AN APPROACH TO IMPROVE QUALITY IN THE CONSTRUCTION OF ELECTRICAL NETWORKS

MAYA NKULULEKO

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AN APPROACH TO IMPROVE QUALITY IN THE CONSTRUCTION OF ELECTRICAL NETWORKS

by

MAYA NKULULEKO

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Supervisor: Prof. Dr. J A Watkins D. Phil., D. Com., Ph. D.
Co-supervisor: Mr P McLaren

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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 indicated are acknowledged by the means of a comprehensive list of references.

Name: Nkululeko Maya

Signature: 

Date: 9 December 2010

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ABSTRACT

Eskom is embarking on a project that addresses security of supply initiatives, which are live work, high-voltage underground cabling, strategic spares, network planning and design, change management, technical training and contractor development, to strengthen the security and the reliability of the supply chain. This research investigates the causes of poor quality workmanship by the contractors during the construction of network infrastructure. The impact that the contractors have on the network's performance, and the reliability of the supply chain are very important to evaluate, as it is one of the key performance indicators measured for business performance. The quality of workmanship and the best practices that the contractors provide during the construction phase have an impact on the performance of the network, which is why this research will focus on the development of the contractors to improve the quality of workmanship.

In the past few years Eskom Distribution Division has experienced numerous electrical faults in the networks, resulting in a loss of power to the customers and loss of revenue to the organisation. Contractor development is one of the methods used to build positive and mutually benefiting relationships between the buyer and the supplier. The method used in this research was through looking at the current practices, from the selection of contractor to development and maintaining of the supplier database.

The objectives of the proposed research are to improve the quality of workmanship of the contractors, improve the project lead times during construction and investigate contractor development initiatives.

GLOSSARY OF TERMS

ASGISA	: Accelerated and Shared Growth Initiative for South Africa
BBBEE	: Broad Base Black Economic Empowerment
CETA	: Construction and Education Training Authority
CIDB	: Construction Industry Development Board
CII	: Construction Industry Indicators
CSDP	: Competitive Supplier Development Programme
CSIR	: Council for Society and Industry Research
DIA	: Data Integrity Audit
DME	: Department of Minerals and Energy
DoE	: Department of Energy
ECDC	: Eastern Cape Development Corporation
ECMBA	: Eastern Cape Master Builders association
EIA	: Environment Impact Assessment
ESCOM	: Electricity Supply Commission
EVKOM	: Elektrisiteitsvoorsieningskommissie
FET	: Further Education Training
HV	: High voltage
INEP	: Integrated National Electrification Programme
ISO	: International Standards Organisation
JIPSA	: Joint Initiative on Priority Skills Acquisition
KPI	: Key Performance Index
MAOSVC	: Manage Availability of Supply Value Chain
MNVC	: Maintain Network Value Chain
NCDP	: National Contractor Development Programme
NEPS	: Network and Equipment Performance Management System
OSI	: Operating Sustainability Index
QMS	: Quality Management System
SAACE	: South African Association for Consulting Engineers
SEDA	: Small Enterprise Development Agency
SADC	: Southern African Developing Countries
SHE	: Safety Health & Environment
SI	: Sustainable Index

SME	: Small and Medium Enterprise
SMME	: Small Medium and Micro Enterprise
SoE	: Security of Supply
TQM	: Total Quality Management
UIF	: Unemployment Insurance Fund
VAT	: Value Added Tax

FIGURES

TABLE OF CONTENT

CHAPTER 1: SCOPE OF THE RESEARCH

1.1 INTRODUCTION AND MOTIVATION

In the past few years Eskom Distribution Division has experienced numerous electrical faults in the networks, resulting in a loss of power to the customers and loss of revenue to the organisation. A number of investigations and network audits were performed to determine what the causes of these faults were. One of the major findings was that during the construction of networks, poor quality of workmanship was evident, and furthermore that there were contraventions of the applicable policies, procedures and standards by the contractors constructing the networks. This research study will attempt to address the situation by focusing on improving the quality of workmanship. A need to develop contractors was highlighted during routine investigations and audits.

1.2 BACKGROUND TO THE RESEARCH PROBLEM

Eskom is embarking on a project that addresses security of supply initiatives, which are live work, high-voltage underground cabling, strategic spares, network planning and design, change management, technical training and contractor development. to strengthen the security and the reliability of the supply chain. This research investigates the poor quality workmanship during the construction of electrical networks. The impact that the contractors have on the network's performance, and the reliability of the supply chain are very important to evaluate, as they are key performance indicators measured for business performance. The quality of workmanship and the best practices that the contractors provide during the construction phase will have an impact on the performance of the network, which is why this research will focus on the improving of the quality in contractors, in order to improve the quality of workmanship. This research will also investigate the issues of performance, quality, safety and the background of the construction industry.

The security of supply and the reliability of supply are two very important issues in the electricity distribution industry, as the industry is the backbone of the economic activities in the country. In this respect, one would recall the impact that was caused to the economy by the electricity blackouts in 2007 and 2008 in the country. Security of supply measures has a regulatory impact in which the National Regulator of South Africa can impose financial penalties, which can negatively impact on the bottom-line profitability and investor confidence, and could lead to downgrading in the ratings by the rating agencies.

1.3 RESEARCH PROBLEM STATEMENT

The research problem statement in this research reads as follows: Poor quality workmanship during the construction of electrical networks by contractors is the cause of poor performance of electricity networks, leading to a loss of power and associated loss of revenue to the country.

1.4 RESEARCH QUESTION

According to Leedy and Ormrod (2001:60), research questions provide a means for guiding and directing the researcher's thinking, and are common in qualitative phenomenological studies. The research question for this research is: "What are the primary causes of poor quality workmanship by the contractors during the construction of electrical networks?"

1.5 INVESTIGATIVE SUB-QUESTIONS

The investigative questions for the proposed research in support of the research question are as follows:

- What are the causes of poor quality workmanship on our networks?
- What are the causes of unnecessary delays in network building projects?
- Are contractors trained, developed and competent to build networks?

- Are contractors made aware of standards and procedures that govern the design and building of networks?

1.6 PRIMARY RESEARCH OBJECTIVES

The objectives of the proposed research are to:

- Improve the quality of workmanship of the contractors.
- Investigate contractor development initiatives.
- Improve the project lead times during construction.

1.7 THE RESEARCH PROCESS

The research process provides insight into the process of "how" the research will be conducted from formulating the research proposal to final submission of the thesis or dissertation. The research process which will be followed in this research study includes the following:

- 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.
- Writing up the dissertation.

1.8 RESEARCH DESIGN AND METHODOLOGY

Primarily, there are two distinct approaches that govern the gathering of data in any research project, namely the qualitative approach and the quantitative approach; both methodologies in the social sciences are governed by specific paradigms (Babbie & Mouton, 2001:73).

According to Mathieu (1998:3), a research design concerns the planning of a scientific inquiry, and the development of a strategy for finding out something. This involves theory, conceptualisation, formalisation, operationalisation of variables, preparations for observation (choice of methods, selection of units of observation and analysis), observation, data analysis and report. Research design can be thought of as the structure of research - it is the "glue" that holds all of the elements in a research project together. We often describe a design using a concise notation that enables us to summarise a complex design structure efficiently.

A research design can be described as the logical sequence that connects the empirical data to a study's initial research question and ultimately, to its conclusions (Yin, 1994:19). The data consists of interviews that are conducted, and the studying of company documents and relevant literature. A unit of analysis could refer to the following: an individual, an event, or an object (Collis & Hussey, 2003:122).

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 Collis and Hussey (2003:68), 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.

1.9 DATA COLLECTION DESIGN AND METHODOLOGY

The data used in this research was mainly collected through different sources of evidence such as: semi-structured face-to-face interviews, questionnaires, telephonic interviews, organisations' written procedures, site-visit observations and e-mail correspondence.

For purposes of this study, the researcher used a population size of 121 contractors, a sample size of 35 contractors and 15 Eskom employees from three different departments which are Technology and Quality, Capital Programme Management and Risk Management Department.

1.10 DATA VALIDITY AND RELIABILITY

Validity is concerned with the extent to which the research findings accurately represent what is happening, and more specifically, whether the data is a true picture of what is being studied (Collis & Hussey, 2003:186). Welman and Kruger (2001:63), describe validity as a mechanism that ensures that the process implemented to collect the data has collected the intended data successfully.

Validity refers to the extent to which a numerical measure adequately reflects the real meaning of the subject under investigation (Babbie, 1995:36).

Babbie (1995:37) describes reliability as a condition in which the same results will be achieved whenever the same technique is repeated to the study.

1.11 ETHICS

Ethical issues are present in any kind of research. The research process creates tension between the aims of research to make generalisations for the good of others, and the rights of participants to maintain privacy. Ethics pertains to doing good and avoiding harm. Harm can be prevented or reduced through the application of appropriate ethical principles. Thus, the protection of human subjects or participants in any research study is imperative (Ramos, 1989:59). The following ethical considerations will be observed during this study research:

- **Informed consent**: Participants will be informed of the nature of the study and will be given a choice to participate or withdraw if they feel uncomfortable about the research.
- **Right to Privacy:** The right to privacy of the participant will be respected.
- **Honesty with Professional Colleagues:** The findings will be reported in a complete and honest fashion, without misrepresenting what the participants have done or said. The data will not be fabricated to support the research conclusion.
- **Confidentiality/anonymity:** The confidentiality and anonymity of all participants and organisational information will be respected in this research.

1.12 RESEARCH ASSUMPTIONS

An assumption is a condition that is taken for granted, without which the research study would be pointless. The requirements to state the assumption on which the research is undertaken are based on the fact that it is essential that others know what one assumes with respect to the research study.

It is the assumption of the researcher that:

- The processes that govern the contractor development do exist between the departments within the organisation but are not properly managed and interrelated to each other.
- The resources are available to manage the contractors' quality development programme; they just need to be realigned, and a procedure needs to be in place for the effective process of its operations.

1.13 RESEARCH CONSTRAINTS

Research constraints (also commonly referred to as "limitation" and "delimitations" of the report, pertain to any inhibiting factor which would in any way constrain the researcher's ability to conduct the research in a normal way. According to Collis and Hussey (2003:128), limitations identify weaknesses in the research, while delimitations explain how the scope of the study was focused on only one particular area or entity, as opposed to a wider or holistic approach.

Limitations in this research are:

- The research will focus only on contractors that are active in the Eskom Western Region Database.

Research delimitations:

- The research will cover contractors only from the geographical areas of Vredendal, Grabouw, Swellendam.,and Table View.

1.14 CHAPTER OUTLINE

The purpose of a chapter outline is to provide a roadmap to show how the content of each chapter is structured into a logical sequence of events. The headings of each chapter are briefly discussed in terms of the proposed content of each of them.

Chapter 1 - The scope of research: In this chapter, a background will be provided of the scope of the proposed research, which is " an integrated approach to improve quality in the construction of electrical networks". The research process will be explained and the research design and methodology elaborated upon. The research constraints will be listed and an overview provided of the chapter and the content of the research.

Chapter 2 - Holistic perspective of research environment: In this chapter, Eskom Holdings Limited background. Background information on Eskom's initiatives and programs capital expansion, electrical network performance, security of supply, construction development, quality management system for contractors and contractor development.

Chapter 3 – Literature review: This chapter will contain an in-depth literature review of construction, quality management in construction, contractor performance and safety management and contractor development as practiced by organisations. The focus will be on systems, best practices and leadership in organisational competitiveness within the global economy.

Chapter 4 – Data collection design and methodology: In this chapter, the survey environment will be elaborated upon and the delimitations of the survey listed. The approach to data collection will be explained and the target population defined. The chapter will be concluded with a list of questions to be posed to the target population.

Chapter 5 – Data analysis and interpretation of results: In this chapter, data gleaned from the survey conducted in Chapter 4 will be analysed in detail and interpreted in terms of the theme of the research. In addition, the results from the survey will be mapped to the literature review conducted in Chapter 3.

Chapter 6 – Conclusion: In this chapter, the research will be concluded. The research design and methodology, the research process, the research problem, research question, and research questions will be revisited and final conclusions drawn. In addition, a holistic reflective overview will be provided of the research.

Major findings and recommendations will be discussed and conclusion will be discussed.

1.15 SIGNIFICANCE OF THE PROPOSED RESEARCH

This research will address the benefits of improving the quality of contractors to improve the quality of workmanship during construction of electrical networks. Improving the quality of workmanship will lead to firm and stable networks, which will improve the performance of the networks. Improved network performance will reduce the frequency of power outages and revenue losses caused by power losses. Developing quality contractors will improve project lead times during the construction phase of projects.

CHAPTER 2: HOLISTIC PERSPECTIVE OF RESEARCH ENVIRONMENT

2.1 BACKGROUND AND INTRODUCTION

Eskom is a South African electricity public utility, established in 1923 as the Electricity Supply Commission (ESCOM) by the Government of South Africa in terms of the Electricity Act (1922). It was also known by its Afrikaans name, namely, the "Elektrisiteitsvoorsieningskommissie" (EVKOM). The two acronyms were juxtaposed in 1986, and the company is now known as Eskom.

Eskom is wholly owned by the South African government. Eskom's operations are located in South Africa, with its head office being located in Johannesburg. Eskom Enterprises also has operations on the African continent, with offices in Uganda, Nigeria and Mali.

Eskom sells power directly to approximately 6 000 industrial, 18 000 commercial, 70 000 agricultural and 4 million residential customers. It owns and operates a number of coal-fired, gas-fired, hydro and pumped storage power stations, as well as one nuclear power station. Its 26 000 kilometres of transmission lines span the entire country and extend into most Southern African Development Community (SADC) countries. Its distribution teams connect an average of 1 000 new homes every day - an achievement unprecedented anywhere else in the world.

Eskom Holdings generates, transports and distributes approximately 95% of South Africa's electricity – making up 60% of the total electricity consumed on the African continent. Eskom is the world's eleventh-largest power utility in terms of generating capacity, ranks ninth in terms of sales, and boasts the world's largest dry-cooling power station. Eskom Holdings' Enterprises Division designs, builds and refurbishes Eskom's assets and acts as a catalyst for project development for the group. Eskom Enterprises' main focus is to support Eskom Holdings and be the custodian of non-regulated businesses as well as offering strategic and commercial lifecycle services to the line divisions.

Electricity is different from the other services we find in the home. Unlike air or water that can be harvested from nature, electricity must be manufactured. This must be done at minimal cost so that electricity bills are kept low, and with the lowest possible impact on the environment. In South Africa we produce about 34 000 megawatts of electricity to meet current demand, and this figure is growing year by year. The most economical method available to us is to use our abundant supplies of low-quality coal in Mpumalanga and the Northern Province, in power stations sited next to the coal deposits.

2.2 ESKOM CAPITAL EXPANSION PROGRAMME

The then Department of Minerals and Energy (DME), now called Department of Energy (DoE) began funding the Integrated National Electrification Programme (INEP) in April 2001. Eskom implements the programme in its licensed areas of supply on behalf of DoE. Operating costs relating to this electrification programme are incurred by Eskom as the licensed distributor supplying electricity to its consumers. Since the inception of the electrification programme in 1991, a total of 3 751 153 (2008: 3 638 188) homes have been electrified. Funding is currently made available for new connection and infrastructure development projects that are part of the INEP going forward. It is expected that the average cost of infrastructure development and the cost per connection will increase as Eskom electrifies communities in more remote rural areas. In addition, technical specifications for network design have been enhanced to better accommodate future growth in electricity demand and to improve the quality and reliability of the electricity supply in these areas. Government aims to achieve universal access to electricity by 2014. The electrification of schools and clinics is funded by the Department of Energy through the National Electrification Fund. This programme is focused on electrifying specifically identified schools and clinics.

Additional power stations, major power lines and substations are being built urgently to meet rising electricity demand in South Africa. The approved capacity expansion budget is R385 billion1 for the five-year period up to March 2013 and

is expected to grow to more than a trillion rand by 2025. South Africa needs to build 40 000MW of new generation capacity by 2025, of which 12 476MW is already under construction.

Eskom will continue to pursue most of its current projects and push ahead with the design and development of future projects. Risks to schedules and timelines have been identified and are being rigorously tracked by the formal project assurance system, whereby schedule, cost, quality and safety risks are tracked in a structured manner.

2.3 ESKOM DISTRIBUTION DIVISION INITIATIVES

Eskom Distribution is embarking on a project that addresses security of supply initiatives, which are live work, high-voltage underground cabling, strategic spares, network planning and design, change management, technical training and contractor development, to strengthen the security and the reliability of the supply chain. The impact that the contractors have on the network's performance and the reliability of the supply chain are very important to evaluate, as they are key performance indicators measured for business performance. The quality of workmanship and the best practices that the contractors provide during the construction phase will have an impact on the performance of the network, which is why this research will focus on the selection and the development of the contractors in order to improve the quality of workmanship. This research will also investigate the issues of performance, quality, safety and the background of the construction industry.

The security of supply and the reliability of supply are two very important issues in the electricity distribution industry as the industry is the backbone of the economic activities in the country. In this respect, one may recall the impact that was caused to the economy by the electricity blackouts in the country in 2007 and 2008. Security of supply measures has a regulatory impact in which the National Regulator of South Africa can impose financial penalties, which can negatively

impact on the bottom-line profitability and investor confidence, and could lead to downgrading in the ratings by the rating agencies.

Eskom is putting in place processes to develop the emerging contractors and companies, aimed at, inter alia, improving the performance of emerging contractors in all Provinces. The development of emerging contractors into viable business enterprises that partake in the mainstream economy forms an important part of Eskom's strategy. Construction plays an indispensable role directly and indirectly as a contributor to economic growth. It is a significant employer of people, it creates numerous economic opportunities for medium and small enterprises, its products have an extraordinarily long life, and they unleash abundant economic opportunities for their consumers. It also contributes directly to improving the quality of life of its users. However, there is serious concern in the industry at the high rate of enterprise failure and the potential consequences of that on the industry's ability to deliver. A significant cause believed by some to be the core challenge is poor management as well as poor technical skills that lead to poor workmanship.

2.4 ELECTRICAL NETWORK PERFORMANCE

Eskom Holdings measures the technical performance of the Distribution Division. The results are used to calculate Operational Sustainability Index (OSI) scores, and for publication in the Directors' Report, which forms part of the Eskom Annual Report. Annual Data Integrity Audits (DIAs) are conducted to provide assurance that the technical performance data is accurate. The technical key performance indicators (KPI) are obtained from the Network and Equipment Performance Management System (NEPS) software application used by Distribution Division. The key performance indicators (KPIs) quantify the loss of supply in terms of the frequency, duration, amount of installed plant (transformers) affected and the number of customers affected by the events occurring on the network. These KPIs form part of the monthly reporting of the Maintain Availability of Supply Value Chain (MAOS VC) and the Maintain Network Value Chain (MN VC). Targets derived from these KPIs can be used as

technical limits to ensure long-term sustainability of the Distribution business as part of the Sustainability Index (SI) scoring and for the annual establishment of the business targets of the Distribution.

2.5 SECURITY OF SUPPLY PROGRAMMES IN ESKOM

Security of supply is currently one of Eskom Distribution Executive Committee's key priorities. Security of Supply can be defined as follows: Security of electrical supply is the ability of the electrical power system to provide electricity to the end-user with a specified level of continuity and quality in a sustainable manner, relating to the existing standards and contractual agreements at the points of delivery. In recent years, Eskom Distribution's technical system performance has been detoriating. The Security of Supply Programme was introduced by the executive committee to:

- Understand the issues contributing to the negative performance trend.
- In conjunction with the regions, develop strategies and action plans to arrest the negative performance.
- Assist the regions to sustainably manage technical performance to acceptable levels.
- Ensure that Eskom Distribution does not breach any regulatory compliance requirements.

2.6 CONSTRUCTION REGULATIONS BACKGROUND

Construction regulations are legal instruments intended to ensure that infrastructures perform in such a way as to provide essentially equivalent, socially acceptable levels of health, safety, welfare and amenity for end users and for the community in which the network infrastructure is located. Over the past years, the number of contractors within the organisation has progressively increased due to the significant expansion programme. This increase brings about additional complexities, often resulting in an increase in incidents. However, Eskom continues to work in partnership with contractor organisations, aiming to influence their attitudes, behaviour and safety cultures, and to establish the highest

standards of health and safety performance as a prerequisite for all work carried out for Eskom.

Strict controls are, nevertheless, required to ensure that contractors adhere to Eskom's requirements. Current interventions include a workgroup engaged in a project that addresses safety, health and environment (SHE) integration into the procurement and supply chain management processes. Contractors and potential contractors will be audited and pre-qualified prior to conducting business with Eskom. Eskom has also developed a guideline for drafting SHE specifications. This sets out the minimum requirements for the development of a SHE specification for construction work that is specific to the scope of work, site, and type of project.

2.7 CONTRACTOR DEVELOPMENT

There is a need for improved collation and diffusion of infrastructure inputs, construction and electrical network development. This will inform electrical network inputs capacity expansion planning, and infrastructure project planning and execution. A strategy to evaluate trade and investment opportunities to increase the supply of these critical electrical network contractors is required due to the shortage of competent contractors. This will help mitigate potential infrastructure inputs supply shortages and ensure minimal disruption to critical electrical network projects during the rollout period. Despite the initiatives from Eskom to increase education and training throughputs, skills challenges are immediate and are expected to increase going forward.

Eskom is looking at intervening further, given that the current initiatives on contractor skills acquisition do not seem to be adequate in addressing the construction skills deficit. There is now a need to consider facilitating the bridging cost of skills development in partnership with the contractors in the database, over the short to medium term, to mitigate the risk of escalating skills costs (due to shortages) and delayed critical electrical network infrastructure projects over the medium to long term. Further initiatives from the construction contractors to

improve training and skills development are also required, complemented by a comprehensive and integrated skills development strategy for the electrical network infrastructure contractors. There is a gap in the following areas:

- Skills development through intensified support of the Construction Education and Training Authority CETA.
- The development of infrastructure inputs information system (database).
- The optimisation of regulatory (especially EIA) business processes, guidelines and information requirements.
- Qualify as beneficiaries of Contractor Development.
- Enhance existing business and technical skills.
- Help contractors set up and implement sound business practices and systems.
- Encourage specialisation.
- Develop the pool of contractors able to add value to the industry and begin to link these.

Eskom is investigating a programme that will be targeted at contractors who have been running a construction business within electrical network construction for at least a year and would like to enhance their ability to manage and grow the business. Such a programme would be appropriate for business owners who have management or construction related experience and have significant potential to further develop their business. The aim is to provide contractors with access to the skills, tools, services, and networks required to operate efficiently and hold their own in the industry.

Special attention is required in the development of technical skills in the electrical network construction industry. The country has started to import various priority skills, from professionals to artisans, because of the increased budgets for infrastructure as a result of the "built programme". This skills development initiative must be designed to support the Eskom built programme and ensure that within the communities Eskom is able to integrate efforts with organisations such as The Construction Education and Training Authority (CETA) and the Further Education and Training colleges (FET). This integrated approach will ensure that Eskom is able to create technical capacity from a contracts manager level down to workers.

Eskom is exploring initiatives that will annually prioritise its input into the development of skills, based on the skills audit of the contractors. The emerging contractors are encouraged to ensure continuous development and retention of own production personnel such as site agents, earthworks and concrete foremen.

Eskom is looking at providing mentorship to emerging contractors in order to curb contract non-performance. Mentorship can be provided by prime contractors or independent mentors. It is common practice that when a mentor is provided in a contract and there is non-performance by the emerging contractor, the obligations of the contractor to perform are taken over by the mentor in order for the work to be completed. It is therefore imperative that the duties of a mentor are clearly defined and the monitoring mechanisms are put in place to ensure that each party adheres to his/her obligations. In each contract, there needs to be clearly defined contract management interventions put in place in order for the work to be successfully completed.

Some of the failures in a particular contract might be attributable to activities outside the contract that was currently being performed. It is therefore important for Eskom to enter into a mentorship agreement with the contractors, whereby the contractor agrees to inform Eskom of:

- Other projects that the contractor may be performing during the current contract period;
- Outstanding creditors, to assist Eskom to conduct an age analysis on all outstanding monies;.
- The credit facilities available, including bank overdraft facilities, which could be used in the performance of the contract;
- The monies taken out of the contract, other than salaries, which may be used to fund other interests;
- The contractor's technical capacity to perform the contract, which must include a staff organogram and audit of competency, contract management systems and the sourcing of plant requirements;
- Compliance with statutory requirements such as VAT, UIF, etc; and

- Any other information that would assist Eskom to manage risks associated with an emerging contractor environment.

Financial and business training is crucial for the sustainability of any business. If emerging contractors have to survive beyond five years of their trading, each emerging contractor within the development programme would need to undergo various awareness training programmes about the importance of good financial management in any firm that is striving for success. The emerging contractors must be aware of capabilities required to manage a business within a construction sector in respect of various CIDB gradings. This would assist contractors to make a right choice in terms of their levels of comfort in relation to work types and values. Besides the training programmes, Eskom would need to facilitate financial and business support services through linkages with other stakeholders such as the Small Enterprise Development Agency (SEDA), financiers, suppliers, etc.

Eskom is looking at the practice of conducting its business on a contractor-by-contractor basis. In order to optimise its capacity building efforts, including information sharing, Eskom is formalising its relationship with contractors through their associations and through initiatives such as the Contractors Forum, where Eskom and contractors meet and discuss the previous projects and performance as well as the future projects in the pipeline. The formation or formalisation of the associations which represent contractors has been finalised with the contractors across the Province and a Memorandum of Understanding (MOU) is to be entered into between Eskom and the Associations. The primary benefit of the MOU is that the contractors will be given an opportunity to know about the challenges associated with planning and implementation of infrastructure projects. This will assist them to understand some of the unfavourable conditions they may encounter in the industry in general.

2.8 QUALITY MANAGEMENT SYSYTEMS FOR CONTRACTORS

Among emerging contractors in general, there is no specific interest in certification, as the interest lies in the effects of the implantation of a Quality

Management System (QMS) in the reduction of costs and an increase in the quality of the construction delivery. The generic approach of norms ISO 9000 and ISO 9001 makes the proposed Quality Management System applicable to any organisation with processes that receive components whose entrance were the result of intermediate or final products. This approach, however, becomes excessively generic if applied in construction SMEs, where a large number of the components of the organisation, people, processes and activities are directly linked to the construction routine.

The proposal of ISO 9001:2008 (ISO 9001) norm structure for the introduction of a QMS is to generate products and for the creation or organisation of quality culture in contractors, using the described structure in ISO 9001 standard.

The ISO 9000 Norm defines the fundamentals and vocabulary to define the QMS. For management and those involved in the control of an organisation, the high level management has to have a systemic vision of all processes and activities, identifying the points of influence and the reach of the entire organisational structure, integrally involving customers and suppliers in the processes. In support of these necessities, the ISO 9000 Norm identifies eight principles for quality management:

- Customer focus.
- Leadership.
- People involvement.
- Process approach.
- Systemic management approach.
- Continuous improvement.
- Information-based decisions.
- Mutual benefits in the relationships with suppliers.

For the construction contractors to function in an efficient way, they have to identify and manage interrelated and interactive processes. Frequently, the output of a process will result directly in the following process: the 3 systematic identifications and the process management used in the organisation and,

particularly, the interactions between such processes are known as the "processes approach". This approach is represented in Figure 2.1.

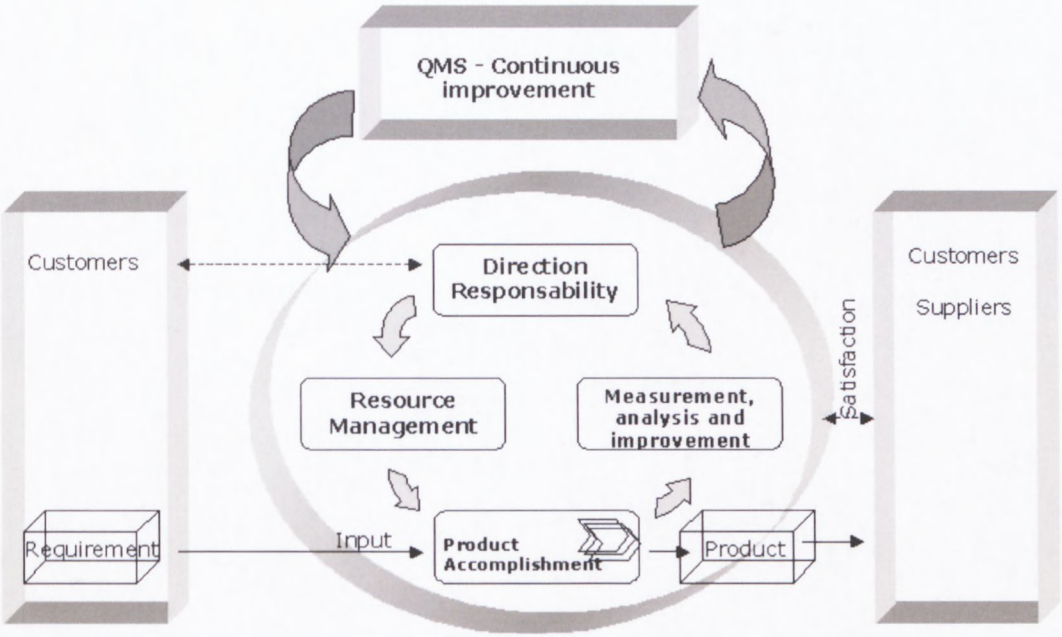

Figure 2.1: QMS-based process Model (Source: ISO Standard)

The contractors should apply their quality policies to prove that the high level management is committed to the QMS. The quality policies must be adequate for the purpose of the contractor, to be genuine and to reflect the values of the contractor to the customers, employees and interested parties. The ISO 9001 Norm recommends that for efficient management, the best form to attend to requirements is the creation of registered procedures. The procedures are specified in a form to develop an activity. The Norm demands the elaboration of only six procedures:

- Document control.
- Record Control.
- Internal audit.
- Non-conformity control.
- Corrective action.
- Preventive action.

2.9.2 Technology and Quality Department

The Technology and Quality department is involved with the contractors by:

- Participating in the contractor selection process.
- Conducting periodic quality assessments at the Principal Contractor's premises, his work places, material and his employees to ensure the contractor's compliance with agreed standards and system performance during the contract period.
- Monitoring contracts during the execution of the project for conformance.
- Participating in contractor related incident investigations where Eskom Distribution is invited to participate, and where mandated or appointed, to attend. Attendance is primarily required where Eskom plant and/or equipment are involved.
- Recommending to both Line Management and the Supplier Management Department the removal of a particular contractor from the approved suppliers list where there is evidence of non-adherence to Eskom Distribution's quality standards both during the contract period and after the project has been handed over.

2.9.3 Risk Management Department

The Risk Management Department is responsible for managing the health and safety of construction contractors in Eskom. The Risk Management Department conducts risk audits to verify that the contractors are compliant with health and safety regulations and Eskom policies and procedures.

2.9.4 Capital Programme Management Department

The Capital Programme Management Department is responsible for project management of all projects, contracting out work to contractors, and making payments for work done by contractors. It manages the contractors in terms of distributing work fairly to all contractors based on their capabilities and competencies.

CHAPTER 3: LITERATURE REVIEW

3.1 BACKGROUND

According to Moroga, author of Eskom Holdings annual report (Eskom Holdings Ltd, 2009:40), over the five years to March 2013 Eskom plans to 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 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 Distribution Western Region over the next five years to 2014 has budgeted a total amount of R4.05bn for the expansion programme to strengthen the network supply and to add capacity to meet the growing demand (van der Westhuizen, 2009:3).

Area	Number of New S/S's	Additional Capacity	New HV Lines	Capital
1. Peninsula	23	4910 MVA	311 km	R 2,035m
2. Worcester & Little Karoo	20	1591 MVA	547 km	R 1,120m
3. George	11	190 MVA	236 km	R 338m
4. West Coast	11	301 MVA	201 km	R 214m
5.Namaqualand & Great Karoo	7	85 MVA	220 km	R 241m
Total	72	7077 MVA	1515 km	R 4.05bn

Figure 3.1: Eskom Western Region Five Year Master Plan Development. (Source: Eskom Western Region)

Gcabashe, author of Eskom Holdings annual report (Eskom Holdings Ltd, 2008:86), explains that the supply chain environment is influenced by the substantial capital expansion programme. Worldwide increases in energy demand

are placing a strain on suppliers, with demand outstripping supply. Eskom has an ageing infrastructure (both its Generation and Customer Network businesses) that requires significant investment of both human and financial resources. The execution of technical plans, major overhauls and refurbishments have a direct bearing on ensuring security of supply.

The state of the construction industry in a country is symptomatic of the state of its national economy. Put another way, the fate of a national economy cannot be separated from that of its construction industry. This is a consequence of the forward and backward linkages that the construction sector forges with the rest of the economy (Drawer, 1980:407).

The construction sector plays an important role in the economies of countries throughout the world. The role of the construction industry in economic development has been validated by several studies. In these studies a strong statistical relationship has been established between the state of a construction industry and economic growth (Strassman, 1975:35).

A construction industry is subject to economic cycles and is dependent on changing governmental priorities and policies with a "stop-go" approach in the sector (Ahmad & Yan, 1996). In most economies in the world, the intensity of construction activities fluctuates according to variations in investor confidence, availability, and the cost of finance and consumer demand, or a combination of these (Porteous, 1999). These variations are typical investor and consumer reactions to changing governmental priorities and policies.

From a system point of view, the basic function of the infrastructures is to transfer resources (tokens) from the location where the resources are produced or stored (generators) to the location where they are utilised or accumulated (loads). Apart from limited local storage, generators and loads are normally geographically separate. The global system's objective is to ensure that at any given moment, and under dynamically changing conditions of generation, load, and transportation channels, the (possibly limited) tokens available in the system are optimally (in

the sense of time and amount) delivered to the loads (Martí, Hollman, Ventura and Jatskevich, 2008:20).

According to Phaladi and Thwala (2008:2), the vast majority of construction firms are small enterprises that rely on outsourcing personnel as required. This has severely affected skills training and the retention of expertise in the industry, as construction workers become highly mobile, walking in and out of the industry, depending on performance in other sectors of the economy. According to Gcabashe, author of Eskom Holdings annual report (Eskom Holdings Ltd, 2008:63), Eskom, by virtue of its core business operations of supplying electricity, significant procurement capability, capital expansion programme and developmental mandate, is ideally positioned to make a significant contribution to ASGISA.

Construction Management as a field of applied science has escaped canonical definition, but one typical definition is that of Clough and Sears (1994:89), which defines it as "the judicious allocation of resources to complete a project at budget, on time, and at desired quality". This definition captures the essence of what inspires, drives, and guides practice and research in the Construction Management field.

Effective Contractor and Consultant management is critical to the successful execution of Eskom's capital programme. Given the projected increase in Eskom's capital expansion and refurbishment projects over the current planning horizon, it is essential that contractor capability/capacity resource planning takes place to ensure that there are sufficient contractors with the suitable capability and available capacity required by Eskom. However, it has been determined that Eskom currently has insufficient information about its contractors/consultants to perform capability/capacity planning at programme and/or project level, (Gütschow, 2007: 4).

According to Moroga (Eskom Holdings Ltd, 2009:40), Eskom is currently in the midst of a crisis driven by an imbalance in demand and supply of electricity.

Growth in demand has increased significantly in the last thirteen years, while investment in new capacity has not kept pace. The result has been a declining reserve margin. The challenges are not limited to the generating units, but also extend to the transmission and distribution networks.

Like almost all sectors, the construction industry has chosen to rationalise its staff levels, yet a significant minority of 35% has not seen reductions. When one considers that, just a year ago, the scarcity of good people – particularly project managers – was considered the single most pressing issue facing the sector (as highlighted in the 2008 KPMG Global Construction Survey), it is understandable that many companies are reluctant to let go of hard-won resources (KPMG, 2009:13).

3.2 CONTRACTOR PERFORMANCE

The word "performance" is widely used in all fields of management. In the management control area, terms such as "performance management" (Euske, Lebas & McNair, 1993:83) "measurement", "evaluation", or "appraisal" (Bruns, 1992:74) are used. Despite the frequency of use of the word, its precise meaning is rarely explicitly defined by authors even when the main focus of the article or the book is performance. Often, performance is identified as or equated with effectiveness and efficiency (Baird, 1986:38).

Mullins (2005:52), describes performance as relating to such factors as increasing profitability, improved service delivery or obtaining the best results in important areas of organisational activities. In construction, because of the numerous participants who contribute towards the achievement of project objectives, performance has been defined in one sense as a participant's (client, architect or contractor) contribution to the execution of the task required to complete the project.

Dlungwana, Noyana, Nxumalo, Rwelamila, Van Huysteen and Xolani (2002:26), point out that overall business performance has been a widely researched subject throughout the world. It is generally accepted that organisations with an entrenched culture of continuous improvement achieve high levels of business performance. Performance can be considered as an evaluation of how well individuals, groups of individuals or organisations have done in pursuit of a specific objective. These objectives vary significantly, but from an industry or organisational perspective, they generally revolve around satisfying the key stakeholders, notably customers, employees, shareholders, the various suppliers, government and society as a whole (Ankrah & Proverbs, 2005) cited by (Ankrah, 2007:22).

According to Beatham, Anumba, Thorpe and Hedges (2004:93), citing Neely (1999), there are seven reasons why performance measurement is now on the management agenda, all of which are relevant to the construction industry:

- The changing nature of work.
- Increasing competition.
- Specific improvement initiatives.
- National and international quality awards.
- Changing organisational roles.
- Changing external demands.
- The power of information technology.

Xiao and Proverbs (2003:330), note that construction time is important to both the contractor and the client because of its economic implications. Delays lead to an increase in construction cost and a reduction in quality. Cain (2004:68), contends that it has become more difficult to "misinterpret, ignore or shrug off" calls for performance improvement, more so because these calls for change have been client-driven, with specific targets that have been defined for the industry to pursue. Powerful entities such as the Construction Clients Forum, Rethinking Construction Organisation, Movement for Innovation (M4I), and the Constructing Excellence programme, have been set up to push forward the performance improvement agenda for the construction industry.

Xiao and Proverbs (2003:328), point out that the overall performance improvement agenda of the construction industry requires improvement in products (right first time), delivery (in terms of quality, cost and time), and the sustainable development of construction firms (profitability and competitiveness). Hsieh (1998:97), is of the opinion that if an element within social embeddedness is lacking, such as when the trade contractor's labour continues to be slow or inefficient after repeated jobs, the relationship with the general contractor will suffer, and an employer may look to more reliable trade contractors to do the work.

Previous research findings have suggested that it is five times more expensive to develop a new construction client than to maintain an existing one and companies could increase their profits by almost 100% by retaining just 5% more of their clients (Reichheld & Sasser, 1990:107). According to BSRIA (2003:43), client satisfaction is therefore a fundamental issue for construction participants, who must constantly seek to improve their performance if they are to survive in the global marketplace.

Performance can be considered as an evaluation of how well individuals, groups of individuals or organisations have done in pursuit of a specific objective. These objectives vary significantly, but from an industrial or organisational perspective, they generally revolve around satisfying the key stakeholders, notably customers, employees, shareholders, the various suppliers, government and society as a whole (Ankrah & Proverbs, 2005) cited by (Ankrah, 2007:22).

Aiyetan and Smallwood (2009:1) explain that the problem of delays in the construction industry is a global phenomenon. It is not in the interest of parties to a contract for projects to be delayed. This situation arises as a result of the influence that factors controlling the execution of projects have on project delivery, with respect to cost, quality, and time. When projects are delayed, it is an indication of the level of competence of either the consultants or the contractors. Observation has revealed that peculiar problems, as far as project management is concerned, still exist.

Supplier performance measurement is an important contract management activity to ensure that the supplier is delivering against specific contractual requirements. Supplier performance measurement is different to the supplier evaluation and selection process that takes place mainly as a result of a tender enquiry. Supplier performance measurement is a continuous process, as opposed to a once-off event when suppliers are loaded into the Vendor Database (van der Merwe, 2010:4).

Performance Evaluation Ratings			
1	2	3	4
Repeated failure of contractual commitments and performance evaluation criteria in respect of Efficiency, Reliability and Regulatory Requirements. Little or no communication and non-responsive to service issues.	Supplier experiencing problems with contractual commitments and performance evaluation criteria. Poor communication although some response to service issues.	Generally satisfactory, but some instances of poor service and communication and mostly responsive to service issues.	Supplier meets and exceeds all contractual commitments and performance evaluation criteria. Eskom-supplier relationship operating on good terms; issues are resolved immediately and communication is open and ongoing.

Figure 3.2: Eskom Performance Evaluation Rating. (Source: Eskom Finance Division)

According to Ankrah (2007:3), (citing Xiao & Proverbs, 2003), the overall performance improvement agenda of the construction industry requires improvements in products (right first time), delivery (in terms of quality, cost and time), and the sustainable development of construction firms (profitability and competitiveness).

According to Johnson (2007:16), (citing Kale, 2001 & Arditi, 1998), elements such as trust, reliability, morale, and aptitude affect the cohesiveness of the contractor-trade contractor relationship. As these qualities develop, there is an improvement in the general contractors' production output.

Akinci and Fischer (1998:72) points out that another finding indicates that the uncertainties in connection with a subcontractor's technical qualifications, timeliness, reliability and financial stability, may bring risks to contractors in terms of cost, time and quality. The success of the general contractor is closely

connected to the work performed by each of the trade contractors employed on the project. It only takes one very poor performance by a key trade contractor to ruin a project. Contractor performance is critical to the success of any construction project, as it is the contractors who convert designs into practical realities. Improved contractor performance leads to increased client satisfaction, improvement in the reputation of contractors, and hence their competitiveness in the market (Xiao & Proverbs, 2003:322).

According to Johnson (2007:23), performance excellence is the highest possible level of performance that can be reached by organisations that incorporate best practices in all their processes and activities, thus becoming highly effective, efficient and competitive. In recent years, many industry development programmes have been conceptualised, developed and implemented. Such programmes have involved many industry stakeholders, including government departments, particularly those involved in public works and infrastructure development.

It is the duty of the contractor to complete the work covered by his or her contract, in accordance with the Approved Plans and Specifications. The contractor must carefully study the Approved Plans and Specifications and should plan a schedule of operations well ahead of time. If at any time it is found that the work which is being done is not in accordance with the Approved Plans and Specifications, the contractor should immediately correct the work (Mullins, 2005:56).

The purpose of the KPI's is to enable measurement of project and organisational performance throughout the construction industry (The KPI Working Group, 2000:23). Collin (2002:7), advocates that the process of developing KPI's involve consideration of the following factors:

- KPI's are general indicators of performance that focus on critical aspects of outputs or outcomes.
- Only a limited, manageable number of KPI's is maintainable for regular use; having too many (and too complex) KPI's can be time- and resource-consuming.

- The systematic use of KPI's is essential because the value of KPI's is almost completely derived from their consistent use over a number of projects.
- Data collection must be made as simple as possible. A large sample size is required to reduce the impact of project-specific variables. Therefore, KPI's should be designed and used on every building project.
- For performance measurement to be effective, the measures or indicators must be accepted, understood and owned across the organisation.
- KPI's will need to evolve, and it is likely that a set of KPI's will be subject to change and refinement.
- Graphic displays of KPI's need to be simple in design, easy to update, and accessible.

3.3 QUALITY AND QUALITY MANAGEMENT IN CONSTRUCTION

Quality management aims at conducting the inherent managerial elements of planning, control and improvement, based on the principles of total quality. The expected results of quality management are: better organisational performance, increased productivity, more effective and efficient processes, and more competitive products (Juran & Godfrey, 1999:194).

The concept of "quality" has moved from a predominantly narrow and mechanistic approach to a more subjective and broader organisational philosophy (Hermel, 1997:133). The interpretation of quality has broadened. Take Crosby's (1979:83) definition, for example. "Quality is conformance to requirements." This can be narrowly interpreted as "following rules without question". But this can also be broadened by realising the importance of considering what these "requirements" are. Because quality is conformance to requirements, the objective of specifying these requirements is to communicate clear goals and processes, avoiding misalignment or confusion. It forces people to establish and communicate requirements clearly before pouring resources into work.

Quality is thus better understood as the enhancement of existing value, including the consistent delivery of that value to the customer. The latter is the aim of

quality assurance, a wide range of activities focused on maintenance of the already achieved level of value embodied in the product or service. The former is the aim of quality management, in addition to a wide range of activities, but focused on the enhancement of the value embodied in the product or service (Ng, 2009:7).

According to Beatty (2006:148), quality is a part of everyone's job, from conceptualisation to delivery. This includes top management, middle-level managers, supervisors, line and staff, maintenance personnel, and all others. Whatever the enterprise, supply partners, secretaries, janitors, buyers, procurement managers, trainers, human resources managers, telephone operators, security staff, compensation analysts, data entry personnel, receptionists, engineers, software specialists, sales, executives, and others, must be a part of this effort. Quality is not simply a responsibility of the quality control department; it must be a major driver for every member of any organisation.

This emphasis on quality is essential to the future livelihood of every business endeavour. Without total commitment and total support from top-level management, quality programmes will have only limited success at best. As suggested by Zilbershtein (2004:39), top management must be committed to a quality culture, and must demonstrate this commitment to quality through a shared vision. However, this commitment to quality must be transparent and must be infectious.

It is generally true to say that in the construction industry globally, the purpose of every construction firm is to win over customers' trust and acknowledgment as a means of gaining greater business competitiveness and for making greater profit. The ISO 9000 series, developed by the International Standards Organisation (ISO) is a standard related to implementing better quality management, control and assurance in companies (Chini & Valdez, 2003:73).

The ISO 9000 series is already widely accepted in many manufacturing, production and services industries, because it focuses on customers, leadership, people involvement, process approach, systems approach, and continual

improvement, and promotes a factual approach to decision-making (Turk, 2005:507). Tricker (2008:14), points out that the standard is actually a generic one, and because of this, is not confined to those industries mentioned, but can also be used successfully by construction companies on their projects, even though every project is unique and involves different sub-contractors and suppliers. The primary benefit of operating an effective, appropriate and transparent quality system is that a construction firm will be admired, and be chosen to bid in both local and global market contracts (Yates & Anifos, 1997:133).

Ankrah (2007:31), expresses the opinion that management philosophy, relating to such issues as supply chain management and Total Quality Management (TQM), affects the way a project is managed on site. Apart from the schedule and cost performance, quality and safety performance are also used to measure the contractor performance. The method used for determining quality performance is to compare the actual work with that specified in the contract (Adanan, 2006:11).

Love, Edwards and Sohal (2004:194), found that a major benefit of initiating a TQM programme, as reported by all contractors, was that there was an increasing awareness and focus by all employees on satisfying both internal and external customers. Total Quality Management is a structured approach to improvement. Construction companies are adopting TQM to improve their performance. If correctly applied, it will assist a construction company in improving its performance (Ahmed & Kangari, 1995:39).

Low and Wee (2001:13), claim that by employing an ISO 9000-certified QMS, work repetition, project delays and failure to meet specifications can be minimised. Other advantages are that the buildability factor of most projects can be increased while the project cost is decreased, because an appropriate framework for controlling the processes is required when constructing the project.

Construction quality is a critical factor in determining project acceptance and resultant contractual payment levels. Participants in the construction industry have

client satisfaction and gain a competitive advantage. Acceptable quality levels in construction have long been a problem to attain on time and within budget in a highly dynamic, complex, and competitive environment (Battikha, 2002:534).

The construction industry has been struggling with quality issues for many years, and the cost to our economy is dramatic. The cost could potentially be reduced significantly if the industry were to embrace the concept of quality assurance that has been used with great success by many other sectors of the economy (Ballard, 2000:32).

The proposed documentation taxonomy policy, process, procedure, form fits readily into the documentation pyramid (below). However, the tiers and various examples of documents are merely guidelines. It is the quality manual, quality objectives, identified processes and their controls, control plans where applicable, six specific procedures, supplemental documents if applicable, work instructions if applicable, and records, that are clearly mandatory hierarchal documents in the Standard (Schlickman, 2003:38).

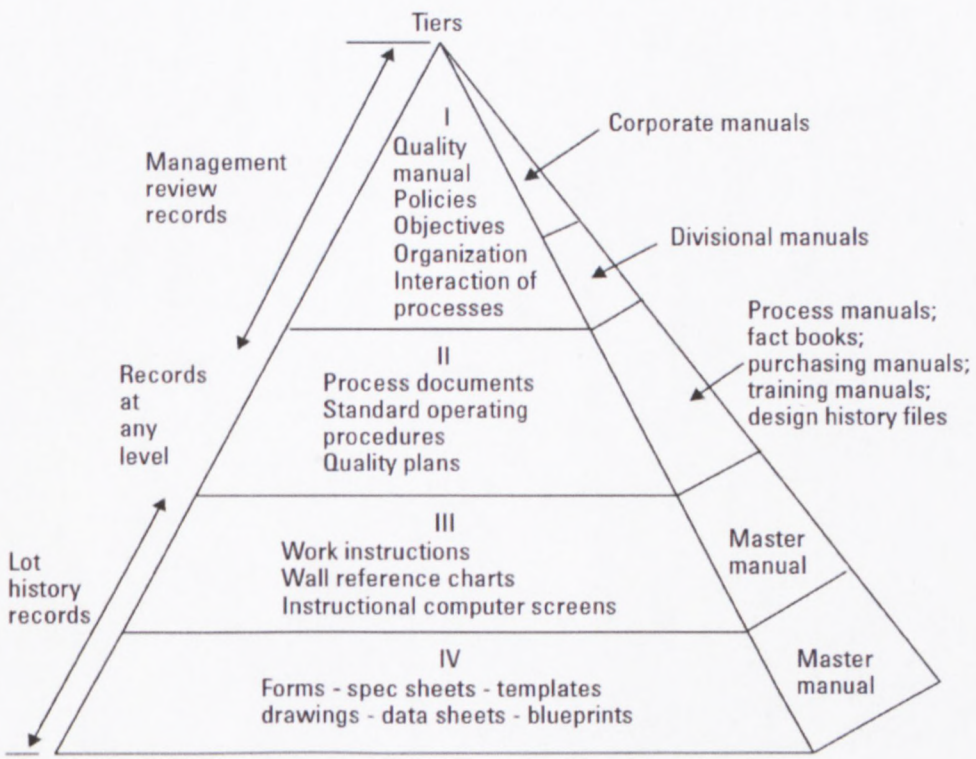

Figure 3.3: The four-tier operational pyramid concept. (Source: ISO 9001:2000 guidelines)

Tan and Lu (1995:26), state the following "The need for construction quality assurance is easy to demonstrate due to the high cost of quality related issues in the industry. Those who are familiar with the construction industry are most likely already aware of this. For those who are not, think back over the last several months at lawsuits, project delays, finger pointing, lost time, and other cost of quality issues in newspapers and industry journals on a routine basis".

Quality control and quality assurance have much in common. Each evaluates performance. Each compares performance to goals. Each acts on the difference. However, they also differ from each other. Quality control has as its primary purpose to maintain control. Performance is evaluated during operations, and performance is compared to goals during operations. The resulting information is received and used by the operating forces (Juran & Godfrey, 1999: 43).

Quality control in construction typically involves insuring compliance with minimum standards of material and workmanship, in order to ensure the performance of the facility according to the design. For the purpose of ensuring compliance, random samples and statistical methods are commonly used as the basis for accepting or rejecting work completed as well as batches of materials. Rejection of a batch is based on non-conformance or violation of the relevant design specifications (Jain, Phatnani & Rao, 2007:28).

The main purpose of quality assurance is to verify that control is being maintained. Performance is evaluated after operations, and the resulting information is provided to both the operating forces and others who need to know. "Others" may include plant, functional, senior management, corporate staffs, regulatory bodies, customers, and the general public (Juran & Godfrey, 1999:43).

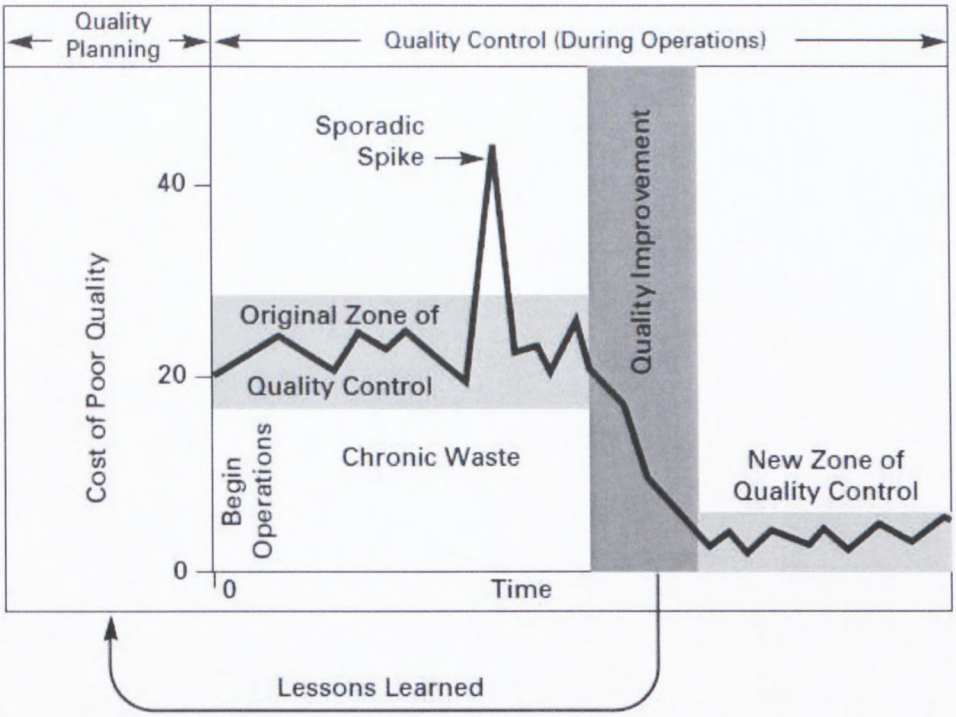

Figure 3.4: Describes the relationships between quality planning, quality improvement, and quality control and the fundamental managerial processes in total quality management (Source: Juran's Quality Hand Book)

Quality management is a way of life. Quality is not guaranteed by inspection of a final acceptance of a product. It is the result of a mindset of excellence and efficiency that underlies the entire production process in a business (SAACE, 2007:1).

According to Hammer and Champy (1993:123), "re-engineering" is the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical measures of performance. Many practitioners believe that quality improvement is associated only with incremental improvements. Nothing could be further from the truth. For many years, the Malcolm Baldrige National Quality Award has defined "continuous improvement" as being both incremental and "breakthrough" improvement. The Japanese have not only relied on *kaizen* but have developed policy management (*hoshin kanri*) and policy deployment (*hoshin tenkai*) in large part, to produce large-scale breakthroughs. Nor is this concept uniquely Japanese. Joseph Juran has maintained a long-standing emphasis on breakthrough efforts aimed at

achieving unprecedented levels of performance. Clearly there is nothing new in the re-engineering concept – it has always been part of the total quality management (TQM) umbrella.

According to Ganaway (2006:41), the requirement for excellence extends well beyond the jobsite. An owner's perception of the level of quality that a contractor produces is certain to be tarnished by that contractor's sloppy handling of paperwork, poor communication, and incomplete documentation. The project owner has performance obligations as well, but of course, one can control only one's own organisation.

Quality on construction projects, as well as project success, can be regarded as the fulfilment of expectations (i.e. the satisfaction) of those participants involved. There is one factor that makes the difference between the costly way and the beneficial way of achieving quality. This factor is quality costs. Quality costs are also very useful to management as they help point out the strengths and weaknesses of a QMS (Ahmed, 2003:156).

With inefficient or nonexistent quality management procedures, significant expenditures of time, money, and resources are wasted on construction projects (Rounds and Chi, 1985) cited by (Battika, 2002:573). A lack of quality due to deficient construction quality management is detected in non-conformance with established requirements (Battikha, 2002:537).

The basic plan–do–study–act (PDSA) cycle, sometimes known as the plan–do–check–act (PDCA) cycle, was developed by Shewhart, and is an effective improvement technique. It is sometimes called the Shewhart Cycle or the Deming Cycle. Figure 3.5 illustrates the cycle. Its four steps are exactly as stated. First, plan carefully what is to be done. Next, carry out the plan (do it). Third, study the results; did the plan work as intended or were the results unexpected? Finally, act on the results by identifying what worked as planned and what did not. Using the knowledge learned, an improved plan should be developed, and the cycle repeated. The PDSA cycle is a simple adaptation of the more elaborate problem-solving method discussed in the next section (Borror, 2008:321).

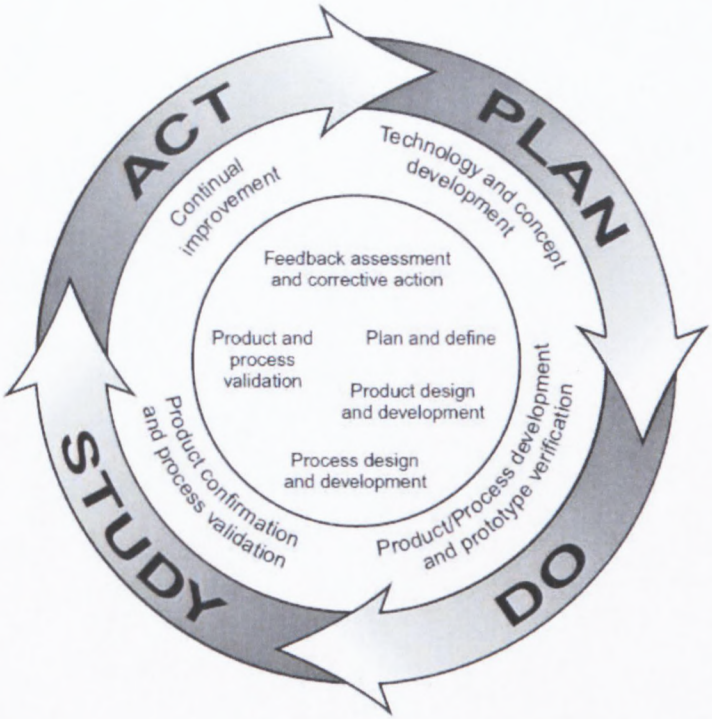

Figure 3.5: Basic plan–do–study–act cycle. (Source: The Certified Quality engineering Handbook)

Management should consider the potential benefits of establishing partnerships with suppliers to the organisation, in order to create value for both parties. A partnership should be based on a joint strategy, sharing knowledge as well as gains and losses. When establishing partnerships, an organisation 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. (ISO 9004:2000, 2000:8).

According to Adanan (2006:16), apart from the schedule and cost performance, quality and safety performance are also used to measure contractor performance. The method used for determining quality performance is to compare the actual work with that specified in the contract.

Aiyetan and Smallwood (2009:8), agree that the factor that exerts the most influence regarding project delivery time, according to architectural technologists and the members of the Executive Committee of the ECMBA, is quality of management during construction. The level of control achieved dictates the promptness with which a project will be delivered. Control in this regard includes:

- control over technology of construction, that is, usage of the correct and advanced methods of construction to avoid repetition of work (getting the work done right first time);
- control over human resources;
- control over machines (movement and maintenance) to avoid machine breakdowns and response to breakdowns of machines, (repairs);
- control of materials in order to avoid situations leading to a lack of materials on site, which will entail regular stocktaking, and ordering of materials long before they are finished.

Total Quality Management (TQM) is a structured approach to improvement. Construction companies are adopting TQM to improve their performance. If correctly applied, it will assist a construction company in improving its performance. It involves a strong commitment to two guiding principles: client satisfaction and continuous improvement. However, construction has lagged behind other industries in implementing total quality management because of its inability to accurately determine client requirements and successfully transform these requirement into its practicality (Ahmed & Kangari , 1995:39-42).

Figure 3.6 illustrates the process-based quality management system described the ISO 9000 family of standards (ISO 9000:2000, 2000:2). This illustration shows that interested parties play a significant role in providing inputs to the organisation. Monitoring the satisfaction of interested parties requires the evaluation of information relating to the perception of interested parties as to the extent to which their needs and expectations have been met.

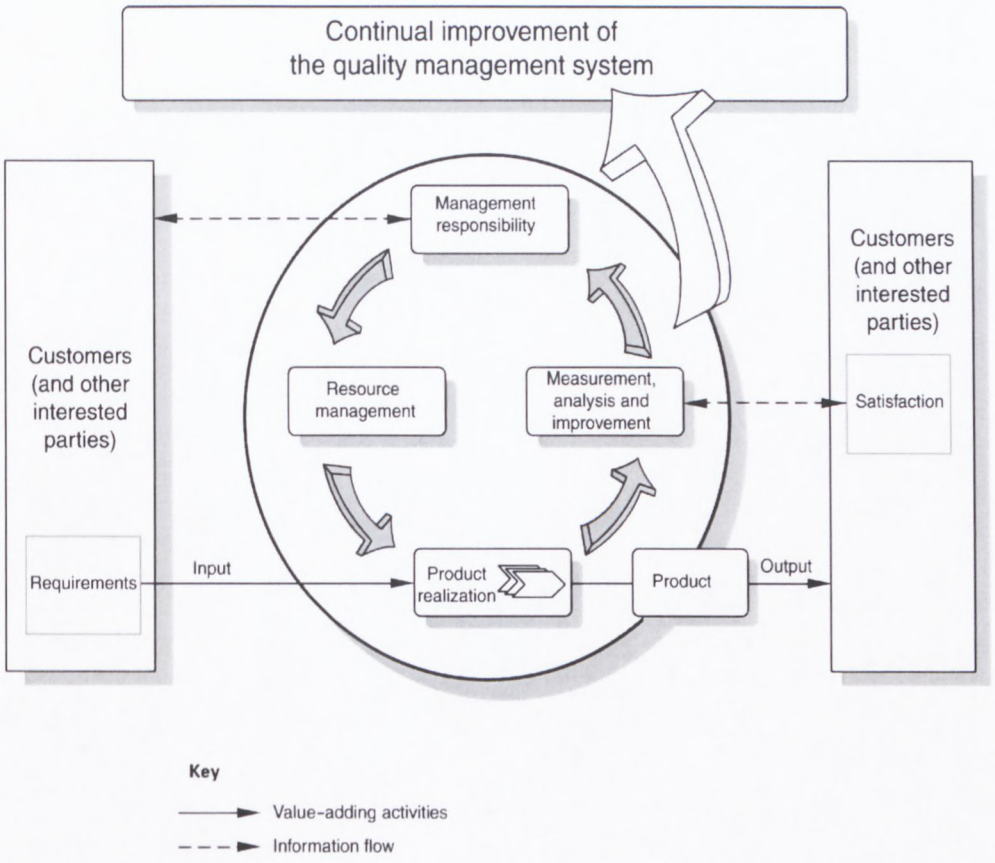

Figure 3.6 Model of a process-based quality management system. (Source: ISO 9000:2000)

Discussion of the issue as to why QMSs cannot be effectively applied by some constructors and builders, is very limited in the extant literature. However, Novessro (2009), states that the 10 root-causes of ineffective ISO 9001 implementation are the following:

- Obtaining of ISO certification just for prestige.
- Lack of top-management commitment.
- Minimum availability of supporting resources.
- Failure in applying continuous improvement concepts.
- Unrealistic timelines set up for rolling-out QMS programmes.
- Failure in disseminating QMS programmes to all organisational levels since it is assumed that the system is only appropriate for manufacturing processes.
- Unsuccessful human resources training with regard to becoming an agent of change.

- Unsuccessful definition and design of QMS documentation.
- Implementation of QMS being allowed only as an add-on to standard operating procedures.
- QMSs being applied without conducting a comprehensive review of the existing management system.

The literature abounds with lists of variables supposedly influencing the quality of a building project. There are some variables common to more than one list, but there is certainly no general agreement on the variables. Review of the previous research reveals some common threads of variables as affecting the quality of a building project. The generally perceived factors that influence quality performance can be grouped under the headings of client, project, project environment, project team leaders, project procedures, and project management procedures (Chan & Tam, 2006:3).

3.4 SAFETY AND RISK MANAGEMENT IN CONSTRUCTION

Risk and quality management are two sides of the same coin, neither of which on its own assures the successful outcome of a business. This distinction will assist understanding that risk and quality management are separate processes. They are complementary and inter-dependent, and even inter-related, but to know that they are separate processes will raise one's awareness that both need to be addressed in a structured manner (SAACE, 2007:1-2).

According to Moroga, (Eskom Holdings Ltd, 2009:18), over the past year, the number of contractors within the organisation has progressively increased owing to the significant expansion programme. This increase has brought about additional complexities, often resulting in an increase in incidents. However, Eskom continues to work in partnership with contractor organisations, aiming to influence their attitudes, behaviour and safety cultures, and to establish the highest standards of health and safety performance as a prerequisite for all work carried

out for Eskom. Strict controls are, nevertheless, required to ensure that contractors adhere to Eskom requirements.

The improvement of construction-worker safety and health has gone through several stages of development. The concept of common law prevailed before the enactment of occupational safety and health legislation to reduce the number of work-related accidents, injuries and fatalities. Common law develops from custom and precedent. Accordingly, when workers accepted employment, they also accepted the consequences of exposure to any risk and hazards associated with that employment. Workers were expected to be smart enough to avoid danger in the workplace (Marshall, 1994:33).

A contractor shall provide and demonstrate to the principal contractor a suitable and sufficiently documented health and safety plan, based on the relevant sections of the principal contactor's health and safety specification contemplated in regulation 5(3)*(a)* provided by the principal contractor, which plan shall be applied from the date of commencement of and for the duration of the construction work, Construction Regulations (2003:8).

Warren (1989:64) points out that job security and safety needs correspond to a positive sense of safety and well-being of the employees. Safety training is mandatory to all survey workers in construction projects. A survey organisation must maintain a high profile of job security and safety in public, in order to satisfy employees' basic needs in the work environment, to motivate workers to stay in the organisation, and to attract talented workers to join the organisation.

According to KPMG Report (2009:23), the issue of safety appears in many ways similar to that of being "green". One needs to show a good record to compete, but it will not necessarily differentiate you from your rivals. Therefore, it is not too much of a surprise that virtually all of those involved in the research have invested substantially in a safety programme, and half (49%) confirm that these programmes continue to be an important criterion when potential customers evaluate their credentials.

Du Toit and Smallwood (2009:2) are of the opinion that in most electrical construction environments, individuals usually perform specific tasks on their own. With this in mind, it would be advantageous to understand how an individual's perception of risk allows him or her to perform certain job functions in a healthy and safe manner. The selection process of persons to perform certain tasks should incorporate both the specific aspects of the job and the characteristics of that individual that make them best suited to undertake such tasks.

The Occupational Health And Safety Act states that "Every employer who has more than 20 employees in his employment at any workplace, shall, within four months after the commencement of this Act or after commencing business, or from such time as the number of employees exceeds 20, as the case may be, designate in writing for a specified period health and safety representatives for such workplace, or for different sections thereof" (Occupational Health And Safety Act, 1993:20).

According to Jain et al. (2007:30), various measures are available to improve jobsite safety in construction. Several of the most important occur before construction is undertaken. These include design, choice of technology, and education. By altering facility designs, particular structures can be either safer or more hazardous to construct. For example, parapets can be designed to appropriate heights for construction worker safety, rather than the minimum height required by building codes.

The health and safety record of construction is the second-worst of any industry. Most accidents seem to occur when people are either not properly trained or working out of process. It is best for the industry to reflect not only on the pure welfare consequences of a poor health and safety record, but to consider as well its cost in terms of lost work days, potential prosecutions and, in extreme cases, the enforced closure of construction sites (Egan, 2006:25).

3.5 CONTRACTOR DEVELOPMENT

The Construction Industry Development Board (CIDB) Act (South Africa Government Gazette, 2000), was passed to establish a statutory body aimed at driving an integrated construction industry development strategy (Marx, 2009:1).

Milford, Hodgson, Chege & Courtney (2006:1) define construction industry development as the deliberate and managed process to optimise the contribution of the construction industry in meeting national construction demand, in promoting national social and economic development objectives, industry performance and competitiveness, and improved value to clients and society.

Jacquet (2002:1) expresses the opinion that the development of the construction industry depends on whether there is a supply of competent contractors to meet the demand that the society has created. The development of emerging contractors into viable business enterprises that partake in the mainstream economy form is an important part of the Department of Public Works Programme's strategy.

Marx (2009:1) points out that Construction Industry Indicators (CIIs) have been developed by the Department of Public Works and the CIDB with assistance from the Council for Society and Industrial Research (CSIR), to play a useful role in developing a sustainable industry, and to be adopted as a tool for improving performance in the South African construction industry. The procurement indicators measured include contractor performance issues, the type of procurement procedure used, and the contracting strategy adopted.

According to Nissanke (2001:358), efforts to promote SMME access to finance might have more impact on development and growth, but access is limited and the cost of capital is high. While the government has made some efforts to increase accessibility to finance, the targeted programmes have had limited success because the awareness and usage of existing promotional programmes is very low. In addition to insufficient access, high interest rates also pose a constraint to micro-enterprise growth.

The ECDC has taken the initiative to develop and apply a holistic and integrated approach, regarding emerging construction contractor development in South Africa, taking the lead from numerous other agencies that have attempted to achieve sustainable development of construction contractors through fragmented interventions and models. The attempts by these agencies produced limited results and the outcomes are not quantified, thus being at best perceptual in nature. The ECDC initiative was firstly driven by risk management needs regarding construction contractor clients, and secondly by its mandate as a development corporation (Eastern Cape Development Corporation, 2007:3).

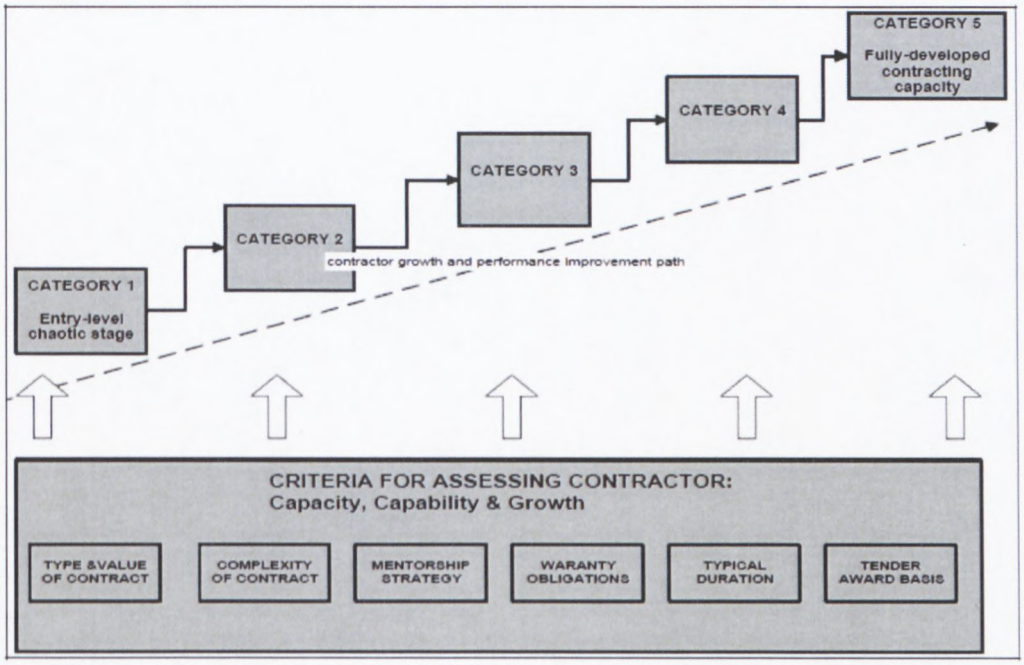

Figure 3.7: Criteria for Assessing Contractors. (Source: ECDP)

Contractors suffer from erratic cash-flow problems and are often forced to delay or suspend works owing to delay in payment or non-payment, with the Government being the main defaulter in this respect. Contractors fail to meet their various obligations, and work ends up costing much more than budgeted because of claims and interests. Cases have been cited where the government owes a single contractor monies amounting to a total of R250 million. In the case of a labour-based contractor, delayed payment inevitably leads to strikes, unrest and serious disruptions (Uriyo, Mwila & Jensen 2004:26).

Given the skills shortages and equity imbalances in the infrastructure maintenance and construction industry, there is a great need for the government to play a role in developing the maintenance industry, particularly with regard to skills development, SMME development, and the promotion of Broad-Based Black Economic Empowerment (BBBEE) in the maintenance industry (CIDB, 2007:16).

Sigh (2010:5) contends that despite the initiatives from Government to increase education and training throughputs, skills challenges are immediate and are expected to increase going forward. Government will need to intervene further, given that the current Joint Initiative on Priority Skills Acquisition (JIPSA) initiatives do not seem to be adequate in addressing the skills deficit. There may therefore be a need to consider facilitating the bridging cost of skills development in partnership with the private sector over the short to medium term, to mitigate the risk of escalating skills costs (due to shortages) and delayed critical infrastructure projects over the medium to long term. Further initiatives from the private sector to improve training and skills development will also be required, complemented by a comprehensive and integrated skills development strategy for the infrastructure inputs sector.

The National Contractor Development Program recognises that there are various components of development through which contractors need to progress in order to become competent experts in their field of operation and to grow and improve their performance – and incorporate the various principles discussed in the preceding sections. The NCDP recognises that contractor development initiatives should therefore cover a broad spectrum of activities, including:

- Construction Work Force Development, incorporating the development of the construction workforce through artisan and supervisor development (typically the ungraded workforce and CIDB Grade 1 and 2 contractors). Key instruments that can be used include learnerships of various forms, together with the necessary supporting structures.
- Contractor Development, focusing on the development of contractors and comprising several subcomponents starting at the emerging contractor stage and progressing to the stage which focuses on developing the contracting

enterprises (i.e. focusing on the business development), together with a focus on improving the performance of contractors.

- Emerging Contractor Development, focusing typically on Grade 2 and 3 contractors. Key instruments that can be used include learnerships within Emerging Contractor Development Programmes (ECDPs), predominantly incorporating mentorship in which the emerging contractor learns the business side of contracting, including tendering for work, pricing, HR management, marketing, financial management, contract administration, etc. Within the ECDPs, budgets are typically ringfenced for allocation, to ensure sustainable work for the learner contractors.
- Enterprise Development, in which enterprises start growing, developing markets for their services, expand their workforce, expand their areas of operation, accumulate capital for future growth, and expand their plant and equipment, business and technical systems. This stage would target Grade! 3 to 6 contractors who exhibit potential to develop. Key instruments which could be used in this stage include a combination of joint ventures, direct contracts, etc. In the enterprise development stage, contractors would be awarded contracts through competitive bidding utilising appropriate procurement strategies to ensure sustainable work supply to the contractors in the competitive bidding environment.
- Performance Improvement, in which established enterprises introduce best-practice systems for health and safety, quality management, environmental management, etc., in order to improve their performance. This stage would target the Grade 4 to 7 contractors who exhibit potential to develop. Key instruments which could be used include a combination of joint ventures, direct contracts and various other instruments within the context of the CIDB Best Practice Contractor Recognition Scheme and the CIDB Best Practice Project Assessment Scheme (CIDB, 2009:12-18).

According to Gcabashe, (Eskom Holdings Ltd, 2008:83-89), Eskom, by virtue of its core business operations of supplying electricity, significant procurement capability, capital expansion programme and developmental mandate, is ideally positioned to make a significant contribution to ASGI SA. In line with this, Eskom's contribution will be twofold:

- Firstly, to facilitate economic growth. Notwithstanding capacity constraints, current operating efficiency has to be maintained, and capacity expansion plans should accommodate the accelerated economic growth rates and hence, the associated electricity demand growth rates.
- Secondly, Eskom can contribute to the development of the 2nd economy,by leveraging economic benefits from associated activities.

According to Moroga, (Eskom Holdings Ltd, 2009:40), the competitive supplier development programme (CSDP) aims to contribute to sustainable local supplier development. The CSDP obligates suppliers with import contracts exceeding $10 million, to invest 30% of the imported contract value in the local power industry and related suppliers. In line with Eskom's CSDP rollout plan submitted to the Department of Public Enterprises, manufacturing facilities have been set up in various tiers of the supplier industries.

3.6 CONSTRUCTION EMPLOYEES SKILLS DEVELOPMENT

During the first half of the 19th century, building still operated under the guild system, with apprentices, journeymen and masters in each of the trades. This system and its individual enterprises can be interpreted as a learning organisation, almost exclusively dependent on tacit knowledge being transmitted to younger people. Under stable technological conditions, the apprenticeship system delivered good craftsmanship quality, and inter-organisational relations were regulated through role definitions rather than by clients, and government authorities through detailed technical building requirements and project-specific administrative procedures (Brodbeck, 2000:4-8).

According to Opfer (1999:4), 54% of all construction defects are related to human factors such as unskilled workers or insufficient supervision of construction work. Furthermore, 12% of construction defects are due to material and system failures. These statistics suggest the vital importance of inspection for achieving higher construction quality. It has been identified that careful inspection during

construction is one of the most important factors in preventing structural failures during construction.

Maslow (1970:36) argued that human beings strive to satisfy the following needs, basically classified in ascending order: physiological needs, safety needs, social or belonging needs, self-esteem needs, and the need for selfactualisation. These needs are arranged hierarchically. For example, if a worker has satisfied his/her own physiological needs, he/she will next pursue safety needs. As soon as these are fulfilled, social needs will be pursued, and so on. On the other hand, McKenzie and Harris (1984: 27) claimed that money was the only motivator for construction workers. Olomolaiye and Ogunlana (1988:183) similarly asserted that earnings-related factors were predominant for motivating construction operatives in the developing country of Nigeria.

Figure 3.8: Marslow's Hierarchy. (Source: Marslow's Theory of Motivation)

According to Burati, Farrington and Ledbetter (1992:39), training is an essential factor for any successful quality management programme. Numerous studies are reported in the literature on the link between TQM practice and organisational performance. With the high staff turnover in South Africa, especially in the technical and construction fields, it has become critical for companies to re-assess their staff strategy (Ghobadian & Gallear, 1997:127).

Uwakweh (1999:7) states that it is generally believed that most developing countries are characterised by abundant supplies of labour. However, in fact they are plagued with a scarcity of skilled construction workers. Training of construction craft workers is not very common in these countries, and when they are available, they may not be adequate. To exacerbate the situation, informal on-the-job training is not well developed and not common.

Uriyo, Mwila and Jensen (2004:26) point out that lack of adequately qualified staff to effectively execute work has hampered the performance of small-scale contractors. This affects both those contractors who at the start do not have adequately qualified staff to execute construction projects, and also those who have been formally trained, but who have been forced to stretch their staff owing to attrition, where they cannot retain their staff, or where a few have more than one project ongoing, thus designating untrained staff in other projects.

CHAPTER 4: PROJECT SURVEY DESIGN AND METHODOLOGY

4.1 THE SURVEY ENVIRONMENT

Eskom Holdings Limited consists of various divisions and departments, each with a unique role in the delivery of services to realise the goals and objectives of the organisation and its major stakeholder, Government. The different stakeholders, who will serve as the research environment, are the following:

- Construction contractors.
- Capital Programme Management Department.
- Technology and Quality Department, and.
- Risk Department.

4.2 AIM OF THIS CHAPTER

Burns and Grove (2003:195) define research "design" as a blueprint for conducting a study with maximum control over factors that may interfere with the validity of the findings. Parahoo (1997:142), describes a research design as a plan that describes how, when and where data are to be collected and analysed.

The ultimate objective is to solve the research problem as defined in Chapter 1, Paragraph 1.3, and which reads as follows:

Poor quality workmanship during the construction of electrical networks by contractors is the cause of poor performance of electricity networks leading to a loss of power and associated loss of revenue to the country.

4.3 CHOICE OF SAMPLING METHOD

Burns and Grove (1997:165) define sampling as "the process of selecting a group of people, events, behaviours or other elements for studying a subset of the population".

Eskom Distribution Division consists of various functional areas, each with a unique role in the delivery and construction of network projects. The various functional areas, which will serve as the individual strata for the research survey, include the following:

- Construction Contractors.
- Capital Programme Management Department.
- Technology and Quality Department, and.
- Risk Management Department.

To ensure that each identifiable strata of the population was taken into account (Hussey & Hussey, 1997) (Easterby-Smith, Thorpe & Lowe, 1996), 35 respondents were selected from the construction contractors and 5 respondents from each department of Eskom, which adds up to 15 respondents from Eskom departments.

4.4 THE TARGET POPULATION

With any survey, it is necessary to clearly define the target population, which Hussey and Hussey (1997) define as follows:

> *A population is any precisely defined set of people or collection of items which is under consideration.*

For purposes of this study, the researcher used a population size of 121 contractors, a sample size of 35 contractors, and 15 Eskom employees from three different departments, namely Technology and Quality, Capital Programme Management Department and Risk Management Department.

The sampling frame is defined by Vogt (1993) as a list or record of the population from which all the sampling units are drawn. For this survey, 35 construction contractors and 5 employees from each of the three mentioned departments were randomly selected to represent the sampling frame. This transposes into 50 respondents from the selected organisation departments and construction contractors. The identified research strata were:

- Construction contractors.
- Capital Programme Management Department.
- Technology and Quality Department, and.
- Risk Department.

4.5 DATA COLLECTION

Data collection is a process of acquiring subjects and collecting the data for the study (Burns & Groove, 2003:298). The data collection method used fell within the ambit of the definitions of "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, while Kerlinger (1986:372), defines "field study" as non-experimental scientific inquiries aimed at discovering the relations and interactions among variables in real structures. As is the case in most academic research, the collection of data forms an important part of the overall dissertation content.

The data used in this research was collected from different sources of evidence namely:

- Semi-structured face-to-face interviews: generally starting with a few specific questions and then following the individual's tangents of thought with interviewer probes (Cooper & Schindler, 2006:204).
- Questionnaires: a questionnaire is a list of carefully structured questions, chosen after considerable testing with the view to elicit reliable responses from a chosen sample (Remenyi, Williams, Money & Swartz, 2002:290).

- Telephonic interviews: the interview serves as a data collection methodology for research methods falling within the context of a phenomenological (qualitative) research paradigm.
- An organisation's written procedures: organisational policies, directives, procedures, work instructions and technical bulletins (ISO 9004, 2000:8).
- Site-visit observations: observation serves as a data collection methodology for research methods falling within the context of either the positivistic (quantitative) or phenomenological (qualitative) research paradigms (Collis & Hussey, 2003: 171-172)
- E-mail correspondence: e-mail correspondence within Eskom departments and with the contractors.

4.6 MEASUREMENT SCALES

The survey was based on the well-known Lickert scale, in which respondents were asked to respond to questions or statements (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, most appropriate to glean data in support of the research problem in question (Emory & Cooper, 1995:180-181). The advantages of using this scale, according to Emory and Cooper (Emory & Cooper 1995:180-181) are:

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

According to Remenyi, Money 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 author acknowledges that a number of strategies can be applied in similar research projects, the well-known concepts of objectivity, reliability etc., 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 one actually wishes to measure. Yin (2003) identifies 3 subsets to the concept 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

Research conducted in areas of a sensitive nature, as in the case of this survey, pose particular challenges to the researcher. 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 Meulenberg-Buskens (1997) as being imperative to assure quality in qualitative research being undertaken. Checkland (1989:152), supports this view, but extends the concept to the opinion that: "The researcher becomes a participant in the action, and the process of change itself becomes the subject of research".

4.9 SURVEY DESIGN

Hussey and Hussey (1997), are of the opinion 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."

The survey design used in this instance was that of the descriptive survey as opposed to the analytical survey. The descriptive survey, according to Collis and Hussey (2003:60-66), is frequently used in business research in the form of attitude surveys. The descriptive survey as defined by Ghauri, Grønhaug and Kristianslund (1995:60), can 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.

According to Patel *et al.* (2005) (citing Leedy & Ormrod 2005), questionnaire construction is a demanding task, which requires not only methodological competence but also extensive experience with research in general and questioning techniques in particular.

The statements in the survey have been designed with the following principles in mind:

- 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, to determine if a paradigm shift occurred after the concept of "improving the quality of workmanship in the construction of elecetrical networks" was adopted.

4.10 THE VALIDATION SURVEY QUESTIONS

The author has developed four separate survey questionnaires. Because face-to-face interviews are highly structured, questions were prepared and piloted to ensure that they reflected a high degree of validity (Easterby-Smith, Thorpe & Lowe, 1996).

A questionnaire is a quantitative data collection method, which has several advantages, namely:

- It is relatively economical.
- It can ensure anonymity.
- It contains questions for specific purposes.
- Existing questionnaires can be used, or modified.

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

4.11 SURVEY QUESTIONS

4.11.1 Contractor Questionnaires

Question 1: Eskom and Government interventions provide value in contractor development. To what extent do you agree with this statement?

Question 2: Does Eskom provide clear instructions and communicate with the contractor throughout the duration of the project?

Question 3: Total Quality Management and ISO 9001:2008 standards add value to the contractor. To what extent do you agree with this statement?

Question 4: Eskom pays contractors at agreed times during the construction phase? To what extent do you agree with this statement?

Question 5: Eskom's procurement processes are transparent. To what extent do you agree with this statement?

Question 6: High Voltage System Operating Regulations are implemented effectively. To what extent do you agree with this statement?

Question 7: Eskom's training manuals are helpful and useful during construction. To what extent do you agree with this statement?

Question 8: Clerk of Works are always on site and are helpful for the contractors. To what extent do you agree with this statement?

Question 9: Eskom Policies, Standards, work instructions and procedures are conveniently available to contractors. To what extent do you agree with this statement?

Question 10: Construction Regulations provide clear guidelines during construction. To what extent do you agree with this statement?

Question 11: The Construction Industry Development Board is accessible and available to contractors. To what extent do you agree with this statement?

Question 12: Contractor Forums add value to my business development and operations. To what extent do you agree with this statement?

Question 13: My company works according to a certain procedure given by Eskom. To what extent do you agree with this statement?

Question 14: I know all the role players working with the contractors in the organisation. To what extent do you agree with this statement?

Question 15: The organisation communicates properly with the contractors, e.g. procedures, standards, requirements, completion dates, etc. To what extent do you agree with this statement?

4.11.2 Capital Programme Management Department Questionnaires

Question 1: Project Management carries out monthly inspections of all contractors performing work for Eskom Distribution in terms of the Construction Regulations, other Legislative requirements and Project Management requirements. To what extent do you agree with this statement?

Question 2: Project Management Clerk of works conducts a site visit on all contractors performing contracts under their control. Where there are deviations then non-conformances are issued to the offender and copies forwarded to all key role players. To what extent do you agree with this statement?

Question 3: On a monthly basis the Capital Programme department provides the Risk Management Coordinator responsible for contractor management with an updated list of all suppliers currently providing a service to Eskom Distribution. To what extent do you agree with this statement?

Question 4: Project Co-ordinators have been sufficiently trained and have sufficient experience to monitor and guide contractors on quality of workmanship. To what extent do you agree with this statement?

Question 5: Clerk of Works has been sufficiently trained and has sufficient experience to monitor and guide contractors on quality of workmanship. To what extent do you agree with this statement?

Question 6: Construction material always arrive on site in time and in correct quantity and quality. To what extent do you agree with this statement?

Question 7: All contractors are trained in material identification and material handling. To what extent do you agree with this statement?

Question 8: All contractors adhere to the prescribed procedures on material handling. To what extent do you agree with this statement?

Question 9: Contractors are given sufficient time to finish the projects on site. To what extent do you agree with this statement?

Question 10: All non-conformances are reported, recorded and followed up by the Project Co-ordinators and Clerk of Works. To what extent do you agree with this statement?

4.11.3 Technology & Quality Department Questionnaires

Question 1: The Technology & Quality department carries out periodic audits of all contractors performing work for Eskom Distribution in terms of the Construction Regulations, other Legislative requirements and Project Management requirements. To what extent do you agree with this statement?

Question 2: The Technology & Quality Department conducts site visits on all contractors performing contracts under their control. Where there are deviations then non-conformances are issued to the offender and copies forwarded to all key role players. To what extent do you agree with this statement?

Question 3: On a monthly basis the Technology & Quality department provides the Procurement and Capital Programme department the audit results from the contractors. To what extent do you agree with this statement?

Question 4: The Technology & Quality department conducts periodic quality audits on construction materials in the equipment stores .To what extent do you agree with this statement?

Question 5: The Technology & Quality department communicates regularly with the contractors to improve quality. To what extent do you agree with this statement?

Question 6: The Technology & Quality department participates in contractor related incident investigations. To what extent do you agree with this statement?

Question 7: The Technology & Quality department participates in the contractor selection process. To what extent do you agree with this statement?

Question 8: The Technology & Quality department monitors contractors during the execution of the project for conformance. To what extent do you agree with this statement?

Question 9: Contractors are given sufficient time to finish the projects on site. To what extent do you agree with this statement?

Question 10: All non-conformances are reported, recorded and followed up by the Technology and Quality department. To what extent do you agree with this statement?

4.11.4 Risk Management Department Questionnaires

Question 1: The Risk department carries out monthly inspections of all contractors performing work for Eskom Distribution in terms of the Construction Regulations, other Legislative requirements and Project Management requirements. To what extent do you agree with this statement?

Question 2: The Safety Co-ordinator conducts a site visit on all contractors performing contracts under their control. Where there are deviations then non-conformances are issued to the offender and copies forwarded to all key role players.

Question 3: On a monthly basis the Capital Programme department provides the Risk Management Coordinator responsible for contractor management with an updated list of all suppliers currently providing a service to Eskom Distribution. To what extent do you agree with this statement?

Question 4: Contractors always work according to Eskom Health and Safety Policy and procedures. To what extent do you agree with this statement?

Question 5: Each Contractor submits weekly Safety Health and Environment statistics. To what extent do you agree with this statement?

Question 6: Contractor employees are provided with safety induction and orientation training and records are kept. To what extent do you agree with this statement?

Question 7: Contractors keep and maintain minimum requirements for the first-aid box on site. To what extent do you agree with this statement?

Question 8: Contractors are working according to the approved written work safe procedures/task analyses and work instructions at all times. To what extent do you agree with this statement?

Question 9: Contractors are given sufficient time to finish the projects on site. To what extent do you agree with this statement?

Question 10: All non-conformances are reported, recorded and followed up by the Project Co-ordinators and Clerk of Works. To what extent do you agree with this statement?

4.12 CONCLUSION

In this chapter, the "integrated approach to improve quality in the construction of electrical networks" 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.
- Validation of survey questions
- Survey questions.

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

CHAPTER 5: DATA ANALYSIS AND INTERPRETATION OF RESULTS

5.1 INTRODUCTION

Data analysis is "the process of bringing order, structure and meaning to the mass of collected data" (de Vos, 2002:339). This chapter discusses the statistical analysis of the questionnaire that was used to collect the data. The aim of this study is to determine the causes of poor quality workmanship by contractors during the construction of electrical networks. The data obtained from the completed questionnaires will be presented and analysed in this chapter.

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,
- Description of the information that was collected (Descriptive Statistics); and
- Testing the assumptions made through hypothesis and modelling (Inferential Statistics).

The responses to the questionnaire developed by the researcher for the purpose of obtaining information regarding what causes a high rate of poor workmanship and quality in our networks; what are the causes of unnecessary delays in network building projects; whether contractors are trained, developed and competent to build networks; and whether contractors are made aware of standards and procedures that govern the design and building of networks; 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 given below. The responses to the questions 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. Validation should be addressed in the planning phases of the survey and when the questionnaire is developed. This questionnaire is supposed to measure what the primary causes of poor quality workmanship by contractors during the construction of electrical networks in ESKOM are.

5.2.2 Data Format

The data was received in questionnaires, which were coded and captured on a database that was developed on Microsoft Access for this purpose. These questionnaires were captured twice and then the two datasets were compared to make sure that the information was captured correctly. When the database was developed, use was made of rules with respect to the questionnaire that set boundaries for the different variables (questions). For instance the Likert scale could be 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 was set on Microsoft Access as less than 6. This meant if the number 6 or more than 6 was captured, an error would show until a number less than 6 was captured. It was then imported into SAS-format through the SAS ACCESS module. This information, which was double checked for correctness, was then analysed.

5.2.3 Preliminary Analysis

The reliability of the statements in the questionnaires was measured by using the Cronbach Alpha tests (See paragraph 5.3.1). A Uni-variate descriptive analysis was performed on all the original variables, displaying frequencies, percentages, cumulative frequencies, cumulative percentages, means, standard deviations, range, median, mode etc. These descriptive statistics are discussed in paragraphs 5.3.2 and 5.3.3. (See also computer printouts in Annexure B & C).

5.2.4 Inferential Statistics

Inferential statistics that were used were:

- 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". The construct was the hypothetical variables that were being measured (Cooper & Schindler, 2001:216-217). Another way to put it would be that Cronbach's alpha measures how well a set of items (or variables) measures a single uni-dimensional latent construct. When data has a multidimensional structure, Cronbach's Alpha will usually be low.
- Chi-square tests for nominal data. The Chi-square (two-sample) tests are probably the most widely used nonparametric test of significance that is useful for tests involving nominal data, but it can be used for higher scales as well, for instance in cases where persons, events or objects are grouped in two or more nominal categories such as "yes-no" or cases A, B, C or D. The technique is used to test for significant differences between the observed distribution of data among categories and the expected distribution based on the null hypothesis. It has to be calculated with actual counts rather than percentages (Cooper & Schindler, 2001:499).
- The SAS software computes a P-value (Probability value) that measures statistical significance when comparing variables with each other, determining relationships between variables or determining association between variables. Results will be regarded as significant if the p-values are smaller than 0.05, because this value presents an acceptable level on a 95% confidence interval

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

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

5.2.5 Assistance To Researcher

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

All inferential statistics are discussed in paragraph 5.3.4.

5.2.6 Sample

The target population was 121 contractors in Eskom and employees from 3 different departments namely:

- Capital Programme management
- Risk Management department

- Technology and quality.

A random sample of 35 was drawn from the target population of 121 contractors and the sample realisation was 28.

5.3 ANALYSIS

In total, 28 contractors completed the contractor questionnaire regarding the integrated approach to improve quality in the construction of electrical networks. Fifteen employees from 3 departments in Eskom also took part of the survey where questions about their environment were posed to them. Descriptive statistics were given for each variable and only the respondents who completed the entire questionnaire were utilised in the inferential statistics.

5.3.1 Reliability Testing

Reliability tests (Cronbach's Alpha Coefficient) were done on the questions/statements (which was the measuring instrument in this case) posed to all these respondents.

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

For instance, if statement Q08 was deleted from this measuring scale then the Cronbach Alpha Coefficient would increase to 0.6272. As this measuring instrument with all the items seemed not to be consistent, the items would be deleted until consistency was reached. Only the first iteration and last iteration of

this procedure will be shown in the tables, but all the statistics will be shown in Annexure A.

The Cronbach's Alpha Coefficients for the items listed in Annexure D table 5.2 were more than 0.70 (the acceptable level according to Nunnally, 1978:245), and thus the remaining items (statements) in the questionnaire, proved to be reliable and consistent for the items in the scale.

The Cronbach's Alpha Coefficients for the items listed in Annexure D table 5.3 were more than 0.70 (the acceptable level according to Nunnally, *1978:*245), and thus these items (statements) in the Capital Programme Management questionnaire proved to be reliable and consistent for the items in the scale.

The Cronbach's Alpha Coefficients for the items listed in Annexure D table 5.4 were less than 0.70 (the acceptable level according to Nunnally, *1978:* 245), and thus these items (statements) in the Risk Management questionnaire, proved to be unreliable and inconsistent for the items in the scale.

By deleting statement Q04 from the measuring scale, the Cronbach Alpha Coefficient increased to 0.6323. This proved to be still not enough and thus the items were deleted until consistency was reached. Only the first iteration and last iteration of this procedure are shown in the tables, but all the statistics are shown in Annexure A.

The Cronbach's Alpha Coefficients for the items listed in Annexure D table 5.5 were more than 0.70 (the acceptable level according to Nunnally, 1978:245), and thus the remaining items (statements) in the Risk Management questionnaire, proved to be reliable and consistent for the items in the scale.

The Cronbach's Alpha Coefficients for the items listed in Annexure D table 5.6 were less than 0.70 (the acceptable level according to Nunnally, 1978:245), and thus these items (statements) in the Technology and Quality Management questionnaire proved to be unreliable and inconsistent for the items in the scale.

By deleting statement Q05 from the measuring scale the Cronbach Alpha Coefficient increased to 0.7478. This proved to be still not enough and thus the items were deleted until consistency was reached. Only the first iteration and last iteration of this procedure are shown in the tables, but all the statistics are shown in Annexure A.

The Cronbach's Alpha Coefficients for the items listed in Annexure D table 5.7 were more than 0.70 (the acceptable level according to Nunnally, 1978:245), and thus the remaining items (statements) in the Technology and Quality Management questionnaire, proved to be reliable and consistent for the items in the scale.

5.3.2 Descriptive Statistics

Annexure D Table 5.8 shows the descriptive statistics for all the variables with the frequencies in each category and the percentage of total number of questionnaires. The descriptive statistics were based on the total sample. These descriptive statistics are also shown in Annexures B & C.

Because there were only 5 respondents from each department, the groups that meant more or less the same were aggregated. For instance "Strongly disagree" and "Disagree" were grouped together to form the category "Disagree to strongly disagree". Thus there are 3 categories: "Disagree to strongly disagree", "Undecided", and "Agree to strongly disagree".

When looking at the dispersion of values around the mean, one could get an idea of how the respondents answered. The higher the mean, the more the respondents disagreed with the statement, and the lower the mean, the more the respondents agreed with the statement.

5.3.3 Uni-Variate Graphs

5.3.3.1 Contractor questionnaire

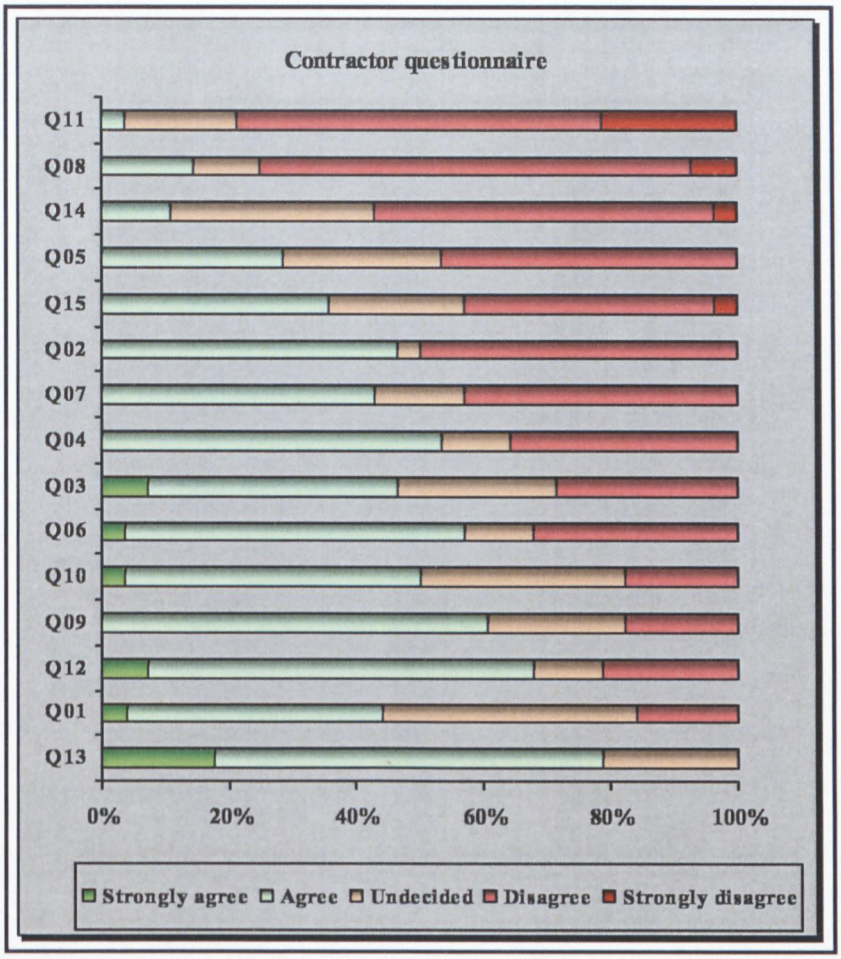

FIGURE 5. 1: Contractor questionnaire

The statements are sorted from the statement where the respondents mostly agreed, to the statement to those that they least agreed with. The respondents agreed least agreed with the following statements:

- Construction Industry Development Board is accessible and available to contractors. (3.6% agree to strongly agree).
- Clerk of Works is always on site and is helpful for the contractors. (14.3% agree to strongly agree).
- I know all the role players working with the contractor in the organisation. (10.7% agree to strongly agree).
- Eskom's procurement processes are transparent. (28.6% agree to strongly agree).

- The organisation communicates properly with the contractors, e.g. procedures, standards, requirements, completion dates, etc. (35.7% agree to strongly agree).
- Eskom provides clear instructions and communicates with the contractor throughout the duration of the project. (46.4% agree to strongly agree).

The respondents mostly agreed with the following statements:

- My company works according to a certain procedure given by Eskom. (78.6% agree to strongly agree).
- Contractor forums add value to my business development and operations. (67.9% agree to strongly agree).
- Eskom Policies, Standards, work instructions and procedures are conveniently available to contractors. (60.0% agree to strongly agree).

5.3.3.2 Capital Programme Management questionnaire

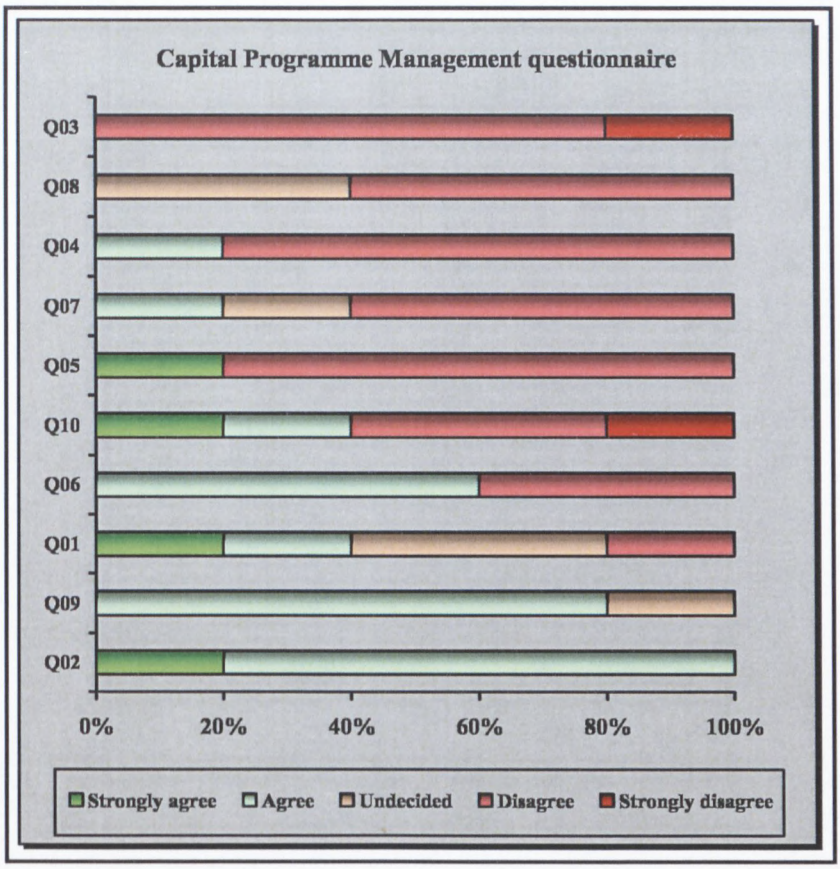

FIGURE 5. 2: Capital Programme Management questionnaire

The statements are sorted from the statements where the respondents mostly agreed, to the statements that they least agree with. The respondents agreed least with the following statements:

- On a monthly basis the Capital Programme department provides the Risk Management Co-ordinator responsible for contractor management with an updated list of all suppliers currently providing a service to Eskom Distribution. (0.0% agree to strongly agree).
- All contractors adhere to the prescribed procedures on material handling. (0.0% agree to strongly agree).
- Project co-ordinators have been sufficiently trained and have sufficient experience to monitor and guide contractors on quality of workmanship. (20.0% agree).
- All contractors are trained in material identification and material handling. (20.0% agree).

- Clerk of Works has been sufficiently trained and has sufficient experience to monitor and guide contractors on quality of workmanship. (20.0% strongly agree).

The respondents mostly agreed with the following statements:

- Project Management conducts a site visit on all contractors performing contracts under their control. Where there are deviations then non-conformances are issued to the offender and copies are forwarded to other all key role players. (100.0% agree to strongly agree).
- Contractors are given sufficient time to finish the projects on site. (80.0% agree to strongly agree).
- Construction material always arrives on site in time and in correct quantity and quality (60.0% agree).

5.3.3.3 Risk Management questionnaire

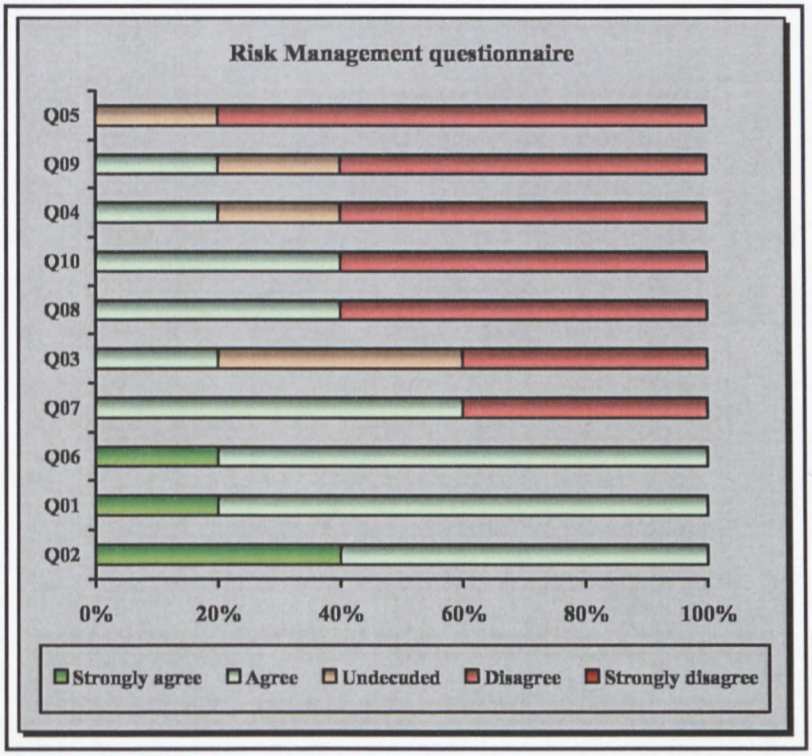

FIGURE 5. 3: Risk Management questionnaire

The statements are sorted from the statements where the respondents mostly agreed, to the statements that they least agree with. In the next graph it is shown that the respondents agreed least with the following statements:

- Each contractor submits weekly Safety Health and Environment statistics. (0.0% agree to strongly agree).
- Contractors are given sufficient time to finish the projects on site. (20.0% agree).
- Contractors always work according to Eskom Health and Safety Policy and procedures. (20.0% agree).

The respondents mostly agreed with the following statements:

- Safety Co-ordinator conducts a site visit on all contractors performing contracts under their control. Where there are deviations then non-conformances are issued to the offender and copies are forwarded to other all key role players. (100.0% agree to strongly agree).
- Risk department carries out monthly inspections of all contractors performing work for Eskom Distribution in terms of Construction regulations, other Legislative requirements and project management requirements. (100.0% agree to strongly agree).
- Contractor employees are provided with safety induction and orientation training and records are kept. (100.0% agree to strongly agree).
- Contractors keep and maintain minimum requirements for the first-aid box on site. (60.0% agree).

5.3.3.4 Technology & Quality Management questionnaire

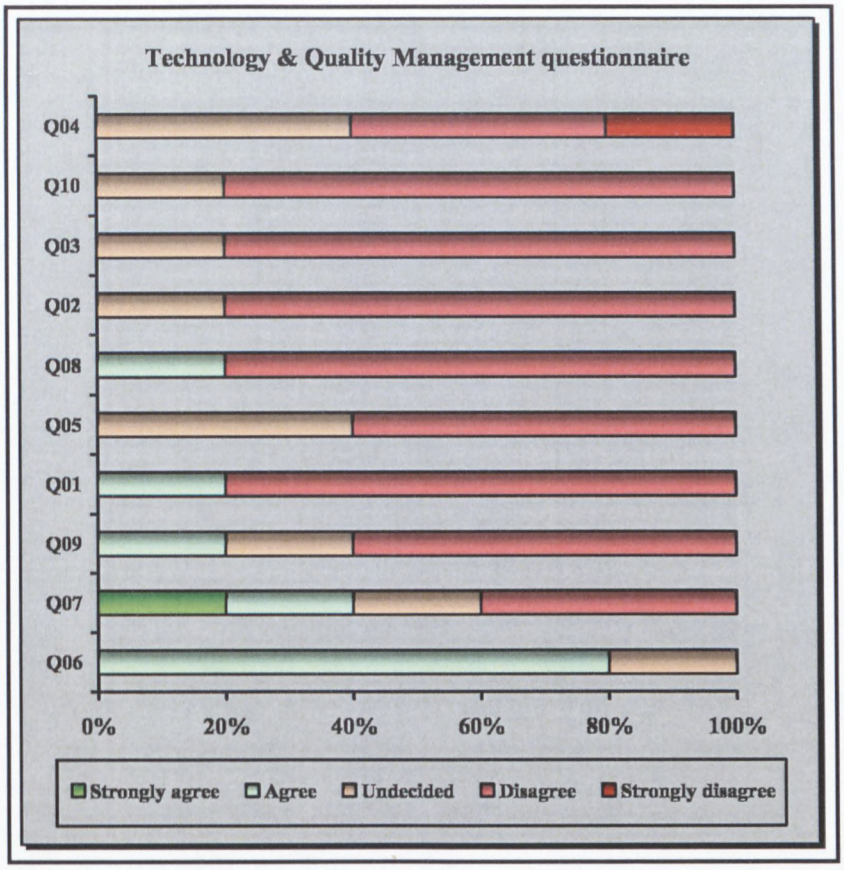

FIGURE 5. 4: Technology and Quality Management questionnaire

The statements are sorted from the statements where the respondents mostly agreed, to the statements that they least agreed with. The respondents agreed least with the following statements:

- The Technology and Quality department conducts periodic quality audits on construction materials in the stores. (0.0% agree to strongly agree).
- All non-conformances are reported, recorded and followed up by the Technology and Quality department. (0.0% agree to strongly agree).
- The Technology and Quality department conduct a site visit on all contractors performing contracts under their control. Where there are deviations then non-conformances are issued to the offender and copies are forwarded to other all key role players. (0.0% agree to strongly agree).

- On a monthly basis the Technology and Quality department provides the Procurement and Capital Programme the audit result from the contractors. (0.0% agree to strongly agree).
- The Technology and Quality department monitors contracts during the execution of the project for conformance. (20.0% agree).
- The Technology and Quality department communicates regularly with the contractors to improve quality. (0.0% agree to strongly agree)
- The Technology and Quality department carries out periodic audits of all contractors performing work for Eskom Distribution in terms of Construction regulations, other Legislative requirements and project management requirements. (20.0% agree).

The respondents mostly agreed with the following statement:

- The Technology and Quality department participates in contractor related incident investigations. (80.0% agree).

5.3.4 Inferential Statistics

The Pearson chi-square test was used to determine whether there were statistically significant differences in the proportion of respondents who agreed or disagreed on the statements for the contractor questionnaire. The following table will show where statistically significant differences of proportions occurred. Annexure B will show all the chi-square tests. Because an expected frequency of 5 is necessary to use the Chi-square test, the groups that meant more or less the same were aggregated. For instance "Strongly disagree" and "Disagree" are grouped together to form the category "Disagree". Thus with only 3 categories "Disagree", "Undecided" and "Agree", the expected frequency would be 28/3=9.33, which is more than 5.

The hypotheses being tested were as follows:

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

- H_1 = There is a difference between the proportions of responses with regard to the measuring instrument.

For all above-mentioned statements in the table, the H_0 hypothesis was rejected and it could be concluded that there was a difference between the proportions. Thus for the following statements there were statistically significantly more respondents who agreed to strongly agreed with the statement than those who were either undecided or disagreed to strongly disagreed:

- My company works according to a certain procedure given by Eskom. (78.6% agree to strongly agree and 21.4% is undecided).
- Contractor Forums add value to my business development and operations. (67.9% agree to strongly agree, 10.7% is undecided and 21.4% disagree to strongly disagree).
- Eskom policies, standards, work instructions and procedures are conveniently available to contractors. (60.7% agree to strongly agree, 21.4% is undecided and 17.9% disagree to strongly disagree).
- High Voltage System Operating Regulations are implemented effectively. (57.1% agree to strongly agree, 10.7% is undecided and 32.1% disagree to strongly disagree).
- Eskom pay contractors in agreed times during the construction phase. (53.6% agree to strongly agree, 10.7% is undecided and 35.7% disagree to strongly disagree).

Statistically significantly more respondents disagreed to strongly disagreed with the following statements:

- Clerk of Works is always on site and is helpful for the contractors. (14.3% agree to strongly agree, 10.7% is undecided and 75.0% disagree to strongly disagree).
- Construction Industry Development Board is accessible and available to contractors. (3.6% agree to strongly agree, 17.9% is undecided and 78.6% disagree to strongly disagree).
- I know all the role players working with the contractors in the organisation. (10.7% agree to strongly agree, 32.1% is undecided and 57.1% disagree to strongly disagree).

For the statement "Eskom provides clear instructions and communication with the contractor through out the duration of the project" (46.2% agreed to strongly agreed, 3.6% undecided and 50.0% disagreed to strongly disagreed); there were statistically significantly fewer respondents who were undecided than disagreed or agreed (the proportion of respondents who disagreed was not statistically significant, unlike the proportion of respondents who agreed).

No statistical tests were performed on the Capital Programme Management questionnaire, Risk Management questionnaire and Technology and Quality Management questionnaire as there were not enough respondents to do these tests.

5.4 DISCUSSION AND CONCLUSIONS

As for the results obtained through this survey on whether poor quality workmanship during the construction of electrical networks by contractors is the cause of poor performance of electricity networks leading to a loss of power and associated loss of revenue to the country, the following analogies can be drawn from this research:

- Construction Industry Development Board is not accessible and available to contractors.
- Clerk of Works is not always on site and is helpful for the contractors.
- I do not know all the role players working with the contractor in the organisation.
- Eskom does not provide clear instructions and communicate with the contractor throughout the duration of the project.
- The contractor companies work according to certain procedures given by Eskom.
- Contractor forums add value to the contractor company's business development and operations.
- Eskom Policies, Standards, work instructions and procedures are conveniently available to contractors.
- High Voltage System Operating Regulations are implemented effectively.
- Eskom pay contractors at agreed times during the construction phase.

With respect to the Capital Programme Management, the following analogies can be drawn:

- On a monthly basis the Capital Programme department does not provide the Risk Management Co-ordinator responsible for contractor management with an updated list of all suppliers currently providing a service to Eskom Distribution.
- All contractors do not adhere to the prescribed procedures on material handling.
- Project co-ordinators have not been sufficiently trained and have not sufficient experience to monitor and guide contractors on quality of workmanship.
- All contractors are not trained in material identification and material handling.
- Clerk of Works has not been sufficiently trained and does not have sufficient experience to monitor and guide contractors on quality of workmanship.
- Project Management conducts a site visit on all contractors performing contracts under their control. Where there are deviations then non-conformances are issued to the offender and copies are forwarded to other all key role players.
- Contractors are given sufficient time to finish the projects on site.
- Construction material always arrives on site in time and in correct quantity and quality.

With respect to Risk Management, the following analogies can be drawn:

- Each contractor does not submit weekly Safety Health and Environment statistics.
- Contractors are not given sufficient time to finish the projects on site.
- Contractors do not always work according to Eskom Health and Safety Policy and procedures.
- Safety Co-ordinator conducts a site visit on all contractors performing contracts under their control. Where there are deviations then non-conformances are issued to the offender and copies are forwarded to other all key role players.

- Risk department carries out monthly inspections of all contractors performing work for Eskom Distribution in terms of Construction regulations, other Legislative requirements and project management requirements.
- Contractor employees are provided with safety induction and orientation training and records are kept
- Contractors keep and maintain minimum requirements for the first aid box on site.

With respect to the Technology and Quality Management the following analogies can be drawn:

- The Technology and Quality department does not conduct periodic quality audits on construction materials in the stores.
- All non-conformances are not reported, recorded and followed up by the Technology and Quality department.
- The Technology and Quality department does not conduct a site visit on all contractors performing contracts under their control. Where there are deviations then non-conformances are not issued to the offender and copies are not forwarded to other all key role players.
- On a monthly basis the Technology and Quality department does not provide the Procurement and Capital Programme the audit result from the contractors.
- The Technology and Quality department does not monitor contracts during the execution of the project for conformance.
- The Technology and Quality department does not communicate regularly with the contractors to improve quality.
- The Technology and Quality department does not carry out periodic audits of all contractors performing work for Eskom Distribution in terms of Construction regulations, other Legislative requirements and project management requirements.
- The Technology and Quality department participates in contractor related incident investigations.

The contractors and the different departments do not seem to see eye to eye with regard to certain aspects in this study. However, to test it statistically it is necessary to pose the exact same questions to the respondents, so that the answers

in the different groups can be compared. Thus the conclusions are made per group as they answered the different questions.

CHAPTER 6: RECOMMENDATIONS AND CONCLUSION

6.1 INTRODUCTION

In this research the causes of poor quality workmanship by the contractors during the construction of network infrastructure was investigated. The impact that the contractors have on the network's performance and the reliability of the supply has been elaborated on. The quality of workmanship and the best practices that the contractors provide during the construction phase and the impact on the performance of the network have been examined.

6.2 RESEARCH PROBLEM STATEMENT REVISITED

The research problem statement in this research reads as follows: Poor quality workmanship during the construction of electrical networks by contractors is the cause of poor performance of electricity networks leading to a loss of power and associated loss of revenue to the country.

6.3 RESEARCH QUESTION REVISITED

The research question for this research was: 'What are the primary causes of poor quality workmanship by the contractors during the construction of electrical networks?'

6.4 INVESTIGATIVE SUB-QUESTIONS REVISITED

The investigative questions for this research in support of the research question, were as follows:

- What causes a high rate of poor workmanship and quality on our networks?
- What are the causes of unnecessary delays in network building projects?
- Are contractors trained, develop and competent to build networks?

- Are contractors made aware of standards and procedures that govern the design and building of networks?

6.5 PRIMARY RESEARCH OBJECTIVES REVISITED

The objectives of the proposed research were to:

- Improve the quality of workmanship of the contractors.
- Improve the projects' lead times during construction.
- Investigate contractor development initiatives.

6.6 RESEARCH FINDINGS AND RECOMMENDATIONS

From the research problem statement which stated that "Poor quality workmanship during the construction of electrical networks by contractors is the cause of poor performance of electricity networks leading to a loss of power and associated loss of revenue to the country". In an effort to solve the problem statement, the research question was asked, "What are the primary causes of poor quality workmanship by the contractors during the construction of electrical networks?" and investigative sub-questions were asked. Survey questionnaires were developed in support of the research question and investigative sub-questions. The major findings from Chapter 5 which were listed by the contractors and the three Eskom departments involved in the research are as follows.

6.6.1 Contractors' Major Findings and Recommendations

The statements are sorted from the statements that the contractors mostly disagreed with. The contractors agreed least with the following statements:

- **Construction Industry Development Board is accessible and available to contractors**. The Construction Industry Development Board (CIDB) (Act South Africa Government Gazette, 2000), was passed to establish a statutory body aimed at driving an integrated construction industry development strategy (Marx, 2009:1). One of the objectives of this research was to

investigate the contractor development initiatives, to see if the CIDB body that is mandated by the government to facilitate the development of contractors is accessible to the contractors. If not, then Eskom has to step in and assist the contractors in this regard. Eskom should investigate if an office in the Procurement Department or Capital Program Department should be established to be a link between the contractors and Eskom.

- **Clerk of Works is always on site and is helpful for the contractors**. The purpose of the Clerk of Works is to provide an effective site project quality service to support the Officer Project Management (Quality Control) and Manager Programme Management or Project Coordinator Engineering in order to ensure that all allocated projects are completed within the time, cost and quality criteria as stipulated in the contractual agreement. The Clerk of Works is the eyes and ears of Eskom and the link between Eskom and contractors during the construction phase. The Clerk of Work's function is to ensure that quality requirements are adhered to during the construction phase and if there are deviations, corrections are implemented with minimal delays. The Clerk of Works is there to ensure that the correct material is issued, used, handled, stored correctly, and delivered in time to site.

- **I know all the role players working with the contractor in the organisation**. Contractors should be inducted and a list of all role players and their functions, in order to minimise the delays in trying to find the right person for the query. Contractors should be given a clear reporting structure with details of who is responsible for which area of responsibility. Eskom should communicate this through its forums, meetings and procedures to contractors. Systems should be put in place to manage the communications between Eskom and the contractors, stipulating requirements for managing the contractors and clarifying all the roles and responsibilities for all departments involved.

- **Eskom's procurement processes are transparent**. King 3's report on corporate governance states that successful companies recognise that the principle of transparency in reporting sustainability (commonly but incorrectly

referred to as "non-financial") information is a critical element of effective reporting. The key consideration is whether the information provided has allowed stakeholders to understand the key issues affecting the company, as well as the effect the company's operation has had on the economic, social and environmental wellbeing of the community, both positively and negatively. In order to effectively communicate and engage with stakeholders, information should be shared openly and transparently. This will engender a relationship based on trust, and will serve to enhance the standing of the company in society. Obviously, this does not include a company's confidential information. This is important because the organisation should ensure that the trust and confidence of the stakeholders in the company are maintained. Stakeholders include suppliers and contractors as well. It is in the interest of Eskom to be transparent to contractors with procurement processes. Eskom should develop a communication process/procedure that will ensure that procurement processes are clearly stipulated and understood by contractors.

- **The organisation communicates properly with the contractors, e.g. procedures, standards, requirements, completion dates, etc**. ISO 9001:2008 clause 7.2.3 states that the organisation shall determine and implement effective arrangements for communicating with customers in relation to product information, enquiries, contracts, order handling, including amendments and customer feedback including customer complaints. Eskom should develop a communication strategy with the contractors to improve the communication between it and the contractors.

6.6.2 Capital Programme Department Major Findings and Recommendations

The statements are selected from the statements where the Capital Program Department mostly disagree with. The respondents agreed least with the following statements:

- **On a monthly basis the Capital Programme department provides the Risk Management Co-ordinator responsible for contractor management with**

an updated list of all suppliers currently providing a service to Eskom Distribution. The Capital Programme department in conjunction with the Procurement department should put systems in place with the list of contractors that will track contractors' standings with the requirements, and present their qualifications for every stakeholder to view.

- **All contractors adhere to the prescribed procedures on material handling.** ISO 9001:2008 clause 7.5.5 states that the organisation shall preserve the product during internal processing and delivery to the intended destination in order to maintain conformity to requirements. As applicable, preservation should include identification, handling, packaging, storage and protection. Preservation should also apply to the constituent parts of the product. Eskom must send out a clear massage on the importance and consequences of material handling. Material handling has an impact on how the product will perform during operations and there are guarantees and warranties that need to be taken into consideration. Original equipment manufacture (O.E.M) handling procedures must be adhered to at all times. The Clerk of work and the Technology and Quality department must be in the forefront in implementing and monitoring how the material is preserved.

- **Project Co-ordinators have been sufficiently trained and have sufficient experience to monitor and guide contractors on quality of workmanship.** The purpose of a Project Co-ordinator is to provide an effective site contract management service in order to support the Middle Manager Programme Management, in order to ensure that all capital projects are completed on time, with cost and quality constraints, while optimising all resources used. Effective site contract management must be achieved by providing regular progress reports (site meetings, submission of required reports, regular visits to construction sites and regular verbal reports to the Programme Manager. Especially concerning variations on scheduled activities including expenditure), chairs site meetings as delegated, assists the Middle Manager Programme Management in the valuation of offers for variation orders or additional work, ensures that contractors submit offers for claims or extra work in reasonable time. ISO 9001:2008 clause 6.2 states that personnel

performing work affecting product quality shall be competent on the basis of appropriate education, training, skills and experience. Clause 6.2.2 on competence, awareness and training states that the organization shall determine the necessary competence for personnel performing work affecting product quality, provide training or take other actions to satisfy these needs, evaluate the effectiveness of the actions taken, ensure that its personnel are aware of the relevance and importance of their activities and how they contribute to the achievement of the quality objectives and maintain appropriate records of education, training, skills and experience. Due to the high staff turn over in the organisation, Eskom must develop a Project Co-ordinator development plan to fast-track the development of Project Co-ordinators to meet the demand and uphold the integrity of Project Co-ordinators.

- **All contractors are trained in material identification and material handling.** Material handling has an impact on how the product will perform during operations, and there are guarantees and warranties that need to be taken into consideration. Original Equipment Manufacture (O.E.M) handling procedures must be adhered to at all times,; the Clerk of work and Technology and Quality department must be in the forefront in implementing and monitoring how the material is preserved. A training programme must be developed for all contractors in the organisation to address the material handling problem.

- **The Clerk of Works has been sufficiently trained and has sufficient experience to monitor and guide contractors on quality of workmanship.** The same approach proposed here for Project co-ordinators should be applied to Clerk of Works as well. Training and development programmes to accelerate the development of Clerk of Works to meet the growing demand should be investigated, developed and implemented.

6.6.3 Risk Management Department Major Findings and Recommendations

The statements are selected from the statements that the Risk Management Department mostly disagreed with.

- **Each contractor submits weekly Safety Health and Environment statistics.** Eskom reports on the safety performance of the organisation, and contractor statistics are included in the safety health and environment (SHE) statistics report. For accuracy and reliability of the reports, the contractors must submit their weekly SHE statistic reports.

- **Contractors are given sufficient time to finish the projects on site.** The contractors and Eskom departments do not see eye to eye when it comes to agreeing on the time frames during the construction phase. Eskom thinks the contractors are delaying the process and the contractors think Eskom is imposing unrealistic project times. The contractors maintain that Eskom is the cause of the delays. Material arrives late on site, wrong material is ordered by Eskom, drawings are incorrect, materials are taken away from site by Eskom to other projects leaving the project the material was ordered originally without material, and the project scope changes without proper consultation with the contractor. These are all complaints one will get from the contractors. Project Co-ordinators, Clerk of Works and contractors must improve the management of projects through basic principles of project management to avoid all the unnecessary time-wasting activities during construction.

- **Contractors always work according to Eskom Health and Safety Policy and procedures.** Occupational health and safety is a cross-disciplinary area concerned with protecting the safety, health and welfare of people engaged in work or employment. The goal of all occupational health and safety programmes is to foster a safe work environment. As a secondary effect, it may also protect co-workers, family members, employers, customers, suppliers, nearby communities, and other members of the public who are

impacted by the workplace environment. It is a requirement that all contractors must work according to the Health and Safety Policy. The Risk Management department must enforce this requirement as it is also a regulatory requirement.

6.6.4 Technology and Quality Department Major Findings and Recommendations

The statements are selected from the statements that the Technology and Quality Department mostly disagreed with. The respondents least agreed with the following statements:

- **Technology and Quality department conducts periodic quality audits on construction materials in the stores.** To ensure that the preservation of construction material in the material stores is adhered to and to comply with ISO 9001:2008 clause 7.5.5, the Technology and Quality Department must conduct periodic quality audits on the material. The Technology and Quality Department should develop and maintain an audit programme for the material stores, which should be risk-based to ensure that high-risk materials are prioritised. These periodic audits should include identification, handling, packaging, storage and protection.

- **All non-conformances are reported, recorded and followed up by the Technology and Quality department.** ISO 9001:2008 clause 8.3 states that the organisation shall ensure that a product which does not conform to product requirements is identified and controlled to prevent its unintended use or delivery. The controls and related responsibilities and authorities for dealing with nonconforming products should be defined in a documented procedure. The organization should deal with nonconforming product in one or more of the following ways: by taking action to eliminate the detected nonconformity; 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. Records of the nature of

nonconformities and any subsequent actions taken, including concessions obtained, should be maintained. The Technology and Quality department should develop and maintain a non-conformance management system that will be accessible to other role-players for managing the non-conformances and producing reports on contractor performances.

- **The Technology and Quality department conducts a site visit on all contractors performing contracts under their control. Where there are deviations then non-conformances are issued to the offender and copies are forwarded to other all key role players**. The Technology and Quality Department, Clerk of Works and Risk Management Department should develop and maintain a site visit programme for all the contractors performing work for Eskom to ensure that all the quality-related issues are addressed.

- **On a monthly basis the Technology and Quality department provides the Procurement and Capital Programme the audit result from the contractors.** Technology and Quality Department should develop and maintain an audit programme and management system for the contractor. This programme should be risk-based to ensure that the high-risk contractors are prioritised. This audit management should be able to produce audit results to be distributed to other departments as per requirement.

- **The Technology and Quality department monitors contracts during the execution of the project for conformance.** The Technology and Quality Department, Clerk of Works and Risk Management Department should develop and maintain a site visit programme for all the contractors performing work for Eskom. Systems should be put in place for monitoring and appraisal of contractor performance. There should be regular review meetings, KPI/payment mechanisms, joint business planning, improved communication and common goals.

- **The Technology and Quality department communicates regularly with the contractors to improve quality.** The Technology and Quality department in conjunction with the Capital Programme department and Risk Management

department should develop a communication strategy in line with the requirements of ISO 9001:2008 clause 7.2.3. Systems should be put in place to manage the communications between Eskom and the contractors. There are various opportunities for organisations to increase value through working with their suppliers and partners, such as establishing two-way communication at appropriate levels in both organisations to facilitate the rapid solution of problems, and to avoid costly delays or disputes (ISO 9004:2000, 2000:19).

- **The Technology and Quality department carries out periodic audits of all contractors performing work for Eskom Distribution in terms of Construction regulations, other Legislative requirements and project management requirements.** The Technology and Quality Department, Clerk of Works and Risk Management Department should develop and maintain a site-visit programme for all the contractors performing work for Eskom. Systems should be put in place for monitoring and appraisal of contractor performance. There should be regular review meetings, KPI/payment mechanisms, joint business planning, improved communication, and common goals

6.7 CONCLUSION

The contractors and the different departments do not seem to see eye to eye with regard to certain aspects in this study. Thus the conclusions are made per group as they answered different questions. There is misunderstanding and pointing of fingers from all stakeholders involved in project management and construction.

Based on the results and analysis from Chapter 5, Eskom Distribution Western Region should set up a structure "committee" with necessary skills and powers to deal with the whole contractor management in the region. The committee should be able to perform supplier analysis in terms of strengths, weaknesses, opportunities and threats of the supplier (Ostring, 2004:42).

A more in-depth study to investigate all the findings highlighted in this study is recommended by the researcher. The objectives of this study have been met.

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Annexure A

Cronbach Alpha Coefficients

Contractor survey

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum	Label
Q01	28	2.82143	0.86297	79.00000	1.00000	4.00000	Q01
Q02	28	3.03571	0.99934	85.00000	2.00000	4.00000	Q02
Q03	28	2.75000	0.96705	77.00000	1.00000	4.00000	Q03
Q04	28	2.82143	0.94491	79.00000	2.00000	4.00000	Q04
Q05	28	3.17857	0.86297	89.00000	2.00000	4.00000	Q05
Q06	28	2.71429	0.97590	76.00000	1.00000	4.00000	Q06
Q07	28	3.00000	0.94281	84.00000	2.00000	4.00000	Q07
Q08	28	3.67857	0.81892	103.00000	2.00000	5.00000	Q08
Q09	28	2.57143	0.79015	72.00000	2.00000	4.00000	Q09
Q10	28	2.64286	0.82616	74.00000	1.00000	4.00000	Q10
Q11	28	3.96429	0.74447	111.00000	2.00000	5.00000	Q11
Q12	28	2.46429	0.92224	69.00000	1.00000	4.00000	Q12
Q13	28	2.03571	0.63725	57.00000	1.00000	3.00000	Q13
Q14	28	3.50000	0.74536	98.00000	2.00000	5.00000	Q14
Q15	28	3.10714	0.95604	87.00000	2.00000	5.00000	Q15

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.551966
Standardized	0.550201

Cronbach Coefficient Alpha with Deleted Variable

Deleted Variable	Raw Variables: Correlation with Total	Raw Variables: Alpha	Standardized Variables: Correlation with Total	Standardized Variables: Alpha	Label
Q01	0.208325	0.533510	0.194684	0.534227	Q01
Q02	0.405896	0.486792	0.424707	0.486621	Q02
Q03	-.112188	0.600009	-.114444	0.592298	Q03
Q04	0.328029	0.507124	0.320809	0.508606	Q04
Q05	0.288466	0.517555	0.285266	0.515943	Q05
Q06	0.275175	0.518555	0.298971	0.513125	Q06
Q07	0.000000	0.576564	0.025788	0.566765	Q07
Q08	-.343595	0.627185	-.342609	0.631106	Q08
Q09	-.062296	0.580228	-.065287	0.583497	Q09
Q10	0.353054	0.505802	0.350855	0.502331	Q10
Q11	0.533326	0.476650	0.517435	0.466311	Q11
Q12	0.297549	0.514410	0.304355	0.512014	Q12
Q13	0.377900	0.510598	0.358197	0.500787	Q13
Q14	0.031242	0.563239	0.002350	0.571124	Q14
Q15	0.622389	0.435584	0.625936	0.441701	Q15

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.627185
Standardized	0.631106

Cronbach Coefficient Alpha with Deleted Variable

Deleted Variable	Raw Variables: Correlation with Total	Raw Variables: Alpha	Standardized Variables: Correlation with Total	Standardized Variables: Alpha	Label
Q01	0.203927	0.618098	0.190934	0.624633	Q01
Q02	0.461332	0.569559	0.482095	0.575648	Q02
Q03	-.083251	0.668354	-.083664	0.666559	Q03
Q04	0.370635	0.588809	0.366311	0.595707	Q04
Q05	0.249727	0.610688	0.244513	0.615978	Q05
Q06	0.266232	0.608079	0.288678	0.608724	Q06
Q07	-.023541	0.657307	-.000649	0.654304	Q07
Q09	-.005341	0.647345	-.004472	0.654876	Q09
Q10	0.337568	0.596828	0.334759	0.601039	Q10
Q11	0.556044	0.566233	0.543823	0.564634	Q11
Q12	0.335306	0.595651	0.344379	0.599419	Q12
Q13	0.393679	0.594683	0.377040	0.593881	Q13
Q14	0.034843	0.640280	0.007545	0.653075	Q14
Q15	0.636940	0.535624	0.641773	0.546687	Q15

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.668354
Standardized	0.666559

Cronbach Coefficient Alpha with Deleted Variable

Deleted Variable	Raw Variables: Correlation with Total	Raw Variables: Alpha	Standardized Variables: Correlation with Total	Standardized Variables: Alpha	Label
Q01	0.225332	0.660933	0.209732	0.661356	Q01
Q02	0.533789	0.606828	0.544621	0.608187	Q02
Q04	0.275652	0.653884	0.281155	0.650516	Q04
Q05	0.238666	0.658945	0.234082	0.657690	Q05
Q06	0.344658	0.642216	0.357971	0.638560	Q06
Q07	-.039213	0.703041	-.014799	0.693748	Q07
Q09	0.041805	0.684510	0.038097	0.686342	Q09
Q10	0.353606	0.641895	0.348622	0.640032	Q10
Q11	0.502186	0.623052	0.492757	0.616818	Q11
Q12	0.361539	0.639579	0.367165	0.637108	Q12

Q13	0.456066	0.633937	0.434804	0.626286	Q13
Q14	0.009942	0.686757	-.014856	0.693756	Q14
Q15	0.631404	0.590168	0.635511	0.592701	Q15

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.703041
Standardized	0.693748

Cronbach Coefficient Alpha with Deleted Variable

Deleted Variable	Raw Variables Correlation with Total	Raw Variables Alpha	Standardized Variables Correlation with Total	Standardized Variables Alpha	Label
Q01	0.246834	0.697281	0.230077	0.689322	Q01
Q02	0.588704	0.640561	0.595959	0.632743	Q02
Q04	0.243638	0.699262	0.252778	0.686014	Q04
Q05	0.250905	0.696708	0.246144	0.686983	Q05
Q06	0.421092	0.670829	0.428900	0.659450	Q06
Q09	-.024274	0.729871	-.023131	0.724501	Q09
Q10	0.267034	0.694051	0.269082	0.683622	Q10
Q11	0.461732	0.669115	0.455970	0.655224	Q11
Q12	0.432431	0.669442	0.433535	0.658729	Q12
Q13	0.501205	0.668539	0.479977	0.651443	Q13
Q14	-.010017	0.726080	-.033532	0.725881	Q14
Q15	0.691448	0.623693	0.692133	0.616677	Q15

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.729871
Standardized	0.724501

Cronbach Coefficient Alpha with Deleted Variable

Deleted Variable	Raw Variables Correlation with Total	Raw Variables Alpha	Standardized Variables Correlation with Total	Standardized Variables Alpha	Label
Q01	0.279582	0.723827	0.266450	0.719664	Q01
Q02	0.562199	0.679512	0.568943	0.675040	Q02
Q04	0.229681	0.732718	0.238001	0.723625	Q04
Q05	0.280968	0.723637	0.279866	0.717782	Q05
Q06	0.438927	0.700727	0.449202	0.693260	Q06
Q10	0.252510	0.726855	0.253417	0.721483	Q10
Q11	0.448159	0.702276	0.441400	0.694421	Q11
Q12	0.480562	0.694454	0.487185	0.687560	Q12
Q13	0.473690	0.702468	0.448756	0.693326	Q13
Q14	0.030506	0.750917	0.010911	0.753865	Q14
Q15	0.675707	0.661070	0.676708	0.657999	Q15

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.750917
Standardized	0.753865

Cronbach Coefficient Alpha with Deleted Variable

Deleted Variable	Raw Variables Correlation with Total	Raw Variables Alpha	Standardized Variables Correlation with Total	Standardized Variables Alpha	Label
Q01	0.230851	0.755404	0.208811	0.762050	Q01
Q02	0.579173	0.702970	0.587533	0.708481	Q02
Q04	0.167489	0.766967	0.165310	0.767756	Q04
Q05	0.271343	0.750000	0.268158	0.754120	Q05
Q06	0.505785	0.715764	0.525869	0.717692	Q06
Q10	0.267286	0.749813	0.270639	0.753784	Q10
Q11	0.474560	0.723810	0.472653	0.725485	Q11
Q12	0.485192	0.719483	0.492043	0.722662	Q12
Q13	0.544442	0.719374	0.535481	0.716269	Q13
Q15	0.674547	0.687627	0.674378	0.695173	Q15

Capital Programme Management survey

---------- GRP=Capital Programme Management ----------

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum	Label
Q01	5	2.60000	1.14018	13.00000	1.00000	4.00000	Q01
Q02	5	1.80000	0.44721	9.00000	1.00000	2.00000	Q02
Q03	5	4.20000	0.44721	21.00000	4.00000	5.00000	Q03
Q04	5	3.60000	0.89443	18.00000	2.00000	4.00000	Q04
Q05	5	3.40000	1.34164	17.00000	1.00000	4.00000	Q05
Q06	5	2.80000	1.09545	14.00000	2.00000	4.00000	Q06
Q07	5	3.40000	0.89443	17.00000	2.00000	4.00000	Q07
Q08	5	3.60000	0.54772	18.00000	3.00000	4.00000	Q08
Q09	5	2.20000	0.44721	11.00000	2.00000	3.00000	Q09
Q10	5	3.20000	1.64317	16.00000	1.00000	5.00000	Q10

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.912698
Standardized	0.929758

Cronbach Coefficient Alpha with Deleted Variable

Deleted Variable	Raw Variables: Correlation with Total	Raw Variables: Alpha	Standardized Variables: Correlation with Total	Standardized Variables: Alpha	Label
Q01	0.769873	0.898342	0.795788	0.918846	Q01
Q02	0.892218	0.904737	0.852074	0.915852	Q02
Q03	0.345101	0.919045	0.317196	0.942699	Q03
Q04	0.877746	0.893069	0.852074	0.915852	Q04
Q05	0.860396	0.892761	0.852074	0.915852	Q05
Q06	0.626452	0.907849	0.688750	0.924428	Q06
Q07	0.965546	0.888015	0.952873	0.910387	Q07
Q08	0.828214	0.903373	0.809588	0.918116	Q08
Q09	0.425632	0.916998	0.386410	0.939422	Q09
Q10	0.778474	0.908286	0.797041	0.918780	Q10

Risk Management survey

GRP=Risk Management

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum	Label
Q01	5	1.80000	0.44721	9.00000	1.00000	2.00000	Q01
Q02	5	1.60000	0.54772	8.00000	1.00000	2.00000	Q02
Q03	5	3.20000	0.83666	16.00000	2.00000	4.00000	Q03
Q04	5	3.40000	0.89443	17.00000	2.00000	4.00000	Q04
Q05	5	3.80000	0.44721	19.00000	3.00000	4.00000	Q05
Q06	5	1.80000	0.44721	9.00000	1.00000	2.00000	Q06
Q07	5	2.80000	1.09545	14.00000	2.00000	4.00000	Q07
Q08	5	3.20000	1.09545	16.00000	2.00000	4.00000	Q08
Q09	5	3.40000	0.89443	17.00000	2.00000	4.00000	Q09
Q10	5	3.20000	1.09545	16.00000	2.00000	4.00000	Q10

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.559611
Standardized	0.601876

Cronbach Coefficient Alpha with Deleted Variable

Deleted Variable	Raw Variables: Correlation with Total	Raw Variables: Alpha	Standardized Variables: Correlation with Total	Standardized Variables: Alpha	Label
Q01	0.061314	0.566729	0.231950	0.586648	Q01
Q02	0.570282	0.477876	0.744129	0.452078	Q02
Q03	-.081325	0.616667	0.207365	0.592412	Q03
Q04	-.120824	0.632299	-.296456	0.697893	Q04
Q05	0.061314	0.566729	0.231950	0.586648	Q05
Q06	0.553303	0.495763	0.421565	0.540119	Q06
Q07	0.162938	0.567478	-.004856	0.639704	Q07
Q08	0.444262	0.461842	0.744129	0.452078	Q08
Q09	0.472595	0.463235	0.241857	0.584308	Q09
Q10	0.626224	0.383824	0.432541	0.537311	Q10

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.632299
Standardized	0.697893

Cronbach Coefficient Alpha with Deleted Variable

Deleted Variable	Raw Variables: Correlation with Total	Raw Variables: Alpha	Standardized Variables: Correlation with Total	Standardized Variables: Alpha	Label
Q01	0.155043	0.632967	0.309212	0.684436	Q01
Q02	0.753497	0.534045	0.882786	0.560821	Q02
Q03	0.119280	0.650407	0.388371	0.668991	Q03
Q05	0.155043	0.632967	0.309212	0.684436	Q05
Q06	0.659380	0.566460	0.495678	0.647257	Q06
Q07	0.000000	0.704000	-.129595	0.761510	Q07
Q08	0.665410	0.481928	0.882786	0.560821	Q08
Q09	0.266076	0.616941	0.076582	0.727043	Q09
Q10	0.478947	0.552995	0.310697	0.684150	Q10

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.704000
Standardized	0.761510

Cronbach Coefficient Alpha with Deleted Variable

Deleted Variable	Raw Variables: Correlation with Total	Raw Variables: Alpha	Standardized Variables: Correlation with Total	Standardized Variables: Alpha	Label
Q01	0.367484	0.687500	0.457427	0.736583	Q01
Q02	0.868092	0.602151	0.926734	0.644640	Q02
Q03	0.402953	0.673540	0.581534	0.713862	Q03
Q05	0.367484	0.687500	0.457427	0.736583	Q05
Q06	0.546869	0.665109	0.389337	0.748584	Q06
Q08	0.811147	0.539801	0.926734	0.644640	Q08
Q09	0.066519	0.753687	-.052267	0.818878	Q09
Q10	0.234484	0.733677	0.155251	0.787426	Q10

Cronbach Coefficient Alpha

Variables	Alpha

Variables	Alpha
Raw	0.753687
Standardized	0.818878

Cronbach Coefficient Alpha with Deleted Variable

Deleted Variable	Raw Variables: Correlation with Total	Raw Variables: Alpha	Standardized Variables: Correlation with Total	Standardized Variables: Alpha	Label
Q01	0.502571	0.729897	0.562204	0.794255	Q01
Q02	0.968246	0.645000	0.974513	0.718285	Q02
Q03	0.599145	0.692308	0.720806	0.766445	Q03
Q05	0.502571	0.729897	0.562204	0.794255	Q05
Q06	0.502571	0.729897	0.332716	0.831529	Q06
Q08	0.951662	0.566038	0.974513	0.718285	Q08
Q10	-.028444	0.873786	-.041420	0.885286	Q10

Variables	Alpha
Raw	0.873786
Standardized	0.885286

Cronbach Coefficient Alpha with Deleted Variable

Deleted Variable	Raw Variables: Correlation with Total	Raw Variables: Alpha	Standardized Variables: Correlation with Total	Standardized Variables: Alpha	Label
Q01	0.698535	0.858434	0.687191	0.867148	Q01
Q02	0.952579	0.815972	0.939945	0.824139	Q02
Q03	0.816026	0.826613	0.833324	0.842793	Q03
Q05	0.698535	0.858434	0.687191	0.867148	Q05
Q06	0.293294	0.900538	0.191170	0.939998	Q06
Q08	0.926367	0.824468	0.939945	0.824139	Q08

Technology and Quality Management survey

GRP=Technology & Quality

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum	Label
Q01	5	3.60000	0.89443	18.00000	2.00000	4.00000	Q01
Q02	5	3.80000	0.44721	19.00000	3.00000	4.00000	Q02
Q03	5	3.80000	0.44721	19.00000	3.00000	4.00000	Q03
Q04	5	3.80000	0.83666	19.00000	3.00000	5.00000	Q04
Q05	5	3.60000	0.54772	18.00000	3.00000	4.00000	Q05
Q06	5	2.20000	0.44721	11.00000	2.00000	3.00000	Q06
Q07	5	2.80000	1.30384	14.00000	1.00000	4.00000	Q07
Q08	5	3.60000	0.89443	18.00000	2.00000	4.00000	Q08
Q09	5	3.40000	0.89443	17.00000	2.00000	4.00000	Q09
Q10	5	3.80000	0.44721	19.00000	3.00000	4.00000	Q10

Variables	Alpha
Raw	0.708930
Standardized	0.563124

Cronbach Coefficient Alpha with Deleted Variable

Deleted Variable	Raw Variables: Correlation with Total	Raw Variables: Alpha	Standardized Variables: Correlation with Total	Standardized Variables: Alpha	Label
Q01	0.820303	0.588785	0.592241	0.437636	Q01
Q02	-.055385	0.731595	0.169066	0.557701	Q02
Q03	-.055385	0.731595	0.169066	0.557701	Q03
Q04	0.562318	0.649390	0.424699	0.487819	Q04
Q05	-.156368	0.747754	-.011826	0.602563	Q05
Q06	0.112867	0.716561	0.077539	0.580858	Q06
Q07	0.587995	0.642857	0.380119	0.500575	Q07
Q08	0.820303	0.588785	0.592241	0.437636	Q08
Q09	0.862582	0.578571	0.867613	0.347108	Q09
Q10	-.322562	0.754335	-.477068	0.702159	Q10

Variables	Alpha
Raw	0.747754
Standardized	0.602563

Cronbach Coefficient Alpha with Deleted Variable

Deleted Variable	Raw Variables: Correlation with Total	Raw Variables: Alpha	Standardized Variables: Correlation with Total	Standardized Variables: Alpha	Label
Q01	0.888662	0.630174	0.743141	0.440523	Q01
Q02	-.135582	0.779832	0.023895	0.639856	Q02
Q03	-.135582	0.779832	0.023895	0.639856	Q03
Q04	0.591608	0.694857	0.500900	0.514827	Q04
Q06	0.055385	0.764242	-.017139	0.649393	Q06
Q07	0.606339	0.697143	0.430808	0.534913	Q07
Q08	0.888662	0.630174	0.743141	0.440523	Q08
Q09	0.867528	0.634921	0.936342	0.375577	Q09
Q10	-.267261	0.790204	-.408517	0.731624	Q10

Cronbach Coefficient Alpha

Variables	Alpha

Raw	0.790204
Standardized	0.731624

Cronbach Coefficient Alpha with Deleted Variable

Deleted Variable	Raw Variables: Correlation with Total	Raw Variables: Alpha	Standardized Variables: Correlation with Total	Standardized Variables: Alpha	Label
Q01	0.898007	0.691740	0.747678	0.635338	Q01
Q02	-.106299	0.823917	0.077661	0.768856	Q02
Q03	-.106299	0.823917	0.077661	0.768856	Q03
Q04	0.500521	0.766423	0.320244	0.724735	Q04
Q06	0.164153	0.803393	0.210396	0.745277	Q06
Q07	0.597893	0.763240	0.417253	0.705792	Q07
Q08	0.898007	0.691740	0.747678	0.635338	Q08
Q09	0.898007	0.691740	0.963433	0.584099	Q09

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.823917
Standardized	0.768856

Cronbach Coefficient Alpha with Deleted Variable

Deleted Variable	Raw Variables: Correlation with Total	Raw Variables: Alpha	Standardized Variables: Correlation with Total	Standardized Variables: Alpha	Label
Q01	0.931266	0.732743	0.876727	0.653158	Q01
Q03	-.209083	0.872131	-.142025	0.854267	Q03
Q04	0.514792	0.808696	0.371712	0.763860	Q04
Q06	0.135582	0.847059	0.158612	0.803886	Q06
Q07	0.681086	0.792233	0.586601	0.719590	Q07
Q08	0.931266	0.732743	0.876727	0.653158	Q08
Q09	0.849837	0.748718	0.937830	0.638143	Q09

Annexure B

Descriptive statistics: Frequency tables

Contractor survey

Q01	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly agree	1	3.57	1	3.57
Agree	10	35.71	11	39.29
Undecided	10	35.71	21	75.00
Disagree	7	25.00	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	7.7143
DF	3
Pr > ChiSq	0.0523

Sample Size = 28

Q02	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	13	46.43	13	46.43
Undecided	1	3.57	14	50.00
Disagree	14	50.00	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	11.2143
DF	2
Pr > ChiSq	0.0037

Sample Size = 28

Q03	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly agree	2	7.14	2	7.14
Agree	11	39.29	13	46.43
Undecided	7	25.00	20	71.43
Disagree	8	28.57	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	6.0000
DF	3
Pr > ChiSq	0.1116

Sample Size = 28

Q04	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	15	53.57	15	53.57
Undecided	3	10.71	18	64.29
Disagree	10	35.71	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	7.7857
DF	2
Pr > ChiSq	0.0204

Sample Size = 28

Q05	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	8	28.57	8	28.57
Undecided	7	25.00	15	53.57
Disagree	13	46.43	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	2.2143
DF	2
Pr > ChiSq	0.3305

Sample Size = 28

Q06	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly agree	1	3.57	1	3.57
Agree	15	53.57	16	57.14
Undecided	3	10.71	19	67.86
Disagree	9	32.14	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	17.1429
DF	3
Pr > ChiSq	0.0007

Sample Size = 28

Q07	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	12	42.86	12	42.86
Undecided	4	14.29	16	57.14
Disagree	12	42.86	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	4.5714
DF	2
Pr > ChiSq	0.1017

Sample Size = 28

Q08	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	4	14.29	4	14.29
Undecided	3	10.71	7	25.00
Disagree	19	67.86	26	92.86
Strongly disagree	2	7.14	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	27.7143
DF	3
Pr > ChiSq	<.0001

Sample Size = 28

Q09	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	17	60.71	17	60.71
Undecided	6	21.43	23	82.14
Disagree	5	17.86	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	9.5000
DF	2
Pr > ChiSq	0.0087

Sample Size = 28

Q10	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly agree	1	3.57	1	3.57
Agree	13	46.43	14	50.00
Undecided	9	32.14	23	82.14
Disagree	5	17.86	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	11.4286
DF	3
Pr > ChiSq	0.0096

Sample Size = 28

Q11	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	1	3.57	1	3.57
Undecided	5	17.86	6	21.43
Disagree	16	57.14	22	78.57
Strongly disagree	6	21.43	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	17.4286
DF	3
Pr > ChiSq	0.0006

Sample Size = 28

Q12	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly agree	2	7.14	2	7.14
Agree	17	60.71	19	67.86
Undecided	3	10.71	22	78.57
Disagree	6	21.43	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	20.2857
DF	3
Pr > ChiSq	0.0001

Sample Size = 28

Q13	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly agree	5	17.86	5	17.86
Agree	17	60.71	22	78.57
Undecided	6	21.43	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	9.5000
DF	2
Pr > ChiSq	0.0087

Sample Size = 28

Q14	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	3	10.71	3	10.71
Undecided	9	32.14	12	42.86
Disagree	15	53.57	27	96.43
Strongly disagree	1	3.57	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	17.1429
DF	3
Pr > ChiSq	0.0007

Sample Size = 28

Q15	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	10	35.71	10	35.71
Undecided	6	21.43	16	57.14
Disagree	11	39.29	27	96.43
Strongly disagree	1	3.57	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	8.8571
DF	3
Pr > ChiSq	0.0313

Sample Size = 28

Q01	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	11	39.29	11	39.29
Undecided	10	35.71	21	75.00
Disagree-Strongly disagree	7	25.00	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	0.9286
DF	2
Pr > ChiSq	0.6286

Sample Size = 28

Q02	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	13	46.43	13	46.43
Undecided	1	3.57	14	50.00
Disagree-Strongly disagree	14	50.00	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	11.2143
DF	2
Pr > ChiSq	0.0037

Sample Size = 28

Q03	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	13	46.43	13	46.43
Undecided	7	25.00	20	71.43
Disagree-Strongly disagree	8	28.57	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	2.2143
DF	2
Pr > ChiSq	0.3305

Sample Size = 28

Q04	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	15	53.57	15	53.57
Undecided	3	10.71	18	64.29

Disagree-Strongly disagree	10	35.71	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	7.7857
DF	2
Pr > ChiSq	0.0204

Sample Size = 28

Q05	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	8	28.57	8	28.57
Undecided	7	25.00	15	53.57
Disagree-Strongly disagree	13	46.43	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	2.2143
DF	2
Pr > ChiSq	0.3305

Sample Size = 28

Q06	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	16	57.14	16	57.14
Undecided	3	10.71	19	67.86
Disagree-Strongly disagree	9	32.14	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	9.0714
DF	2
Pr > ChiSq	0.0107

Sample Size = 28

Q07	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	12	42.86	12	42.86
Undecided	4	14.29	16	57.14
Disagree-Strongly disagree	12	42.86	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	4.5714
DF	2
Pr > ChiSq	0.1017

Sample Size = 28

Q08	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	4	14.29	4	14.29
Undecided	3	10.71	7	25.00
Disagree-Strongly disagree	21	75.00	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	21.9286
DF	2
Pr > ChiSq	<.0001

Sample Size = 28

Q09	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	17	60.71	17	60.71
Undecided	6	21.43	23	82.14
Disagree-Strongly disagree	5	17.86	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	9.5000
DF	2
Pr > ChiSq	0.0087

Sample Size = 28

Q10	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	14	50.00	14	50.00
Undecided	9	32.14	23	82.14
Disagree-Strongly disagree	5	17.86	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	4.3571
DF	2
Pr > ChiSq	0.1132

Sample Size = 28

Q11	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	1	3.57	1	3.57
Undecided	5	17.86	6	21.43
Disagree-Strongly disagree	22	78.57	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	26.6429
DF	2
Pr > ChiSq	<.0001

Sample Size = 28

Q12	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	19	67.86	19	67.86
Undecided	3	10.71	22	78.57
Disagree-Strongly disagree	6	21.43	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	15.5000
DF	2
Pr > ChiSq	0.0004

Sample Size = 28

Q13	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	22	78.57	22	78.57
Undecided	6	21.43	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	9.1429
DF	1
Pr > ChiSq	0.0025

Sample Size = 28

Q14	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	3	10.71	3	10.71
Undecided	9	32.14	12	42.86
Disagree-Strongly disagree	16	57.14	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	9.0714
DF	2
Pr > ChiSq	0.0107

Sample Size = 28

Q15	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	10	35.71	10	35.71
Undecided	6	21.43	16	57.14
Disagree-Strongly disagree	12	42.86	28	100.00

Chi-Square Test for Equal Proportions

Chi-Square	2.0000
DF	2
Pr > ChiSq	0.3679

Sample Size = 28

Capital Programme Management survey

GRP=Capital Programme Management

Q01	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	2	40.00	2	40.00
Undecided	2	40.00	4	80.00
Disagree-Strongly disagree	1	20.00	5	100.00

Chi-Square Test for Equal Proportions

Chi-Square	0.4000
DF	2
Pr > ChiSq	0.8187

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

Sample Size = 5

Q02	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	5	100.00	5	100.00

Q03	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree-Strongly disagree	5	100.00	5	100.00

Q04	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	1	20.00	1	20.00
Disagree-Strongly disagree	4	80.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	1.8000
DF	1
Pr > ChiSq	0.1797

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

Sample Size = 5

Q05	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	1	20.00	1	20.00
Disagree-Strongly disagree	4	80.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	1.8000
DF	1
Pr > ChiSq	0.1797

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

Sample Size = 5

Q06	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	3	60.00	3	60.00
Disagree-Strongly disagree	2	40.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	0.2000
DF	1
Pr > ChiSq	0.6547

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

Sample Size = 5

Q07	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	1	20.00	1	20.00
Undecided	1	20.00	2	40.00
Disagree-Strongly disagree	3	60.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	1.6000
DF	2
Pr > ChiSq	0.4493

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

Sample Size = 5

Q08	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Undecided	2	40.00	2	40.00
Disagree-Strongly disagree	3	60.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	0.2000
DF	1
Pr > ChiSq	0.6547

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

Sample Size = 5

Q09	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	4	80.00	4	80.00
Undecided	1	20.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	1.8000
DF	1
Pr > ChiSq	0.1797

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

Sample Size = 5

Q10	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	2	40.00	2	40.00
Disagree-Strongly disagree	3	60.00	5	100.00

Chi-Square Test for Equal Proportions

Chi-Square	0.2000
DF	1
Pr > ChiSq	0.6547

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

Sample Size = 5

---------- GRP=Capital Programme Management ----------

Q01	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly agree	1	20.00	1	20.00
Agree	1	20.00	2	40.00
Undecided	2	40.00	4	80.00
Disagree	1	20.00	5	100.00

Q02	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly agree	1	20.00	1	20.00
Agree	4	80.00	5	100.00

Q03	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Disagree	4	80.00	4	80.00
Strongly disagree	1	20.00	5	100.00

Q04	Frequency	Percent	Frequency	Percent
Agree	1	20.00	1	20.00
Disagree	4	80.00	5	100.00

Q05	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly agree	1	20.00	1	20.00
Disagree	4	80.00	5	100.00

Q06	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	3	60.00	3	60.00
Disagree	2	40.00	5	100.00

Q07	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	1	20.00	1	20.00
Undecided	1	20.00	2	40.00
Disagree	3	60.00	5	100.00

Q08	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Undecided	2	40.00	2	40.00
Disagree	3	60.00	5	100.00

Q09	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	4	80.00	4	80.00
Undecided	1	20.00	5	100.00

Q10	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly agree	1	20.00	1	20.00
Agree	1	20.00	2	40.00
Disagree	2	40.00	4	80.00
Strongly disagree	1	20.00	5	100.00

Risk Management survey

---------- GRP=Risk Management ----------

Q01	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	5	100.00	5	100.00

Q02	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	5	100.00	5	100.00

Q03	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	1	20.00	1	20.00
Undecided	2	40.00	3	60.00
Disagree-Strongly disagree	2	40.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	0.4000
DF	2
Pr > ChiSq	0.8187

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

Sample Size = 5

Q04	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	1	20.00	1	20.00
Undecided	1	20.00	2	40.00
Disagree-Strongly disagree	3	60.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	1.6000
DF	2
Pr > ChiSq	0.4493

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

Sample Size = 5

Q05	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Undecided	1	20.00	1	20.00
Disagree-Strongly disagree	4	80.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	1.8000
DF	1
Pr > ChiSq	0.1797

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

Sample Size = 5

Q06	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	5	100.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	0.0000
DF	0
Pr > ChiSq	.

Sample Size = 5

Q07	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	3	60.00	3	60.00
Disagree-Strongly disagree	2	40.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	0.2000
DF	1
Pr > ChiSq	0.6547

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

Sample Size = 5

Q08	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	2	40.00	2	40.00
Disagree-Strongly disagree	3	60.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	0.2000
DF	1
Pr > ChiSq	0.6547

WARNING: The table cells have expected counts less

than 5. Chi-Square may not be a valid test.
Sample Size = 5

Q09	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	1	20.00	1	20.00
Undecided	1	20.00	2	40.00
Disagree-Strongly disagree	3	60.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	1.6000
DF	2
Pr > ChiSq	0.4493

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

Q10	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	2	40.00	2	40.00
Disagree-Strongly disagree	3	60.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	0.2000
DF	1
Pr > ChiSq	0.6547

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

---------- GRP=Risk Management ----------

Q01	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly agree	1	20.00	1	20.00
Agree	4	80.00	5	100.00

Q02	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly agree	2	40.00	2	40.00
Agree	3	60.00	5	100.00

Q03	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	1	20.00	1	20.00
Undecided	2	40.00	3	60.00
Disagree	2	40.00	5	100.00

Q04	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	1	20.00	1	20.00
Undecided	1	20.00	2	40.00
Disagree	3	60.00	5	100.00

Q05	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Undecided	1	20.00	1	20.00
Disagree	4	80.00	5	100.00

Q06	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly agree	1	20.00	1	20.00
Agree	4	80.00	5	100.00

Q07	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	3	60.00	3	60.00
Disagree	2	40.00	5	100.00

Q08	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	2	40.00	2	40.00
Disagree	3	60.00	5	100.00

Q09	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	1	20.00	1	20.00
Undecided	1	20.00	2	40.00
Disagree	3	60.00	5	100.00

Q10	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	2	40.00	2	40.00
Disagree	3	60.00	5	100.00

Technology and Quality Management survey

---------- GRP=Technology & Quality ----------

Q01	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	1	20.00	1	20.00
Disagree-Strongly disagree	4	80.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	1.8000
DF	1
Pr > ChiSq	0.1797

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

Sample Size = 5

Q02	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Undecided	1	20.00	1	20.00
Disagree-Strongly disagree	4	80.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	1.8000
DF	1
Pr > ChiSq	0.1797

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

Sample Size = 5

Q03	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Undecided	1	20.00	1	20.00
Disagree-Strongly disagree	4	80.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	1.8000
DF	1
Pr > ChiSq	0.1797

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

Q04	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Undecided	2	40.00	2	40.00
Disagree-Strongly disagree	3	60.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	0.2000
DF	1
Pr > ChiSq	0.6547

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

Sample Size = 5

Q05	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Undecided	2	40.00	2	40.00
Disagree-Strongly disagree	3	60.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	0.2000
DF	1
Pr > ChiSq	0.6547

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

Sample Size = 5

Q06	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	4	80.00	4	80.00
Undecided	1	20.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	1.8000
DF	1
Pr > ChiSq	0.1797

WARNING: The table cells have expected counts less

than 5. Chi-Square may not be a valid test.
Sample Size = 5

Q07	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	2	40.00	2	40.00
Undecided	1	20.00	3	60.00
Disagree-Strongly disagree	2	40.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	0.4000
DF	2
Pr > ChiSq	0.8187

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

Q08	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	1	20.00	1	20.00
Disagree-Strongly disagree	4	80.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	1.8000
DF	1
Pr > ChiSq	0.1797

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

Q09	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree-Strongly agree	1	20.00	1	20.00
Undecided	1	20.00	2	40.00
Disagree-Strongly disagree	3	60.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	1.6000
DF	2
Pr > ChiSq	0.4493

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

Q10	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Undecided	1	20.00	1	20.00
Disagree-Strongly disagree	4	80.00	5	100.00

Chi-Square Test
for Equal Proportions

Chi-Square	1.8000
DF	1
Pr > ChiSq	0.1797

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

---------- GRP=Technology & Quality ----------

Q01	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	1	20.00	1	20.00
Disagree	4	80.00	5	100.00

Q02	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Undecided	1	20.00	1	20.00
Disagree	4	80.00	5	100.00

Q03	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Undecided	1	20.00	1	20.00
Disagree	4	80.00	5	100.00

Q04	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Undecided	2	40.00	2	40.00
Disagree	2	40.00	4	80.00
Strongly disagree	1	20.00	5	100.00

Q05	Frequency	Percent	Cumulative Frequency	Cumulative Percent

Undecided	2	40.00	2	40.00
Disagree	3	60.00	5	100.00

Q06	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	4	80.00	4	80.00
Undecided	1	20.00	5	100.00

Q07	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Strongly agree	1	20.00	1	20.00
Agree	1	20.00	2	40.00
Undecided	1	20.00	3	60.00
Disagree	2	40.00	5	100.00

Q08	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	1	20.00	1	20.00
Disagree	4	80.00	5	100.00

Q09	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	1	20.00	1	20.00
Undecided	1	20.00	2	40.00
Disagree	3	60.00	5	100.00

Q10	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Undecided	1	20.00	1	20.00
Disagree	4	80.00	5	100.00

Annexure C

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

Contractor survey

Variable: Q01 (Q01)

N	28	Sum Weights	28
Mean	2.82142857	Sum Observations	79
Std Deviation	0.86296523	Variance	0.74470899
Skewness	-0.0042748	Kurtosis	-0.9389554
Uncorrected SS	243	Corrected SS	20.1071429
Coeff Variation	30.5861096	Std Error Mean	0.1630851

Basic Statistical Measures

Location		Variability	
Mean	2.821429	Std Deviation	0.86297
Median	3.000000	Variance	0.74471
Mode	2.000000	Range	3.00000
		Interquartile Range	1.50000

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

Variable: Q02 (Q02)

N	28	Sum Weights	28
Mean	3.03571429	Sum Observations	85
Std Deviation	0.99933841	Variance	0.99867725
Skewness	-0.0755467	Kurtosis	-2.109121
Uncorrected SS	285	Corrected SS	26.9642857
Coeff Variation	32.9193828	Std Error Mean	0.18885721

Basic Statistical Measures

Location		Variability	
Mean	3.035714	Std Deviation	0.99934
Median	3.500000	Variance	0.99868
Mode	4.000000	Range	2.00000
		Interquartile Range	2.00000

Variable: Q03 (Q03)

N	28	Sum Weights	28
Mean	2.75	Sum Observations	77
Std Deviation	0.96704973	Variance	0.93518519
Skewness	0.01653887	Kurtosis	-1.1534181
Uncorrected SS	237	Corrected SS	25.25
Coeff Variation	35.1654448	Std Error Mean	0.18275522

Basic Statistical Measures

Location		Variability	
Mean	2.750000	Std Deviation	0.96705
Median	3.000000	Variance	0.93519
Mode	2.000000	Range	3.00000
		Interquartile Range	2.00000

Variable: Q04 (Q04)

N	28	Sum Weights	28
Mean	2.82142857	Sum Observations	79
Std Deviation	0.94491118	Variance	0.89285714
Skewness	0.38171181	Kurtosis	-1.8482872
Uncorrected SS	247	Corrected SS	24.1071429
Coeff Variation	33.4905229	Std Error Mean	0.17857143

Basic Statistical Measures

Location		Variability	
Mean	2.821429	Std Deviation	0.94491
Median	2.000000	Variance	0.89286
Mode	2.000000	Range	2.00000
		Interquartile Range	2.00000

Variable: Q05 (Q05)

N	28	Sum Weights	28
Mean	3.17857143	Sum Observations	89
Std Deviation	0.86296523	Variance	0.74470899
Skewness	-0.3681102	Kurtosis	-1.5825338
Uncorrected SS	303	Corrected SS	20.1071429
Coeff Variation	27.149468	Std Error Mean	0.1630851

Basic Statistical Measures

Location		Variability	
Mean	3.178571	Std Deviation	0.86297
Median	3.000000	Variance	0.74471
Mode	4.000000	Range	2.00000
		Interquartile Range	2.00000

Variable: Q06 (Q06)

N	28	Sum Weights	28
Mean	2.71428571	Sum Observations	76
Std Deviation	0.97590007	Variance	0.95238095
Skewness	0.3730941	Kurtosis	-1.4693538
Uncorrected SS	232	Corrected SS	25.7142857
Coeff Variation	35.9542132	Std Error Mean	0.18442778

Basic Statistical Measures

Location		Variability	
Mean	2.714286	Std Deviation	0.97590
Median	2.000000	Variance	0.95238
Mode	2.000000	Range	3.00000
		Interquartile Range	2.00000

Variable: Q07 (Q07)

N	28	Sum Weights	28
Mean	3	Sum Observations	84
Std Deviation	0.94280904	Variance	0.88888889
Skewness	0	Kurtosis	-1.9592308
Uncorrected SS	276	Corrected SS	24
Coeff Variation	31.4269681	Std Error Mean	0.17817416

Basic Statistical Measures

Location		Variability	
Mean	3.000000	Std Deviation	0.94281
Median	3.000000	Variance	0.88889
Mode	2.000000	Range	2.00000
		Interquartile Range	2.00000

NOTE: The mode displayed is the smallest of 2 modes with a count of 12.

Variable: Q08 (Q08)

N	28	Sum Weights	28
Mean	3.67857143	Sum Observations	103
Std Deviation	0.81892302	Variance	0.67063492
Skewness	-1.0610425	Kurtosis	0.61586079
Uncorrected SS	397	Corrected SS	18.1071429
Coeff Variation	22.2619851	Std Error Mean	0.1547619

Basic Statistical Measures

Location		Variability	
Mean	3.678571	Std Deviation	0.81892
Median	4.000000	Variance	0.67063
Mode	4.000000	Range	3.00000
		Interquartile Range	0.50000

Variable: Q09 (Q09)

N	28	Sum Weights	28
Mean	2.57142857	Sum Observations	72
Std Deviation	0.79015101	Variance	0.62433862
Skewness	0.96032342	Kurtosis	-0.6536252
Uncorrected SS	202	Corrected SS	16.8571429
Coeff Variation	30.728095	Std Error Mean	0.14932451

Basic Statistical Measures

Location		Variability	
Mean	2.571429	Std Deviation	0.79015
Median	2.000000	Variance	0.62434
Mode	2.000000	Range	2.00000
		Interquartile Range	1.00000

Variable: Q10 (Q10)

N	28	Sum Weights	28
Mean	2.64285714	Sum Observations	74
Std Deviation	0.8261596	Variance	0.68253968
Skewness	0.35511424	Kurtosis	-0.7214977
Uncorrected SS	214	Corrected SS	18.4285714
Coeff Variation	31.2600929	Std Error Mean	0.15612949

Basic Statistical Measures

Location		Variability	
Mean	2.642857	Std Deviation	0.82616
Median	2.500000	Variance	0.68254
Mode	2.000000	Range	3.00000
		Interquartile Range	1.00000

Variable: Q11 (Q11)

N	28	Sum Weights	28
Mean	3.96428571	Sum Observations	111
Std Deviation	0.74446814	Variance	0.5542328
Skewness	-0.5215631	Kurtosis	0.56888156
Uncorrected SS	455	Corrected SS	14.9642857
Coeff Variation	18.7793764	Std Error Mean	0.14069125

Basic Statistical Measures

Location		Variability	
Mean	3.964286	Std Deviation	0.74447
Median	4.000000	Variance	0.55423
Mode	4.000000	Range	3.00000
		Interquartile Range	0

Variable: Q12 (Q12)

N	28	Sum Weights	28
Mean	2.46428571	Sum Observations	69
Std Deviation	0.92224135	Variance	0.8505291
Skewness	0.72266038	Kurtosis	-0.5757252
Uncorrected SS	193	Corrected SS	22.9642857
Coeff Variation	37.4242865	Std Error Mean	0.17428723

Basic Statistical Measures

Location		Variability	
Mean	2.464286	Std Deviation	0.92224
Median	2.000000	Variance	0.85053
Mode	2.000000	Range	3.00000
		Interquartile Range	1.00000

Variable: Q13 (Q13)

N	28	Sum Weights	28
Mean	2.03571429	Sum Observations	57
Std Deviation	0.63724772	Variance	0.40608466
Skewness	-0.0271306	Kurtosis	-0.2948138
Uncorrected SS	127	Corrected SS	10.9642857

Coeff Variation	31.3033968	Std Error Mean	0.1204285

Basic Statistical Measures

Location		Variability	
Mean	2.035714	Std Deviation	0.63725
Median	2.000000	Variance	0.40608
Mode	2.000000	Range	2.00000
		Interquartile Range	0

Variable: Q14 (Q14)

N	28	Sum Weights	28
Mean	3.5	Sum Observations	98
Std Deviation	0.74535599	Variance	0.55555556
Skewness	-0.5779376	Kurtosis	-0.1041231
Uncorrected SS	358	Corrected SS	15
Coeff Variation	21.2958855	Std Error Mean	0.14085904

Basic Statistical Measures

Location		Variability	
Mean	3.500000	Std Deviation	0.74536
Median	4.000000	Variance	0.55556
Mode	4.000000	Range	3.00000
		Interquartile Range	1.00000

Variable: Q15 (Q15)

N	28	Sum Weights	28
Mean	3.10714286	Sum Observations	87
Std Deviation	0.95604454	Variance	0.91402116
Skewness	0.04715801	Kurtosis	-1.4343562
Uncorrected SS	295	Corrected SS	24.6785714
Coeff Variation	30.7692496	Std Error Mean	0.18067544

Basic Statistical Measures

Location		Variability	
Mean	3.107143	Std Deviation	0.95604
Median	3.000000	Variance	0.91402
Mode	4.000000	Range	3.00000
		Interquartile Range	2.00000

Capital Programme Management survey

---------- GRP=Capital Programme Management ----------

Variable: Q01 (Q01)

N	5	Sum Weights	5
Mean	2.6	Sum Observations	13
Std Deviation	1.14017543	Variance	1.3
Skewness	-0.404796	Kurtosis	-0.1775148
Uncorrected SS	39	Corrected SS	5.2
Coeff Variation	43.852901	Std Error Mean	0.50990195

Basic Statistical Measures

Location		Variability	
Mean	2.600000	Std Deviation	1.14018
Median	3.000000	Variance	1.30000
Mode	3.000000	Range	3.00000
		Interquartile Range	1.00000

Variable: Q02 (Q02)

N	5	Sum Weights	5
Mean	1.8	Sum Observations	9
Std Deviation	0.4472136	Variance	0.2
Skewness	-2.236068	Kurtosis	5
Uncorrected SS	17	Corrected SS	0.8
Coeff Variation	24.8451997	Std Error Mean	0.2

Basic Statistical Measures

Location		Variability	
Mean	1.800000	Std Deviation	0.44721
Median	2.000000	Variance	0.20000
Mode	2.000000	Range	1.00000
		Interquartile Range	0

Variable: Q03 (Q03)

N	5	Sum Weights	5
Mean	4.2	Sum Observations	21
Std Deviation	0.4472136	Variance	0.2
Skewness	2.23606798	Kurtosis	5
Uncorrected SS	89	Corrected SS	0.8
Coeff Variation	10.6479427	Std Error Mean	0.2

Basic Statistical Measures

Location		Variability	
Mean	4.200000	Std Deviation	0.44721
Median	4.000000	Variance	0.20000
Mode	4.000000	Range	1.00000
		Interquartile Range	0

Variable: Q04 (Q04)

N	5	Sum Weights	5
Mean	3.6	Sum Observations	18
Std Deviation	0.89442719	Variance	0.8
Skewness	-2.236068	Kurtosis	5
Uncorrected SS	68	Corrected SS	3.2
Coeff Variation	24.8451997	Std Error Mean	0.4

Basic Statistical Measures

Location		Variability	
Mean	3.600000	Std Deviation	0.89443
Median	4.000000	Variance	0.80000
Mode	4.000000	Range	2.00000
		Interquartile Range	0

Variable: Q05 (Q05)

N	5	Sum Weights	5
Mean	3.4	Sum Observations	17
Std Deviation	1.34164079	Variance	1.8
Skewness	-2.236068	Kurtosis	5
Uncorrected SS	65	Corrected SS	7.2
Coeff Variation	39.4600231	Std Error Mean	0.6

Basic Statistical Measures

Location		Variability	
Mean	3.400000	Std Deviation	1.34164
Median	4.000000	Variance	1.80000
Mode	4.000000	Range	3.00000
		Interquartile Range	0

Variable: Q06 (Q06)

N	5	Sum Weights	5
Mean	2.8	Sum Observations	14
Std Deviation	1.09544512	Variance	1.2
Skewness	0.60858062	Kurtosis	-3.3333333
Uncorrected SS	44	Corrected SS	4.8
Coeff Variation	39.1230398	Std Error Mean	0.48989795

Basic Statistical Measures

Location		Variability	
Mean	2.800000	Std Deviation	1.09545
Median	2.000000	Variance	1.20000
Mode	2.000000	Range	2.00000
		Interquartile Range	2.00000

Variable: Q07 (Q07)

N	5	Sum Weights	5
Mean	3.4	Sum Observations	17
Std Deviation	0.89442719	Variance	0.8
Skewness	-1.2577882	Kurtosis	0.3125
Uncorrected SS	61	Corrected SS	3.2
Coeff Variation	26.3066821	Std Error Mean	0.4

Basic Statistical Measures

Location		Variability	
Mean	3.400000	Std Deviation	0.89443
Median	4.000000	Variance	0.80000
Mode	4.000000	Range	2.00000
		Interquartile Range	1.00000

Variable: Q08 (Q08)

N	5	Sum Weights	5
Mean	3.6	Sum Observations	18
Std Deviation	0.54772256	Variance	0.3
Skewness	-0.6085806	Kurtosis	-3.3333333
Uncorrected SS	66	Corrected SS	1.2
Coeff Variation	15.2145155	Std Error Mean	0.24494897

Basic Statistical Measures

Location		Variability	
Mean	3.600000	Std Deviation	0.54772
Median	4.000000	Variance	0.30000
Mode	4.000000	Range	1.00000
		Interquartile Range	1.00000

Variable: Q09 (Q09)

N	5	Sum Weights	5
Mean	2.2	Sum Observations	11
Std Deviation	0.4472136	Variance	0.2
Skewness	2.23606798	Kurtosis	5
Uncorrected SS	25	Corrected SS	0.8
Coeff Variation	20.3278907	Std Error Mean	0.2

Basic Statistical Measures

Location		Variability	
Mean	2.200000	Std Deviation	0.44721
Median	2.000000	Variance	0.20000
Mode	2.000000	Range	1.00000
		Interquartile Range	0

Variable: Q10 (Q10)

N	5	Sum Weights	5
Mean	3.2	Sum Observations	16
Std Deviation	1.64316767	Variance	2.7
Skewness	-0.5184205	Kurtosis	-1.6872428
Uncorrected SS	62	Corrected SS	10.8
Coeff Variation	51.3489898	Std Error Mean	0.73484692

Basic Statistical Measures

Location		Variability	
Mean	3.200000	Std Deviation	1.64317
Median	4.000000	Variance	2.70000
Mode	4.000000	Range	4.00000
		Interquartile Range	2.00000

Risk Management survey

---------- GRP=Risk Management ----------

Variable: Q01 (Q01)

N	5	Sum Weights	5
Mean	1.8	Sum Observations	9
Std Deviation	0.4472136	Variance	0.2
Skewness	-2.236068	Kurtosis	5
Uncorrected SS	17	Corrected SS	0.8
Coeff Variation	24.8451997	Std Error Mean	0.2

Basic Statistical Measures

Location		Variability	
Mean	1.800000	Std Deviation	0.44721
Median	2.000000	Variance	0.20000
Mode	2.000000	Range	1.00000
		Interquartile Range	0

Variable: Q02 (Q02)

N	5	Sum Weights	5
Mean	1.6	Sum Observations	8
Std Deviation	0.54772256	Variance	0.3
Skewness	-0.6085806	Kurtosis	-3.3333333
Uncorrected SS	14	Corrected SS	1.2
Coeff Variation	34.2326598	Std Error Mean	0.24494897

Basic Statistical Measures

Location		Variability	
Mean	1.600000	Std Deviation	0.54772
Median	2.000000	Variance	0.30000
Mode	2.000000	Range	1.00000
		Interquartile Range	1.00000

Variable: Q03 (Q03)

N	5	Sum Weights	5
Mean	3.2	Sum Observations	16
Std Deviation	0.83666003	Variance	0.7
Skewness	-0.5122408	Kurtosis	-0.6122449
Uncorrected SS	54	Corrected SS	2.8
Coeff Variation	26.1456258	Std Error Mean	0.37416574

Basic Statistical Measures

Location		Variability	
Mean	3.200000	Std Deviation	0.83666
Median	3.000000	Variance	0.70000
Mode	3.000000	Range	2.00000
		Interquartile Range	1.00000

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

Variable: Q04 (Q04)

N	5	Sum Weights	5
Mean	3.4	Sum Observations	17
Std Deviation	0.89442719	Variance	0.8
Skewness	-1.2577882	Kurtosis	0.3125
Uncorrected SS	61	Corrected SS	3.2
Coeff Variation	26.3066821	Std Error Mean	0.4

Basic Statistical Measures

Location		Variability	
Mean	3.400000	Std Deviation	0.89443
Median	4.000000	Variance	0.80000
Mode	4.000000	Range	2.00000
		Interquartile Range	1.00000

Variable: Q05 (Q05)

N	5	Sum Weights	5
Mean	3.8	Sum Observations	19
Std Deviation	0.4472136	Variance	0.2
Skewness	-2.236068	Kurtosis	5
Uncorrected SS	73	Corrected SS	0.8
Coeff Variation	11.7687788	Std Error Mean	0.2

Basic Statistical Measures

Location		Variability	
Mean	3.800000	Std Deviation	0.44721
Median	4.000000	Variance	0.20000
Mode	4.000000	Range	1.00000
		Interquartile Range	0

Variable: Q06 (Q06)

N	5	Sum Weights	5
Mean	1.8	Sum Observations	9
Std Deviation	0.4472136	Variance	0.2
Skewness	-2.236068	Kurtosis	5
Uncorrected SS	17	Corrected SS	0.8
Coeff Variation	24.8451997	Std Error Mean	0.2

Basic Statistical Measures

Location		Variability	
Mean	1.800000	Std Deviation	0.44721
Median	2.000000	Variance	0.20000
Mode	2.000000	Range	1.00000
		Interquartile Range	0

Variable: Q07 (Q07)

N	5	Sum Weights	5

Mean	2.8	Sum Observations	14
Std Deviation	1.09544512	Variance	1.2
Skewness	0.60858062	Kurtosis	-3.3333333
Uncorrected SS	44	Corrected SS	4.8
Coeff Variation	39.1230398	Std Error Mean	0.48989795

Basic Statistical Measures

Location		Variability	
Mean	2.800000	Std Deviation	1.09545
Median	2.000000	Variance	1.20000
Mode	2.000000	Range	2.00000
		Interquartile Range	2.00000

Variable: Q08 (Q08)

N	5	Sum Weights	5
Mean	3.2	Sum Observations	16
Std Deviation	1.09544512	Variance	1.2
Skewness	-0.6085806	Kurtosis	-3.3333333
Uncorrected SS	56	Corrected SS	4.8
Coeff Variation	34.2326598	Std Error Mean	0.48989795

Basic Statistical Measures

Location		Variability	
Mean	3.200000	Std Deviation	1.09545
Median	4.000000	Variance	1.20000
Mode	4.000000	Range	2.00000
		Interquartile Range	2.00000

Variable: Q09 (Q09)

N	5	Sum Weights	5
Mean	3.4	Sum Observations	17
Std Deviation	0.89442719	Variance	0.8
Skewness	-1.2577882	Kurtosis	0.3125
Uncorrected SS	61	Corrected SS	3.2
Coeff Variation	26.3066821	Std Error Mean	0.4

Basic Statistical Measures

Location		Variability	
Mean	3.400000	Std Deviation	0.89443
Median	4.000000	Variance	0.80000
Mode	4.000000	Range	2.00000
		Interquartile Range	1.00000

Variable: Q10 (Q10)

N	5	Sum Weights	5
Mean	3.2	Sum Observations	16
Std Deviation	1.09544512	Variance	1.2
Skewness	-0.6085806	Kurtosis	-3.3333333
Uncorrected SS	56	Corrected SS	4.8
Coeff Variation	34.2326598	Std Error Mean	0.48989795

Basic Statistical Measures

Location		Variability	
Mean	3.200000	Std Deviation	1.09545
Median	4.000000	Variance	1.20000
Mode	4.000000	Range	2.00000
		Interquartile Range	2.00000

Technology and Quality Management survey

---------- GRP=Technology & Quality ----------

Variable: Q01 (Q01)

N	5	Sum Weights	5
Mean	3.6	Sum Observations	18
Std Deviation	0.89442719	Variance	0.8
Skewness	-2.236068	Kurtosis	5
Uncorrected SS	68	Corrected SS	3.2
Coeff Variation	24.8451997	Std Error Mean	0.4

Basic Statistical Measures

Location		Variability	
Mean	3.600000	Std Deviation	0.89443
Median	4.000000	Variance	0.80000
Mode	4.000000	Range	2.00000
		Interquartile Range	0

Variable: Q02 (Q02)

N	5	Sum Weights	5
Mean	3.8	Sum Observations	19
Std Deviation	0.4472136	Variance	0.2
Skewness	-2.236068	Kurtosis	5
Uncorrected SS	73	Corrected SS	0.8
Coeff Variation	11.7687788	Std Error Mean	0.2

Basic Statistical Measures

Location		Variability	
Mean	3.800000	Std Deviation	0.44721
Median	4.000000	Variance	0.20000
Mode	4.000000	Range	1.00000
		Interquartile Range	0

Variable: Q03 (Q03)

N	5	Sum Weights	5
Mean	3.8	Sum Observations	19
Std Deviation	0.4472136	Variance	0.2
Skewness	-2.236068	Kurtosis	5
Uncorrected SS	73	Corrected SS	0.8

Coeff Variation	11.7687788	Std Error Mean	0.2

Basic Statistical Measures

Location		Variability	
Mean	3.800000	Std Deviation	0.44721
Median	4.000000	Variance	0.20000
Mode	4.000000	Range	1.00000
		Interquartile Range	0

Variable: Q04 (Q04)

N	5	Sum Weights	5
Mean	3.8	Sum Observations	19
Std Deviation	0.83666003	Variance	0.7
Skewness	0.51224083	Kurtosis	-0.6122449
Uncorrected SS	75	Corrected SS	2.8
Coeff Variation	22.0173691	Std Error Mean	0.37416574

Basic Statistical Measures

Location		Variability	
Mean	3.800000	Std Deviation	0.83666
Median	4.000000	Variance	0.70000
Mode	3.000000	Range	2.00000
		Interquartile Range	1.00000

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

Variable: Q05 (Q05)

N	5	Sum Weights	5
Mean	3.6	Sum Observations	18
Std Deviation	0.54772256	Variance	0.3
Skewness	-0.6085806	Kurtosis	-3.3333333
Uncorrected SS	66	Corrected SS	1.2
Coeff Variation	15.2145155	Std Error Mean	0.24494897

Basic Statistical Measures

Location		Variability	
Mean	3.600000	Std Deviation	0.54772
Median	4.000000	Variance	0.30000
Mode	4.000000	Range	1.00000
		Interquartile Range	1.00000

Variable: Q06 (Q06)

N	5	Sum Weights	5
Mean	2.2	Sum Observations	11
Std Deviation	0.4472136	Variance	0.2
Skewness	2.23606798	Kurtosis	5
Uncorrected SS	25	Corrected SS	0.8
Coeff Variation	20.3278907	Std Error Mean	0.2

Basic Statistical Measures

Location		Variability	
Mean	2.200000	Std Deviation	0.44721
Median	2.000000	Variance	0.20000
Mode	2.000000	Range	1.00000
		Interquartile Range	0

Variable: Q07 (Q07)

N	5	Sum Weights	5
Mean	2.8	Sum Observations	14
Std Deviation	1.30384048	Variance	1.7
Skewness	-0.5413871	Kurtosis	-1.4878893
Uncorrected SS	46	Corrected SS	6.8
Coeff Variation	46.5657315	Std Error Mean	0.58309519

Basic Statistical Measures

Location		Variability	
Mean	2.800000	Std Deviation	1.30384
Median	3.000000	Variance	1.70000
Mode	4.000000	Range	3.00000
		Interquartile Range	2.00000

Variable: Q08 (Q08)

N	5	Sum Weights	5
Mean	3.6	Sum Observations	18
Std Deviation	0.89442719	Variance	0.8
Skewness	-2.236068	Kurtosis	5
Uncorrected SS	68	Corrected SS	3.2
Coeff Variation	24.8451997	Std Error Mean	0.4

Basic Statistical Measures

Location		Variability	
Mean	3.600000	Std Deviation	0.89443
Median	4.000000	Variance	0.80000
Mode	4.000000	Range	2.00000
		Interquartile Range	0

Variable: Q09 (Q09)

N	5	Sum Weights	5
Mean	3.4	Sum Observations	17
Std Deviation	0.89442719	Variance	0.8
Skewness	-1.2577882	Kurtosis	0.3125
Uncorrected SS	61	Corrected SS	3.2
Coeff Variation	26.3066821	Std Error Mean	0.4

Basic Statistical Measures

Location		Variability	
Mean	3.400000	Std Deviation	0.89443
Median	4.000000	Variance	0.80000
Mode	4.000000	Range	2.00000
		Interquartile Range	1.00000

Variable: Q10 (Q10)

N	5	Sum Weights	5
Mean	3.8	Sum Observations	19
Std Deviation	0.4472136	Variance	0.2
Skewness	-2.236068	Kurtosis	5
Uncorrected SS	73	Corrected SS	0.8
Coeff Variation	11.7687788	Std Error Mean	0.2

Basic Statistical Measures

Location		Variability	
Mean	3.800000	Std Deviation	0.44721
Median	4.000000	Variance	0.20000
Mode	4.000000	Range	1.00000
		Interquartile Range	0

Annexure D

TABLE 5.1: Cronbach's Alpha Coefficient for all the items forming the measuring instrument in the contractor questionnaire.

Statements (Test all statements without current one's input)	Variable nr.	Correlation with total	Cronbach's Alpha Coefficient
1. Eskom and Government interventions provide value in contractor development.	Q01	0.2083	0.5335
2. Does Eskom provide clear instructions and communication with the contractor through out the duration of the project?	Q02	0.4059	0.4868
3. Total Quality Management and ISO 9001:2008 standards add value to the contractor.	Q03	-0.1122	0.6000
4. Does Eskom pay contractors in agreed times during the construction phase?	Q04	0.3280	0.5071
5. Eskom's procurement processes are transparent.	Q05	0.2885	0.5176
6. High Voltage System Operating Regulations are implemented effectively.	Q06	0.2752	0.5186
7. Eskom's training manuals are helpful and useful during construction.	Q07	0.0000	0.5766
8. Clerk of Works is always on site and is helpful for the contractors.	Q08	-0.3436	0.6272
9. Eskom policies, standards, work instructions and procedures are conveniently available to contractors.	Q09	-0.0623	0.5802
10. Construction Regulations are providing clear guidelines during construction.	Q10	0.3530	0.5058
11. Construction Industry Development Board is accessible and available to contractors.	Q11	0.5333	0.4766
12. Contractor Forums add value to my business development and operations.	Q12	0.2975	0.5144
13. My company works according to a certain procedure given by Eskom.	Q13	0.3779	0.5106
14. I do know all the role players working with the contractors in the organisation.	Q14	0.0.12	0.5632
15. The organisation communicates properly with the contractors, procedures, standards,	Q15	0.6224	0.4356

Statements (Test all statements without current one's input)	Variable nr.	Correlation with total	Cronbach's Alpha Coefficient
requirements, completion dates etc.			
Cronbach's Coefficient Alpha for standardized variables			**0.5502**
Cronbach's Coefficient Alpha for raw variables			**0.5520**

TABLE 5.2: Cronbach's Alpha Coefficient for the measuring instrument without items Q08, Q03, Q07, Q09 and Qa10 in the contractor questionnaire.

Statements (Test all statements without current one's input)	Variable nr.	Correlation with total	Cronbach's Alpha Coefficient
1. Eskom and Government interventions provide value in contractor development.	Q01	0.2308	0.7554
2. Does Eskom provide clear instructions and communication with the contractor through out the duration of the project?	Q02	0.5792	0.7030
4. Does Eskom pay contractors in agreed times during the construction phase?	Q04	0.1675	0.7670
5. Eskom's procurement processes are transparent.	Q05	0.2713	0.7500
6. High Voltage System Operating Regulations are implemented effectively.	Q06	0.5058	0.7158
10. Construction Regulations are providing clear guidelines during construction.	Q10	0.2673	0.7498
11. Construction Industry Development Board is accessible and available to contractors.	Q11	0.4746	0.7238
12. Contractor Forums add value to my business development and operations.	Q12	0.4852	0.7195
13. My company works according to a certain procedure given by Eskom.	Q13	0.5444	0.7194
15. The organisation communicates properly with the contractors, procedures, standards, requirements, completion dates etc.	Q15	0.6745	0.6876
Cronbach's Coefficient Alpha for standardized variables			**0.7539**
Cronbach's Coefficient Alpha for raw variables			**0.7509**

TABLE 5.3: Cronbach's Alpha Coefficient for all the items forming the measuring instrument in the Capital Programme Management questionnaire.

Statements (Test all statements without current one's input)	Variable nr.	Correlation with total	Cronbach's Alpha Coefficient
1. Project Management carry out monthly inspections of all contractors performing work for Eskom Distribution in terms of the Construction Regulations, other Legislative requirements and Project management requirements.	Q01	0.7699	0.8983
2. Project Management (CoW's) conduct a site visit on all contractors performing contracts under their control. Where there are deviations then non-conformances are issued to the offender and copies forwarded to other all key role players.	Q02	0.8922	0.9047
3. On a monthly basis the Capital Programme department provides the Risk Management Coordinator responsible for contractor management with an updated list of all suppliers currently providing a service to Eskom Distribution.	Q03	0.3451	0.9190
4. Project Coordinators have been sufficiently trained and have sufficient experience to monitor and guide contractors' o quality of workmanship.	Q04	0.8777	0.8931
5. Clerk of Works has been sufficiently trained and has sufficient experience to monitor and guide contractors' o quality of workmanship.	Q05	0.8604	0.8928
6. Construction material always arrives on site in time and in correct quantity and quality.	Q06	0.6264	0.9078
7. All contractors are trained in material identification and material handling.	Q07	0.9655	0.8880
8. All contractors adhere to the prescribed procedures on material handling.	Q08	0.8282	0.9034
9. Contractors are given sufficient time to finish the projects on site.	Q09	0.4256	0.9170
10. All non-conformances are reported, recorded and followed up by Project coordinators and Clerk of Works	Q10	0.7785	0.9083

Statements (Test all statements without current one's input)	Variable nr.	Correlation with total	Cronbach's Alpha Coefficient
Cronbach's Coefficient Alpha for standardized variables			**0.9298**
Cronbach's Coefficient Alpha for raw variables			**0.9127**

TABLE 5.4: Cronbach's Alpha Coefficient for all the items forming the measuring instrument in the risk management department questionnaire.

Statements (Test all statements without current one's input)	Variable nr.	Correlation with total	Cronbach's Alpha Coefficient
1. Risk department carry out monthly inspections of all contractors performing work for Eskom Distribution in terms of the Construction Regulations, other Legislative requirements and Project management requirements.	Q01	0.0613	0.5667
2. Safety Coordinator conducts a site visit on all contractors performing contracts under their control. Where there are deviations then non-conformances are issued to the offender and copies forwarded to other all key role players.	Q02	0.5703	0.4779
3. On a monthly basis the Capital Programme department provides the Risk Management Coordinator responsible for contractor management with an updated list of all suppliers currently providing a service to Eskom Distribution.	Q03	-0.0813	0.6167
4. Contractors always work according to Eskom Health and Safety Policy and procedures.	Q04	-0.1208	0.6323
5. Does each contractor submit weekly Safety, Health and Environment statistics?	Q05	0.0613	0.5667
6. Contractor employees are provided with safety induction and orientation training and records are kept.	Q06	0.5533	0.4958
7. Contractors keep and maintain minimum requirements for the first aid box on site.	Q07	0.1629	0.5675
8. Contractors are working according to the	Q08	0.4443	0.4618

Statements (Test all statements without current one's input)	Variable nr.	Correlation with total	Cronbach's Alpha Coefficient
approved written work safe procedures/task analyses and work instructions at all times.			
9. Contractors are given sufficient time to finish the projects on site.	Q09	0.4726	0.4632
10. All non-conformances are reported, recorded and followed up by Project coordinators and Clerk of Works	Q10	0.6262	0.3838
Cronbach's Coefficient Alpha for standardized variables			**0.6019**
Cronbach's Coefficient Alpha for raw variables			**0.5596**

TABLE 5.5: Cronbach's Alpha Coefficient for measuring instrument without statements Q04, Q07, Q09 & q10 in the risk management department questionnaire.

Statements (Test all statements without current one's input)	Variable nr.	Correlation with total	Cronbach's Alpha Coefficient
1. Risk department carry out monthly inspections of all contractors performing work for Eskom Distribution in terms of the Construction Regulations, other Legislative requirements and Project management requirements.	Q01	0.6985	0.8584
2. Safety Coordinator conducts a site visit on all contractors performing contracts under their control. Where there are deviations then non-conformances are issued to the offender and copies forwarded to other all key role players.	Q02	0.9526	0.8160
3. On a monthly basis the Capital Programme department provides the Risk Management Coordinator responsible for contractor management with an updated list of all suppliers currently providing a service to Eskom Distribution.	Q03	0.8160	0.8266
5. Does each contractor submit weekly Safety, Health and Environment statistics?	Q05	0.6985	0.8584
6. Contractor employees are provided with safety	Q06	0.2933	0.9005

Statements (Test all statements without current one's input)	Variable nr.	Correlation with total	Cronbach's Alpha Coefficient
induction and orientation training and records are kept.			
8. Contractors are working according to the approved written work safe procedures/task analyses and work instructions at all times.	Q08	0.9264	0.8245
Cronbach's Coefficient Alpha for standardized variables			**0.8853**
Cronbach's Coefficient Alpha for raw variables			**0.8738**

TABLE 5.6: Cronbach's Alpha Coefficient for all the items forming the measuring instrument in the technology and quality department questionnaire.

Statements (Test all statements without current one's input)	Variable nr.	Correlation with total	Cronbach's Alpha Coefficient
1. Technology and Quality department carry out monthly inspections of all contractors performing work for Eskom Distribution in terms of the Construction Regulations, other Legislative requirements and Project management requirements.	Q01	0.8203	0.5888
2. Technology and Quality department conducts a site visit on all contractors performing contracts under their control. Where there are deviations then non-conformances are issued to the offender and copies forwarded to other all key role players.	Q02	-0.0554	0.7316
3. On a monthly basis the Technology and Quality department provides the Procurement and Capital Programme department the audit results from the contractors.	Q03	-0.0554	0.7316
4. Technology and Quality department conducts periodic quality audits on construction materials in the stores.	Q04	0.5623	0.6494
5. Technology and Quality department communicates regularly with the contractors to improve QUALITY.	Q05	-0.1564	0.7478

Statements (Test all statements without current one's input)	Variable nr.	Correlation with total	Cronbach's Alpha Coefficient
6. Technology and Quality department participates in contractor related incident investigations.	Q06	0.1129	0.7166
7. Technology and Quality department participates in the contractor selection process.	Q07	0.5880	0.6429
8. Technology and Quality department monitors contracts during the execution of the project for conformance.	Q08	0.8203	0.5888
9. Contractors are given sufficient time to finish the projects on site.	Q09	0.8626	0.5786
10. All non-conformances are reported, recorded and followed up by Technology and Quality department.	Q10	-0.3226	0.7543
Cronbach's Coefficient Alpha for standardized variables			**0.5631**
Cronbach's Coefficient Alpha for raw variables			**0.7089**

TABLE 5.7: Cronbach's Alpha Coefficient for the measuring instrument without statements Q05, Q10 and Q02 in the technology and quality department questionnaire.

Statements (Test all statements without current one's input)	Variable nr.	Correlation with total	Cronbach's Alpha Coefficient
1. Technology and Quality department carry out monthly inspections of all contractors performing work for Eskom Distribution in terms of the Construction Regulations, other Legislative requirements and Project management requirements.	Q01	0.9313	0.7327
3. On a monthly basis the Technology and Quality department provides the Procurement and Capital Programme department the audit results from the contractors.	Q03	-0.2091	0.8721
4. Technology and Quality department conducts periodic quality audits on construction materials in the stores.	Q04	0.5148	0.8087
6. Technology and Quality department participates	Q06	0.1356	0.8471

Statements (Test all statements without current one's input)	Variable nr.	Correlation with total	Cronbach's Alpha Coefficient
in contractor related incident investigations.			
7. Technology and Quality department participates in the contractor selection process.	Q07	0.6811	0.7922
8. Technology and Quality department monitors contracts during the execution of the project for conformance.	Q08	0.9313	0.7327
9. Contractors are given sufficient time to finish the projects on site.	Q09	0.8498	0.7487
Cronbach's Coefficient Alpha for standardized variables			**0.7689**
Cronbach's Coefficient Alpha for raw variables			**0.8239**

TABLE 5. 8: Descriptive statistics for all the variables in the contractor questionnaire

Variables	Categories	Frequency	Percentage out of total
1. Eskom and Government interventions provide value in contractor development.	Strongly agree	1	3.6%
	Agree	10	35.7%
	Undecided	10	35.7%
	Disagree	7	25.0%
	Strongly disagree	0	0.0%
2. Does Eskom provide clear instructions and communication with the contractor through out the duration of the project?	Strongly agree	0	0.0%
	Agree	13	46.4%
	Undecided	1	3.6%
	Disagree	14	50.0%
	Strongly disagree	0	50.0%
3. Total Quality Management and ISO 9001:2008 standards add value to the contractor.	Strongly agree	2	7.1%
	Agree	11	39.3%
	Undecided	7	25.0%
	Disagree	8	28.6%
	Strongly disagree	0	0.0%
4. Does Eskom pay contractors in agreed times during the construction phase?	Strongly agree	0	0.0%
	Agree	15	53.6%
	Undecided	3	10.7%

Variables	Categories	Frequency	Percentage out of total
	Disagree	10	35.7%
	Strongly disagree	0	0.0%
5. Eskom's procurement processes are transparent.	Strongly agree	0	0.0%
	Agree	8	28.6%
	Undecided	7	25.0%
	Disagree	13	46.4%
	Strongly disagree	0	0.0%
6. High Voltage System Operating Regulations are implemented effectively.	Strongly agree	1	3.6%
	Agree	15	53.6%
	Undecided	3	10.7%
	Disagree	9	32.1%
	Strongly disagree	0	0.0%
7. Eskom's training manuals are helpful and useful during construction.	Strongly agree	0	0.0%
	Agree	12	42.9%
	Undecided	4	14.3%
	Disagree	12	42.9%
	Strongly disagree	0	0.0%
8. Clerk of Works is always on site and is helpful for the contractors.	Strongly agree	0	0.0%
	Agree	4	14.3%
	Undecided	3	10.7%
	Disagree	19	67.9%
	Strongly disagree	2	7.1%
9. Eskom policies, standards, work instructions and procedures are conveniently available to contractors.	Strongly agree	0	0.0%
	Agree	17	60.7%
	Undecided	6	21.4%
	Disagree	5	17.9%
	Strongly disagree	0	0.0%
10. Construction Regulations are providing clear guidelines during construction.	Strongly agree	1	3.6%
	Agree	13	46.4%
	Undecided	9	32.1%
	Disagree	5	17.9%
	Strongly disagree	0	0.0%
11. Construction Industry Development	Strongly agree	0	0.0%

Variables	Categories	Frequency	Percentage out of total
Board is accessible and available to contractors.	Agree	1	3.6%
	Undecided	5	17.9%
	Disagree	16	57.1%
	Strongly disagree	6	21.4%
12. Contractor Forums add value to my business development and operations.	Strongly agree	2	7.1%
	Agree	17	60.7%
	Undecided	3	10.7%
	Disagree	6	21.4%
	Strongly disagree	0	0.0%
13. My company works according to a certain procedure given by Eskom.	Strongly agree	5	17.9%
	Agree	17	60.7%
	Undecided	6	21.4%
	Disagree	0	0.0%
	Strongly disagree	0	0.0%
14. I do know all the role players working with the contractors in the organisation.	Strongly agree	0	0.0%
	Agree	3	10.7%
	Undecided	9	32.1%
	Disagree	15	53.6%
	Strongly disagree	1	3.6%
15. The organisation communicates properly with the contractors, procedures, standards, requirements, completion dates etc.	Strongly agree	0	0.0%
	Agree	10	35.7%
	Undecided	6	21.4%
	Disagree	11	39.3%
	Strongly disagree	1	3.6%

TABLE 5. 9: Descriptive statistics for all the variablesin the Capital Programme Management questionnaire

Variables	Categories	Frequency	Percentage out of total
1. Project Management carry out monthly inspections of all contractors performing work for Eskom	Agree to strongly agree	2	40.0%
	Undecided	2	40.0%

Variables	Categories	Frequency	Percentage out of total
Distribution in terms of the Construction Regulations, other Legislative requirements and Project management requirements.	Disagree to strongly disagree	1	20.0%
2. Project Management (CoW's) conduct a site visit on all contractors performing contracts under their control. Where there are deviations then non-conformances are issued to the offender and copies forwarded to other all key role players.	Agree to strongly agree	5	100.0%
	Undecided	0	0.0%
	Disagree to strongly disagree	0	0.0%
3. On a monthly basis the Capital Programme department provides the Risk Management Coordinator responsible for contractor management with an updated list of all suppliers currently providing a service to Eskom Distribution.	Agree to strongly agree	0	0.0%
	Undecided	0	0.0%
	Disagree to strongly disagree	5	100.0%
4. Project Coordinators have been sufficiently trained and have sufficient experience to monitor and guide contractors' o quality of workmanship.	Agree to strongly agree	1	20.0%
	Undecided	0	0.0%
	Disagree to strongly disagree	4	80.0%
5. Clerk of Works has been sufficiently trained and has sufficient experience to monitor and guide contractors' o quality of workmanship.	Agree to strongly agree	1	20.0%
	Undecided	0	0.0%
	Disagree to strongly disagree	4	80.0%
6. Construction material always arrives on site in time and in correct quantity and quality.	Agree to strongly agree	3	60.0%
	Undecided	0	0.0%
	Disagree to strongly disagree	2	40.0%
7. All contractors are trained in material identification and material handling.	Agree to strongly agree	1	20.0%
	Undecided	1	20.0%

Variables	Categories	Frequency	Percentage out of total
	Disagree to strongly disagree	3	60.0%
8. All contractors adhere to the prescribed procedures on material handling.	Agree to strongly agree	0	0.0%
	Undecided	2	40.0%
	Disagree to strongly disagree	3	60.0%
9. Contractors are given sufficient time to finish the projects on site.	Agree to strongly agree	4	80.0%
	Undecided	1	20.0%
	Disagree to strongly disagree	0	0.0%
10. All non-conformances are reported, recorded and followed up by Project coordinators and Clerk of Works	Agree to strongly agree	2	40.0%
	Undecided	0	0.0%
	Disagree to strongly disagree	3	60.0%

TABLE 5. 10: Descriptive statistics for all the variablesin the Risk Management questionnaire

Variables	Categories	Frequency	Percentage out of total
1. Risk department carry out monthly inspections of all contractors performing work for Eskom Distribution in terms of the Construction Regulations, other Legislative requirements and Project management requirements.	Agree to strongly agree	5	100.0%
	Undecided	0	0.0%
	Disagree to strongly disagree	0	0.0%
2. Safety Coordinator conducts a site visit on all contractors performing contracts under their control. Where there are deviations then non-conformances are issued to the offender and copies forwarded to	Agree to strongly agree	5	100.0%
	Undecided	0	0.0%
	Disagree to strongly disagree	0	0.0%

Variables	Categories	Frequency	Percentage out of total
other all key role players.			
3. On a monthly basis the Capital Programme department provides the Risk Management Coordinator responsible for contractor management with an updated list of all suppliers currently providing a service to Eskom Distribution.	Agree to strongly agree	1	20.0%
	Undecided	2	40.0%
	Disagree to strongly disagree	2	40.0%
4. Contractors always work according to Eskom Health and Safety Policy and procedures.	Agree to strongly agree	1	20.0%
	Undecided	1	20.0%
	Disagree to strongly disagree	3	60.0%
5. Does each contractor submit weekly Safety, Health and Environment statistics?	Agree to strongly agree	0	0.0%
	Undecided	1	20.0%
	Disagree to strongly disagree	4	80.0%
6. Contractor employees are provided with safety induction and orientation training and records are kept.	Agree to strongly agree	5	100.0%
	Undecided	0	0.0%
	Disagree to strongly disagree	0	0.0%
7. Contractors keep and maintain minimum requirements for the first aid box on site.	Agree to strongly agree	3	60.0%
	Undecided	0	0.0%
	Disagree to strongly disagree	2	40.0%
8. Contractors are working according to the approved written work safe procedures/task analyses and work instructions at all times.	Agree to strongly agree	2	40.0%
	Undecided	0	0.0%
	Disagree to strongly disagree	3	60.0%
9. Contractors are given sufficient time to finish the projects on site.	Agree to strongly agree	1	20.0%

Variables	Categories	Frequency	Percentage out of total
	Undecided	1	20.0%
	Disagree to strongly disagree	3	60.0%
10. All non-conformances are reported, recorded and followed up by Project coordinators and Clerk of Works	Agree to strongly agree	2	40.0%
	Undecided	0	0.0%
	Disagree to strongly disagree	3	60.0%

TABLE 5. 11: Descriptive statistics for all the variablesin the Technology and Quality Management questionnaire

Variables	Categories	Frequency	Percentage out of total
1. Technology and Quality department carry out monthly inspections of all contractors performing work for Eskom Distribution in terms of the Construction Regulations, other Legislative requirements and Project management requirements.	Agree to strongly agree	1	20.0%
	Undecided	0	0.0%
	Disagree to strongly disagree	4	80.0%
2. Technology and Quality department conducts a site visit on all contractors performing contracts under their control. Where there are deviations then non-conformances are issued to the offender and copies forwarded to other all key role players.	Agree to strongly agree	0	0.0%
	Undecided	1	20.0%
	Disagree to strongly disagree	4	80.0%
3. On a monthly basis the Technology and Quality department provides the Procurement and Capital Programme department the audit results from the contractors.	Agree to strongly agree	0	0.0%
	Undecided	1	20.0%
	Disagree to strongly disagree	4	80.0%
4. Technology and Quality department conducts periodic quality audits on construction materials in the stores.	Agree to strongly agree	0	0.0%
	Undecided	2	40.0%

Variables	Categories	Frequency	Percentage out of total
	Disagree to strongly disagree	3	60.0%
5. Technology and Quality department communicates regularly with the contractors to improve QUALITY.	Agree to strongly agree	0	0.0%
	Undecided	2	40.0%
	Disagree to strongly disagree	3	60.0%
6. Technology and Quality department participates in contractor related incident investigations.	Agree to strongly agree	4	80.0%
	Undecided	1	20.0%
	Disagree to strongly disagree	0	0.0%
7. Technology and Quality department participates in the contractor selection process.	Agree to strongly agree	2	40.0%
	Undecided	1	20.0%
	Disagree to strongly disagree	2	40.0%
8. Technology and Quality department monitors contracts during the execution of the project for conformance.	Agree to strongly agree	1	20.0%
	Undecided	0	0.0%
	Disagree to strongly disagree	4	80.0%
9. Contractors are given sufficient time to finish the projects on site.	Agree to strongly agree	1	20.0%
	Undecided	1	20.0%
	Disagree to strongly disagree	3	60.0%
10. All non-conformances are reported, recorded and followed up by Technology and Quality department.	Agree to strongly agree	0	0.0%
	Undecided	1	20.0%
	Disagree to strongly disagree	4	80.0%

TABLE 5. 12: Descriptive statistics – Mean, Median, Standard Deviation and Range For contractors questionnaire

Variable	N	Mean	Std Dev	Median	Range
1. Eskom and Government interventions provide value in contractor development.	28	2.82	0.8630	3.0	3.0
2. Does Eskom provide clear instructions and communication with the contractor through out the duration of the project?	28	3.04	0.9993	3.5	2.0
3. Total Quality Management and ISO 9001:2008 standards add value to the contractor.	28	2.75	0.9670	3.0	3.0
4. Does Eskom pay contractors in agreed times during the construction phase?	28	2.82	0.9449	2.0	2.0
5. Eskom's procurement processes are transparent.	28	3.18	0.8630	3.0	2.0
6. High Voltage System Operating Regulations are implemented effectively.	28	2.71	0.9759	2.0	3.0
7. Eskom's training manuals are helpful and useful during construction.	28	3.00	0.9428	3.0	2.0
8. Clerk of Works is always on site and is helpful for the contractors.	28	3.68	0.8189	4.0	3.0
9. Eskom policies, standards, work instructions and procedures are conveniently available to contractors.	28	2.57	0.7902	2.0	2.0
10. Construction Regulations are providing clear guidelines during construction.	28	2.64	0.8262	2.5	3.0
11. Construction Industry Development Board is accessible and available to contractors.	28	3.96	0.7445	4.0	3.0
12. Contractor Forums add value to my business development and operations.	28	2.46	0.9222	2.0	3.0
13. My company works according to a certain procedure given by Eskom.	28	2.04	0.6372	2.0	2.0
14. I do know all the role players working with the contractors in the organisation.	28	3.50	0.7454	4.0	3.0
15. The organisation communicates properly with the contractors, procedures, standards, requirements, completion dates etc.	28	3.11	0.9560	3.0	3.0

TABLE 5. 13: Descriptive statistics – Mean, Median, Standard Deviation and Range for project management questionnaire

Variable	N	Mean	Std Dev	Median	Range
1. Project Management carry out monthly inspections of all contractors performing work for Eskom Distribution in terms of the Construction Regulations, other Legislative requirements and Project management requirements.	5	2.60	1.1402	3.0	3.0
2. Project Management (CoW's) conduct a site visit on all contractors performing contracts under their control. Where there are deviations then non-conformances are issued to the offender and copies forwarded to other all key role players.	5	1.80	0.4472	2.0	1.0
3. On a monthly basis the Capital Programme department provides the Risk Management Coordinator responsible for contractor management with an updated list of all suppliers currently providing a service to Eskom Distribution.	5	4.20	0.4472	4.0	1.0
4. Project Coordinators have been sufficiently trained and have sufficient experience to monitor and guide contractors' o quality of workmanship.	5	3.60	0.8944	4.0	2.0
5. Clerk of Works has been sufficiently trained and has sufficient experience to monitor and guide contractors' o quality of workmanship.	5	3.40	1.3416	4.0	3.0
6. Construction material always arrives on site in time and in correct quantity and quality.	5	2.80	1.0954	2.0	2.0
7. All contractors are trained in material identification and material handling.	5	3.40	0.8944	4.0	2.0
8. All contractors adhere to the prescribed procedures on material handling.	5	3.60	0.5477	4.0	1.0
9. Contractors are given sufficient time to finish the projects on site.	5	2.20	0.4472	2.0	1.0
10. All non-conformances are reported, recorded and followed up by Project coordinators and Clerk of Works	5	3.20	1.6432	4.0	4.0

TABLE 5. 14: Descriptive statistics – Mean, Median, Standard Deviation and Range for risk management department questionnaire

Variable	N	Mean	Std Dev	Median	Range
1. Risk department carry out monthly inspections of all contractors performing work for Eskom Distribution in terms of the Construction Regulations, other Legislative requirements and Project management requirements.	5	1.80	0.4472	2.0	1.0
2. Safety Coordinator conducts a site visit on all contractors performing contracts under their control. Where there are deviations then non-conformances are issued to the offender and copies forwarded to other all key role players.	5	1.60	0.5477	2.0	1.0
3. On a monthly basis the Capital Programme department provides the Risk Management Coordinator responsible for contractor management with an updated list of all suppliers currently providing a service to Eskom Distribution.	5	3.20	0.8367	3.0	2.0
4. Contractors always work according to Eskom Health and Safety Policy and procedures.	5	3.40	0.8944	4.0	2.0
5. Does each contractor submit weekly Safety, Health and Environment statistics?	5	3.80	0.4472	4.0	1.0
6. Contractor employees are provided with safety induction and orientation training and records are kept.	5	1.80	0.4472	2.0	1.0
7. Contractors keep and maintain minimum requirements for the first aid box on site.	5	2.80	1.0954	2.0	2.0
8. Contractors are working according to the approved written work safe procedures/task analyses and work instructions at all times.	5	3.20	1.0954	4.0	2.0
9. Contractors are given sufficient time to finish the projects on site.	5	3.40	0.8944	4.0	2.0
10. All non-conformances are reported, recorded and followed up by Project coordinators and Clerk of Works	5	3.20	1.0954	4.0	2.0

TABLE 5. 15: Descriptive statistics – Mean, Median, Standard Deviation and Range for Technology and Quality department questionnaire

Variable	N	Mean	Std Dev	Median	Range
1. Technology and Quality department carry out monthly inspections of all contractors performing work for Eskom Distribution in terms of the Construction Regulations, other Legislative requirements and Project management requirements.	5	3.6	0.8944	4.0	2.0
2. Technology and Quality department conducts a site visit on all contractors performing contracts under their control. Where there are deviations then non-conformances are issued to the offender and copies forwarded to other all key role players.	5	3.80	0.4472	4.0	1.0
3. On a monthly basis the Technology and Quality department provides the Procurement and Capital Programme department the audit results from the contractors.	5	3.80	0.4472	4.0	1.0
4. Technology and Quality department conducts periodic quality audits on construction materials in the stores.	5	3.80	0.8367	4.0	2.0
5. Technology and Quality department communicates regularly with the contractors to improve QUALITY.	5	3.60	0.5477	4.0	1.0
6. Technology and Quality department participates in contractor related incident investigations.	5	2.20	0.4472	2.0	1.0
7. Technology and Quality department participates in the contractor selection process.	5	2.80	1.3038	3.0	3.0
8. Technology and Quality department monitors contracts during the execution of the project for conformance.	5	3.60	0.8944	4.0	2.0
9. Contractors are given sufficient time to finish the projects on site.	5	3.40	0.8944	4.0	2.0
10. All non-conformances are reported, recorded and followed up by Technology and Quality department.	5	3.80	0.4472	4.0	1.0

TABLE 5. 16: Statistically Significant Chi-square tests.

Statement	Category	N	Percentage	Chi-square	P-Value
	Agree	13	46.4%	11.2143	0.0037**

Statement	Category	N	Percentage	Chi-square	P-Value
2. Does Eskom provide clear instructions and communication with the contractor through out the duration of the project?	Agree	13	46.4%	11.2143	0.0037**
	Undecided	1	3.6%		
	Disagree	14	50.0%		
4. Does Eskom pay contractors in agreed times during the construction phase?	Agree	15	53.6%	7.7857	0.0204*
	Undecided	3	10.7%		
	Disagree	10	35.7%		
6. High Voltage System Operating Regulations are implemented effectively.	Agree	16	57.1%	9.0714	0.0107*
	Undecided	3	10.7%		
	Disagree	9	32.1%		
8. Clerk of Works is always on site and is helpful for the contractors. .	Agree	4	14.3%	21.9286	<0.0001***
	Undecided	3	10.7%		
	Disagree	21	75.0%		
9. Eskom policies, standards, work instructions and procedures are conveniently available to contractors.	Agree	17	60.7%	9.5000	0.0087**
	Undecided	6	21.4%		
	Disagree	5	17.9%		
11. Construction Industry Development Board is accessible and available to contractors.	Agree	1	3.6%	26.6429	<0.0001***
	Undecided	6	17.9%		
	Disagree	22	78.6%		
12. Contractor Forums add value to my business development and operations	Agree	19	67.86%	15.5000	0.0004**
	Undecided	3	10.7%		
	Disagree	6	21.4%		
13. My company works according to a certain procedure given by Eskom.	Agree	22	78.6%	9.1429	0.0025**
	Undecided	6	21.4%		
14. I do know all the role players working with the contractors in the organisation.	Agree	3	10.7%	9.0714	0.0107*
	Undecided	9	32.1%		
	Disagree	16	57.1%		