q1)

N	51	Sum Weights	51
Mean	1.45098039	Sum Observations	74
Std Deviation	0.87894768	Variance	0.77254902
Skewness	2.45436317	Kurtosis	6.30756042
Uncorrected SS	146	Corrected SS	38.627451
Coeff Variation	60.5761237	Std Error Mean	0.12307729

Basic Statistical Measures

Location	Variability
Mean 1.450980	Std Deviation 0.87895
Median 1.000000	Variance 0.77255
Mode 1.000000	Range 4.00000
Interquartile Range 1.00000	

Tests for Location: Mu0=0

Test	-Statistic-	-----p Value-----
Student's t	t 11.78918	Pr > t <.0001
Sign	M 25.5	Pr >= M <.0001
Signed Rank	S 663	Pr >= S <.0001

Quantiles (Definition 5)

Quantile	Estimate
100% Max	5
99%	5
95%	4
90%	2
75% Q3	2
50% Median	1
25% Q1	1
10%	1
5%	1
1%	1
0% Min	1

Variable: Q2 (Q2)

N	51	Sum Weights	51
Mean	2.80392157	Sum Observations	143
Std Deviation	1.09580305	Variance	1.20078431
Skewness	0.21676021	Kurtosis	-0.7673761
Uncorrected SS	461	Corrected SS	60.0392157
Coeff Variation	39.0810876	Std Error Mean	0.15344312

Basic Statistical Measures

Location	Variability
Mean 2.803922	Std Deviation 1.09580
Median 3.000000	Variance 1.20078
Mode 2.000000	Range 4.00000
Interquartile Range 2.00000	

Tests for Location: Mu0=0

Test	-Statistic-	-----p Value-----
Student's t	t 18.27336	Pr > t <.0001
Sign	M 25.5	Pr >= M <.0001
Signed Rank	S 663	Pr >= S <.0001

Quantiles (Definition 5)

Quantile	Estimate
100% Max	5
99%	5
95%	5
90%	4
75% Q3	4
50% Median	3
25% Q1	2
10%	2
5%	1
1%	1
0% Min	1

Variable: Q3 (Q3)

N	50	Sum Weights	50
Mean	2.82	Sum Observations	141
Std Deviation	0.74751288	Variance	0.55877551
Skewness	0.30927982	Kurtosis	0.64898089
Uncorrected SS	425	Corrected SS	27.38
Coeff Variation	26.507549	Std Error Mean	0.10571429

Basic Statistical Measures

Location	Variability
Mean 2.820000	Std Deviation 0.74751
Median 3.000000	Variance 0.55878
Mode 3.000000	Range 4.00000
Interquartile Range 1.00000	

Tests for Location: Mu0=0

Test	-Statistic-	-----p Value-----
Student's t	t 26.67568	Pr > t <.0001

Sign M 25 Pr >= |M| <.0001
Signed Rank S 637.5 Pr >= |S| <.0001

Quantiles (Definition 5)	
Quantile	Estimate
100% Max	5
99%	5
95%	4
90%	4
75% Q3	3
50% Median	3
25% Q1	2
10%	2
5%	2
1%	1
0% Min	1

Variable: Q4 (Q4)
N 51 Sum Weights 51
Mean 2.1372549 Sum Observations 109
Std Deviation 0.56637824 Variance 0.32078431
Skewness 1.40510089 Kurtosis 3.9195261
Uncorrected SS 249 Corrected SS 16.0392157
Coeff Variation 26.5002664 Std Error Mean 0.07930882

Basic Statistical Measures		
Location	Variability	
Mean	2.137255	Std Deviation 0.56638
Median	2.000000	Variance 0.32078
Mode	2.000000	Range 3.00000
	Interquartile Range	0

Tests for Location: Mu0=0
Test -Statistic- -----p Value-----
Student's t t 26.94852 Pr > |t| <.0001
Sign M 25.5 Pr >= |M| <.0001
Signed Rank S 663 Pr >= |S| <.0001

Quantiles (Definition 5)	
Quantile	Estimate
100% Max	4
99%	4
95%	3
90%	3
75% Q3	2
50% Median	2
25% Q1	2
10%	2
5%	1
1%	1
0% Min	1

Variable: Q5 (Q5)
N 51 Sum Weights 51
Mean 2.17647059 Sum Observations 111
Std Deviation 0.74042913 Variance 0.54823529
Skewness 1.85675026 Kurtosis 4.78463522
Uncorrected SS 269 Corrected SS 27.4117647
Coeff Variation 34.0197167 Std Error Mean 0.10368082

Basic Statistical Measures		
Location	Variability	
Mean	2.176471	Std Deviation 0.74043
Median	2.000000	Variance 0.54824
Mode	2.000000	Range 4.00000
	Interquartile Range	0

Tests for Location: Mu0=0
Test -Statistic- -----p Value-----
Student's t t 20.99203 Pr > |t| <.0001
Sign M 25.5 Pr >= |M| <.0001
Signed Rank S 663 Pr >= |S| <.0001

Quantiles (Definition 5)	
Quantile	Estimate
100% Max	5
99%	5
95%	4
90%	3
75% Q3	2
50% Median	2
25% Q1	2
10%	2
5%	1
1%	1
0% Min	1

Variable: Q6 (Q6)
N 51 Sum Weights 51
Mean 2.70588235 Sum Observations 138
Std Deviation 0.94433294 Variance 0.89176471
Skewness 0.63379533 Kurtosis -0.2498043
Uncorrected SS 418 Corrected SS 44.5882353
Coeff Variation 34.8992609 Std Error Mean 0.13223306

Basic Statistical Measures		
Location	Variability	
Mean	2.705882	Std Deviation 0.94433

Median	2.000000	Variance	0.89176
Mode	2.000000	Range	4.00000
		Interquartile Range	1.00000

Tests for Location: Mu0=0

Test	-Statistic-	-----p Value-----
Student's t	t 20.46298	Pr > t <.0001
Sign	M 25.5	Pr >= M <.0001
Signed Rank	S 663	Pr >= S <.0001

Quantiles (Definition 5)

Quantile	Estimate
100% Max	5
99%	5
95%	4
90%	4
75% Q3	3
50% Median	2
25% Q1	2
10%	2
5%	2
1%	1
0% Min	1

Variable: Q7 (Q7)

N	51	Sum Weights	51
Mean	3	Sum Observations	153
Std Deviation	0.84852814	Variance	0.72
Skewness	-0.2044356	Kurtosis	-1.1007181
Uncorrected SS	495	Corrected SS	36
Coeff Variation	28.2842712	Std Error Mean	0.11881771

Basic Statistical Measures

Location	Variability
Mean 3.000000	Std Deviation 0.84853
Median 3.000000	Variance 0.72000
Mode 3.000000	Range 3.00000
	Interquartile Range 2.00000

Tests for Location: Mu0=0

Test	-Statistic-	-----p Value-----
Student's t	t 25.24876	Pr > t <.0001
Sign	M 25.5	Pr >= M <.0001
Signed Rank	S 663	Pr >= S <.0001

Quantiles (Definition 5)

Quantile	Estimate
100% Max	4
99%	4
95%	4
90%	4
75% Q3	4
50% Median	3
25% Q1	2
10%	2
5%	2
1%	1
0% Min	1

Variable: Q8 (Q8)

N	51	Sum Weights	51
Mean	2.78431373	Sum Observations	142
Std Deviation	0.85589078	Variance	0.73254902
Skewness	0.43864422	Kurtosis	0.51200808
Uncorrected SS	432	Corrected SS	36.627451
Coeff Variation	30.7397391	Std Error Mean	0.11984868

Basic Statistical Measures

Location	Variability
Mean 2.784314	Std Deviation 0.85589
Median 3.000000	Variance 0.73255
Mode 3.000000	Range 4.00000
	Interquartile Range 1.00000

Tests for Location: Mu0=0

Test	-Statistic-	-----p Value-----
Student's t	t 23.23191	Pr > t <.0001
Sign	M 25.5	Pr >= M <.0001
Signed Rank	S 663	Pr >= S <.0001

Quantiles (Definition 5)

Quantile	Estimate
100% Max	5
99%	5
95%	4
90%	4
75% Q3	3
50% Median	3
25% Q1	2
10%	2
5%	2
1%	1
0% Min	1

Variable: Q9 (Q9)

N	51	Sum Weights	51
Mean	3.25490196	Sum Observations	166
Std Deviation	0.95588989	Variance	0.91372549

Skewness -0.1139517 Kurtosis 0.04841831
Uncorrected SS 586 Corrected SS 45.6862745
Coeff Variation 29.3677016 Std Error Mean 0.13385136

Basic Statistical Measures
Location Variability
Mean 3.254902 Std Deviation 0.95589
Median 3.000000 Variance 0.91373
Mode 3.000000 Range 4.00000
Interquartile Range 1.00000

Tests for Location: Mu0=0
Test -Statistic- -----p Value-----
Student's t t 24.31729 Pr > |t| <.0001
Sign M 25.5 Pr >= |M| <.0001
Signed Rank S 663 Pr >= |S| <.0001

Quantiles (Definition 5)
Quantile Estimate
100% Max 5
99% 5
95% 5
90% 4
75% Q3 4
50% Median 3
25% Q1 3
10% 2
5% 2
1% 1
0% Min 1

Variable: Q10 (Q10)
N 51 Sum Weights 51
Mean 3.19607843 Sum Observations 163
Std Deviation 1.11390498 Variance 1.24078431
Skewness 0.04701921 Kurtosis -0.9159456
Uncorrected SS 583 Corrected SS 62.0392157
Coeff Variation 34.8522418 Std Error Mean 0.1559779

Basic Statistical Measures
Location Variability
Mean 3.196078 Std Deviation 1.11390
Median 3.000000 Variance 1.24078
Mode 2.000000 Range 4.00000
Interquartile Range 2.00000

Note: The mode displayed is the smallest of 3 modes with a count of 14.

Tests for Location: Mu0=0
Test -Statistic- -----p Value-----
Student's t t 20.49059 Pr > |t| <.0001
Sign M 25.5 Pr >= |M| <.0001
Signed Rank S 663 Pr >= |S| <.0001

Quantiles (Definition 5)
Quantile Estimate
100% Max 5
99% 5
95% 5
90% 5
75% Q3 4
50% Median 3
25% Q1 2
10% 2
5% 2
1% 1
0% Min 1

Variable: Q11 (Q11)
N 51 Sum Weights 51
Mean 3.74509804 Sum Observations 191
Std Deviation 1.1634971 Variance 1.35372549
Skewness -0.3488459 Kurtosis -1.3492709
Uncorrected SS 783 Corrected SS 67.6862745
Coeff Variation 31.0671999 Std Error Mean 0.16292218

Basic Statistical Measures
Location Variability
Mean 3.745098 Std Deviation 1.16350
Median 4.000000 Variance 1.35373
Mode 5.000000 Range 3.00000
Interquartile Range 2.00000

Tests for Location: Mu0=0
Test -Statistic- -----p Value-----
Student's t t 22.98704 Pr > |t| <.0001
Sign M 25.5 Pr >= |M| <.0001
Signed Rank S 663 Pr >= |S| <.0001

Quantiles (Definition 5)
Quantile Estimate
100% Max 5
99% 5
95% 5
90% 5
75% Q3 5
50% Median 4
25% Q1 3
10% 2

5% 2
1% 2
0% Min 2

Variable: Q12 (Q12)
N 51 Sum Weights 51
Mean 3.64705882 Sum Observations 186
Std Deviation 1.03582874 Variance 1.07294118
Skewness -0.6921714 Kurtosis -0.3103388
Uncorrected SS 732 Corrected SS 53.6470588
Coeff Variation 28.4017557 Std Error Mean 0.14504504

Basic Statistical Measures
Location Variability
Mean 3.647059 Std Deviation 1.03583
Median 4.000000 Variance 1.07294
Mode 4.000000 Range 4.00000
Interquartile Range 1.00000

Tests for Location: Mu0=0
Test -Statistic- ----p Value-----
Student's t t 25.14432 Pr > |t| <.0001
Sign M 25.5 Pr >= |M| <.0001
Signed Rank S 663 Pr >= |S| <.0001

Quantiles (Definition 5)
Quantile Estimate
100% Max 5
99% 5
95% 5
90% 5
75% Q3 4
50% Median 4
25% Q1 3
10% 2
5% 2
1% 1
0% Min 1

Variable: Q13 (Q13)
N 51 Sum Weights 51
Mean 4.09803922 Sum Observations 209
Std Deviation 0.92206078 Variance 0.85019608
Skewness -1.3157621 Kurtosis 2.05173873
Uncorrected SS 899 Corrected SS 42.5098039
Coeff Variation 22.5000477 Std Error Mean 0.12911433

Basic Statistical Measures
Location Variability
Mean 4.098039 Std Deviation 0.92206
Median 4.000000 Variance 0.85020
Mode 4.000000 Range 4.00000
Interquartile Range 1.00000

Tests for Location: Mu0=0
Test -Statistic- ----p Value-----
Student's t t 31.73961 Pr > |t| <.0001
Sign M 25.5 Pr >= |M| <.0001
Signed Rank S 663 Pr >= |S| <.0001

Quantiles (Definition 5)
Quantile Estimate
100% Max 5
99% 5
95% 5
90% 5
75% Q3 5
50% Median 4
25% Q1 4
10% 3
5% 2
1% 1
0% Min 1

Variable: Q14 (Q14)
N 51 Sum Weights 51
Mean 3.23529412 Sum Observations 165
Std Deviation 1.08790138 Variance 1.18352941
Skewness -0.3950621 Kurtosis -0.4006109
Uncorrected SS 593 Corrected SS 59.1764706
Coeff Variation 33.6260426 Std Error Mean 0.15233666

Basic Statistical Measures
Location Variability
Mean 3.235294 Std Deviation 1.08790
Median 3.000000 Variance 1.18353
Mode 4.000000 Range 4.00000
Interquartile Range 1.00000

Tests for Location: Mu0=0
Test -Statistic- ----p Value-----
Student's t t 21.23779 Pr > |t| <.0001
Sign M 25.5 Pr >= |M| <.0001
Signed Rank S 663 Pr >= |S| <.0001

Quantiles (Definition 5)
Quantile Estimate
100% Max 5

99%	5
95%	5
90%	4
75% Q3	4
50% Median	3
25% Q1	3
10%	2
5%	1
1%	1
0% Min	1

Variable: Q15 (Q15)			
N	51	Sum Weights	51
Mean	2.64705882	Sum Observations	135
Std Deviation	0.77002674	Variance	0.59294118
Skewness	0.16564492	Kurtosis	1.05611618
Uncorrected SS	387	Corrected SS	29.6470588
Coeff Variation	29.089899	Std Error Mean	0.10782531

Basic Statistical Measures			
Location		Variability	
Mean	2.647059	Std Deviation	0.77003
Median	3.000000	Variance	0.59294
Mode	3.000000	Range	4.00000
		Interquartile Range	1.00000

Tests for Location: Mu0=0			
Test	-Statistic-	-----p Value-----	
Student's t	t 24.54951	Pr > t	<.0001
Sign	M 25.5	Pr >= M	<.0001
Signed Rank	S 663	Pr >= S	<.0001

Quantiles (Definition 5)	
Quantile	Estimate
100% Max	5
99%	5
95%	4
90%	3
75% Q3	3
50% Median	3
25% Q1	2
10%	2
5%	1
1%	1
0% Min	1

Variable: Q16 (Q16)			
N	51	Sum Weights	51
Mean	2.54901961	Sum Observations	130
Std Deviation	0.85589078	Variance	0.73254902
Skewness	0.43933351	Kurtosis	0.34391384
Uncorrected SS	368	Corrected SS	36.627451
Coeff Variation	33.5772535	Std Error Mean	0.11984868

Basic Statistical Measures			
Location		Variability	
Mean	2.549020	Std Deviation	0.85589
Median	2.000000	Variance	0.73255
Mode	2.000000	Range	4.00000
		Interquartile Range	1.00000

Tests for Location: Mu0=0			
Test	-Statistic-	-----p Value-----	
Student's t	t 21.26865	Pr > t	<.0001
Sign	M 25.5	Pr >= M	<.0001
Signed Rank	S 663	Pr >= S	<.0001

Quantiles (Definition 5)	
Quantile	Estimate
100% Max	5
99%	5
95%	4
90%	4
75% Q3	3
50% Median	2
25% Q1	2
10%	2
5%	1
1%	1
0% Min	1

Variable: Q17 (Q17)			
N	51	Sum Weights	51
Mean	2.47058824	Sum Observations	126
Std Deviation	0.70293502	Variance	0.49411765
Skewness	0.10825082	Kurtosis	-0.1156463
Uncorrected SS	336	Corrected SS	24.7058824
Coeff Variation	28.4521319	Std Error Mean	0.09843059

Basic Statistical Measures			
Location		Variability	
Mean	2.470588	Std Deviation	0.70294
Median	2.000000	Variance	0.49412
Mode	2.000000	Range	3.00000
		Interquartile Range	1.00000

Tests for Location: Mu0=0			
Test	-Statistic-	-----p Value-----	

Student's t t 25.0998 Pr > |t| <.0001
Sign M 25.5 Pr >= |M| <.0001
Signed Rank S 663 Pr >= |S| <.0001

Quantiles (Definition 5)	
Quantile	Estimate
100% Max	4
99%	4
95%	4
90%	3
75% Q3	3
50% Median	2
25% Q1	2
10%	2
5%	1
1%	1
0% Min	1

Variable: Q18 (Q18)

N	51	Sum Weights	51
Mean	2.62745098	Sum Observations	134
Std Deviation	0.72002179	Variance	0.51843137
Skewness	0.36851246	Kurtosis	-0.4804522
Uncorrected SS	378	Corrected SS	25.9215686
Coeff Variation	27.4038142	Std Error Mean	0.10082322

Basic Statistical Measures			
Location		Variability	
Mean	2.627451	Std Deviation	0.72002
Median	3.000000	Variance	0.51843
Mode	2.000000	Range	3.00000
		Interquartile Range	1.00000

Tests for Location: Mu0=0

Test	-Statistic-	-----p Value-----
Student's t t	26.05998	Pr > t <.0001
Sign	M 25.5	Pr >= M <.0001
Signed Rank	S 663	Pr >= S <.0001

Quantiles (Definition 5)	
Quantile	Estimate
100% Max	4
99%	4
95%	4
90%	4
75% Q3	3
50% Median	3
25% Q1	2
10%	2
5%	2
1%	1
0% Min	1

Variable: Q19 (Q19)

N	51	Sum Weights	51
Mean	1.98039216	Sum Observations	101
Std Deviation	0.70682943	Variance	0.49960784
Skewness	1.79609829	Kurtosis	6.86961117
Uncorrected SS	225	Corrected SS	24.9803922
Coeff Variation	35.6913871	Std Error Mean	0.09897592

Basic Statistical Measures			
Location		Variability	
Mean	1.980392	Std Deviation	0.70683
Median	2.000000	Variance	0.49961
Mode	2.000000	Range	4.00000
		Interquartile Range	0

Tests for Location: Mu0=0

Test	-Statistic-	-----p Value-----
Student's t t	20.00883	Pr > t <.0001
Sign	M 25.5	Pr >= M <.0001
Signed Rank	S 663	Pr >= S <.0001

Quantiles (Definition 5)	
Quantile	Estimate
100% Max	5
99%	5
95%	3
90%	2
75% Q3	2
50% Median	2
25% Q1	2
10%	1
5%	1
1%	1
0% Min	1

Variable: Q20 (Q20)

N	50	Sum Weights	50
Mean	3.58	Sum Observations	179
Std Deviation	1.19676435	Variance	1.4322449
Skewness	-0.6805064	Kurtosis	-0.5503342
Uncorrected SS	711	Corrected SS	70.18
Coeff Variation	33.4291717	Std Error Mean	0.16924804

Basic Statistical Measures			
Location		Variability	
Mean	3.580000	Std Deviation	1.19676

Median	4.000000	Variance	1.43224
Mode	4.000000	Range	4.00000
		Interquartile Range	1.00000

Tests for Location: Mu0=0

Test	-Statistic-	-----p Value-----
Student's t	t 21.15239	Pr > t <.0001
Sign	M 25	Pr >= M <.0001
Signed Rank	S 637.5	Pr >= S <.0001

Quantiles (Definition 5)

Quantile	Estimate
100% Max	5
99%	5
95%	5
90%	5
75% Q3	4
50% Median	4
25% Q1	3
10%	2
5%	1
1%	1
0% Min	1

Variable: Q21 (Q21)

N	51	Sum Weights	51
Mean	2.07843137	Sum Observations	106
Std Deviation	0.71674646	Variance	0.51372549
Skewness	0.56146812	Kurtosis	0.73623154
Uncorrected SS	246	Corrected SS	25.6862745
Coeff Variation	34.4849713	Std Error Mean	0.10036458

Basic Statistical Measures

Location	Variability
Mean 2.078431	Std Deviation 0.71675
Median 2.000000	Variance 0.51373
Mode 2.000000	Range 3.00000
	Interquartile Range 0

Tests for Location: Mu0=0

Test	-Statistic-	-----p Value-----
Student's t	t 20.70881	Pr > t <.0001
Sign	M 25.5	Pr >= M <.0001
Signed Rank	S 663	Pr >= S <.0001

Quantiles (Definition 5)

Quantile	Estimate
100% Max	4
99%	4
95%	3
90%	3
75% Q3	2
50% Median	2
25% Q1	2
10%	1
5%	1
1%	1
0% Min	1

Variable: Q22 (Q22)

N	51	Sum Weights	51
Mean	2.41176471	Sum Observations	123
Std Deviation	0.75303308	Variance	0.56705882
Skewness	0.31273307	Kurtosis	1.58883934
Uncorrected SS	325	Corrected SS	28.3529412
Coeff Variation	31.2233229	Std Error Mean	0.10544572

Basic Statistical Measures

Location	Variability
Mean 2.411765	Std Deviation 0.75303
Median 2.000000	Variance 0.56706
Mode 3.000000	Range 4.00000
	Interquartile Range 1.00000

Tests for Location: Mu0=0

Test	-Statistic-	-----p Value-----
Student's t	t 22.8721	Pr > t <.0001
Sign	M 25.5	Pr >= M <.0001
Signed Rank	S 663	Pr >= S <.0001

Quantiles (Definition 5)

Quantile	Estimate
100% Max	5
99%	5
95%	3
90%	3
75% Q3	3
50% Median	2
25% Q1	2
10%	2
5%	1
1%	1
0% Min	1

Variable: Q23 (Q23)

N	51	Sum Weights	51	Std Deviation	0.74042913	Variance	0.54823529
Mean	3.17647059	Sum Observations	162				
Skewness	1.24138234	Kurtosis	1.8187621				

Uncorrected SS 542 Corrected SS 27.4117647
 Coeff Variation 23.3098059 Std Error Mean 0.10368082

Basic Statistical Measures
 Location Variability
 Mean 3.176471 Std Deviation 0.74043
 Median 3.000000 Variance 0.54824
 Mode 3.000000 Range 3.00000
 Interquartile Range 0

Tests for Location: Mu0=0
 Test -Statistic- -----p Value-----
 Student's t t 30.63701 Pr > |t| <.0001
 Sign M 25.5 Pr >= |M| <.0001
 Signed Rank S 663 Pr >= |S| <.0001

Quantiles (Definition 5)
 Quantile Estimate
 100% Max 5
 99% 5
 95% 5
 90% 4
 75% Q3 3
 50% Median 3
 25% Q1 3
 10% 3
 5% 2
 1% 2
 0% Min 2

Variable: Q24 (Q24)
 N 51 Sum Weights 51
 Mean 3.07843137 Sum Observations 157
 Std Deviation 1.09257745 Variance 1.19372549
 Skewness -0.2564608 Kurtosis -0.8650203
 Uncorrected SS 543 Corrected SS 59.6862745
 Coeff Variation 35.4913695 Std Error Mean 0.15299144

Basic Statistical Measures
 Location Variability
 Mean 3.078431 Std Deviation 1.09258
 Median 3.000000 Variance 1.19373
 Mode 4.000000 Range 4.00000
 Interquartile Range 2.00000

Tests for Location: Mu0=0
 Test -Statistic- -----p Value-----
 Student's t t 20.12159 Pr > |t| <.0001
 Sign M 25.5 Pr >= |M| <.0001
 Signed Rank S 663 Pr >= |S| <.0001

Quantiles (Definition 5)
 Quantile Estimate
 100% Max 5
 99% 5
 95% 5
 90% 4
 75% Q3 4
 50% Median 3
 25% Q1 2
 10% 2
 5% 1
 1% 1
 0% Min 1

Variable: Q25 (Q25)
 N 51 Sum Weights 51
 Mean 2.7254902 Sum Observations 139
 Std Deviation 0.93975383 Variance 0.88313725
 Skewness -0.0145612 Kurtosis -1.0170911
 Uncorrected SS 423 Corrected SS 44.1568627
 Coeff Variation 34.4801764 Std Error Mean 0.13159186

Basic Statistical Measures
 Location Variability
 Mean 2.725490 Std Deviation 0.93975
 Median 3.000000 Variance 0.88314
 Mode 2.000000 Range 3.00000
 Interquartile Range 2.00000

Tests for Location: Mu0=0
 Test -Statistic- -----p Value-----
 Student's t t 20.71169 Pr > |t| <.0001
 Sign M 25.5 Pr >= |M| <.0001
 Signed Rank S 663 Pr >= |S| <.0001

Quantiles (Definition 5)
 Quantile Estimate
 100% Max 4
 99% 4
 95% 4
 90% 4
 75% Q3 4
 50% Median 3
 25% Q1 2
 10% 2
 5% 1
 1% 1
 0% Min 1

Annexure D :

Comparison of proportions

Total
The FREQ Procedure

	Q1	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree - Strongly Agree		47	92.16	47	92.16
Undecided		1	1.96	48	94.12
Strongly Disagree- Disagree		3	5.88	51	100.00

Chi-Square Test
for Equal Proportions

Chi-Square 79.5294
DF 2
Pr > ChiSq <.0001
Sample Size = 51

	Q2	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree - Strongly Agree		23	45.10	23	45.10
Undecided		13	25.49	36	70.59
Strongly Disagree- Disagree		15	29.41	51	100.00

Chi-Square Test
for Equal Proportions

Chi-Square 3.2941
DF 2
Pr > ChiSq 0.1926
Sample Size = 51

	Q3	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree - Strongly Agree		16	32.00	16	32.00
Undecided		27	54.00	43	86.00
Strongly Disagree- Disagree		7	14.00	50	100.00

Chi-Square Test
for Equal Proportions

Chi-Square 12.0400
DF 2
Pr > ChiSq 0.0024
Effective Sample Size = 50
Frequency Missing = 1

	Q4	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree - Strongly Agree		43	84.31	43	84.31
Undecided		6	11.76	49	96.08
Strongly Disagree- Disagree		2	3.92	51	100.00

Chi-Square Test
for Equal Proportions

Chi-Square 60.1176
DF 2
Pr > ChiSq <.0001
Sample Size = 51

	Q5	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree - Strongly Agree		43	84.31	43	84.31
Undecided		4	7.84	47	92.16
Strongly Disagree- Disagree		4	7.84	51	100.00

Chi-Square Test
for Equal Proportions

Chi-Square 59.6471
DF 2
Pr > ChiSq <.0001
Sample Size = 51

	Q6	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree - Strongly Agree		26	50.98	26	50.98
Undecided		14	27.45	40	78.43
Strongly Disagree- Disagree		11	21.57	51	100.00

Chi-Square Test
for Equal Proportions

Chi-Square 7.4118
DF 2
Pr > ChiSq 0.0246
Sample Size = 51

	Q7 Frequency	Cumulative Percent	Cumulative Frequency	Cumulative Percent
Agree - Strongly Agree	16	31.37	16	31.37
Undecided	18	35.29	34	66.67
Strongly Disagree- Disagree	17	33.33	51	100.00

Chi-Square Test
for Equal Proportions
Chi-Square 0.1176
DF 2
Pr > ChiSq 0.9429
Sample Size = 51

	Q8 Frequency	Cumulative Percent	Cumulative Frequency	Cumulative Percent
Agree - Strongly Agree	19	37.25	19	37.25
Undecided	24	47.06	43	84.31
Strongly Disagree- Disagree	8	15.69	51	100.00

Chi-Square Test
for Equal Proportions
Chi-Square 7.8824
DF 2
Pr > ChiSq 0.0194
Sample Size = 51

	Q9 Frequency	Cumulative Percent	Cumulative Frequency	Cumulative Percent
Agree - Strongly Agree	9	17.65	9	17.65
Undecided	23	45.10	32	62.75
Strongly Disagree- Disagree	19	37.25	51	100.00

Chi-Square Test
for Equal Proportions
Chi-Square 6.1176
DF 2
Pr > ChiSq 0.0469
Sample Size = 51

	Q10 Frequency	Cumulative Percent	Cumulative Frequency	Cumulative Percent
Agree - Strongly Agree	16	31.37	16	31.37
Undecided	14	27.45	30	58.82
Strongly Disagree- Disagree	21	41.18	51	100.00

Chi-Square Test
for Equal Proportions
Chi-Square 1.5294
DF 2
Pr > ChiSq 0.4655
Sample Size = 51

	Q11 Frequency	Cumulative Percent	Cumulative Frequency	Cumulative Percent
Agree - Strongly Agree	11	21.57	11	21.57
Undecided	9	17.65	20	39.22
Strongly Disagree- Disagree	31	60.78	51	100.00

Chi-Square Test
for Equal Proportions
Chi-Square 17.4118
DF 2
Pr > ChiSq 0.0002
Sample Size = 51

	Q12 Frequency	Cumulative Percent	Cumulative Frequency	Cumulative Percent
Agree - Strongly Agree	10	19.61	10	19.61
Undecided	6	11.76	16	31.37
Strongly Disagree- Disagree	35	68.63	51	100.00

Chi-Square Test
for Equal Proportions
Chi-Square 29.0588
DF 2
Pr > ChiSq <.0001
Sample Size = 51

	Q13 Frequency	Cumulative Percent	Cumulative Frequency	Cumulative Percent
Agree - Strongly Agree	4	7.84	4	7.84
Undecided	4	7.84	8	15.69
Strongly Disagree- Disagree	43	84.31	51	100.00

Chi-Square Test
for Equal Proportions

Chi-Square 59.6471
 DF 2
 Pr > ChiSq <.0001
 Sample Size = 51

Q14	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree - Strongly Agree	12	23.53	12	23.53
Undecided	16	31.37	28	54.90
Strongly Disagree- Disagree	23	45.10	51	100.00

Chi-Square Test
 for Equal Proportions
 Chi-Square 3.6471
 DF 2
 Pr > ChiSq 0.1615
 Sample Size = 51

Q15	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree - Strongly Agree	20	39.22	20	39.22
Undecided	27	52.94	47	92.16
Strongly Disagree- Disagree	4	7.84	51	100.00

Chi-Square Test
 for Equal Proportions
 Chi-Square 16.3529
 DF 2
 Pr > ChiSq 0.0003
 Sample Size = 51

Q16	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree - Strongly Agree	26	50.98	26	50.98
Undecided	19	37.25	45	88.24
Strongly Disagree- Disagree	6	11.76	51	100.00

Chi-Square Test
 for Equal Proportions
 Chi-Square 12.1176
 DF 2
 Pr > ChiSq 0.0023
 Sample Size = 51

Q17	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree - Strongly Agree	27	52.94	27	52.94
Undecided	21	41.18	48	94.12
Strongly Disagree- Disagree	3	5.88	51	100.00

Chi-Square Test
 for Equal Proportions
 Chi-Square 18.3529
 DF 2
 Pr > ChiSq 0.0001
 Sample Size = 51

Q18	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree - Strongly Agree	24	47.06	24	47.06
Undecided	21	41.18	45	88.24
Strongly Disagree- Disagree	6	11.76	51	100.00

Chi-Square Test
 for Equal Proportions
 Chi-Square 10.9412
 DF 2
 Pr > ChiSq 0.0042
 Sample Size = 51

Q19	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree - Strongly Agree	46	90.20	46	90.20
Undecided	3	5.88	49	96.08
Strongly Disagree- Disagree	2	3.92	51	100.00

Chi-Square Test
 for Equal Proportions
 Chi-Square 74.2353
 DF 2
 Pr > ChiSq <.0001
 Sample Size = 51

Q20	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree - Strongly Agree	12	24.00	12	24.00
Undecided	5	10.00	17	34.00
Strongly Disagree- Disagree	33	66.00	50	100.00

Chi-Square Test
for Equal Proportions
~~~~~  
Chi-Square 25.4800  
DF 2  
Pr > ChiSq <.0001  
Effective Sample Size = 50  
Frequency Missing = 1

|                             | Q21 | Frequency | Cumulative<br>Percent | Cumulative<br>Frequency | Percent |
|-----------------------------|-----|-----------|-----------------------|-------------------------|---------|
| Agree - Strongly Agree      |     | 40        | 78.43                 | 40                      | 78.43   |
| Undecided                   |     | 9         | 17.65                 | 49                      | 96.08   |
| Strongly Disagree- Disagree |     | 2         | 3.92                  | 51                      | 100.00  |

Chi-Square Test  
for Equal Proportions  
~~~~~  
Chi-Square 48.1176
DF 2
Pr > ChiSq <.0001
Sample Size = 51

	Q22	Frequency	Cumulative Percent	Cumulative Frequency	Percent
Agree - Strongly Agree		27	52.94	27	52.94
Undecided		23	45.10	50	98.04
Strongly Disagree- Disagree		1	1.96	51	100.00

Chi-Square Test
for Equal Proportions
~~~~~  
Chi-Square 23.0588  
DF 2  
Pr > ChiSq <.0001  
Sample Size = 51

|                             | Q23 | Frequency | Cumulative<br>Percent | Cumulative<br>Frequency | Percent |
|-----------------------------|-----|-----------|-----------------------|-------------------------|---------|
| Agree - Strongly Agree      |     | 5         | 9.80                  | 5                       | 9.80    |
| Undecided                   |     | 37        | 72.55                 | 42                      | 82.35   |
| Strongly Disagree- Disagree |     | 9         | 17.65                 | 51                      | 100.00  |

Chi-Square Test  
for Equal Proportions  
~~~~~  
Chi-Square 35.7647
DF 2
Pr > ChiSq <.0001
Sample Size = 51

	Q24	Frequency	Cumulative Percent	Cumulative Frequency	Percent
Agree - Strongly Agree		17	33.33	17	33.33
Undecided		12	23.53	29	56.86
Strongly Disagree- Disagree		22	43.14	51	100.00

Chi-Square Test
for Equal Proportions
~~~~~  
Chi-Square 2.9412  
DF 2  
Pr > ChiSq 0.2298  
Sample Size = 51

|                             | Q25 | Frequency | Cumulative<br>Percent | Cumulative<br>Frequency | Percent |
|-----------------------------|-----|-----------|-----------------------|-------------------------|---------|
| Agree - Strongly Agree      |     | 23        | 45.10                 | 23                      | 45.10   |
| Undecided                   |     | 15        | 29.41                 | 38                      | 74.51   |
| Strongly Disagree- Disagree |     | 13        | 25.49                 | 51                      | 100.00  |

Chi-Square Test  
for Equal Proportions  
~~~~~  
Chi-Square 3.2941
DF 2
Pr > ChiSq 0.1926
Sample Size = 51

Annexure E : Chi-square test for comparisons

Table of Group by Q1

Frequency				
Percent				
Row Pct				
Col Pct	Agree -	Undecide,	Strongly,	Total
	Strongly,d		Disagre,	
	Agree ,		e- Disag,	
			ree	
Buyers	24	1	0	25
	47.06	1.96	0.00	49.02
	96.00	4.00	0.00	
	51.06	100.00	0.00	
Material Managem ,	23	0	3	26
ent	45.10	0.00	5.88	50.98
	88.46	0.00	11.54	
	48.94	0.00	100.00	
Total	47	1	3	51
	92.16	1.96	5.88	100.00

Statistics for Table of Group by Q1

Statistic	DF	Value	Prob
Chi-Square	2	4.0032	0.1351
Likelihood Ratio Chi-Square	2	5.5468	0.0624
Mantel-Haenszel Chi-Square	1	1.5769	0.2092
Phi Coefficient		0.2802	
Contingency Coefficient		0.2698	
Cramer's V		0.2802	

WARNING: 67% of the cells have expected counts less than 5. Chi-Square may not be a valid test.

Sample Size = 51

Table of Group by Q2

Frequency				
Percent				
Row Pct				
Col Pct	Agree -	Undecide,	Strongly,	Total
	Strongly,d		Disagre,	
	Agree ,		e- Disag,	
			ree	
Buyers	15	5	5	25
	29.41	9.80	9.80	49.02
	60.00	20.00	20.00	
	65.22	38.46	33.33	
Material Managem ,	8	8	10	26
ent	15.69	15.69	19.61	50.98
	30.77	30.77	38.46	
	34.78	61.54	66.67	
Total	23	13	15	51
	45.10	25.49	29.41	100.00

Statistics for Table of Group by Q2

Statistic	DF	Value	Prob
Chi-Square	2	4.4715	0.1069
Likelihood Ratio Chi-Square	2	4.5426	0.1032
Mantel-Haenszel Chi-Square	1	4.2773	0.0386
Phi Coefficient		0.2961	
Contingency Coefficient		0.2839	
Cramer's V		0.2961	

Sample Size = 51

Table of Group by Q3

Frequency				
Percent				
Row Pct				
Col Pct	Agree -	Undecide,	Strongly,	Total
	Strongly,d		Disagre,	
	Agree ,		e- Disag,	
			ree	
Buyers	11	12	1	24
	22.00	24.00	2.00	48.00
	45.83	50.00	4.17	
	68.75	44.44	14.29	
Material Managem ,	5	15	6	26
ent	10.00	30.00	12.00	52.00
	19.23	57.69	23.08	
	31.25	55.56	85.71	
Total	16	27	7	50
	32.00	54.00	14.00	100.00

Statistics for Table of Group by Q3

Statistic	DF	Value	Prob
-----------	----	-------	------

Chi-Square 2 6.0845 0.0477
Likelihood Ratio Chi-Square 2 6.5224 0.0383
Mantel-Haenszel Chi-Square 1 5.4364 0.0197
Phi Coefficient 0.3488
Contingency Coefficient 0.3294
Cramer's V 0.3488
WARNING: 33% of the cells have expected counts less
than 5. Chi-Square may not be a valid test.
Effective Sample Size = 50
Frequency Missing = 1

Table of Group by Q4
Frequency ,
Percent ,
Row Pct ,
Col Pct ,Agree - ,Undecide,Strongly, Total
,Strongly,d ,Disagre,
, Agree , ,e- Disag,
,ree ,
////////////////////
Buyers , 20, 3, 2, 25
, 39.22, 5.88, 3.92, 49.02
, 80.00, 12.00, 8.00,
, 46.51, 50.00, 100.00,
////////////////////
Material Managem, 23, 3, 0, 26
ent , 45.10, 5.88, 0.00, 50.98
, 88.46, 11.54, 0.00,
, 53.49, 50.00, 0.00,
////////////////////
Total 43 6 2 51
84.31 11.76 3.92 100.00

Statistics for Table of Group by Q4
Statistic DF Value Prob
////////////////////
Chi-Square 2 2.1905 0.3344
Likelihood Ratio Chi-Square 2 2.9625 0.2274
Mantel-Haenszel Chi-Square 1 1.1104 0.2920
Phi Coefficient 0.2072
Contingency Coefficient 0.2029
Cramer's V 0.2072
WARNING: 67% of the cells have expected counts less
than 5. Chi-Square may not be a valid test.
Sample Size = 51

Table of Group by Q5
Frequency ,
Percent ,
Row Pct ,
Col Pct ,Agree - ,Undecide,Strongly, Total
,Strongly,d ,Disagre,
, Agree , ,e- Disag,
,ree ,
////////////////////
Buyers , 21, 2, 2, 25
, 41.18, 3.92, 3.92, 49.02
, 84.00, 8.00, 8.00,
, 48.84, 50.00, 50.00,
////////////////////
Material Managem, 22, 2, 2, 26
ent , 43.14, 3.92, 3.92, 50.98
, 84.62, 7.69, 7.69,
, 51.16, 50.00, 50.00,
////////////////////
Total 43 4 4 51
84.31 7.84 7.84 100.00

Statistics for Table of Group by Q5
Statistic DF Value Prob
////////////////////
Chi-Square 2 0.0036 0.9982
Likelihood Ratio Chi-Square 2 0.0036 0.9982
Mantel-Haenszel Chi-Square 1 0.0034 0.9534
Phi Coefficient 0.0085
Contingency Coefficient 0.0085
Cramer's V 0.0085
WARNING: 67% of the cells have expected counts less
than 5. Chi-Square may not be a valid test.
Sample Size = 51

Table of Group by Q6
Frequency ,
Percent ,
Row Pct ,
Col Pct ,Agree - ,Undecide,Strongly, Total
,Strongly,d ,Disagre,
, Agree , ,e- Disag,
,ree ,
////////////////////
Buyers , 14, 8, 3, 25
, 27.45, 15.69, 5.88, 49.02
, 56.00, 32.00, 12.00,
, 53.85, 57.14, 27.27,
////////////////////
Material Managem, 12, 6, 8, 26
ent , 23.53, 11.76, 15.69, 50.98
, 46.15, 23.08, 30.77,


```

, 46.15 , 42.86 , 72.73 ,
////////////////////
Total      26   14   11   51
          50.98 27.45 21.57 100.00

```

Statistics for Table of Group by Q6

Statistic	DF	Value	Prob
Chi-Square	2	2.6937	0.2601
Likelihood Ratio Chi-Square	2	2.7794	0.2492
Mantel-Haenszel Chi-Square	1	1.1491	0.2837
Phi Coefficient		0.2298	
Contingency Coefficient		0.2240	
Cramer's V		0.2298	

Sample Size = 51

Table of Group by Q7

```

Frequency      ,
Percent        ,
Row Pct        ,
Col Pct        ,Agree - ,Undecide,Strongly, Total
,Strongly,d    , Disagre,
, Agree ,      ,e- Disag,
,ree ,
////////////////////
Buyers          7, 13, 5, 25
, 13.73, 25.49, 9.80, 49.02
, 28.00, 52.00, 20.00,
, 43.75, 72.22, 29.41,
////////////////////
Material Managem, 9, 5, 12, 26
ent , 17.65, 9.80, 23.53, 50.98
, 34.62, 19.23, 46.15,
, 56.25, 27.78, 70.59,
////////////////////
Total          16  18  17  51
          31.37 35.29 33.33 100.00

```

Statistics for Table of Group by Q7

Statistic	DF	Value	Prob
Chi-Square	2	6.6709	0.0356
Likelihood Ratio Chi-Square	2	6.8839	0.0320
Mantel-Haenszel Chi-Square	1	0.1390	0.7093
Phi Coefficient		0.3617	
Contingency Coefficient		0.3401	
Cramer's V		0.3617	

Sample Size = 51

Table of Group by Q8

```

Frequency      ,
Percent        ,
Row Pct        ,
Col Pct        ,Agree - ,Undecide,Strongly, Total
,Strongly,d    , Disagre,
, Agree ,      ,e- Disag,
,ree ,
////////////////////
Buyers          9, 13, 3, 25
, 17.65, 25.49, 5.88, 49.02
, 36.00, 52.00, 12.00,
, 47.37, 54.17, 37.50,
////////////////////
Material Managem, 10, 11, 5, 26
ent , 19.61, 21.57, 9.80, 50.98
, 38.46, 42.31, 19.23,
, 52.63, 45.83, 62.50,
////////////////////
Total          19  24  8  51
          37.25 47.06 15.69 100.00

```

Statistics for Table of Group by Q8

Statistic	DF	Value	Prob
Chi-Square	2	0.7000	0.7047
Likelihood Ratio Chi-Square	2	0.7052	0.7028
Mantel-Haenszel Chi-Square	1	0.0051	0.9430
Phi Coefficient		0.1172	
Contingency Coefficient		0.1164	
Cramer's V		0.1172	

WARNING: 33% of the cells have expected counts less than 5. Chi-Square may not be a valid test.

Sample Size = 51

Table of Group by Q9

```

Frequency      ,
Percent        ,
Row Pct        ,
Col Pct        ,Agree - ,Undecide,Strongly, Total
,Strongly,d    , Disagre,
, Agree ,      ,e- Disag,
,ree ,
////////////////////
Buyers          3, 16, 6, 25
, 5.88, 31.37, 11.76, 49.02
, 12.00, 64.00, 24.00,

```



```

, 33.33 , 69.57 , 31.58 ,
////////////////////
Material Managem , 6 , 7 , 13 , 26
ent , 11.76 , 13.73 , 25.49 , 50.98
, 23.08 , 26.92 , 50.00 ,
, 66.67 , 30.43 , 68.42 ,
////////////////////
Total 9 23 19 51
17.65 45.10 37.25 100.00

```

Statistics for Table of Group by Q9

Statistic	DF	Value	Prob
Chi-Square	2	7.0838	0.0290
Likelihood Ratio Chi-Square	2	7.2581	0.0265
Mantel-Haenszel Chi-Square	1	0.0171	0.8958
Phi Coefficient		0.3727	
Contingency Coefficient		0.3492	
Cramer's V		0.3727	

WARNING: 33% of the cells have expected counts less than 5. Chi-Square may not be a valid test.
Sample Size = 51

Table of Group by Q10

Frequency ,
Percent ,
Row Pct ,
Col Pct ,Agree - ,Undecide,Strongly, Total
,Strongly,d , Disagre,
, Agree , ,e- Disag,
,ree ,

```

////////////////////
Buyers , 6 , 10 , 9 , 25
, 11.76 , 19.61 , 17.65 , 49.02
, 24.00 , 40.00 , 36.00 ,
, 37.50 , 71.43 , 42.86 ,
////////////////////
Material Managem , 10 , 4 , 12 , 26
ent , 19.61 , 7.84 , 23.53 , 50.98
, 38.46 , 15.38 , 46.15 ,
, 62.50 , 28.57 , 57.14 ,
////////////////////
Total 16 14 21 51
31.37 27.45 41.18 100.00

```

Statistics for Table of Group by Q10

Statistic	DF	Value	Prob
Chi-Square	2	3.9819	0.1366
Likelihood Ratio Chi-Square	2	4.0777	0.1302
Mantel-Haenszel Chi-Square	1	0.2717	0.6022
Phi Coefficient		0.2794	
Contingency Coefficient		0.2691	
Cramer's V		0.2794	

Sample Size = 51

Table of Group by Q11

Frequency ,
Percent ,
Row Pct ,
Col Pct ,Agree - ,Undecide,Strongly, Total
,Strongly,d , Disagre,
, Agree , ,e- Disag,
,ree ,

```

////////////////////
Buyers , 3 , 5 , 17 , 25
, 5.88 , 9.80 , 33.33 , 49.02
, 12.00 , 20.00 , 68.00 ,
, 27.27 , 55.56 , 54.84 ,
////////////////////
Material Managem , 8 , 4 , 14 , 26
ent , 15.69 , 7.84 , 27.45 , 50.98
, 30.77 , 15.38 , 53.85 ,
, 72.73 , 44.44 , 45.16 ,
////////////////////
Total 11 9 31 51
21.57 17.65 60.78 100.00

```

Statistics for Table of Group by Q11

Statistic	DF	Value	Prob
Chi-Square	2	2.6556	0.2651
Likelihood Ratio Chi-Square	2	2.7408	0.2540
Mantel-Haenszel Chi-Square	1	2.0223	0.1550
Phi Coefficient		0.2282	
Contingency Coefficient		0.2225	
Cramer's V		0.2282	

WARNING: 33% of the cells have expected counts less than 5. Chi-Square may not be a valid test.
Sample Size = 51

Table of Group by Q12

Frequency ,
Percent ,
Row Pct ,
Col Pct ,Agree - ,Undecide,Strongly, Total
,Strongly,d , Disagre,


```

Statistics for Table of Group by Q12
Statistic      DF      Value      Prob
-----
Chi-Square      2      1.3047      0.5208
Likelihood Ratio Chi-Square      2      1.3202      0.5168
Mantel-Haenszel Chi-Square      1      0.7392      0.3899
Phi Coefficient      0.1599
Contingency Coefficient      0.1579
Cramer's V      0.1599
WARNING: 50% of the cells have expected counts less
than 5. Chi-Square may not be a valid test.
Sample Size = 51

```

```

Statistics for Table of Group by Q13
Statistic      DF      Value      Prob
-----
Chi-Square      2      4.1913      0.1230
Likelihood Ratio Chi-Square      2      5.7350      0.0568
Mantel-Haenszel Chi-Square      1      3.8291      0.0504
Phi Coefficient      0.2867
Contingency Coefficient      0.2756
Cramer's V      0.2867
WARNING: 67% of the cells have expected counts less
        than 5. Chi-Square may not be a valid test.
Sample Size = 51

```

Statistics for Table of Group by Q14			
Statistic	DF	Value	Prob
Chi-Square	2	1.7057	0.4262
Likelihood Ratio Chi-Square	2	1.7184	0.4235
Mantel-Haenszel Chi-Square	1	0.0133	0.9083
Phi Coefficient		0.1829	
Contingency Coefficient		0.1799	
Cramer's V		0.1829	
Sample Size = 51			

132

Frequency ,
Percent ,
Row Pct ,
Col Pct ,Agree - ,Undecide,Strongly, Total
,Strongly,d , Disagre,
, Agree , ,e- Disag,
,ree ,

```

////////////////////
Buyers      , 11, 13, 1, 25
            , 21.57, 25.49, 1.96, 49.02
            , 44.00, 52.00, 4.00,
            , 55.00, 48.15, 25.00,
////////////////////
Material Managem, 9, 14, 3, 26
ent          , 17.65, 27.45, 5.88, 50.98
            , 34.62, 53.85, 11.54,
            , 45.00, 51.85, 75.00,
////////////////////
Total       20 27 4 51
            39.22 52.94 7.84 100.00

```

Statistics for Table of Group by Q15

Statistic	DF	Value	Prob
Chi-Square	2	1.2179	0.5439
Likelihood Ratio Chi-Square	2	1.2643	0.5315
Mantel-Haenszel Chi-Square	1	0.7528	0.3856
Phi Coefficient		0.1545	
Contingency Coefficient		0.1527	
Cramer's V		0.1545	

WARNING: 33% of the cells have expected counts less than 5. Chi-Square may not be a valid test.
Sample Size = 51

Table of Group by Q16

Frequency ,
Percent ,
Row Pct ,
Col Pct ,Agree - ,Undecide,Strongly, Total
,Strongly,d , Disagre,
, Agree , ,e- Disag,
,ree ,

```

////////////////////
Buyers      , 16, 8, 1, 25
            , 31.37, 15.69, 1.96, 49.02
            , 64.00, 32.00, 4.00,
            , 61.54, 42.11, 16.67,
////////////////////
Material Managem, 10, 11, 5, 26
ent          , 19.61, 21.57, 9.80, 50.98
            , 38.46, 42.31, 19.23,
            , 38.46, 57.89, 83.33,
////////////////////
Total       26 19 6 51
            50.98 37.25 11.76 100.00

```

Statistics for Table of Group by Q16

Statistic	DF	Value	Prob
Chi-Square	2	4.5071	0.1050
Likelihood Ratio Chi-Square	2	4.7643	0.0924
Mantel-Haenszel Chi-Square	1	4.0897	0.0431
Phi Coefficient		0.2973	
Contingency Coefficient		0.2850	
Cramer's V		0.2973	

WARNING: 33% of the cells have expected counts less than 5. Chi-Square may not be a valid test.
Sample Size = 51

Table of Group by Q17

Frequency ,
Percent ,
Row Pct ,
Col Pct ,Agree - ,Undecide,Strongly, Total
,Strongly,d , Disagre,
, Agree , ,e- Disag,
,ree ,

```

////////////////////
Buyers      , 14, 10, 1, 25
            , 27.45, 19.61, 1.96, 49.02
            , 56.00, 40.00, 4.00,
            , 51.85, 47.62, 33.33,
////////////////////
Material Managem, 13, 11, 2, 26
ent          , 25.49, 21.57, 3.92, 50.98
            , 50.00, 42.31, 7.69,
            , 48.15, 52.38, 66.67,
////////////////////
Total       27 21 3 51
            52.94 41.18 5.88 100.00

```

Statistics for Table of Group by Q17

Statistic	DF	Value	Prob
Chi-Square	2	0.3985	0.8193
Likelihood Ratio Chi-Square	2	0.4049	0.8167
Mantel-Haenszel Chi-Square	1	0.2615	0.6091
Phi Coefficient		0.0884	
Contingency Coefficient		0.0881	

Cramer's V 0.0884
 WARNING: 33% of the cells have expected counts less than 5. Chi-Square may not be a valid test.
 Sample Size = 51

Table of Group by Q18

Frequency				
Percent				
Row Pct				
Col Pct	Agree - , Undecide, Strongly, Total			
	Strongly, d , Disagre,			
	Agree , ,e- Disag,			
	,ree ,			
Buyers	14 , 9 , 2 , 25			
	27.45 , 17.65 , 3.92 , 49.02			
	56.00 , 36.00 , 8.00 ,			
	58.33 , 42.86 , 33.33 ,			
Material Managem ,	10 , 12 , 4 , 26			
ent	19.61 , 23.53 , 7.84 , 50.98			
	38.46 , 46.15 , 15.38 ,			
	41.67 , 57.14 , 66.67 ,			
Total	24 21 6 51			
	47.06 41.18 11.76 100.00			

Statistics for Table of Group by Q18

Statistic	DF	Value	Prob
Chi-Square	2	1.7430	0.4183
Likelihood Ratio Chi-Square	2	1.7598	0.4148
Mantel-Haenszel Chi-Square	1	1.7044	0.1917
Phi Coefficient		0.1849	
Contingency Coefficient		0.1818	
Cramer's V		0.1849	

WARNING: 33% of the cells have expected counts less than 5. Chi-Square may not be a valid test.
 Sample Size = 51

Table of Group by Q19

Frequency				
Percent				
Row Pct				
Col Pct	Agree - , Undecide, Strongly, Total			
	Strongly, d , Disagre,			
	Agree , ,e- Disag,			
	,ree ,			
Buyers	23 , 1 , 1 , 25			
	45.10 , 1.96 , 1.96 , 49.02			
	92.00 , 4.00 , 4.00 ,			
	50.00 , 33.33 , 50.00 ,			
Material Managem ,	23 , 2 , 1 , 26			
ent	45.10 , 3.92 , 1.96 , 50.98			
	88.46 , 7.69 , 3.85 ,			
	50.00 , 66.67 , 50.00 ,			
Total	46 3 2 51			
	90.20 5.88 3.92 100.00			

Statistics for Table of Group by Q19

Statistic	DF	Value	Prob
Chi-Square	2	0.3138	0.8548
Likelihood Ratio Chi-Square	2	0.3202	0.8521
Mantel-Haenszel Chi-Square	1	0.1124	0.7374
Phi Coefficient		0.0784	
Contingency Coefficient		0.0782	
Cramer's V		0.0784	

WARNING: 67% of the cells have expected counts less than 5. Chi-Square may not be a valid test.
 Sample Size = 51

Table of Group by Q20

Frequency				
Percent				
Row Pct				
Col Pct	Agree - , Undecide, Strongly, Total			
	Strongly, d , Disagre,			
	Agree , ,e- Disag,			
	,ree ,			
Buyers	5 , 0 , 19 , 24			
	10.00 , 0.00 , 38.00 , 48.00			
	20.83 , 0.00 , 79.17 ,			
	41.67 , 0.00 , 57.58 ,			
Material Managem ,	7 , 5 , 14 , 26			
ent	14.00 , 10.00 , 28.00 , 52.00			
	26.92 , 19.23 , 53.85 ,			
	58.33 , 100.00 , 42.42 ,			
Total	12 5 33 50			
	24.00 10.00 66.00 100.00			

Statistics for Table of Group by Q20


```

Statistic      DF      Value      Prob
-----
Chi-Square      2      6.0205      0.0493
Likelihood Ratio Chi-Square      2      7.9468      0.0188
Mantel-Haenszel Chi-Square      1      1.0833      0.2980
Phi Coefficient      0.3470
Contingency Coefficient      0.3278
Cramer's V      0.3470
WARNING: 33% of the cells have expected counts less
than 5. Chi-Square may not be a valid test.
Effective Sample Size = 50
Frequency Missing = 1

```

Table of Group by Q21

```

Frequency      ,
Percent      ,
Row Pct      ,
Col Pct      ,Agree - ,Undecide,Strongly, Total
,Strongly,d ,Disagre,
,Agree , ,e- Disag,
, ,ree ,
-----
Buyers      , 21, 3, 1, 25
, 41.18, 5.88, 1.96, 49.02
, 84.00, 12.00, 4.00,
, 52.50, 33.33, 50.00,
-----
Material Managem, 19, 6, 1, 26
ent , 37.25, 11.76, 1.96, 50.98
, 73.08, 23.08, 3.85,
, 47.50, 66.67, 50.00,
-----
Total      40 9 2 51
78.43 17.65 3.92 100.00

```

Statistics for Table of Group by Q21

```

Statistic      DF      Value      Prob
-----
Chi-Square      2      1.0808      0.5825
Likelihood Ratio Chi-Square      2      1.0998      0.5770
Mantel-Haenszel Chi-Square      1      0.7022      0.4021
Phi Coefficient      0.1456
Contingency Coefficient      0.1441
Cramer's V      0.1456
WARNING: 67% of the cells have expected counts less
than 5. Chi-Square may not be a valid test.
Sample Size = 51

```

Table of Group by Q22

```

Frequency      ,
Percent      ,
Row Pct      ,
Col Pct      ,Agree - ,Undecide,Strongly, Total
,Strongly,d ,Disagre,
,Agree , ,e- Disag,
, ,ree ,
-----
Buyers      , 7, 18, 0, 25
, 13.73, 35.29, 0.00, 49.02
, 28.00, 72.00, 0.00,
, 25.93, 78.26, 0.00,
-----
Material Managem, 20, 5, 1, 26
ent , 39.22, 9.80, 1.96, 50.98
, 76.92, 19.23, 3.85,
, 74.07, 21.74, 100.00,
-----
Total      27 23 1 51
52.94 45.10 1.96 100.00

```

Statistics for Table of Group by Q22

```

Statistic      DF      Value      Prob
-----
Chi-Square      2      14.5931      0.0007
Likelihood Ratio Chi-Square      2      15.6933      0.0004
Mantel-Haenszel Chi-Square      1      8.7816      0.0030
Phi Coefficient      0.5349
Contingency Coefficient      0.4717
Cramer's V      0.5349
WARNING: 33% of the cells have expected counts less
than 5. Chi-Square may not be a valid test.
Sample Size = 51

```

Table of Group by Q23

```

Frequency      ,
Percent      ,
Row Pct      ,
Col Pct      ,Agree - ,Undecide,Strongly, Total
,Strongly,d ,Disagre,
,Agree , ,e- Disag,
, ,ree ,
-----
Buyers      , 3, 18, 4, 25
, 5.88, 35.29, 7.84, 49.02
, 12.00, 72.00, 16.00,
, 60.00, 48.65, 44.44,
-----
Material Managem, 2, 19, 5, 26

```



```

ent      , 3.92 , 37.25 , 9.80 , 50.98
          , 7.69 , 73.08 , 19.23 ,
          , 40.00 , 51.35 , 55.56 ,
/////////
Total      5      37      9      51
          9.80  72.55  17.65 100.00

Statistics for Table of Group by Q23
Statistic      DF      Value      Prob
/////////
Chi-Square      2      0.3187  0.8527
Likelihood Ratio Chi-Square  2      0.3201  0.8521
Mantel-Haenszel Chi-Square  1      0.2646  0.6070
Phi Coefficient      0.0790
Contingency Coefficient      0.0788
Cramer's V      0.0790
WARNING: 67% of the cells have expected counts less
than 5. Chi-Square may not be a valid test.
Sample Size = 51

```

```

Table of Group by Q24
Frequency      ,
Percent      ,
Row Pct      ,
Col Pct      ,Agree - ,Undecide,Strongly, Total
,Strongly,d ,Disagre,
,Agree , ,e-Disag,
,ree
/////////
Buyers      , 13 , 3 , 9 , 25
          , 25.49 , 5.88 , 17.65 , 49.02
          , 52.00 , 12.00 , 36.00 ,
          , 76.47 , 25.00 , 40.91 ,
/////////
Material Managem , 4 , 9 , 13 , 26
ent      , 7.84 , 17.65 , 25.49 , 50.98
          , 15.38 , 34.62 , 50.00 ,
          , 23.53 , 75.00 , 59.09 ,
/////////
Total      17      12      22      51
          33.33  23.53  43.14 100.00

Statistics for Table of Group by Q24
Statistic      DF      Value      Prob
/////////
Chi-Square      2      8.4756  0.0144
Likelihood Ratio Chi-Square  2      8.8680  0.0119
Mantel-Haenszel Chi-Square  1      5.5623  0.0184
Phi Coefficient      0.4077
Contingency Coefficient      0.3775
Cramer's V      0.4077
Sample Size = 51

```

```

Table of Group by Q25
Frequency      ,
Percent      ,
Row Pct      ,
Col Pct      ,Agree - ,Undecide,Strongly, Total
,Strongly,d ,Disagre,
,Agree , ,e-Disag,
,ree
/////////
Buyers      , 13 , 6 , 6 , 25
          , 25.49 , 11.76 , 11.76 , 49.02
          , 52.00 , 24.00 , 24.00 ,
          , 56.52 , 40.00 , 46.15 ,
/////////
Material Managem , 10 , 9 , 7 , 26
ent      , 19.61 , 17.65 , 13.73 , 50.98
          , 38.46 , 34.62 , 26.92 ,
          , 43.48 , 60.00 , 53.85 ,
/////////
Total      23      15      13      51
          45.10  29.41  25.49 100.00

Statistics for Table of Group by Q25
Statistic      DF      Value      Prob
/////////
Chi-Square      2      1.0490  0.5918
Likelihood Ratio Chi-Square  2      1.0539  0.5904
Mantel-Haenszel Chi-Square  1      0.6857  0.4076
Phi Coefficient      0.1434
Contingency Coefficient      0.1420
Cramer's V      0.1434
Sample Size = 51

```


Annexure F : ANOVA & Man Whitney test

The NPAR1WAY Procedure					
Analysis of Variance for Variable Q6_Q10					
Classified by Variable Group					
Group	N	Mean			
////////////////////////////////////					
Buyers	25	14.600000			
Material Management	26	15.269231			
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
////////////////////////////////////					
Among	1	5.708145	5.708145	0.4309	0.5146
Within	49	649.115385	13.247253		
Average scores were used for ties.					
Wilcoxon Scores (Rank Sums) for Variable Q6_Q10					
Classified by Variable Group					
	Sum of	Expected	Std Dev	Mean	
Group	N	Scores	Under H0	Under H0	Score
////////////////////////////////////					
Buyers	25	607.0	650.0	52.871376	24.280000
Material Management	26	719.0	676.0	52.871376	27.653846
Kruskal-Wallis Test					
Chi-Square	0.6614				
DF	1				
Pr > Chi-Square	0.4160				
Analysis of Variance for Variable Q11_Q15					
Classified by Variable Group					
Group	N	Mean			
////////////////////////////////////					
Buyers	25	17.720000			
Material Management	26	17.038462			
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
////////////////////////////////////					
Among	1	5.920030	5.920030	0.3868	0.5369
Within	49	750.001538	15.306154		
Average scores were used for ties.					
Wilcoxon Scores (Rank Sums) for Variable Q11_Q15					
Classified by Variable Group					
	Sum of	Expected	Std Dev	Mean	
Group	N	Scores	Under H0	Under H0	Score
////////////////////////////////////					
Buyers	25	663.0	650.0	52.630976	26.520
Material Management	26	663.0	676.0	52.630976	25.500
Z	0.2375				
Kruskal-Wallis Test					
Chi-Square	0.0610				
DF	1				
Pr > Chi-Square	0.8049				

Annexure G :

TABLE 5.1: Cronbach's Alpha Coefficient for all the items forming the measuring instrument in this survey for the total sample

Statements (Test all statements without current one's input)	Variable nr.	Correlation with total	Cronbach's Alpha Coefficient
IMPACT OF NON-CONFORMANCES			
1. Poor service delivery and products are often received from suppliers.	NQ1	0.4752	0.8507
2. There are sufficient measures in place to reduce wastage due to poor quality.	Q2	0.4420	0.8518
3. Surveillances are conducted with suppliers.	Q3	0.0666	0.8618
4. There are proper procedures that govern non-conformances.	Q4	0.1134	0.8596
5. There are proper corrective procedures that deal with non-conformances.	Q5	0.0063	0.8633
THE IMPORTANCE OF QUALITY IN THE SUPPLY CHAIN MANAGEMENT			
6. There are proper preventative procedures that deal with non-conformances.	Q6	0.5128	0.8492
7. There are proper preventative procedures that deal with prevention of non-conformances.	Q7	0.5384	0.8488
8. Proper records of non-conformances are kept.	Q8	0.4504	0.8515
9. Preventative measures are communicated with Suppliers.	Q9	0.5680	0.8473
10. Preventative measures are communicated with End-users.	Q10	0.7008	0.8412
QUALITY MANAGEMENT TOOLS TO MEASURE THE REDUCTION OF NON-CONFORMANCES			
11. Quality Management tools are often used to analyse non-conformances.	Q11	0.5860	0.8459
12. I often use Quality Management tools to analyse non-conformances.	Q12	0.6714	0.8430
13. I have been trained to use Quality Management tools to analyse non-conformances.	Q13	0.6113	0.8460
14. There are proper procedures that govern the use of Quality Management tools.	Q14	0.7484	0.8394

Statements (Test all statements without current one's input)	Variable nr.	Correlation with total	Cronbach's Alpha Coefficient
15. I work in accordance with a Quality Management System.	Q15	0.4084	0.8529
MECHANISMS TO BE DEPLOYED TO REDUCE NON-CONFORMANCES			
16. Sound procedures are in place in order to identify non-conformances.	Q16	0.6022	0.8468
17. Sound procedures are in place in order to correct non-conformances.	Q17	0.4402	0.8523
18. Records of root causes for non-conformances are kept.	Q18	0.3212	0.8553
19. Problem notification is raised to address non-conformances.	Q19	0.0778	0.8612
IMPROVEMENT OF QUALITY OF GOODS AND SERVICES THROUGH THE APPLICATION OF QMS WITHIN THE SUPPLY CHAIN			
20. Awareness and training is conducted.	Q20	0.6464	0.8431
21. Suppliers use different Quality standards.	Q21	0.2163	0.8579
22. Receipt inspections and surveillances are conducted by the client organisation.	Q22	0.0797	0.8616
23. The supplier database is updated regularly.	NQ23	0.0669	0.8618
24. Buyers always send correct information to Suppliers when purchasing items.	Q24	0.0447	0.8667
25. There is adequate communication between Buyers and Suppliers.	Q25	0.4343	0.8519
Cronbach's Coefficient Alpha for standardized variables			0.8427
Cronbach's Coefficient Alpha for raw variables			0.8578

Annexure H :

TABLE 5.7: Descriptive statistics for all the variables

Variables	Categories	Frequency	Percentage out of total
Respondent type	Procurement	25	49.0%
	Materials Management	26	51.0%
IMPACT OF NON-CONFORMANCES			
1. Poor service delivery and products are often received from suppliers.	Strongly agree	36	70.6%
	Agree	11	21.6%
	Undecided	1	2.0%
	Disagree	2	3.9%
	Strongly disagree	1	2.0%
2. There are sufficient measures in place to reduce wastage due to poor quality.	Strongly agree	5	9.8%
	Agree	18	35.3%
	Undecided	13	25.5%
	Disagree	12	23.5%
	Strongly disagree	3	5.9%
3. Surveillances are conducted with suppliers.	Strongly agree	1	2.0%
	Agree	15	29.4%
	Undecided	27	52.9%
	Disagree	6	11.8%
	Strongly disagree	1	2.0%
	Unknown	1	2.0%
4. There are proper procedures that govern non-conformances.	Strongly agree	3	5.9%
	Agree	40	78.4%
	Undecided	6	11.8%
	Disagree	2	3.9%
	Strongly disagree	0	0.0%
5. There are proper corrective procedures that deal with non-conformances.	Strongly agree	4	7.8%
	Agree	39	76.5%
	Undecided	4	7.8%
	Disagree	3	5.9%
	Strongly disagree	1	2.0%
THE IMPORTANCE OF QUALITY IN THE SUPPLY CHAIN MANAGEMENT			
6. There are proper preventative	Strongly agree	3	3.9%

Variables	Categories	Frequency	Percentage out of total
procedures that deal with non-conformances.	Agree	24	47.1%
	Undecided	14	27.4%
	Disagree	9	17.6%
	Strongly disagree	2	3.9%
7. There are proper preventative procedures that deal with prevention of non-conformances.	Strongly agree	1	2.0%
	Agree	15	29.4%
	Undecided	18	35.3%
	Disagree	17	33.3%
	Strongly disagree	0	0.0%
8. Proper records of non-conformances are kept.	Strongly agree	2	3.9%
	Agree	17	33.3%
	Undecided	24	47.1%
	Disagree	6	11.8%
	Strongly disagree	2	3.9%
9. Preventative measures are communicated with Suppliers.	Strongly agree	2	3.9%
	Agree	7	13.7%
	Undecided	23	45.1%
	Disagree	14	27.4%
	Strongly disagree	5	9.8%
10. Preventative measures are communicated with End-users.	Strongly agree	2	3.9%
	Agree	14	27.4%
	Undecided	14	27.4%
	Disagree	14	27.4%
	Strongly disagree	7	13.7%
QUALITY MANAGEMENT TOOLS TO MEASURE THE REDUCTION OF NON-CONFORMANCES			
11. Quality Management tools are often used to analyse non-conformances.	Strongly agree	0	0.0%
	Agree	11	21.6%
	Undecided	9	17.6%
	Disagree	13	25.5%
	Strongly disagree	18	35.3%
12. I often use Quality Management tools to analyse non-conformances.	Strongly agree	1	2.0%
	Agree	9	17.6%

Variables	Categories	Frequency	Percentage out of total
	Undecided	6	11.8%
	Disagree	26	51.0%
	Strongly disagree	9	17.6%
13. I have been trained to use Quality Management tools to analyse non-conformances.	Strongly agree	1	2.0%
	Agree	3	5.9%
	Undecided	4	7.8%
	Disagree	25	49.0%
	Strongly disagree	18	35.3%
14. There are proper procedures that govern the use of Quality Management tools.	Strongly agree	4	7.8%
	Agree	8	15.7%
	Undecided	16	31.4%
	Disagree	18	35.3%
	Strongly disagree	5	9.8%
15. I work in accordance with a Quality Management System.	Strongly agree	3	5.9%
	Agree	17	33.3%
	Undecided	27	52.9%
	Disagree	3	5.9%
	Strongly disagree	1	2.0%
MECHANISMS TO BE DEPLOYED TO REDUCE NON-CONFORMANCES			
16. Sound procedures are in place in order to identify non-conformances.	Strongly agree	4	7.8%
	Agree	22	43.1%
	Undecided	19	37.2%
	Disagree	5	9.8%
	Strongly disagree	1	2.0%
17. Sound procedures are in place in order to correct non-conformances.	Strongly agree	3	5.9%
	Agree	24	47.1%
	Undecided	21	41.2%
	Disagree	3	5.9%
	Strongly disagree	0	0.0%
18. Records of root causes for non-conformances are kept.	Strongly agree	1	2.0%
	Agree	23	45.1%
	Undecided	21	41.2%
	Disagree	6	11.8%

Variables	Categories	Frequency	Percentage out of total
	Strongly disagree	0	0.0%
19. Problem notification is raised to address non-conformances.	Strongly agree	9	17.6%
	Agree	337	72.6%
	Undecided	3	5.9%
	Disagree	1	2.0%
	Strongly disagree	1	2.0%
IMPROVEMENT OF QUALITY OF GOODS AND SERVICES THROUGH THE APPLICATION OF QMS WITHIN THE SUPPLY CHAIN			
20. Awareness and training is conducted.	Strongly agree	3	5.9%
	Agree	9	17.6%
	Undecided	5	9.8%
	Disagree	22	43.1%
	Strongly disagree	11	21.6%
	Unknown	1	2.0%
21. Suppliers use different Quality standards.	Strongly agree	9	17.6%
	Agree	31	60.8%
	Undecided	9	17.6%
	Disagree	2	3.9%
	Strongly disagree	0	0.0%
22. Receipt inspections and surveillances are conducted by the client organisation.	Strongly agree	5	9.8%
	Agree	22	43.1%
	Undecided	23	45.1%
	Disagree	0	0.0%
	Strongly disagree	1	2.0%
23. The supplier database is updated regularly.	Strongly agree	0	0.0%
	Agree	5	9.8%
	Undecided	37	72.6%
	Disagree	4	7.8%
	Strongly disagree	5	9.8%
24. Buyers always send correct information to Suppliers when purchasing items.	Strongly agree	4	7.8%
	Agree	13	25.5%
	Undecided	12	23.5%
	Disagree	19	37.2%

Variables	Categories	Frequency	Percentage out of total
	Strongly disagree	3	5.9%
25. There is adequate communication between Buyers and Suppliers.	Strongly agree	4	7.8%
	Agree	19	37.2%
	Undecided	15	29.4%
	Disagree	13	25.5%
	Strongly disagree	0	0.0%

Annexure I :

TABLE 5.8: Descriptive statistics – Mean, Median, Standard Deviation and Range

Variable	N	Mean	Std Dev	Median	Range
IMPACT OF NON-CONFORMANCES					
1. Poor service delivery and products are often received from suppliers.	51	1.45	0.8789	1.00	4
2. There are sufficient measures in place to reduce wastage due to poor quality.	51	2.80	1.0958	3.00	4
3. Surveillances are conducted with suppliers.	50	2.82	0.7475	3.00	4
4. There are proper procedures that govern non-conformances.	51	2.14	0.5664	2.00	3
5. There are proper corrective procedures that deal with non-conformances.	51	2.18	0.7404	2.00	4
THE IMPORTANCE OF QUALITY IN THE SUPPLY CHAIN MANAGEMENT					
6. There are proper preventative procedures that deal with non-conformances.	51	2.71	0.9443	2.00	4
7. There are proper preventative procedures that deal with prevention of non-conformances.	51	3.00	0.8485	3.00	3
8. Proper records of non-conformances are kept.	51	2.78	0.8559	3.00	4
9. Preventative measures are communicated with Suppliers.	51	3.25	0.9559	3.00	4
10. Preventative measures are communicated with End-users.	51	3.20	1.1139	3.00	4
QUALITY MANAGEMENT TOOLS TO MEASURE THE REDUCTION OF NON-CONFORMANCES					
11. Quality Management tools are often used to analyse non-conformances.	51	3.74	1.1635	4.00	3
12. I often use Quality Management tools to analyse non-conformances.	51	3.65	1.0358	4.00	4
13. I have been trained to use Quality Management tools to analyse non-	51	4.10	0.9221	4.00	4

Variable	N	Mean	Std Dev	Median	Range
conformances.					
14. There are proper procedures that govern the use of Quality Management tools.	51	3.24	1.0879	3.00	4
15. I work in accordance with a Quality Management System.	51	2.65	0.7700	3.00	4
MECHANISMS TO BE DEPLOYED TO REDUCE NON-CONFORMANCES					
16. Sound procedures are in place in order to identify non-conformances.	51	2.55	0.8559	2.00	4
17. Sound procedures are in place in order to correct non-conformances.	51	2.47	0.7029	2.00	3
18. Records of root causes for non-conformances are kept.	51	2.63	0.7200	3.00	3
19. Problem notification is raised to address non-conformances.	51	1.98	0.7068	2.00	4
IMPROVEMENT OF QUALITY OF GOODS AND SERVICES THROUGH THE APPLICATION OF QMS WITHIN THE SUPPLY CHAIN					
20. Awareness and training is conducted.	50	3.58	1.1968	4.00	4
21. Suppliers use different Quality standards.	51	2.08	0.7167	2.00	3
22. Receipt inspections and surveillances are conducted by the client organisation.	51	2.41	0.7530	2.00	4
23. The supplier database is updated regularly.	51	3.18	0.7404	3.00	3
24. Buyers always send correct information to Suppliers when purchasing items.	51	3.08	1.0926	3.00	4
25. There is adequate communication between Buyers and Suppliers.	51	2.72	0.9398	3.00	3

CAPE PENINSULA
UNIVERSITY OF TECHNOLOGY

