

DIFFUSION OF A QUALITY MANAGEMENT SYSTEM: A CASE STUDY

by

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ABSTRACT

The diffusion of a Quality Management System (QMS) to improve business performance depends upon the quality management strategy used. The aim of Eskom's QMS strategy was to create a sustainable quality drive throughout the company to improve customer and stakeholder satisfaction.

This research project's objective is to determine how the diffusion of a QMS can improve the electricity supply industry in the Western Cape division of the electricity sector in South Africa.

The key research objectives within the research study are:

- to assess what effect a QMS has on a sustainable long-term solution for energy supply;
- to assess how a QMS contributes to the establishment of world class processes and practices;
- to determine how a QMS affects quality culture;
- to determine what factors of a QMS play a role in a continual improvement process, and
- to determine what barriers affect a sustainable QMS implementation.

The research question is: "how can the diffusion of a QMS bring improvement to the electricity supply industry?"

A quantitative research methodology was employed in the study. The responses to a survey questionnaire were analysed and conclusions were drawn.

The research finding is that diffusion of a QMS improves the electricity industry by positively affecting attitudes towards the challenge of securing a sustainable long-term energy supply, improving processes and practices, engendering a quality culture and contributing towards continual improvement. At the same time, certain barriers to the implementation of a sustainable QMS were identified.

Key words:

Quality Management Systems diffusion, ISO 9001, QMS adoption, ISO 9001 implementation, continuous process improvement, electricity industry case study

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Author

Noel Solomon

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GLOSSARY OF TERMS

- Action research:** Research strategy concerned with the management of change and involving close collaboration between practitioner and researcher. (Saunders, Lewis, & Thornhill, 2003:472)
- Case study:** Research strategy that involves the imperial investigation of a particular contemporary phenomenon with in its real life context, using multiple sources of evidence. (Saunders *et al.*, 2003:473)
- Diffusion:** A process where a new initiative is communicated through certain channels over time amongst members of a social system. (Rogers, 1983:5)
- Quality management:** The management processes that overarch and tie together quality control and quality assurance activities. (Foster, 2010:530)
- Research:** A systematic collection and interpretation of information with a clear purpose, to find out things. (Saunders *et al.*, 2003:473)
- Research question:** One of a number of key questions a researcher will address. (Saunders *et al.*, 2003:473)
- Sample:** A part representing a whole. (Foster, 2010:530)
- Value chain:** A concept that decomposes a firm into its core activities. (Foster, 2010:530)

CHAPTER 1: SCOPE OF RESEARCH

1.1. INTRODUCTION

The effective diffusion of a QMS (Quality Management System) is vital to the success of Eskom as a business as it has the potential to promote continual improvement to maximise profit in a sustainable manner. Promoting continual quality improvement in all products and services, along with the other Eskom core values, is central to Eskom's business plan (Eskom, 2014).

This research aims to establish the effectiveness of the diffusion of a QMS within the electricity industry, using a case study research approach. This chapter describes the scope of the research by expanding on the following:

- Motivation.
- Research design framework.
- Background and statement of the research problem.
- The research questions and investigative questions.
- The primary research objectives.
- The research process.
- The research design and methodology.
- Data Validity and Reliability.
- Ethics.
- Research assumptions and constraints.
- Significance of the research.

1.2. MOTIVATION

The effective diffusion of a QMS was highly anticipated within Eskom as many other businesses showed positive results after embarking on a similar journey. The reasons for resorting to a QMS included improving the company's quality image, improving its efficiency, improving communication, resolving quality problems arising from poor work,

reducing risk and aiding in a cost-saving drive. The QMS chosen by Eskom was ISO 9001 (ISO, 2008).

Using this standard should ensure compliance to regulatory requirements concerning the products being produced and simultaneously deliver improved customer satisfaction. The QMS should also result in the organisation growing its market share while minimising production costs. Using the QMS is meant to result in internal departmental improvement throughout the organisation.

A case study of the diffusion of the QMS within Eskom stands to benefit the business by enabling self-reflection on the QMS diffusion process, to determine whether the expectations around it have been met. The value within the academic environment will be to create a benchmark on the effective diffusion of a QMS within the electricity industry in South Africa. While quality management systems have been adopted by organisations in countries around the world, including South Africa, this study will help ascertain how the diffusion of a QMS is affected by different business environments, and how Eskom compares to the ISO 9001 best practices (Eskom, 2014).

1.3. RESEARCH DESIGN FRAMEWORK

The research of Creswell (2003), shows that a research design is the plan of a research study. Research design is the framework that has been created to find answers to research questions. The research design framework used for this research is illustrated in Annexure A.

The research framework forms the basic plan used to execute this research through its cycle. It begins with the problem statement and its associated research question. This research question contains detailed investigative questions with the common objective to answer the main research question. These investigative research questions are further broken down to detailed investigative questions all with the common aim of meeting the research objectives.

1.4. BACKGROUND TO THE RESEARCH PROBLEM

The purpose of Eskom's adopting a QMS was to improve overall business performance. Business performance for an electricity producing company is affected by the following factors, as indicated in Figure 1.1:

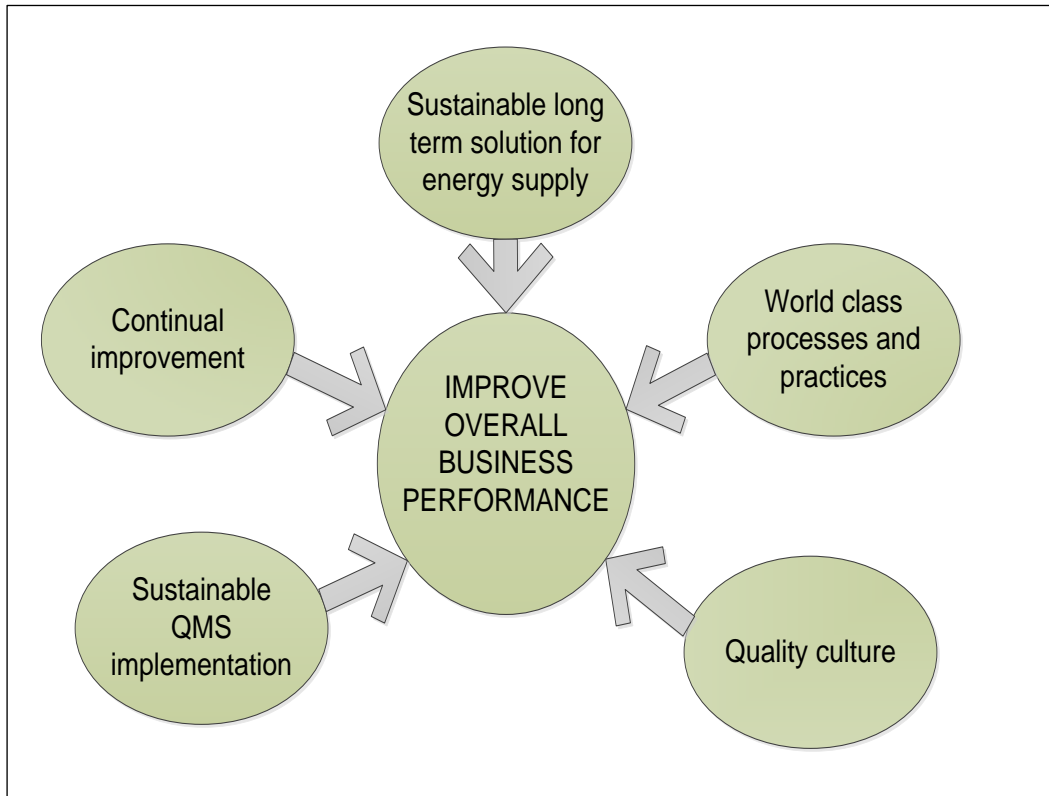


Figure 1.1: Electricity producing company business performance factors
(Source: own)

- **Sustainable long-term solution for energy supply:** the ability of an energy supplier to meet the energy consumers' demands, and the consumers using energy efficiently to enable the supplier to satisfy their energy requirements.
- **Development of world-class processes and practices:** the ability to develop world-class processes and adopt practices to aid overall business performance.
- **Adoption of a quality culture:** the effective adoption of a quality culture introduced by ISO 9001 to improve overall business performance.

- **Sustainable QMS implementation:** the implementation of a QMS needs to be sustainable in order to improve overall business performance.
- **Continual improvement:** the concept of continual improvement has to be adopted within the organisation in order to advance business value.

The introduction of ISO 9001 was accepted in the organisation with many mixed feelings, with the majority of employees not knowing what it was, many fearing change and worrying about its impact on productivity, and some seeing it as just another system to be implemented.

ISO 9001 QMS was implemented within 8 months of its announcement in the business. Many employees saw the implementation as the installation of another system that somehow ran separately from what they did on a daily basis. They did not understand why it was being implemented and what the benefits were.

Because of these reactions, the Business Analysis department conducted a survey to ascertain the situation. A QMS survey was conducted on all aspects of ISO 9001 understanding and experience. A sample of 20 employees was selected from various parts of the business to participate in this exercise and the data was analysed. The results showed that the situation outlined above was indeed true.

A root cause analysis workshop was conducted to determine the underlining issues regarding the poor diffusion of the QMS.

The root cause analysis highlighted issues such as:

- Problematic ISO 9001 implementation.
- Bad communication and training.
- Bad Quality Management System usage.
- Minimal involvement of people.
- Lack of ISO 9001 understanding within the organisation.
- Insufficient ISO 9001 awareness drives.

1.5. STATEMENT OF THE RESEARCH PROBLEM

The root cause analysis highlighted many issues pointing towards the conclusion that the diffusion of the QMS had been poor. Therefore, the research problem can be stated as follows: “The diffusion of a quality management system has not improved the electricity supply industry”.

1.6. RESEARCH QUESTION

The research question is this: “how can the diffusion of a QMS bring improvement to the electricity supply industry?”

1.7. INVESTIGATIVE QUESTIONS

Below are the investigative questions stemming from the main research question:

- What effect does a QMS have on a sustainable long-term solution to the problem of energy supply?
- How does a QMS contribute to the establishment of world-class processes and practices?
- How does a QMS influence quality culture?
- How does a QMS ensure a continual improvement process?
- What factors affect a sustainable QMS implementation?

1.8. PRIMARY AND KEY RESEARCH OBJECTIVES

The primary research objective is:

- To determine how can the diffusion of a QMS bring improvement to the electricity supply industry.

The key research objectives within the research study are:

- to assess what effect a QMS has on a sustainable long term solution to the problem of energy supply;
- to determine what QMS factors contribute to the establishment of world class processes and practices;
- to determine how a QMS influences quality culture;

- to determine how a QMS facilitates a continual improvement process, and
- to determine what critical success factors and barriers hinder the sustainable implementation of a QMS.

1.9. THE RESEARCH PROCESS

Saunders *et al.* (2003:6) and Mouton (2014:86), characterise the research process as follows:

- The topic for the research will be identified.
- The focus will be on the research problem.
- Decide on which research plan and method to use.
- Data will be collected as per the method and plan.
- The data will be analysed.
- The dissertation will be developed.

This research process outline will guide the researcher through the research study.

1.10. RESEARCH DESIGN AND METHODOLOGY

Geringer, Frayne and Milliman (2009:5-50) and Peh and Low (2013:133), describe research design as “the logical sequence that connects the empirical data to a study’s initial research question and ultimately, to its conclusions. Colloquially, a research design *is an action plan for getting from here to there*, where *here* may be defined as the initial set of questions to be answered, and *there* is some set of conclusions (answers) about these questions”. For this research, a case study methodology will be used. This will fall mainly within the quantitative paradigm but partly within the qualitative paradigm. The research design and methodology are fully described in Chapter 4.

1.11. DATA COLLECTION DESIGN AND METHODOLOGY

Cooper and Schindler (2006:204) and Mouton (2014:105), confirm that the use of a survey questionnaire is in line with the positivistic (quantitative) research paradigm.

The data collection design and methodology are explained in Chapter 5.

1.12. ETHICS

Saunders, Lewis and Thornhill (2000:130), quotes that “ethics refers to the appropriateness of your behaviour in relation to the rights of those who become the subject of your work, or are affected by it”.

The research of Mouton (2014:239) and Leedy and Ormrod (2001:107-108), shows that most ethical issues fall within the following four categories:

- **Protection from Harm:** When the participant takes part in a study that creates an uncomfortable situation, the necessary debriefing or counselling must follow directly thereafter.
- **Informed consent:** The study should be made optional for participants, based on its nature being explained in advance. The participants must be able to remove themselves from the study at any time.
- **Right to privacy:** The participants’ particulars and progress should not be made publicly available.
- **Honesty with professional colleagues:** The data generated should not be made up and without merit to support the conclusion. Any findings of this nature should be reported immediately.

The main ethical categories considered for this study were “informed consent”, “right of privacy” and “Honesty with professional colleagues”

1.13. RESEARCH ASSUMPTIONS

Leedy and Ormrod (2001:62-63), describe research assumptions in the following terms: they are “what the researcher takes for granted. However, taking things for granted may cause misunderstanding. What is tacitly assumed, others may have never considered. If we act on our assumptions, and if in the result such action makes a big difference in the outcome, we may face a situation we are totally unprepared to accept. In

research we try to leave nothing to chance in the hope of preventing misunderstanding”.

This research makes the following assumptions:

- The participants are available to take part in this research.
- The participants answer the questionnaire honestly and truthfully.
- The participants understand the questions on the questionnaire.
- A briefing session is needed before all data gathering activities.
- The participants are knowledgeable about the QMS within the organisation.

1.14. RESEARCH CONSTRAINTS

Collis and Hussy (2003:128-129), are of the opinion that ‘limitations’ can be regarded as flaws in the study. ‘De-limitation’ describes when a study focuses on a certain area and not a more comprehensive topic.

The following apply to this research:

Limitations: The research focus is solely on the quality aspect of a business following implementation of a QMS.

De-limitation: The research is conducted in the Eskom distribution department in the Western Cape region.

The following constraints apply to this research:

- The availability of participants to part take in this research.
- The sensitivity of some information, which might therefore be withheld.

1.15. CHAPTER OUTLINE

The study comprises the following chapters:

- **Chapter 1: The scope of the research:** the chapter sketches the background of the research and offers a brief introduction to it. It explains what the research is about and provides an outline of how the research was conducted.
- **Chapter 2: A holistic perspective on the research environment:** Chapter 2 discusses the research environment and provides a

comprehensive background to help the reader understand where the research took place and why it was done.

- **Chapter 3: Literature review:** Chapter 3 comprises a literature review relating to the research topic, “Diffusion of a quality management system”. It elaborates on the research problem through consulting and scrutinising the relevant literature in books and journals.
- **Chapter 4: Data collection design and methodology:** This chapter offers an overview of the research design and methods used in this study.
- **Chapter 5: Data analysis and interpretation of results:** In this chapter, the data gathered are analysed and subjected to interpretation.
- **Chapter 6: Conclusion and recommendations:** This chapter concludes the research. It reflects on the findings of the research in relation to previous studies consulted (Chapter 3). Recommendations are made, aimed at benefiting the organisation as a whole.

1.16. SIGNIFICANCE OF THE RESEARCH

The significance of this research lies in its making a quantitative measurement of the success of the diffusion of a QMS. It reveals what impact the QMS has had on the objectives formulated by the business and serves to indicate which areas, according to the diffusion of the QMS, should be focussed on. This will positively support the drive for continual improvement and aid in developing a sustainable business.

1.17. CONCLUSION

This chapter introduced the research topic, why this topic was chosen for this research and the framework to be used to conduct the research. Stemming from above, it introduces the research problem statement, research questions and investigative research question with its associated objectives.

It touches all needed aspect of the research such as the research methodology, data collection design, assumptions and ethics to be used for this research. In brief, it provides the framework in which to execute the research study.

The next chapter provides the context within the research environment in order to prove the research problem's existence for the study.

CHAPTER 2: A HOLISTIC PERSPECTIVE ON THE ELECTRICITY PRODUCING INDUSTRY ENVIRONMENT FOR THE DIFFUSION OF A QMS

2.1. INTRODUCTION

The diffusion of a QMS leading to an improvement in business performance is affected by the business's quality management strategy. The aim of Eskom's QMS strategy was to have a sustainable quality drive throughout the company to achieve improved customer and stakeholder satisfaction. The following will be discussed to clarify the environment in which the business problem at the basis of this thesis was identified:

- Quality management strategy.
- Drivers for quality management in Eskom.
- Quality management strategy objective and goal.
- Eskom internal ISO 9001 QMS audits.
- Business problem root cause analysis.

2.2. QUALITY MANAGEMENT STRATEGY

The Eskom Holdings Quality Management Strategy shows that document ESG 32-800, the Eskom Holdings Quality Management Strategy, was initially developed with the aim of achieving sustainable and improved business performance (Eskom 2009).

The Eskom Holdings Quality Management Strategy, document ESG 32-800, states that the strategy consists of Eskom-wide QMS implementation using the electricity supply process and the integration of the ISO 9001 auditable QMS into all business systems throughout Eskom. The strategy was widely supported by the divisional Executive and Management Committees and subsequently approved by the Board Sustainability Committee on 9 March 2006. In 2008, a review of the old Quality Management strategy was initiated due to its focusing on ISO 9001 compliant management systems, with no other activities to entrench the

required culture to sustain quality management and use it as a tool to improve business performance (Eskom 2009).

The QM strategy was therefore reviewed to incorporate actions aimed at integrating quality management into all business processes and activities, and to entrench a quality culture to achieve sustainable performance improvement.

2.3. DRIVERS FOR QUALITY MANAGEMENT IN ESKOM

There were several external and internal forces driving Eskom to introduce a QMS into their business. Table 2.1., illustrates these driving forces, as indicated in the Eskom Holdings Quality Management Strategy document.

Table 2.1: The external and internal driving forces for Eskom to adopt a QMS
(Source: Eskom, 2009)

External Drivers	Internal Drivers
Highly publicised supply interruptions: these could damage Eskom’s reputation if any form of negligence is suspected.	Required capacity development and maintenance of existing plant with limited resources (funds, skills),
Ever-increasing regulatory oversight: the regulator needs to have confidence that our operations are managed effectively.	The prospect of a durable power system to keep the lights on during an unstable power delivery era due to ageing plants.
Customer expectations for a reliable electricity supply despite current constraints.	Business sustainability through achievement of economic, social and environmental goals.
	Long-term plant health through proactive management of our assets.

The adoption of a QMS has the potential to encourage a proactive way of doing business despite the company’s current constraints. A framework introduced by the QMS to support this proactive way of doing business is the Plan-Do-Check-Act (PDCA) cycle approach. The PDCA approach has proven to be successful as it is used in many organisations that have achieved excellence.

The Eskom Holdings Quality Management Strategy document (Eskom, 2009), states that the implementation of a QMS in Eskom will also confer the following benefits, stemming from the proactive way of working:

- A holistic view of customer and stakeholder requirements.
- Successful business objectives aimed at exceeding customer and investor needs.
- Highlighting the business's strengths and opportunities for improvement.
- An organised method to manage business processes.
- Highlighting the business return of investments.

2.4. QUALITY MANAGEMENT STRATEGY OBJECTIVE AND GOAL

The quality management strategy was developed with input from all Eskom divisions through Eskom Quality Forums and Quality Leadership Committee meetings. The strategy was then shared with divisional executive committees to obtain their input and at the same time support the strategy (Eskom, 2009).

The QM strategy's objective in Eskom was to integrate quality into all activities throughout Eskom for a sustainable electricity supply and continual improvement directed towards increased customer and stakeholder satisfaction.

In order to achieve the QM strategic objective, the following goals had to be achieved:

- Establish an optimum quality management structure across Eskom.
- Define a quality roadmap for long-term sustainable business performance.
- Promote and entrench quality.
- Measure and report on quality improvement in Eskom.
- Achieve continual improvement.

These goals form the basis for implementing the QMS within Eskom. A high-level implementation and action plan was developed to deploy the QMS. This is reproduced in Annexure C.

2.5. ESKOM INTERNAL ISO 9001 QMS AUDITS

The implementation of ISO 9001 QMS was carried out as per the implementation plan (Annexure C).

The Eskom Holdings Quality Management Strategy document (Eskom, 2009; Eskom, 2012), reveals that the QMS implementation was conducted within 14 months after its announcement. Thereafter many departments conducted internal audits to ensure their readiness for ISO 9001 QMS certification. Many departments conducted second internal audits based on their initial audit results. The results, as stated in some department's internal audit report: "Business Management System's (QMS) maturity levels have not increased since their initial audit".

An analysis of the internal audit findings revealed, as per Figure 2.1, the total number of findings of faults was 153 across the business unit.

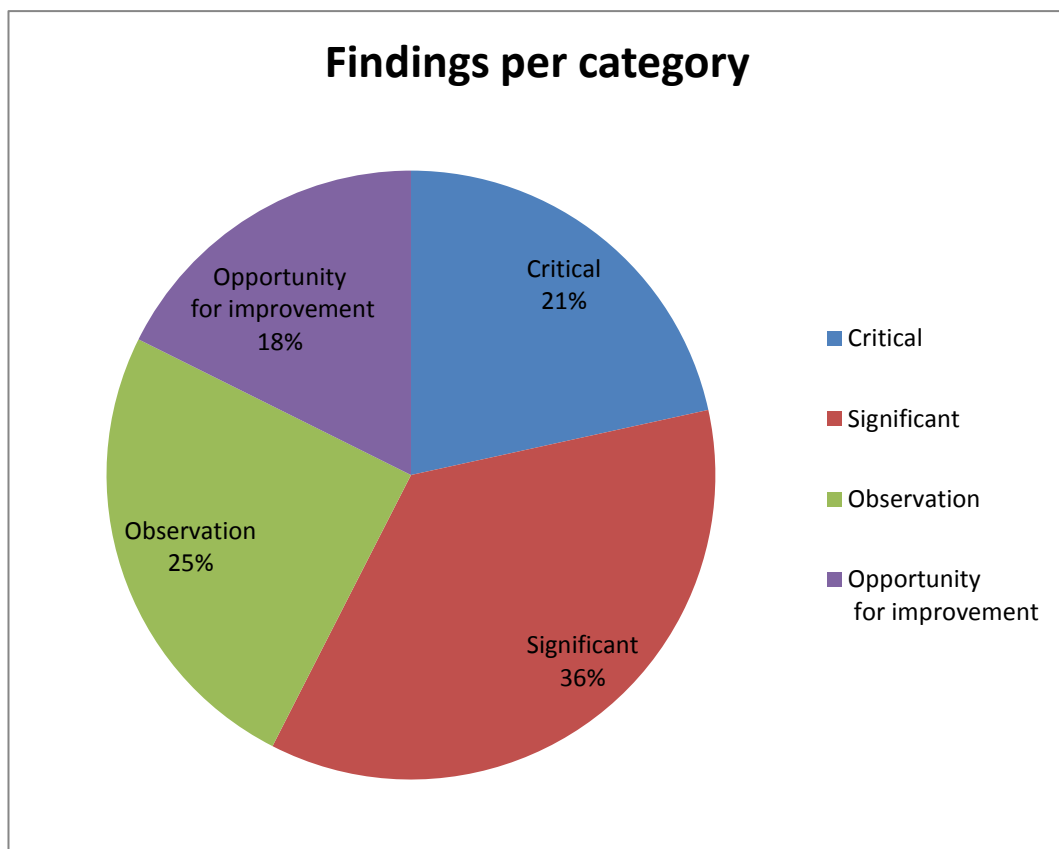


Figure 2.1: Findings per category

(Source: Eskom, 2012)

Twenty one percent (21%) were critical findings, 36% were significant, 25% observations and 18% opportunities for improvement.

A further analysis of the report reveals that the findings per ISO 9001 clause were as shown in Figure 2.2.

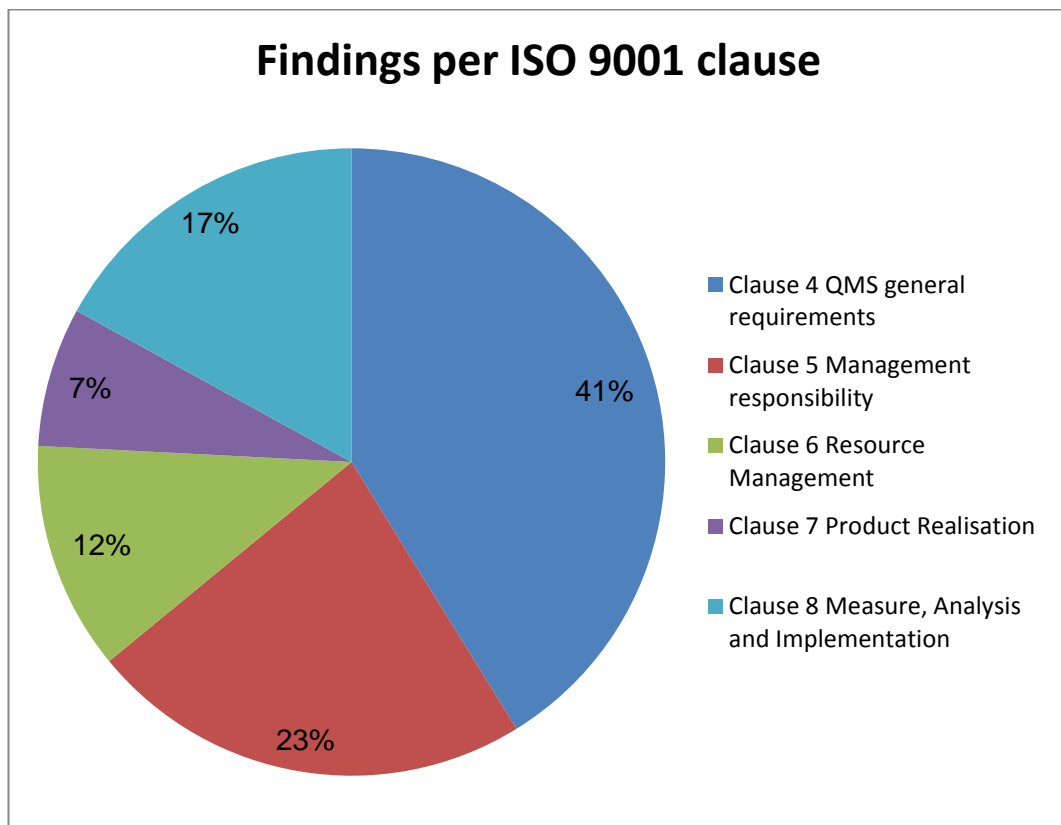


Figure 2.2: Findings per ISO 9001 clause
(Source: Eskom, 2012)

Forty one percent (41%) of findings was raised against Clause 4: QMS General Requirements and documentation, 23% against Clause 5: Management Responsibility, 12% for Clause 6: Resource management, 7% for Clause 7: product realisation and 17% clause 8: Measure analysis and improvement.

The internal audit report highlights ISO 9001 QMS diffusion issues that affect the contribution of the QMS to improving business performance. The next section will focus on the root causes of the poor audit report.

2.6. BUSINESS PROBLEM ROOT CAUSE ANALYSIS

Based on the internal audit reports it was necessary to conduct further investigation into the root causes of the poor audit results. The fishbone diagram, Annexure B, was developed to determine the root causes of the business problem “ISO 9001 is not improving the business”. The root cause analysis, using the fishbone diagram, provoked the following questions in Table 2.2:

Table 2.2: Root cause analysis questions

(Source: Own)

Root cause analysis questions
<ol style="list-style-type: none">1. Was the ISO 9001 QMS implementation successful?2. Is management committed to the ISO 901 QMS drive?3. Is our business more customer-focused after the ISO 9001 implementation?4. Is quality communicated in your department?5. Are all employees aware of and competent in ISO 9001?6. Is ISO 9001 QMS delivering what was expected from it?7. Has your department's performance improved after ISO 9001 certification?

Thereafter a survey was conducted using a random sample based on various departments that had conducted internal audits. The sample size was limited to the number of employees in the selected departments. The survey research method was chosen because of its quick implementation. The rating scale used was the Likert scale with the following properties:

- 1: Strongly disagree
- 2: Disagree
- 3: Neither agree nor disagree
- 4: Agree
- 5: Strongly agree

The questionnaire method was used to collect data from participants via email, and they were given a week in which to answer and return the questionnaire. A total of 30 questionnaires was received and analysed to

verify the existence of a business problem. The survey results are illustrated in Figure 2.3.

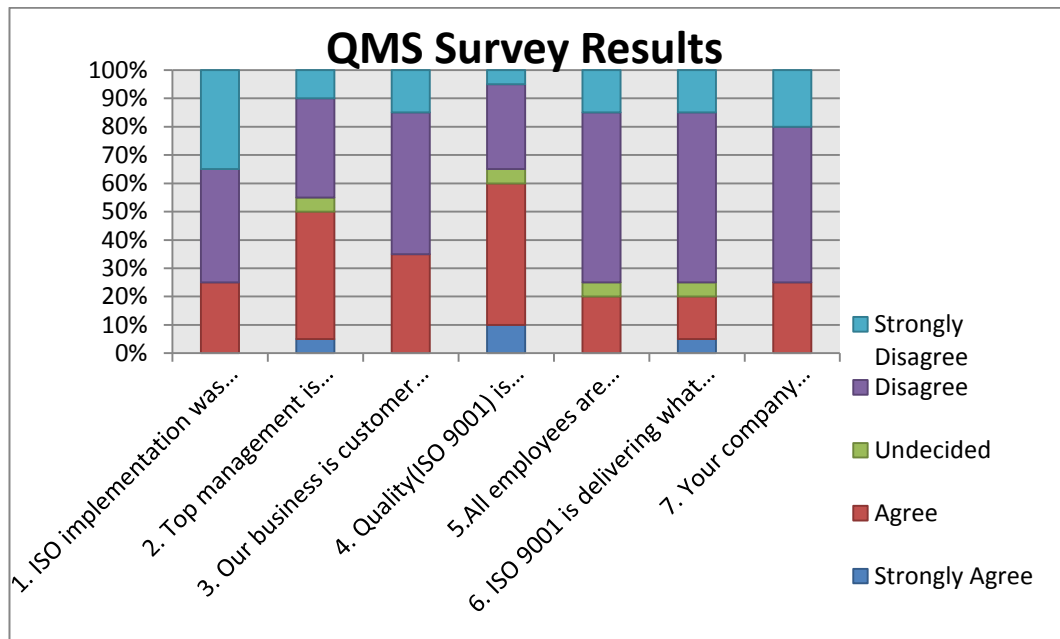


Figure 2.3: QMS survey results
(Source: Own)

From the above survey data, the perceptions of employees that participated in the survey are:

- **QMS implementation was successful:** 75% of participants disagreed that the QMS implementation was successful in the business.
- **Top Management is committed to the QMS drive:** 55% agreed that top management is committed to the QMS.
- **Our business is customer-focused because of the QMS:** 65% of participants disagreed their business is customer-focused because of the QMS.
- **Quality is communicated in our business:** 60% of participants agreed that quality is communicated within the business.
- **All employees are competent and aware of the QMS:** 75% disagreed that all employees are competent and aware of the QMS.
- **The QMS is delivering what is expected:** 75% disagreed that the QMS is delivering what is expected.

- **The company's performance has increased because of the QMS:**
75% disagreed that the company's performance has increased because of the QMS.

The internal audit results analysis and the root cause analysis both indicate there is a problem with the diffusion of the ISO 9001 QMS in terms of actually improving business performance. Hence the "The diffusion of a quality management system has not improved the electricity supply industry".

2.7. CONCLUSION

This chapter provides the context in which the research was executed. It consists of: the evolution quality management strategy adopted by Eskom; the drivers for adopting quality management in Eskom; the quality management strategy objective and goal; the Eskom internal ISO 9001 QMS audit and results which highlights a diffusion issue and the analysis which confirms that the existence of the business problem.

In short, the internal audit performed by the various departments show that there is a problem with the diffusion of the QMS namely ISO 9001, 2008. This initiated the investigation to confirm the existence of the business problem by means of a survey and root-cause analysis on the data.

In the next chapter, literature will be explored based on the following topics: the evolution of the ISO 9001 QMS, the effect a QMS has on a sustainable long term solution to the problem of energy supply; QMS factors contribute to the establishment of world class processes and practices; the QMS influences quality culture, how QMS facilitates a continual improvement process and what critical success factors and barriers hinder the sustainable implementation of a QMS. This will establish the context and theoretical framework in which the study will be conducted in order to achieve the research objective.

CHAPTER 3: LITERATURE REVIEW: DIFFUSION OF A QUALITY MANAGEMENT SYSTEM IN THE ELECTRICITY SUPPLY INDUSTRY

3.1. INTRODUCTION

Long-term business success is dependent on the business's ability to provide quality products and services. The International Organisation of Standards (ISO) consists of 130 national standard bodies and has the general aim of promoting standardisation. ISO aids organisations through its international presence, using ISO 9000 as a quality standard.

Fuentes, Benavent, Moreno, Cruz and Pardo del Val (2000), maintain that the ISO 9000 standard series makes use of a formalised system for evaluating any organisation's ability within the business world. Najmi and Kehoe (2001) point out that, since its introduction in 1987 the quality standard has sought to show proof of quality through a world-wide commonly accepted structure.

Mutual benefits are conferred on the supplier and customer through the standardising of certain parts of a QMS. This results in not focussing on the product/service quality but rather the process (Casadesús & Karapetrovic, 2005).

To elaborate on the topic, the following will be discussed in this literature review:

- The ISO 9000 journey.
- The effect of a QMS on a sustainable long-term solution for energy supply.
- QMS contribution to the establishment of world-class processes and practices.
- QMS affects quality culture.
- QMS and the continual improvement process.
- Implementation of a QMS.

3.2. THE ISO JOURNEY

The ISO series comprises five separate standards: ISO 9000, 9001, 9002, 9003 and 9004. ISO 9001, 9002 and 9003 relate to supplier-customer relationships, while ISO 9000 and 9004 are aimed at facilitating the development of quality systems within the organisation.

Okwiri and Mbeche (2014), show that the ISO 9001 standard introduces the “process approach” for managing an organisation. A major part of this is done by highlighting and attending to areas in need of improvement. This process-based QMS approach is shown in Figure 3.1. It aims at building continual improvement into the business in order to meet business objective measures.

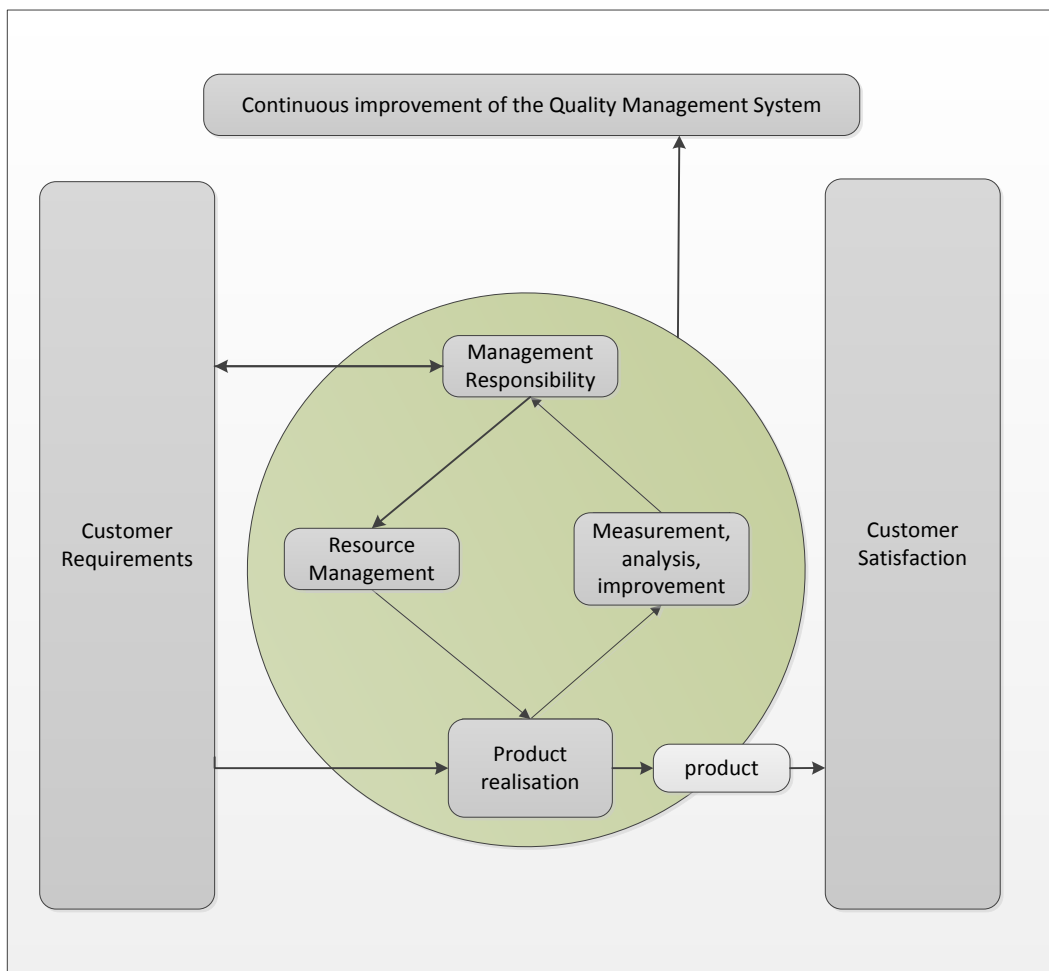


Figure 3.1: ISO 9001 process-based QMS
(Source: Biazzo and Bernardi, 2003:9)

Biazzo and Bernardi (2003:9), are of the opinion that the process approach explains the following four key elements:

- **The management responsibility element:** This refers to the responsibility of management to develop the QMS and improve it by taking into consideration the voice of the customer and using it as a guideline.
- **The resource management element:** This requirement refers to managing infrastructural and human resources to improve customer satisfaction.
- **The product realisation element:** In order for product realisation to be achieved, customer requirements, customer communication, developing the customer's products, and related processes, need to be identified.
- **The measurement, analysis and improvement element:** The fourth activity is the need to monitor, measure and analyse improvement activities so as to develop them.

These four key elements of the quality standard are connected together to form the Plan-Do-Check-Act (PDCA) improvement circle. The QMS's objective is to show the effect of the organisation's quality management system on its ability to produce goods and services that conform to specific requirements (Okwiri & Mbeche, 2014).

The research of Abraham, Fisher, and Crawford (1997:9), reveals that the ISO 9000 series has been adopted by most developed countries around the world. The standard aids companies on the export side of their business to do international business that supports the quality management standard. This is why the ISO 9000 series certification is a well sought-after standard.

On the other hand, the ISO 9000 series is also helpful in providing "control to ensure quality of production and service" that is sustainable. The justification to adopt this standard is normally based on a perception that it

will sustainably provide improved efficiency, promotion of the business, improved customer satisfaction, fewer audits and improved customer and staff attitudes (Okwiri & Mbeche, 2014).

3.3. THE EFFECT OF A QMS ON ESTABLISHING A SUSTAINABLE LONG TERM SOLUTION TO THE QUESTION OF ENERGY SUPPLY

Establishing a sustainable energy supply is a two-fold process. It consists of the energy supplier being able to meet the energy consumer's requirements, and the consumer using energy efficiently to enable the supplier to satisfy these requirements. Using the ISO 50001 (2011) standard allows an organisation to infuse a QMS for providing a sustainable long-term energy supply, resulting in that organisation improving their energy performance.

ISO 50001 is modelled using the ISO 9001 QMS and the ISO 14001 Environmental Management System (EMS) and therefore contains essential elements of both to contribute towards continual improvement (International Standard ISO 50001:2011; Eccleston, March & Cohen, 2011:300). This section will discuss the following issues:

- QMS contribution to proper planning for long-term solutions.
- PDCS cycle in the Energy Management Systems (EnMS).
- Energy performance.
- Energy planning.
- Energy review.

3.3.1. QMS contribution to proper planning for long-term solutions

Collins and Steiger (2009:2), observe that the QMS contribution to proper planning for short and long-term energy solutions occurs when it is decided what level of quality the organisation desires, and a plan is made to attain that level. This involves both the "quality plan" and "quality planning" within the QMS, a distinction that is explained below.

3.3.1.1. Quality planning

Quality planning is a simple activity that involves mostly management establishing the Quality Objectives and Quality Policy. This is to meet the general requirements established earlier in the QMS. The result of Quality Planning should be a summary describing what and how activities are executed in the organisation in respect of quality (International Standard ISO 9001, 2008).

3.3.1.2. Quality plan

A quality plan is the result of the process in which quality is planned for the product or service you supply. It entails focussing on a process approach to ensure that the product or service rendered meets the desired criteria. To summarise, "quality plan" and "quality planning" are linked in the sense that the plan is the product of conducting planning. (International Standard ISO 9001).

3.3.2. PDCA Cycle in the Energy Management Systems (EnMS)

The EnMS standard directly relates to establishing a long-term solution for the supply of energy by applying management system principles to ensure sustainability.

A management system's characteristics ensure that all the company's objectives are achieved in a process fashion and the performance can be established at any moment in the process. Management systems in general, if used correctly, contribute towards the organisation's performance. Management systems should not be viewed in isolation because their structures are interlinked. Management standards overlap each other and might form the bases for each other (International Standard ISO 50001, 2011; Karcher & Jochem, 2015).

Klute-Wenig and Refflinghaus (2015), are of the opinion that energy management involves every measure to keep energy use at a minimal

level. The system affects both technical and non-technical behaviour to minimise the total operating energy consumption and to improve efficiency. The EnMS is used to determine the baseline of energy consumed and to motivate investment to improve energy efficiency.

International Standard ISO 50001 (2011) and Paeger-Consulting (2011) mention that ISO 50001 EnMS uses the PDCA cycle for continual improvement in the use of energy management practices. Figure 3.2 shows how the PDCA cycle is incorporated into the EnMS model as per ISO 50001 energy management systems standard.

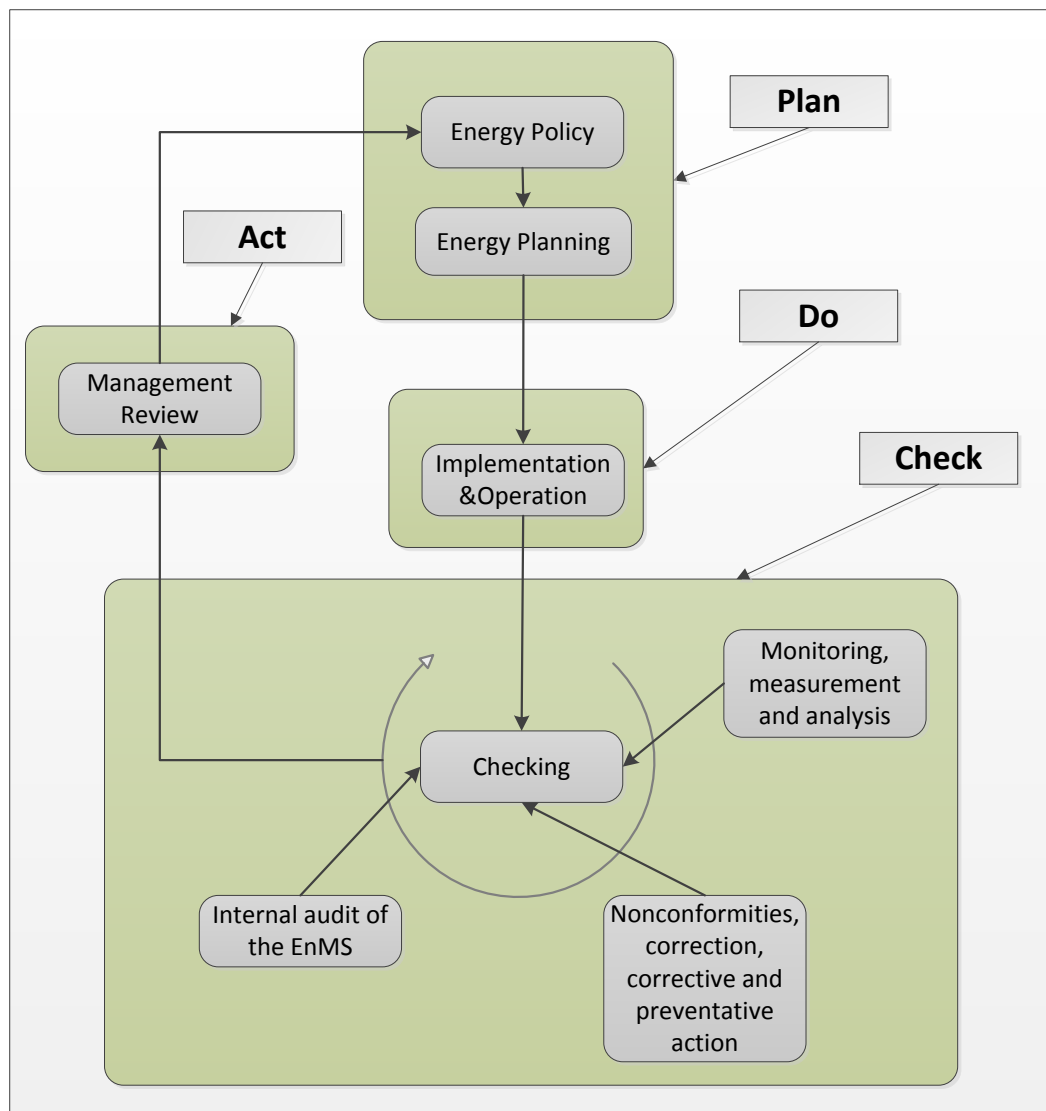


Figure 3.2: ISO 50001 Energy management system model

(Source: International Standard ISO 50001, 2011)

The International Standard ISO 50001 (2011) and Karcher and Jochem (2015), shows that Energy Management, Figure 3.2 is explained as:

- **Plan** (*energy policy and energy planning*): a baseline is established by means of an energy review. The organisation's energy policy will guide how to improve energy performance by developing the necessary objectives, energy performance indicators, targets and action plans.
- **Do** (*implementation and operation*): the action plans for energy management are implemented. Management structures are established to maintain a continual improvement process.
- **Check** (*checking, monitoring, measurement and analysis, nonconformities, correction and preventative action, internal audit*): In order to determine energy performance, elements of operations and the monitoring and measuring of processes have to be compared with the energy policy and objectives, and reported on.
- **Act** (*review management*): action is needed to improve both energy performance and the energy performance indicators.

3.3.3. Energy performance

Energy efficiency, energy consumption and energy use make up the concept of energy performance. Through addressing these elements, an organisation can change its energy performance in many ways and do so without being restricted to one area of the business. Any change in the use of energy will have an impact on energy performance. This entails certain flexibility in the capacity of any situation to influence the performance (International Standard ISO 50001, 2011).

The term energy efficiency is commonly used in the energy sector and is a variable measured by using specific key indicators. These indicators will not be the same in all businesses, but specific for every application. Energy efficiency is generally defined as using less, or the least, energy to produce the same service or useful output (International Standard ISO 50001, 2011).

3.3.4. Energy Planning

“Energy planning” can have different meanings, dependent on context. But here it refers to the process of developing long-term policies to aid future energy systems. Energy planning is usually incentivised by government and carried out by energy-producing companies with the input of different stakeholders (Paeger-Consulting, 2011).

Sustainable energy planning should consider environmental factors and limits and their impact on energy consumption. This is mainly done to limit or prevent the build-up of greenhouse gasses that is caused by producing most types of energy. It is a growing international trend for organisations to adopt targets for reducing greenhouse gases for more sustainable energy production. In light of the importance of sustainable energy, energy planning is becoming an increasingly important activity.

In sum, for a sustainable energy plan, one should look at the bigger picture for future energy needs. The plan should be based on a clear structure for decision-making (International Standard ISO 50001, 2011).

Energy planning is the process in which the organisation’s plans for “what” and “how” in terms of energy are improved. Figure 3.3 illustrates a typical energy planning process.

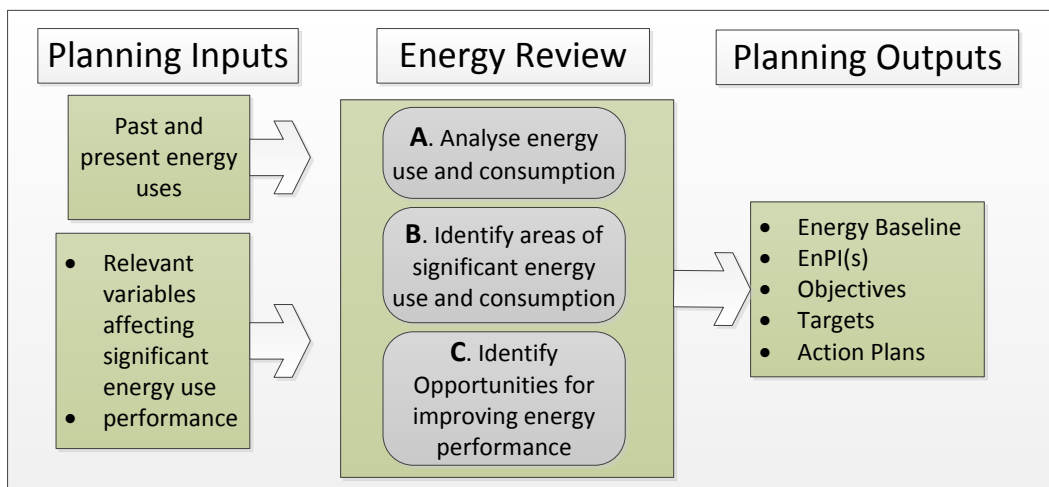


Figure 3.3: Energy planning process

(Source: International Standard ISO 50001:2011)

This is a conceptual process and may need to be altered to accommodate different organisations (International Standard ISO 50001, 2011).

The International Standard ISO 50001 (2011) asserts that the process involves establishing planning inputs, which are typically derived from benchmarking, past data and performance, or some other data collection method. These are then reviewed and analysed to highlight areas of high energy use. The output activity for this process lies in identifying opportunities for energy improvement. It concludes with output implementation relating to energy objectives, targets, energy baseline and action plans.

3.3.5. Energy review

The International Standard ISO 50001 (2011) points out that an energy review is necessary as it evaluates the use of energy so as to identify areas for improving energy performance. In most cases, an energy review is carried out as an audit or assessment of the energy performance of an organisation. Energy review is included in the energy planning stage, as seen in Figure 3.3. The steps for energy review are as follows:

- **Analyse energy use and consumption:** information on the use of energy and gathered and analysed to prepare for identifying areas of significant use.
- **Identify areas of significant high energy use:** These areas of significant use are identified and prioritised as areas for improvement.
- **Classify areas for improving energy performance:** Energy improvement opportunities are identified in specific areas where significant impact can be expected.

The energy review process is a continuous cycle aimed at improving the system's performance.

3.4. QMS CONTRIBUTION TO THE ESTABLISHMENT OF WORLD CLASS PROCESSES AND PRACTICES

The aim of this concept is to improve a business's performance and help it to achieve its business objectives. ISO 9001 (2008) is a process essentially designed to establish what the customer desires and then satisfy those desires (International Standard ISO 900, 2008; Segatto, Ines Dallavalle de Padua & Pinheiro Martinelli, 2013). This approach has numerous benefits, as listed in Table 3.1.

Table 3.1: The benefits of the process approach

(Source: Segatto *et al.*, 2013)

Using the process approach advantages
<ul style="list-style-type: none">• Process interlinking and standardisation to obtain specific outcome.• The highlighting of areas that need improvement.• The attraction of customers due to the performance of the organisation.• All staff knows what to do operationally.• Cost reduction in all areas of the business.• The knowledge to enable predicting results.• The ability to select specific areas of improvement based on processes.• The recognised value of employees' contribution and clearly knowing their responsibilities.

In order to understand the QMS's contribution to world-class processes and practices, The following will discussed:

- A process defined.
- Reference to processes in ISO 9001 QMS.
- Different process types.
- Defining the process way.
- Process approach application.
- Planning the process.

3.4.1. A process defined

For Kalpic and Bernus (2007:10), the term process denotes "a set of gradual changes that lead to a particular result", while Davenport

(1993:20) defines it as “a set of structured and measured activities designed to produce a specific output”. Palmberg (2009:21) acknowledges that different authors define process differently and there is no real single definition. The ISO 9001 (2008) standards usefully describe a process as “a set of interrelated activities that uses inputs to deliver outputs”.

A process thus requires inputs and outputs of a tangible or intangible nature, and typically uses people or material as resources. Figure 3.4 shows a typical process with an input, an activity and an output.

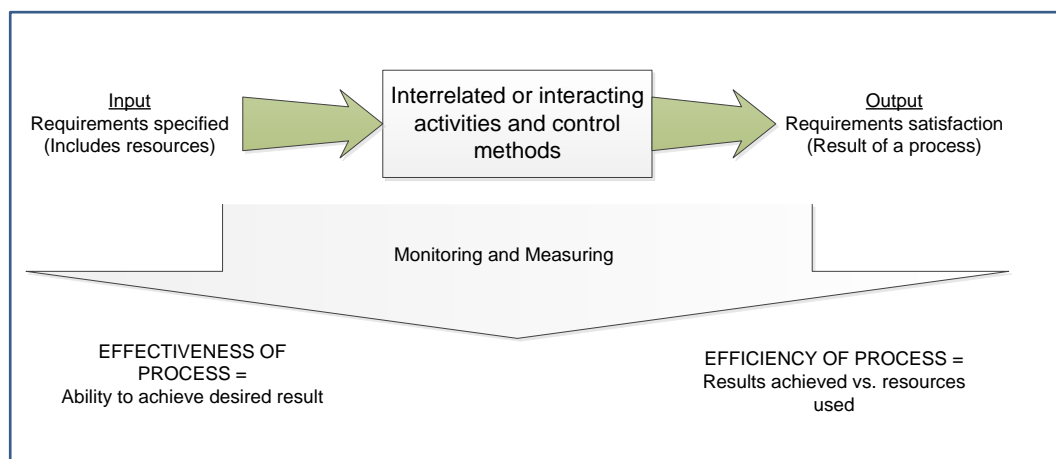


Figure 3.4: A typical generic process
 (Source: International Standards for Organisation, 2008)

Gryna, Chua and DeFeo (2007:196-213), point out that output can be unintended, such as waste. A process also consists of a customer who expects certain process outputs and assumes the inputs needed for that process. The process performance is measured by gathering process performance data and analysing it to enable corrective and/or preventative action to occur. All processes should be developed in alignment with the business objectives and should add value at every step. They should also be assessed for effectiveness and efficiency through an internal and/or external review process.

3.4.2. Reference to processes in ISO 9001 QMS

The reference to processes in the ISO 9001 (2008) standard is strong and clear: “The design and implementation of an organisation’s quality management system is influenced by: its business environment, changes in that environment, or risks associated with that environment; its varying needs; its particular objectives; the products it provides; the processes it employs; its size and organisational structure. It is not the intent of this International Standard to imply uniformity in the structure of quality management systems or uniformity of documentation” (International Standard ISO 9001, sub clause 0.1, General:2008).

There is more specificity given in sub clause 0.2, Process Approach: “The application of a system of processes within an organisation, together with the identification and interactions of these processes, and their management to produce the desired outcome, can be referred to as the process approach” (International Standard ISO 9001, 2008).

Sub clause 4.1, General in the ISO 9001 QMS states: “The organisation shall establish, document, implement and maintain a quality management system and continually improve its effectiveness in accordance with the requirements of this International Standard. The organisation shall:

- a) determine the processes needed for the quality management system and their application throughout the organisation;
 - b) determine the sequence and interaction of these processes;
 - c) determine criteria and methods needed to ensure that both the operation and control of these processes are effective;
 - d) ensure the availability of resources and information necessary to support the operation and monitoring of these processes;
 - e) monitor, measure (where applicable), and analyse these processes;
- and
- f) implement actions necessary to achieve planned results and continual improvement of these processes.

These processes shall be managed by the organisation in accordance with the requirements of this International Standard” (International Standard ISO 9001, 2008).

In sum, the organisation should identify and document the processes needed to achieve its business objectives.

3.4.3. Different process types

In the opinion of ISO (2008) and Gryna *et al.* (2007:196-213), the business has to describe the different types of processes required to satisfy the organisation’s goals. Although such processes will be specific to their own organisation, one can still distinguish certain general types such as:

- **Organisational management processes:** These processes refer to all strategic activities performed by management.
- **Resource management processes:** The processes for obtaining and utilising resources to achieve the business quality objectives.
- **Realization processes:** All the processes that lead to the achievement of business objectives.
- **Performance management processes:** The processes associated with measuring, analysing and improving business performance.

3.4.4. Defining the process way

A process-orientated approach such as the one suggested by ISO 9001 (2008) is a method of strenuous process management to achieve desired business objectives.

Aparecida da Silva, Pelogia Martins Dam and Ines Dallavalle de Padua (2012), note that most companies’ structures are hierarchal and consist of different departments or functional units. The units often operate vertically with independently driven outputs, as shown in Figure 3.5. Often these outputs do not share the same overall objective of customer satisfaction, which means that the result of departments or sections working in parallel or “in silos” is that business objectives are not met.

Biazzo (2000) and Gryna *et al.* (2007) suggest that the processes approach is an alternative view of business where value is added by introducing a horizontal management entity called a process.

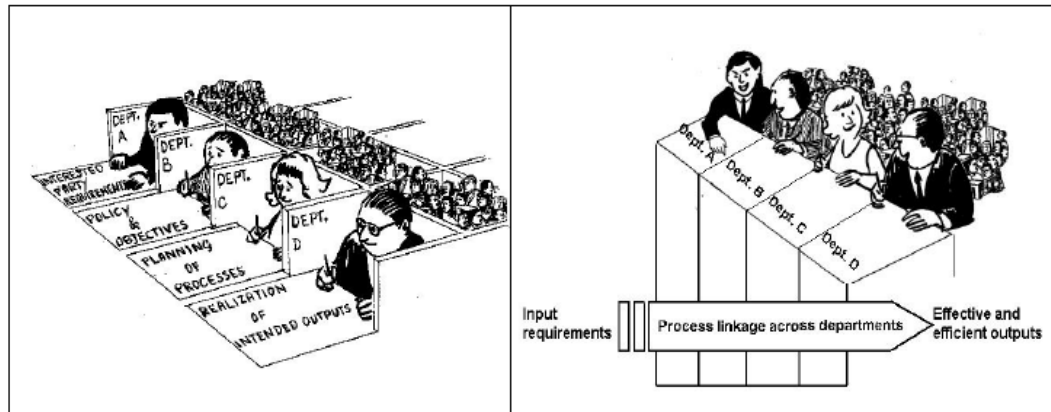


Figure 3.5: Process linkages across departments in an organisation
(**Source:** International Standards for Organisation, 2008)

This process approach cuts across the business departments or silos and aligns their focus with the main goal of the organisation, as shown in Figure 3.5. Management processes can interact with other processes in the business to form a system where value is added at every step.

Businesses that use systems to form networks in order to operate are known to adopt a “systems approach” to management. In the system, the output of one process is the input into another, creating interlinking throughout the system.

3.4.5. Process approach application

Al-Mashari and Zairi (1999) and Gudmundsson, Boer and Corso (2004), observe that an implementation methodology can be used for any type of process, though it is not the only means that can be used. The following steps can occur simultaneously:

- Identifying and planning the organisational processes.
- Implementing and measuring the process.
- Scrutinising the process.
- Corrective action and process improvement.

- Risk-based thinking, PDCA (Plan, Do, Check and Act) and the process approach.

3.4.5.1. Identification of organisation processes

The identification of processes in the organisation proceeds as illustrated in Figure 3.6, below:

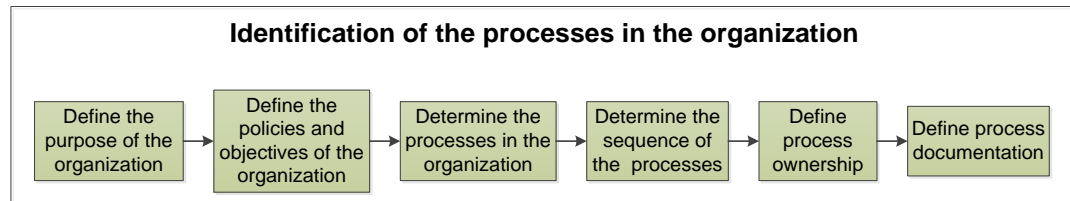


Figure 3.6: Identification of the processes in the organisation
(Source: International Standards for Organisation, 2008)

ISO 9001 (2008), shows the first step in this process is for the organisation to highlight its customer expectations and requirements and compare them to the organisation's actual outputs. Based on the above requirements, the organisation's policies and objectives are defined.

The next step is processes in the organisation need to be identified along with their outputs along with its process sequence interactions. Each process needs an associated person or unit RACI (Responsible, Accountable, Consulted and Informed) associated to it, finally documented, and archived appropriately.

3.4.5.2. Implementation and measurement of process

Bell and Omachonu (2011) and Srivastav (2010), found that the implementation of the processes should be conducted with the following considerations in mind:

- Awareness of the processes.
- Communication of the processes.
- Training to be conducted.
- A change management process to be followed.
- Management involvement is key.

➤ Where applicable, activities should be reviewed.

All controls, performance monitoring and measuring must be planned and applied.

3.4.5.3. Scrutinising the process

ISO (2008) and Gryna *et al.* (2007), note that the measuring of the process performance is conducted by obtaining data from the process and analysing it, using statistical tools if needed. This process performance information is then compared with the defined requirements to determine the effectiveness and efficiency of the process and whether there is a need for corrective action. Process improvement opportunities are also determined according to the analysis of the process. The process performance is communicated to top management in the organisation.

3.4.5.4. Corrective action and improvement of the process

Srivastav (2010), is of the view that developing corrective action in the business should always be paired with an implementation plan. The corrective action should identify the root causes of the problems. These could range from errors and defects to a lack of control. When the corrective action is conducted, the performance should be constantly monitored to assess the action's effectiveness as per the plan.

Gudmundsson *et al.* (2004), explain that when the corrective actions have achieved the desired results, the focus should move to continually improving process performance. The PDCA methodology can be used in all business processes, including continual process improvement.

Applying the PDCA methodology will result in business performance improvement, which includes business process maintenance (International Standard ISO 9001, 2008).

3.4.5.5. Risk-based thinking, PDCA (Plan, Do, Check and Act) and the process approach

Biazzo and Bernardi (2003) and Hwang, Kim and Jeong (2012), are of the opinion that risk-based thinking, the PDCA methodology and the process approach, comprise an important section of ISO 9001 (QMS). The QMS must address the risks that influence the objectives and results of the business. It is for this reason that the standard uses risk-based thinking to achieve the following:

- The method of processing the risk and producing the processes needed to mitigate it.
- Marking out the process planning and associated controls.
- Increasing QMS effectiveness.
- Managing the QMS that addresses risk and meets objectives.

In this instance, the PCDA tool is used to manage processes and systems. PDCA is a continual cycle of improvement and uses risk-based thinking for each activity in the cycle (International Standard ISO 9001, 2008).

3.4.6. Planning the process

Aparecida da Silva *et al.* (2012) and ISO 9001 (2008), agree that when one is implementing a process approach, it is important to plan the business processes in order to achieve success. The following diagram (Figure 3.7) describes the steps needed to plan the process.

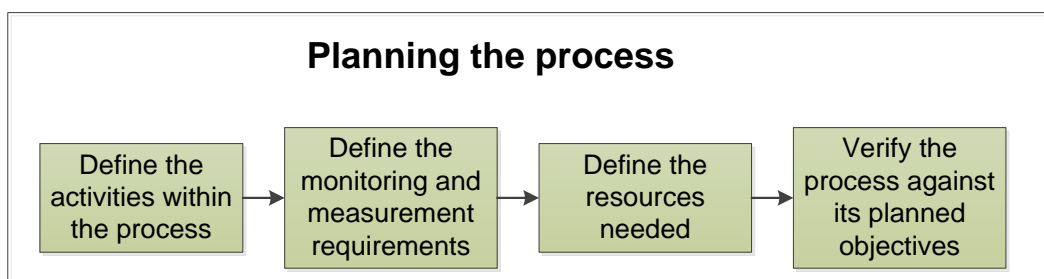


Figure 3.7: Planning the process in an organisation
(Source: International Standards for Organisation, 2008)

These steps require no explanation.

3.4.6.1. The process approach defined

ISO (2008), noted that a process is defined as “a set of interrelated activities that use inputs to deliver outputs.” Both the inputs and outputs may be tangible or intangible. The process approach enables the organisation to operate as an integrated and complete system by means of the following:

- The QMS combines processes and measures in order to satisfy planned business or organisational objectives.
- Processes define interconnected process activities and quality checks, to deliver planned outputs.

Detailed process management such as content planning and controls, can be added to the process document where required.

3.5. QMS AFFECTS QUALITY CULTURE

In order to become superior in quality, one has to embrace two courses of action, namely technology and culture. Gryna *et al.* (2007:265), define quality culture as “the pattern of human habits, beliefs, values, and behaviour concerning quality. Technology touches the head; culture touches the heart”. Most quality problems can be controlled by means of proper management, but cultural issues apply to all levels in the business, from top management to the rest of the workforce.

The following will be discussed in order to broaden the understanding of the effect of QMS on quality culture:

- Hierarchy of human needs in the quality world.
- Corporate culture.
- Quality culture.
- Changing the culture for quality.

3.5.1. Hierarchy of human needs in the quality world

Marslow (1970), explains that there is a hierarchy of human needs comprising five fundamental categories. Table 3.2, below, displays

Maslow's list of needs with its associated form of motivation in the quality world.

Table 3.2: Hierarchy of human needs in the quality world

(Source: Maslow, 1970)

Maslow's list of human needs	Motivation in the quality world
Physiological need: the need for food, shelter, basic survival.	Opportunity to increase earnings by receiving a bonus for good work.
Safety needs: once the subsistence level has been achieved, there is a need to remain employed at that level.	Job security: quality makes sales and sales make jobs.
Belongingness and love needs: the need to belong to and be accepted by a group.	Referring to an employee as a member of a team that they should not let down.
Esteem needs: the need for self-respect and the respect of others.	Pride in workmanship, receiving recognition and rewards.
Self-actualisation needs: the need for self-expression.	Opportunity to propose creative ideas and participate in creative planning.

3.5.1.1. Physiological need

There are certain needs in the quality world whose satisfaction will aid human endeavours towards achieving a quality way of living. For Maslow, the primary need is for survival, the physical need for food, water, and shelter. So, too, in the quality world people need the opportunity to increase their earnings by being rewarded for performing good work (Gryna *et al.*, 2007:266; Martin & Joomis, 2009).

3.5.1.2. Safety needs

Gryna *et al.* (2007:265), Koltko-Rivera (2006:302-307) and Heylighen (1992), are of the opinion that after people's physiological needs have been met, they focus next on their need for safety and security. Koltko-Rivera (2006:302-307) defines safety as "the feeling people get when they know no harm will befall them, physically, mentally, or emotionally; security

is the feeling people get when their fears and anxieties are low". In the quality world, safety needs take the form of job security, which is directly related to how successfully a business performs and what its growth potential is. Enhancing quality in a business will ensure growth, which will in turn create more jobs and thus satisfy employees' need for security.

3.5.1.3. Belongingness and love needs

Koltko-Rivera (2006:302-307) and Martin and Joomis (2009), observe that love and belonging needs can only be attended to after survival and security needs have been met. These boil down to the need to have relationships with people, whether family, friends or colleagues. The objective of this need is interaction with people so as to be accepted by them. In the workplace this is done by referring to an employee as a team player, a member of a team to which they owe loyalty. Employees' working well as a team is very important in improving business performance.

3.5.1.4. Esteem needs

Heylighen (1992) and Gryna *et al.* (2007:267), observe that once "individuals have satisfactorily met their need for love and belonging, they can begin to develop positive feelings of self-worth and self-esteem, and act to foster pride in their work and in themselves as people". Similarly, in the quality world one's self-worth is reflected through pride in one's workmanship. The reward for evincing this pride would be some sort of recognition for excellent work.

3.5.1.5. Self-actualisation needs

Maslow (1970), research that the top-most level in the pyramid of needs is the need for self-actualisation. At this level one fulfils one's desire by fulfilling one's potential. The quality world equivalent is when one gets to the level of conceiving ideas and participating in creative planning.

3.5.2. Corporate Culture

Naicker (2008:**Online**) and Mullins (2010:780), explains there has been a lot of focus on corporate culture in the 21st century. Many organisations have realised that non-tangible elements, like corporate culture, affect their company's performance. The concept of culture includes habits, beliefs, behaviours and values, and a corporate culture is no different. Management needs to create the right kind of culture in order for a business to achieve success. In order to unpack the notion of corporate culture, the following will be discussed:

- Characteristics of corporate culture.
- The cultural web.
- The importance of organisational culture.

3.5.2.1. Characteristics of corporate culture

Collins and Porras (2000:338) and Johnson, Scholes and Whittington (2005), suggest that an organisational culture is identifiable in terms of the meaning shared among its members. An organisation's culture can be summed up in these seven characteristics:

- **Innovation and risk taking:** The level to which employees are inspired by innovation and risk taking.
- **Attention to detail:** Employees are expected to be meticulous when attending to detail.
- **Outcome orientation:** An outcomes-based focus on the part of management rather than the expected process-based focus.
- **People orientation:** The amount of consideration management has for the effect their decisions have on the outcomes of their employees.
- **Team orientation:** The level to which work strategies are developed based on teams rather than a single individual.
- **Aggressiveness:** The amount of aggression and competitiveness in the workplace.
- **Stability:** The extent to which resistance to change is promoted over growth.

An organisation's culture can be evaluated in terms of these seven characteristics, each of which is measurable on a low to high scale.

3.5.2.2. The cultural web

Gryna *et al.* (2007), believe that organisational or corporate culture can be described and understood in terms of the notion of a cultural web. This is illustrated in Figure 3.8.

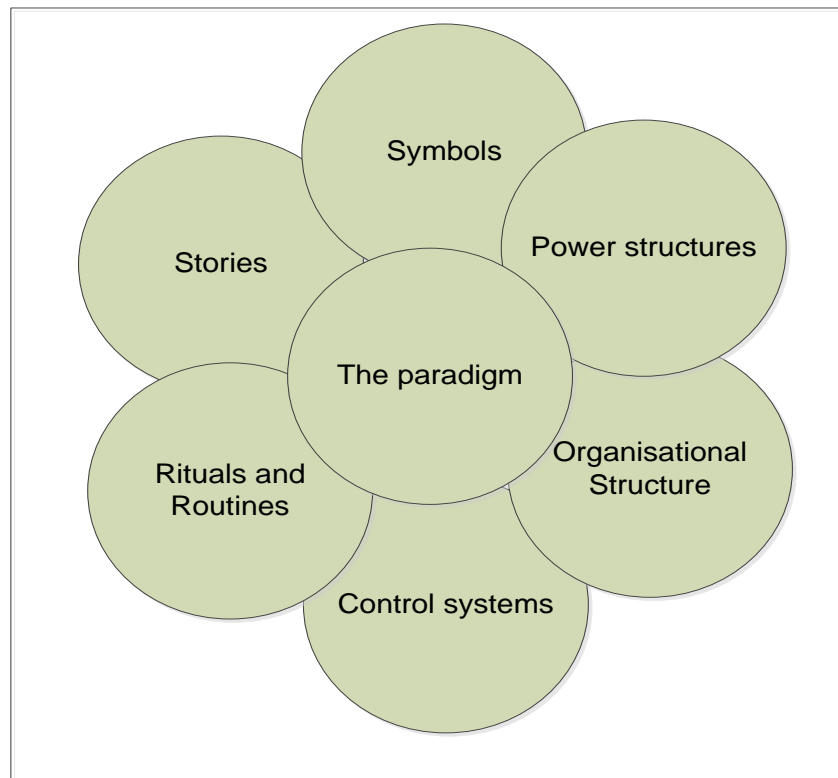


Figure 3.8: The cultural web
(Source: Gryna *et al.*, 2007)

Mullins (2010), describes the elements of the cultural web as:

- **Routines:** The employees' behaviour towards each other and customers that make up the normal behaviour in the organisation.
- **Rituals:** The events that are emphasised by the organisation as important.
- **Stories:** The stories told about special events and people, by employees in the business.

- **Symbols:** The symbols include tangible and intangible items relating to the business that represent it in some way.
- **Power structures:** This refers to decision-making groups such as management. It can also refer to a higher level such as government or foreign role-players.
- **Control Systems:** Initiatives that involve monitoring and rewarding that which is important in the business.
- **Organisation structure:** It highlights the hierarchical structure in an organisation which includes a formal and informal relationship structure.
- **The paradigm:** It summarises the finding using the cultural web elements to describe it.

All of these elements together make up the cultural web, which embodies and promotes culture in the organisation. The organisation's culture can be analysed by investigating each element in the cultural web.

3.5.2.3. The importance of organisational culture

Mullins (2010:783) and Naicker (2008), report that through investigation of culture one can account for variations among organisations and managers. Culture allows different groups to perceive the same thing in different ways. Cultural strength is developed when various aspects of culture are deliberately aligned and combined in an organisation. The strength of an organisation's culture has a direct impact on its performance.

Naicker (2008), describes corporate culture as one of the most important qualities of a successful company. There is a direct correlation between the market place and organisational culture. A strong culture will need less managerial intervention to attain the organisation's objectives. If guidelines for employees are few and clear, the culture will be strong, and many people will perform well in most parts of that business.

It is management's responsibility to ensure that an organisation's culture is strong and embedded in every part of the business.

3.5.3. Quality Culture

Gryna *et al.* (2007:269), Cameron and Sine (1999:7-23) and Cameron (2004), is of the opinion that quality culture forms an important part of corporate culture. This section will describe the attributes of four different types of, or approaches to, quality culture, namely:

- Absence of a Quality Emphasis.
- Error Detection Culture.
- Error Prevention Culture.
- Creative Quality Culture.

3.5.3.1. Absence of a Quality Emphasis

This occurs when organisations pay little or no attention to quality as a topic (Cameron & Sine, 1999:7-23). The quality aspect did not exist in their corporate strategy and was not driven by top management. Quality was not given a priority platform and no incentive was linked to customer satisfaction. In sum, quality is not included in the cultural values of the organisation.

3.5.3.2. Error Detection Culture

Gryna *et al.* (2007:267), identify another type of quality culture as "error detection", also known as "inspection culture" or "statistical control" culture. In this culture, quality control consists in detecting mistakes, fixing them and making sure they do not occur again. Culture equates to "the old ways of working". It includes seeking to meet customers' demands and requirements, but the extent to which this happens is only measured after the service has been provided.

3.5.3.3. Error Prevention Culture

Cameron and Sine (1999:7), describe a third type of quality culture as an “error prevention” type, involving a more proactive way of handling problems. Error prevention quality culture consists of a combination of quality assurance and strategic quality management culture, which holds top management ultimately accountable for ensuring that quality exists throughout the organisation. At the same time, it implies that quality is everyone’s responsibility and not just that of the end-of-line inspectors. Quality is built into the process at every step, thus enabling the management team to focus on the customers’ needs and whether they are being met.

3.5.3.4. Creative Quality Culture

Cameron (2004) and Gryna *et al.* (2007:267), distinguish a final type of quality culture, creative quality culture. In this culture, the organisation’s entire strategy, including its business strategy, is centred on quality. The key business objective in this type of culture is to constantly raise standards and business performance level. Products and services are produced not only to be flawless and to satisfy customers’ requirements, but also to add extra value through being recyclable or user-friendly, costing less or being safer to use. Creative quality culture is obviously the most advanced type of quality culture.

3.5.4. Changing the culture for quality

The studies of Gryna *et al.* (2007:267) and Adebajo and Kehoe (1998), affirm that culture can be changed. To change a culture for quality, one has to consider certain critical success factors that drive action, which will lead to a change in attitude that will eventually develop into a change in culture. The critical success factors are:

- Provide goals and measurements.
- Evidence of upper management leadership.
- Self-development and empowerment.

- Participation to inspire action.
- Recognition and rewards.

3.5.4.1. Provide goals and measurements

Quality can only be actioned if there are goals and progress towards these can be measured at all levels in the business. In most cases, management (top and middle) and staff on the ground define these goals and measure achievement in relation to them. The problem is that they do not speak the same business language. Top management expresses quality by speaking the language of money while the general staff speak the language of quality in products and services. Middle management is normally bilingual, relating to both top management and ground staff. Good relations between the three tiers enable the organisation to develop quality goals and ensure that they are measurable (Gryna *et al.*, 2007:271; Abraham *et al.*, 1997).

3.5.4.2. Evidence of upper management leadership

It is important to have management commitment, but it alone is not sufficient to inspire action for quality within a company. Management *leadership* in quality is the most important element required for a company to achieve quality. The role of top management in terms of strategic quality management in particular is clear: managers have to initiate and support a vision of total quality culture in the company. Evidence of this leadership role can take the form of managers' actively participating in quality training initiatives or forming a quality management team dedicated to deal with quality issues (Kotter, 2001; Abraham *et al.*, 1997).

3.5.4.3. Self-development and empowerment

The study by Adebajo and Kehoe (1998), suggests that self-development and empowerment are among the steps required in order to move towards quality. Gryna *et al.* (2007), view empowerment as a process whereby decision making is delegated to the lower levels of the business in order to encourage people to take control of their own situations and become

accountable. It also encourages management's trust and support and makes the empowered employees feel valued. Self-development is the training of personal in order to develop their capacity to support the empowerment process.

3.5.4.4. Participation to inspire action

The objective of participation is to help change behaviour. Through participation in quality activities, staff usually acquire new knowledge and see the benefits of adopting a quality way of working. This leads to a sustainable change in behaviour. Participation inspires a change in people's behaviour and leads to a change in people's attitudes (Adebanjo & Kehoe, 1998; Gryna *et al.*, 2007:267).

3.5.4.5. Recognition and rewards

Gryna *et al.* (2007:267), define recognition as public acknowledgement of superior performance, and rewards as benefits over and above what one usually gets. Recognition can be either tangible or intangible, and which of the two is best will be determined by the local culture in the organisation. Rewards can also be of a tangible or intangible nature and should be in keeping with the nature of the recognition, which in turn depends upon the culture of the organisation.

To summarise, in order to succeed in terms of quality, we need to satisfy the customers' needs with our products and services and develop a culture that puts quality at the heart of everything. Culture change takes years, not months, as quality ultimately depends upon trust, not techniques.

3.6. QMS AND THE CONTINUAL IMPROVEMENT PROCESS

Continual improvement forms a vital aspect of many QMS's, including ISO 9001 (2008). It is key to organisational competitiveness and should have a strong presence in the business. It is common for companies that do not

improve as quickly as their competitors to close down. The following points will explain the link between continual improvement and the QMS:

- Quality Management and continual improvement.
- Continual improvement as a concept.
- Clauses in ISO 9001 that reflect continuous improvement.
- Breakthrough improvement and incremental improvement.

3.6.1. Quality management and continual improvement

Quality management is defined by Sousa and Voss (2002:91) as “the execution of quality philosophies such as service and product quality, customer focus and continual improvement”. Many companies use the quality philosophies in the ISO standards to manage objectives pertaining to the environment, quality products and services and health. Quality management models such as the Malcolm Baldrige Criteria for Performance Excellence, TQM philosophies and the ISO9000 series help to facilitate improvement in organisations.

Sa´nchez-Roderiguez and Martinez-Lorente (2004:666-687) and Millen, Sohal and Moss (1999:166-180), are of the opinion that quality management modules consist of two sorts of practice, infrastructure and core. Infrastructure quality management practices consist of management commitment, the development of the quality policy and quality objectives, empowerment of employees and customer focus. Core quality management practices consist of elements such as data and analysis, process improvement, benchmarking and the use of applied statistics. According to the researchers, both practices lead to continual improvement.

Quality management modules all share the concept of continual improvement in the organisation’s efficiency and effectiveness. Continual improvement promotes the organisation’s ability to adapt to ever-changing conditions to ensure that it remains in business. ISO 9001-type systems use continual improvement as a source of control, though partly stimulated

by the competitiveness of other organisations (Govender, 2013:259-275; Larsen & Haversjo, 2000:226).

3.6.2. Continual improvement as a concept

The research of Harrington (1995:31), Bolton and Heap (2002:309-313), and Nilsson-Witell, Antoni and Dahlgard (2005:753), has revealed that the concept of continuous improvement is commonly confused with continual improvement. However, “continuous improvement” suggests that improvement happens constantly and can be represented as a straight line moving upwards, as indicated in Figure 3.9.

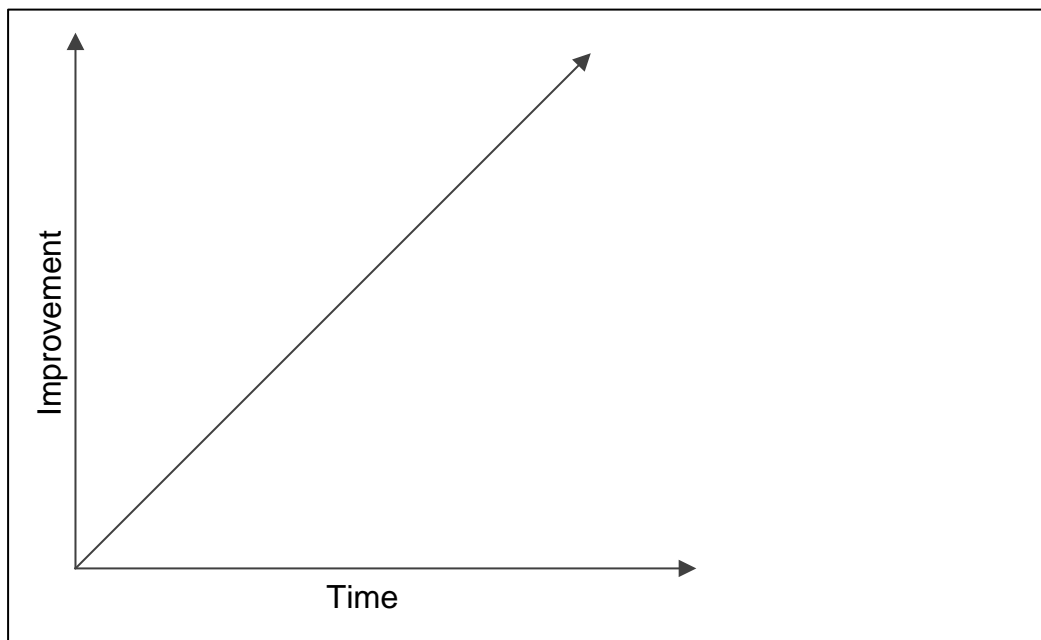


Figure 3.9: Continuous improvement

(Source: Bolton & Heap, 2002)

Bolton and Heap (2002:309-313), observe that continual improvement is rather a gradual upward trend that is staggered but continues to move up. These staggered upward movements may represent periods of improvement brought on by innovation, process improvements or any other improvement initiative. Continuous improvement can therefore be seen as a component within continual improvement. Continual improvement is illustrated in Figure 3.10.

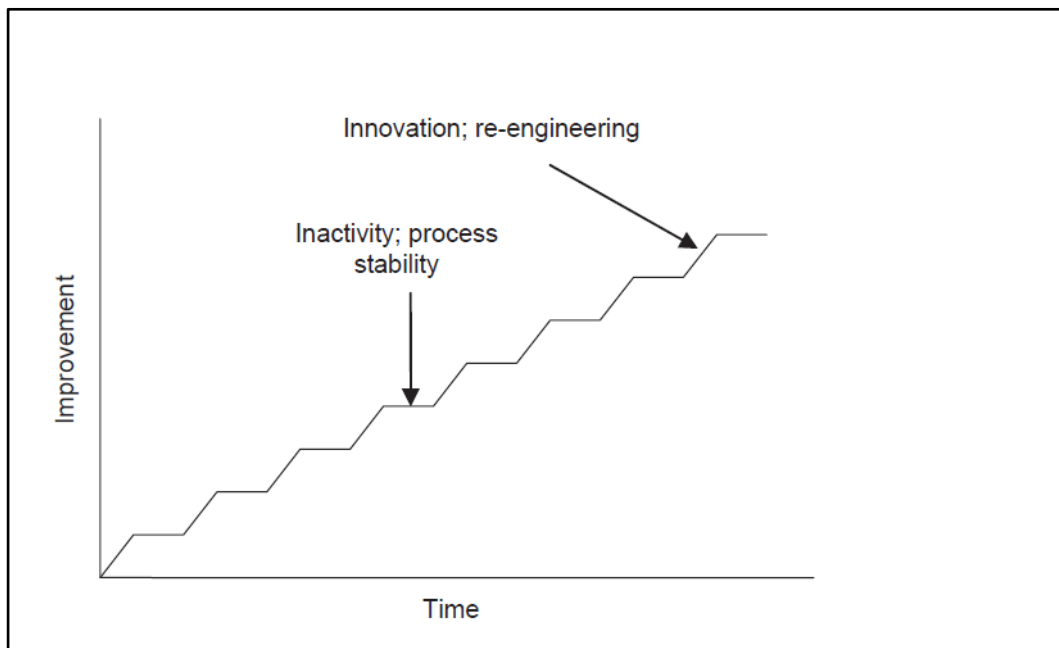


Figure 3.10: Continual improvement
 (Source: Bolton & Heap, 2002)

The process approach was proposed by Deming and adopted by the ISO 9000 series after the 2000 version of the standard. The continual improvement concept helped with building quality into the process by providing a means of preventing the stagnation of systems after they were implemented (Foster, 2010:129; Plura, 2000).

Continual improvement is when a type of change in line with the organisation's policy and objectives brings about an increase of effectiveness. This refers not just to quality initiatives, but includes business strategy, business performance, and customer, employee and supplier relationships. In layman's terms, it means getting better at it all the time (Foster, 2010:129; Plura, 2000).

Foster (2010:134) and Plura (2000), explain that continual improvement is not just about using a set of tools and techniques, or organising departments that focus on improvement and training people. Improvement is result that occurs after a change in the organisation. Continual improvement need to focus on a wide range of issues including leadership

and communication, no matter what the level of the organisation. This should lead to improvements in cost, productivity, delivery, responsiveness, profit and customer and employee satisfaction. It should not focus only on departmental improvement but on improvement of the organisation as a whole.

3.6.3. Clauses in ISO 9001 (2008) that reflect continuous improvement

Sokovic, Pavletic and Pipan (2010), expresses the opinion that the process model used by ISO 9001 ensures the quality of products or services. The outcome of using the process model is that it brings unstable processes back to stability with the aim of improving customer satisfaction. A change in customer requirements may of course mean that stable processes have to change. The effectiveness of a system is assessed by measuring the customer's satisfaction.

The research of Sokovic *et al.* (2010), explains that the continual improvement process followed by the ISO 9001 standard is based on the PDCA model for continual improvement. This process should involve the following:

- The reason for working on a process should be highlighted.
- The selected process should be measured in terms of efficiency and effectiveness.
- The analysis.
- The evaluation of effects.
- Implementation and standardization of new solution.
- Evaluation of the effectiveness and efficiency of the process with the improvement action completed.

With regard to ISO 9001, continual improvement is embedded everywhere in the requirements and recommendations, as illustrated in Table 3.3.

Table 3.3: ISO 9001 clauses that reflect continual improvement

(Source: Sokovic *et al.*, 2010)

Clause	Detail
Clause 4.1(f)	Implement actions necessary to achieve planned results and continual improvement of these processes
Clause 8.5.1.	The organisation shall continually improve the effectiveness of the quality management system with the quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions and management review.
Clause 8.1(c)	The organisation shall plan and implement the monitoring, measurement, analysis and improvement processes needed to continually improve the effectiveness of the quality management system. This shall include determination of applicable methods, including statistical techniques, and the extent of their use.
Clause 5.1.	Top management shall provide evidence of its commitment to the development and implementation of the quality management system and continually improving its effectiveness.
Clause 5.3(b)	Top management shall ensure that the quality policy includes a commitment to comply with requirements and continually improve the effectiveness of the quality management system.
Clause 5.6.1.	Top management shall review the organisation's quality management system, at planned intervals, to ensure its continuing suitability, adequacy and effectiveness. This review shall include assessing opportunities for improvement and the need for changes to the quality management system, including the quality policy and quality objectives.

3.6.4. Breakthrough improvement and incremental improvement

Plura (2000), suggests that continual improvement can be conducted in two ways, breakthrough improvement and incremental improvement, also known as Kaizen breakthrough and re-engineering improvement. This consists of projects that lead to process improvement and are often

carried out by cross-functional teams outside routine operations. Incremental improvements consist of recurring improvement activities within the organisation. The best results are obtained when both approaches are used, as seen in Figure 3.11.

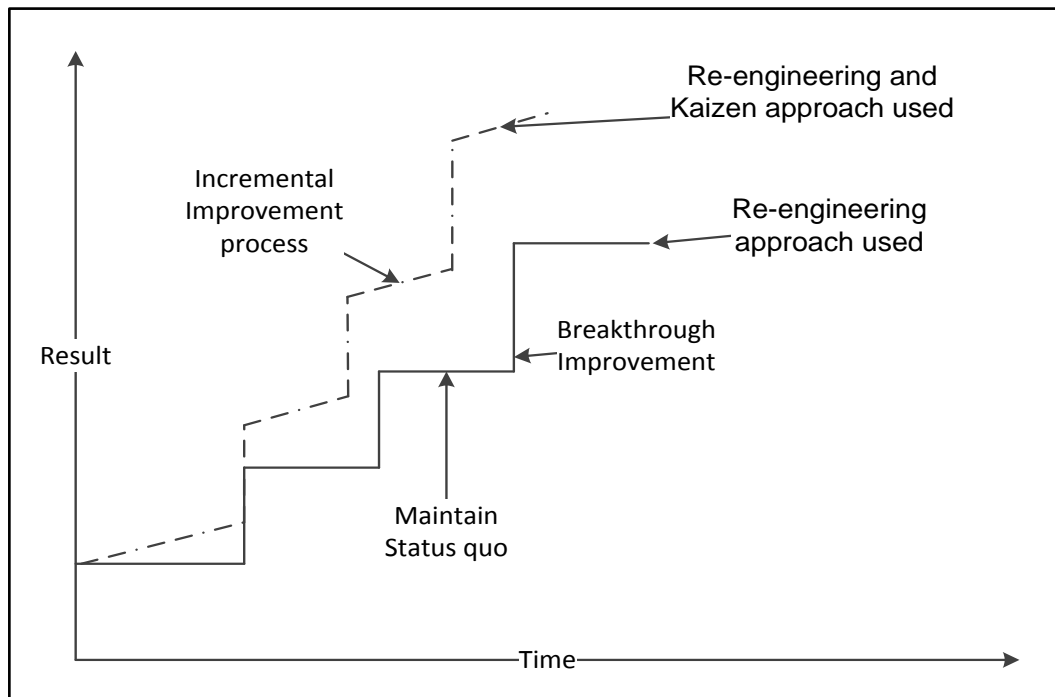


Figure 3.11: Reengineering and Kaizen vs just Reengineering continual improvement approach

(Source: Plura, 2000:Online)

3.7. IMPLEMENTATION OF A QUALITY MANAGEMENT SYSTEM

Quality management systems such as ISO 9001 (2008), are being adopted by organisations to increase competitiveness and customer satisfaction, and to enhance efficiency (Magd, 2008:173-200).

These organisations realise that if the ISO 9001 system is implemented effectively, the benefits from improving business performance and ensuring a competitive advantage far exceed the cost of implementation. Effective implementation will benefit the organisation more than using ISO 9001 as a marketing tool for promotional purposes (Sampaio, Saraiva & Rodrigues, 2009:38-58).

In many organisations, the introduction of a QMS produces weak results due to ineffective implementation. There are many factors responsible for the ineffective implementation of a QMS, as has been noted by Jang and Lin (2008:194-216), Magd (2008:173-200), Feng, Terziovski & Samson (2008:22-37) and Sroufe and Curkovic (2008:503-520). To explain these factors, the following will be discussed:

- Critical success factors and barriers to ISO 9001 certification.
- Motivations for ISO 9001 certification.
- Barriers in organisations that affect QMS adoption.

3.7.1. Critical success factors and barriers to ISO 9001 certification

Psomas, Fotopoulos and Kafetzopoulos (2010:450-457), assert that the phrase “critical success factors” in this context refers to the fundamentals that are important to ensure the successful attaining of an objective. Thus the critical success factors for ISO 9001 certification are the elements that are crucial to obtaining certification. The literature on the critical success factors for ISO 9001 (2008) implementation suggests that these factors and/or barriers tend to be the same, irrespective of the industry involved.

The research of Park, Kim, Kang and Jung (2007:32-48), notes that the time when most barriers were encountered was during and after the certification process. Obstacles such as a lack of leadership, lack of management support, lack of training, employees’ inadequate perception of quality, resource constraints and employees, resistance to change were all identified as critical to the successful implementation of ISO 9001. Barriers to the implementation of ISO 9001 include the following:

- Company policy and cultural background.
- ISO 9001 (2008) requirements.
- Quality management system effect.
- Quality management certification body.
- Customer policy.

These barriers reveal the short-sightedness of seeking certification on the basis of sector trend, with no total commitment to the QMS (Zeng, Tian & Tam, 2007:244-254; Bhuiyan & Alam, 2005:199-213; Chow-Chua, Goh and Wan, 2003:936-953).

3.7.2. Motivations for ISO 9001 certification

Motivation for ISO 9001 (2008), certification is an important aspect to note as it influences the success of implementation. The research of Gotzamani and Tsiotras (2002:151-169) and Feng *et al.* (2008:22-37) insists that successful QMS implementation depends on the organisation's genuine commitment to improving quality rather than its image for marketing purposes. Organisations that seek certification in order to improve quality are more likely to succeed in ISO 9001 QMS implementation. Similarly, the recovery of the initial investment to obtain ISO 9001 certification is dependent on the reason for certification.

Zaramdini (2007:472-491), suggests that there is a correlation between the motive for seeking ISO 9001 certification and benefits derived from obtaining certification. Such motives may include:

- process improvement;
- product enhancement and/or level of service quality;
- productivity improvement/efficiency;
- reduction in non-conformances and customer complaints; and
- improvement of the business's image in the market.

3.7.3. Barriers in organisations that affect QMS adoption

Gotzamani (2005:645-657), observes that change in any organisation is never easy. For any change to be successful, the need to change should first be recognised. The organisation needs to have a complete view of its current state including its strengths, weaknesses and limitations, the desired future state and the obstacles associated with the transition stage. The important obstacles to consider during the transition stage are:

- Change of culture.

- Adoption of “paper certificates”.
- Management commitment.
- Unrealistic requirements.

3.7.3.1. Change of culture

In any organisation, in order to adopt a new standard, a change of culture is vital. With the introduction of ISO 9001, the most common change is to move from a typical quality assurance approach that aims to satisfy conformity with a specification, to a holistic quality management approach that focuses on continual improvement and customer satisfaction. The change in culture entails abandoning existing ways of doing things and identifying resistance to accepting the new routines. The strength of the resistance indicates the how successfully the current QMS has been implemented (Janas & Luczac, 2002:127-132; Gryna *et al.*, 2007:267).

3.7.3.2. Adoption of “paper certificates”

For Laszlo (2000:336-339), “paper certificates” refer to organisations who manage to convince the registrar of ISO that they comply with the quality standard when in fact they don’t. The culture that endorses that type of behaviour will realise that adopting ISO 9001 (2008) is quite the opposite. Two cultural shifts have to be made by these companies: from being deceptive to being honest, and from having a quality assurance drive to a quality management drive.

3.7.3.3. Management commitment

The research of Tsim, Yeung and Leung (2002:245-250) and Boulter and Bendell (2002), returned that the main concerns of organisations adopting ISO 9001 are:

- management activity;
- process approach management;
- customer satisfaction; and
- continual improvement.

Boulter and Bendell (2002:34-41) suggest that the concern found most challenging was “management activity”. The other concerns such as continual improvement and customer satisfaction are common in most QMS. But when it came to the ISO 9001 (2000) standard for management commitment, it was unclear what was expected of management.

3.7.3.4. Unrealistic requirements

The aim of many QMS is to develop a tool to control daily processes in order to satisfy the customer. However, in the case of ISO 9001 (2008), many researchers feared that because its requirements sound a bit unrealistic, it would be effective in talking about quality rather than doing something about quality. In fact, ISO 9001 has been proven to bring about innovation in the fields of customer satisfaction, process management and continual improvement. (Larsen & Haversjo, 2000:226-237; Biazzo & Bernardi, 2003:149-169).

3.8. CONCLUSION

This literature review has established the context and theoretical framework in which the study will be conducted in order to achieve the research objective. The context and theoretical framework evaluated in this chapter include:

- **The ISO 9000 system approach:** This area unpacks the development of the ISO 9001 journey.
- **The effect of a QMS on the sustainable long-term provision of energy:** QMS factors that influence achieving a sustainable long-term provision for energy supply, which includes energy planning, review, performance and association to ISO 50001 energy management system.
- **The QMS contribution to the establishment of world-class processes and practices:** The elements of linking a QMS to current work practices and processes will result in aligning and adopting a process approach for business. This process approach will result in

improved business performance by creating linkages across departments in the organisation.

- **The effect of a QMS on quality culture:** This area focuses on the relationship between corporate culture and quality culture with the move towards a quality culture.
- **QMS and the continual improvement process:** The elements mentioned in this area focuses on the continual improvement concept brought about by means of the QMS and its effect on business.

In Chapter 4, the research design and methodology employed in this research will be discussed in order to select the most appropriate research methodology for this study. This is accomplished by researching the theoretical element for each methodology and comparing common elements of the methodology with how it is applied. The result will indicate the most appropriate research methodology to be used for this study.

CHAPTER 4: RESEARCH DESIGN AND METHODOLOGY

4.1. INTRODUCTION

Geringer *et al.* (2009) and Peh and Low (2013:133-147), describe a research design as:

“the logical sequence that connects the empirical data to a study’s initial research question and ultimately, to its conclusions. Colloquially, a research design is an action plan for getting from here to there, where here may be defined as the initial set of questions to be answered, and there is some set of conclusions (answers) about these questions.”

In this chapter, the reader is provided with a detailed description of the design and method utilised in this research study. It covers the steps planned and taken by the researcher, the data collected by following these steps, and the analysis conducted on the collected data.

The framework used in this chapter consist of three sections: a research theory section that explains to the reader which strategies are available, an explanation of how these theories are applied, and an account of the particular strategy selected for this research. The following will be discussed:

- The research approach.
- The different research strategies.
- Application of the research strategies.
- The research strategy adopted for this study.
- The research questionnaire.

4.2. THE RESEARCH APPROACH

Mouton (2014:56) and Creswell (2008:5-6), agree that research design and research methodology are different aspects of the research process. With reference to research design, one decides on what type of research to do in order to answer the research question. Research design focuses on the planning part of the study in order to produce the desired result. It

considers how to produce the evidence needed to answer the research question adequately. Research methodology concentrates on the “how” of the research, considering what tools and procedures are to be used. It identifies the most unbiased procedures and emphasises the individual steps to be followed in the research process.

Saunders *et al.* (2003:378), distinguish between quantitative and qualitative research, and the difference is clear when one looks at the data produced by these research approaches. Table 4.1 illustrates the distinction between quantitative and qualitative data.

Table 4.1. : Distinctions between qualitative and quantitative data
(Source: Saunders *et al.*, 2003:378)

Quantitative Data	Qualitative Data
➤ The studies are based on quantifiable phenomena.	➤ The studies are based on meanings expressed by thoughts and words.
➤ Data are collected and presented in a numerical and standardised format.	➤ Data collecting is done in a non-standardised format which needs to be grouped into categories.
➤ The analysis consists of the use of diagrams and statistics.	➤ The analysis consists of the use of conceptualisation.

Qualitative data are defined as “non-numerical data or data that have not been quantified” and quantitative data is defined as “numerical data or data that have been quantified”. This distinction is elaborated on, below.

4.2.1. Qualitative approach

Qualitative research is commonly used to answer the ‘why’ question. This research approach consists of studying things in their natural environment and trying to make sense of them (Creswell, 2003:19-22; Saunders *et al.*, 2003:378).

Creswell (2003:8), points out that qualitative research is often conducted when you need to address a research problem in which the variables are not known. The existing literature might reveal little about the phenomenon

being studied, indicating a need for further exploration. The literature review in qualitative research is less important in the case of quantitative research. In quantitative research, the literature is reviewed to justify posing the research problem, but it does not provide direction. In qualitative research, the problem statement and research question are formulated in such a way as to enable you to learn from your participants.

Saunders *et al.* (2003:378), describe the characteristics of qualitative research in the following terms:

- Researching and understanding a problem pertaining to a common phenomenon.
- The literature review plays a monitoring role that justifies the problem.
- The research questions and purpose are stated in a broad way.
- Data collection is word-based.
- The data is analysed for descriptive themes.
- The report writing style is flexible and includes the researcher's subjective views.

4.2.2. Quantitative approach

Creswell (2003:16-26) and Saunders *et al.* (2003:378), is of the opinion that quantitative research is commonly conducted to answer the question "how". It is used to elaborate on and provide feedback about the interactions that occur between measured variables, with the aim of compiling an explanation of, forecasting and regulating events.

Mouton (2014:107), is of the opinion that in quantitative research, the researcher identifies a problem based on phenomena that require an explanation for their occurrence. There is typically an extensive literature review in quantitative in order to justify the research and suggest appropriate research questions. The research question developed is very specific, with the aim of obtaining measurable data from the variables. Data analysis in quantitative research uses mathematical tools such as statistics to prove a hypothesis or prediction.

4.3. RESEARCH STRATEGIES

This section discusses the various types of research strategy one might consider when conducting research. Mouton (2014:144-180), notes that some strategies strongly correlate with a qualitative or a quantitative research approach, while others can be used with both. What the researcher should focus on is whether the strategy is appropriate for his or her particular research question and objective.

Saunders *et al.* (2003:380), suggest that strategies be compared according to the following criteria:

- **Design classification:** the design is classified in terms of empirical or non-empirical research, using existing or new data, the nature of the data and the degree of control.
- **Key research questions:** Typical key research questions addressed by the design.
- **Application:** Where the design is generally used.
- **Mode of observation:** Methods used for gathering data.
- **Analysis:** Methods used to analyse the data.
- **Strengths:** The advantages of the design.
- **Limitations:** The limitations to consider for the design type.
- **Sources of error:** The main threats to validity.

The following research strategies will be briefly discussed using these criteria in order to justify the use of a specific research strategy for this study:

- Experimental.
- Survey.
- Case study.
- Grounded theory.
- Action research.
- Statistical modelling and computer simulation studies.

4.3.1. Experiments

Mouton (2014:91) and Wagner and Harvey (1997:33), point out that experimental studies are associated with the quantitative approach and aim to study a small number of cases under strictly controlled conditions, usually within a laboratory. The aim is to observe the effect on the dependent variable as the independent variable is manipulated.

Experimental research is grounded in the fact that a cause will always lead to an effect, and it is used mostly when a strong correlation has been observed (Given, 2008:2).

The planning of an experiment is crucial to its correct execution and production of close to real-world results. Another important point is the sampling of groups. Usually group sampling is critical when there is more than one group to consider for the experiment. One sample group will usually serve as a control group while another will go through the experimental conditions. Incorrect sampling can result in invalid results, and often researchers end up adjusting sample size to reduce the chance of random error (Saunders *et al.*, 2003:91).

A pilot study is part of best practice when conducting an experiment and helps ensure that the process will produce the desired results. Normally minor errors are detected during the pilot study, which might have negatively affected results. The pilot study strengthens the design so that most of the effort can be aimed at the actual experiment (Wang & Wan, 2008:32; Wagner & Harvey, 1997:33).

The research of Given (2008:715-716), Mouton (2014:91) and Creswell (2008:294-336), found that the experimental strategy can be characterised as follows:

- **Design Classification:** Experimental design falls within the quantitative arena and is aimed at producing a causal study of a small

number of cases under highly controlled conditions. This is typically done in a laboratory or under laboratory conditions.

- **Key research questions:** Key research questions are of a causal nature and often address the “why?” question and the causes of “why”.
- **Application:** This design is used in behavioural and natural science research as well as clinical trials.
- **Mode of Observation:** An experiment uses a structured and physical measurement to get the data from the source.
- **Analysis:** This method makes use of Mathematics and Statistics to perform the analysis.
- **Strengths:** The strength of this research method is that it gathers, connects and tests causal relationships.
- **Limitation:** The limitations are that it typically focuses on a small sample, which could negatively affect the results. It does not consider the human element in the research because of the laboratory environment.
- **Sources of error:** The main sources of error for this type of study are measurement error, subject error and experimental process error.

4.3.2. Survey

A survey makes use of questioning techniques to acquire information from subjects in order to establish the attributes of a population in relation to one or more variables. A survey can be conducted in different ways, such as a questionnaire, which is a written survey, and an interview, which is an oral survey. While both will provide the researcher with the desired outcome, one or both will be chosen according to the nature of the research conducted (Mouton, 2014:56; Saunders *et al.*, 2003:191).

Saunders *et al.* (2003:191), researched that a survey design is associated with the quantitative approach and its objective is to provide a general indication regarding a representative sample of a population. It is also used when a deductive approach is needed. Data for the survey is typically obtained via a questionnaire and is standardised, which allows for

easy comparison. The availability of the data for the survey is dependent on the population being surveyed and not the researcher. Questionnaires are not the only way of collecting data within this strategy: one can use observations and interviews as well. But these require more effort when it comes to analysing the data collected.

Given (2008:846-848), Mouton (2014:56) and Creswell (2008:375-421), classify the survey strategy as follows:

- **Design Classification:** Surveys falls within the quantitative arena. This method uses primary numeric data for its analysis and has a medium measure of control, falling somewhere between laboratory and natural field conditions.
- **Key research questions:** Key research questions in this design could be exploratory, as in the event of a pilot survey; descriptive, as in opinions of people in a public poll; or causal, as in the case of an analytical survey.
- **Application:** This design is used to carry out organisational surveys, public opinions polls, attitudinal surveys, needs assessment surveys and community-based surveys.
- **Mode of Observation:** The data is sourced by means of questionnaires and/or interviews.
- **Analysis:** The analysis for this method will include descriptive and inferential statistics, tabulation, correlation and regression. For visual representation, charts and graphs are used.
- **Strengths:** It has the potential to generalise to large populations if the sampling is correct, high validity if the proper controls are in place, and high reliability if the questions are constructed correctly.
- **Limitations:** The limitations to consider for this design type is that it sometimes lacks depth and insider perspective, the data gathered is context specific and does not reveal more than what was asked.
- **Sources of error:** The main source of error for this type of study are sampling error, questionnaire error, high non-response, data capture error, respondent effect and fieldwork error.

4.3.3. Case study

Case studies lean towards the qualitative approach and provide a detailed account of a small number of cases. Case study research is appropriate to contemporary events in which one has no control over the behaviour concerned. A variety of sources is used as evidence in a case study, such as documents, interviews, observations and other available resources that might have been used in past studies. In most cases, case studies are conducted when one has to ask the questions 'how' or 'why' about a set of events. The researcher has little or no control over these events (Peh & Low, 2013:133-147; Geringer *et al.*, 2002).

Peh and Low (2013:133-147), Robson (2002:178) and Yin (2003), concur that a case study is "a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence" (Robson).

Geringer *et al.* (2002) and Peh and Low (2013:133-147), point out that a strength of the case study approach is its ability to produce an in-depth study in a descriptive, process-orientated manner.

4.3.3.1. Types of Case Studies

The research of Mouton (2014:150), Saunders *et al.* (2003:93) and Yin (2003), confirms that case studies are well known as exploratory research, often used in contexts where there is a lack of theoretical understanding or not much is known about the subject. The different types of case studies are as follows:

- **Descriptive case studies:** A descriptive case study consists of a specific study in which questions about a phenomenon are studied and reported. The setting out of what is already known about the phenomenon is known as descriptive theory. This aids in determining the scope of the case being studied. The strength of descriptive case studies lies in the various interpretations of the data and theory that

may be developed from them. The goal of a case study is to assess a sample in detail and in depth, based on a voiced descriptive theory.

- **Explanatory case studies:** Explanatory case studies use both qualitative and quantitative research methods and are used to build theories for explaining casual relationships pertaining to a phenomenon. This type of case study stands out from the rest by not only exploring a phenomenon but explaining it as well.
- **Experimental case studies:** These are studies in which an outcome is observed after the introduction of a change.
- **Illustrative case studies:** This is where the effects of a new practice within an organisational context is shown.

4.3.3.2. Research Design for Case Studies

Peh and Low (2013:133-147), Mouton (2014:49) and Yin (2003), indicate that the following components are important in case studies:

- **Study questions:** The question one wishes to answer with the case study. Formulating this question is a very difficult task that should take into account relevant theory in the existing literature.
- **Study propositions:** For descriptive and explanatory studies, a proposition is needed. A proposition is normally derived from the research question. A study proposition tells us why the study needs to be conducted.
- **Unit of analysis:** The entity studied in the analysis is the unit of analysis. It could be a variety of things, from an individual person to a series of events.
- **Logical linking the data to the proposition:** This is the linking of the qualitative or quantitative evidence to the proposition. With this in mind, it is important that the correct unit of analysis or case be selected. Case selection should be based on the research purpose, research question and proposition.
- **Criteria for interpreting findings:** The criteria for deciding what information is vital for a specific end goal to be achieved, and for translating one's discoveries accordingly.

The research of Given (2008:68-71), Creswell, (2008:465-466) and Yin (2003), returns that the following is a measure for case study strategy using specific criteria. This will be used in comparison with the rest of the strategies to be addressed in this section.

- **Design Classification:** Case studies fall within the qualitative arena. This paradigm uses a mixture of numerical and textual data for its analysis and has a low measure of control because the case occurs in natural field conditions.
- **Key research questions:** Key research questions to address the design are both exploratory and descriptive.
- **Application:** Case studies are carried out in various contexts, such as businesses (financial or organisational case studies), schools, communities (sociological or social work research), and even regions and countries (political science research).
- **Mode of Observation:** The data is sourced by means of participant observation through questionnaires, interviews and the use of existing documents or data.
- **Analysis:** The method of analysis for case study research will include a precise examination of likenesses between various social phenomena to create ideas or thoughts.
- **Strengths:** Its strength is the potential to have in-depth insight into a situation where abnormal or rare behaviour can be noted because of the rich data collected.
- **Limitation:** The limitations to consider for the design type is that case studies are sometimes non-scientific, and the data collected cannot necessarily be generalised to a wider sample or population.
- **Sources of error:** The main source of errors for this type of study is the potential bias of the researcher and the lack of firmness in the analysis.

4.3.4. Grounded theory

Researchers tend to regard grounded theory as the best example of the inductive approach. Grounded theory involves theory building through induction and deduction. It starts with data being collected without a prior theoretical framework or design. The theory from the data by means of a series of observations. Grounded theory thus involves building an explanation or designing a theory around a core theme produced by one's data (Mouton, 2014:56; Saunders *et al.*, 2003:398).

The research of Smith (2008) and Creswell (2008:422-460), suggests that grounded theory mainly concentrates on how to inquire – what method of enquiry is employed – and builds theories based on it. This theory is used to explore complicated social relationships in groups where little research has hitherto been conducted. Features of grounded theory include the following:

- The collecting and data analysis happen simultaneously.
- Analytic codes and categories are developed from data and not from pre-existing concepts.
- Discovery of essential social procedures in the information.
- Inductive development of theoretical classifications.
- Theoretical testing to refine classifications.
- Writing diagnostic reminders as the phase in amongs coding and composing.
- The combination of classifications into a theoretical framework.

Given (2008:374-376), Creswell (2008:422-460) and Smith (2008), identify the following characteristics of grounded theory strategy using specific criteria:

- **Design Classification:** Grounded theory falls within the qualitative arena. This method uses textual and numerical data for its analysis and involves a low measure of control because it occurs in natural field conditions.

- **Key research questions:** Key research questions to be addressed in grounded theory research are questions of meaning and explanation, involving finding relationships and patterns of linkage.
- **Application:** Grounded theory research is carried out when developing new theories or linking theories.
- **Mode of Observation:** The data is sourced by means of participant interviews, observation and the use of existing documents.
- **Analysis:** The method used to analyse this data is descriptive analysis, through which a theory is designed around a core theme produced by the data.
- **Strengths:** Its strength is that it pioneers the way by suggesting new ideas, theories and models.
- **Limitation:** Possible limitations are that the design type could result in a claim that is not testable, vague and confusing.
- **Sources of error:** The main source of error in this type of study derives from the assumptions made when theories are built.

4.3.5. Action research

Action research occurs when the research participants get involved with the study as an integral part of its design. It usually falls within the qualitative research paradigm as it aims to understand the context in which the participants live, work or interact. This type of research affects the participants directly and is aimed at changing some aspect of their context. There are three main areas of concern: management of the change, the involvement of the practitioner, and the effect of the change beyond the project. The fundamental difference between action research and any other research is the emphasis on action or change within the environment (Kemmis & McTaggart, 2000: 595; Mouton, 2014:56).

Kemmis and McTaggart (2000:595), found that any type of research generates knowledge. Action research generates knowledge by conducting enquiry within a real-life context, with the purpose of learning and driving personal and professional development. It has a participatory

nature, which leads some researchers to describe it as participatory research.

4.3.5.1. Key characteristics of action research

The research of Kemmis and McTaggart (2000:595) and Mouton (2014:56), suggests that the uniqueness of action research cannot be underestimated. It demands that participants buy into the idea of the need to change and creates an environment that promotes a willingness to change. For this to happen it is important for the researcher to gain the trust of the participant, agree on the rules for data control, and on how to resolve potential conflicts.

Mouton (2014:56) and Creswell (2008:576-601), classify action research in terms of the established criteria as follows:

- **Design Classification:** Action research falls within the qualitative arena. This method uses textual data for its analysis and has a low degree of control because it occurs in natural field conditions.
- **Key research questions:** Key research questions in action research are both exploratory and descriptive, and focused on action.
- **Application:** Action research is typically carried out in the classroom or other environments mostly in the field of education.
- **Mode of Observation:** The data is sourced through participant observation, interviews and existing documents.
- **Analysis:** The methods and techniques used to analyse this data are qualitative. The data analysis could be a result of collaboration between the participant(s) and the researcher.
- **Strengths:** Its strength lies in its involvement of the participants, resulting in both a low refusal rate and a real potential for managed change.
- **Limitation:** The limitations for this design type are that its dependence on participants makes for a low degree of overall control.

- **Sources of error:** The main source of error in this type of study is the emotional or subjective involvement of the researcher, and his or her possible manipulation by the participants for their own gain.

4.3.6. Statistical modelling and computer simulation studies

Statistical modelling and computer simulation studies are used to develop and validate models of the real world. The process involves statistically modelling a portion of a process in the real world and producing, by means of statistical analysis, expected values that are compared to the actual data. The strength of this type of study is that it has the ability to model huge populations and simplify the data in order to explain it better.

The research of Saunders *et al.* (2003:97) and Creswell (2008:192), returned that the following classification according to specific criteria applies to statistical modelling and computer simulation studies:

- **Design Classification:** This research falls within the quantitative arena, using both numerical and textual data for its analysis with a medium level of statistical control.
- **Key research questions:** Key research questions in statistical modelling and computer simulation research are descriptive, causal and predictive.
- **Application:** typical applications would involve modelling financial data and trends in society.
- **Mode of Observation:** The method uses survey data, market and financial data and systematic observation data as structured sources of information.
- **Analysis:** The data analysis involves models of observation, multiple regression and survey data.
- **Strengths:** Its strength lies in its ability to monitor large-scale phenomena and explain relationships in order to achieve an accurate prediction capacity.

- **Limitation:** The main limitation for this design type would stem from the quality of the data, which does not always satisfy the model being used.
- **Sources of error:** Errors in this type of study are also attributable to the quality of the data.

4.4. APPLICATION OF THE RESEARCH STRATEGIES

The previous section highlighted various research strategies available to the researcher. The strategies were all descriptively classified in terms of the same specific criteria for the purposes of comparability. The strategies will be now be discussed with reference to relevant literature sources.

4.4.1. Experimental

The experimental research methodology works well in the scientific field as the strong control factor is essential in that environment, while in other disciplines the opposite applies (Jaluria, 2010:20).

Zoogah and Zoogah (2014:10), identify three different types of experiments: laboratory, field and natural experiments. Laboratory experiments are conducted in a well-controlled environment and are essential when accurate measurements are required. This research usually unfolds over a considerable time, and therefore choosing the correct place to conduct the experiment is vital. The researcher has control over the independent variable that is manipulated to conduct the experiment. The operational process followed for laboratory experiments consists of the set of steps used to carry out the experiment. Field experiments conducted in a real-life environment are sometimes referred to as social experiments as they involve the manipulation of social groups. Natural experiments are also conducted in the real-life environment of the participants, but in this case, the researcher has no control over the independent variable, which simply occurs naturally.

To summarise, Jaluria (2010:20) and Zoogah and Zoogah (2014:10), are of the opinion that experimental research is aimed at producing a causal study of a small number of cases in a strictly controlled environment.

4.4.2. Survey research

Survey research is commonly conducted in the health environment but also in many other environments. It is regarded as the easiest research approach, but like any other research approach being used, it can suffer from the creation of weak data (Kelley, Clark, Brown & Sitzia, m2003:15).

Gable (1994:3), found that a survey can be defined as “the selection of a large sample of people from a pre-determined population followed by data collection from the sample”. The researcher uses the information gained to make some deduction about the wider population. The data is normally collected by means of a questionnaire and/or interviews. Surveys are used to create snapshots in time of a specific condition or situation. They are used in a context in which there is no need to control conditions for research purposes. Surveys are conducted for descriptive study purposes and to explore an explanation and provide data for testing an hypothesis. A survey is a research strategy and not a research method. Research methods are chosen according to the research question and can include questionnaires and interviews.

Summing up, Gable (1994:3) and Kelley *et al.* (2003:15), maintain that survey research is appropriate when information needs to be obtained from a population sample in order to determine the characteristics of a wider population in terms of one or more variables.

4.4.3. Case Study

The research of Rowley (2002:25), shows that a case study is the common choice for new researchers. Yin (2003) asserts that a case study design should be employed when:

- The “how” question is the focus of the study.

- The behaviour of the study subjects cannot be changed.
- Contextual conditions relevant to the study are covered.
- The relationship between the phenomenon and its context is not clear.

Both Yin (2003) and Rowley (2002:25), believe that one's choice of research methodology should be based on the kind of research question being asked and the methods most appropriate to that question. Case studies answer the questions "how" and "why" through a highly detailed response to the research question. Although the experimental strategy also answers the "how" and "why" questions, the case study strategy is most apt when there is no control over the variables in the research.

4.4.4. Grounded Theory

In this section, examples of the application of a grounded theory strategy are briefly reviewed.

The research of Marcrì, Tagliaventi and Bertolotti (2002:15), as reported in their article "A grounded theory for resistance to change in a small organisation", focuses on the process that generates resistance to change in a small organisation. In their study, they concentrated on a company that manufactures staircases in Italy. With additional interview data from five other companies, the authors built a grounded theory that interprets resistance to change in that sector.

A second example of grounded theory is the research of Wafler and Swierczek (2013:8) reported in their article "Closing the distance". This study seeks to consider the impact of psychic, cultural and institutional distance, the adaptation of international joint ventures and the performance of international companies entering an emerging economy. The research design featured a case study of six companies entering the market using a grounded theory approach. This approach was appropriate for this study because it was able to accommodate human interaction and

the interrelationship between action, environmental conditions that affect that action, and the result of that action.

In short, Glaser and Strauss (1967), Marcri *et al.* (2002:15), and Wafler and Swierczek (2013:8), found that grounded theory is a research method used in which a theory is developed from and grounded in the data gathered.

4.4.5. Action Research

The application of an action research strategy is illustrated by reviewing studies that use action research theory as their research strategy.

In their journal article “Reflective internet searching”, Edwards and Bruce (2002:9), suggest that sources of information and other opportunities made available by the internet are increasing exponentially. They used the action research cycle model of planning, acting, recording and reflecting to develop a research approach to Internet use. This approach is a working conceptual framework or model for internet searching that will aid people to overcome the challenges of an environment that is constantly changing and expanding in terms of content and technology.

A second study examined is that of Marcinkoniene and Kekäle (2007:2), as reported in their article “Action research as culture change tool”. The purpose of their research was to report on, and help change, the institutional culture at three Lithuanian schools by means of action research. The culture change data was collected by means of a survey and the findings were positive for changing towards the target culture.

To summarise, Edwards and Bruce (2002:9) and Marcinkoniene and Kekäle (2007:2), show that action research is used when a change is needed. It accomplishes this in two stages, first a diagnostic stage and then a therapeutic stage that involves collaboration. Change is thus introduced, and its effects are then studied.

4.4.6. Statistical modelling and computer simulation studies

The application of statistical modelling and computer simulation is illustrated by reviewing studies that make use of this research strategy.

The first study to be reviewed is the research of Vasermanis, Nechval and Nechval (2003:32), as published in their article “Statistical validation of simulation models of observable systems”. This article discusses a new approach to solve the Behrens-Fisher problem when the covariance matrices of two multivariate normal populations (compared with respect to their means) are different and unknown. It uses a validating computer simulation model of real, observable systems, and develops a uniformly powerful invariant test from the generalized maximum likelihood ratio (GMLR).

Verma (2006:36), expresses that in the research article “Improving agility of supply chains using base stock model and computer based simulations”, computer simulation serves to develop and validate models of the real world. In this study, an inventory model for a supply chain is developed and its values are confirmed in a mathematical model using computer simulation. The supply chain demands fixed lead times for replenishment, and failure to comply may result in extra cost. A physical simulation is conducted to highlight the assumptions made for the model and then used to verify the values obtained by the model.

Summarising the above, Vasermanis *et al.* (2003:32) and Verma (2006:36), show how statistical modelling and computer simulation studies are used to develop and validate models of the real world. Data gathered in the real world are extrapolated to produce, through computer-simulated statistical analysis, expected values that are then compared to the actual data.

4.5. RESEARCH STRATEGY ADOPTED FOR THIS STUDY

The theory and research study adopted for this study have to answer the research question, “how can the diffusion of a QMS bring improvement to the electricity supply industry?”, and satisfy the research objectives:

- to assess what effect a QMS has on a sustainable long term solution for energy supply;
- to assess how a QMS contributes to the establishment of world-class processes and practices;
- to determine how a QMS affects quality culture;
- to determine what factors of a QMS contribute to a process of continual improvement; and
- to determine what barriers hinder the sustainable implementation of a QMS.

The same criteria employed in introducing and comparing research strategies will be used to explain and justify the strategy chosen for this study.

- **Design Classification:** This research falls within the quantitative arena. This method requires the use of both numerical and textual data for its analysis and has a low degree of control over the research environment.
- **Key research questions:** Key research questions to be addressed in this research are of a descriptive and explanatory nature.
- **Application:** Typical application would occur in a company or other organisation.
- **Mode of Observation:** The data is derived from the organisation’s personnel in the form of interviews or responses to a questionnaire.
- **Analysis:** The data analysis includes survey data and descriptive and inferential statistics. For visual representation, charts and graphs are used.
- **Strengths:** Its strength lies in the potential to obtain in-depth insight into the diffusion situation through the collection of rich data.

- **Limitation:** The main limitation might stem from the quality of the data, which may not always satisfy the model being used.
- **Sources of error:** Source of error in this type of study includes sampling error, questionnaire error, high non-response, data capture error, respondent effect and fieldwork error.

Based on the criteria used to benchmark the various research strategies, and on the particular requirements of this study, the most appropriate research approach is a case study utilising a questionnaire.

4.6. THE RESEARCH QUESTIONNAIRE

The research questions in Table 4.2. will be used for collecting data in order to answer the primary research objectives set out in Chapter 1. These questions will be aligned with the literature review conducted in Chapter 3 and form the basis for answering the primary research objective.

Table 4.2. : The research questionnaire
(Source: Own)

The Research Questionnaire	
What effect does a QMS have on a sustainable long-term solution for energy supply?	
Q1:	The quality policy introduced by the QMS (ISO 9001) supports Eskom's sustainable drive.
Q2:	The Eskom energy management programmes support the Social, Environmental and Economic pillars of sustainability.
Q3:	The QMS (ISO 9001) performance affects the Eskom energy improvement programmes.
Q4:	The energy improvement programmes use the continual improvement principle introduced by the QMS (ISO 9001).
Q5:	QMS (ISO 9001) supports the monitoring of energy improvement initiatives.

Does a QMS (ISO 9001, 2008) contribute to the establishment of world-class processes and practices?	
Q6:	Eskom has adopted the process and systems approach introduced by the QMS (ISO 9001).
Q7:	QMS (ISO 9001) process and systems approach leads to an improvement of processes in Eskom.
Q8:	All Eskom staff has been trained in and is familiar with the Eskom processes and practices (PCMs).
Q9:	QMS (ISO 9001) provides us with tools to improve processes.
Q10:	Improvement of processes is directly related to the Quality Management System.
Does a QMS affect quality culture?	
Q11:	A quality culture is when quality is embedded in every part of the business.
Q12:	Eskom has a quality culture due to QMS (ISO 9001).
Q13:	Open and honest communication is part of Eskom's culture.
Q14:	Which quality culture best describes quality culture in Eskom: 1- Absence of a Quality Emphasis (paying little or no attention to quality as a topic) 2- Error Detection Culture (quality is associated with detecting mistakes at the end of the process) 3- Error Prevention Culture (implies that quality is everyone's responsibility) 4- Creative Quality Culture (the organisation's entire strategy is centred on quality) 5- None of the above
Q15:	Eskom learns from past mistakes.

How does a QMS ensure a continual improvement process?	
Q16:	Eskom's quality policy promotes continual improvement.
Q17:	Continual improvement introduced by QMS (ISO 9001), is practised within Eskom.
Q18:	Continual improvement practiced in Eskom is based on the PDCA cycle.
Q19:	Monitoring, measuring and analyses are performed on all continual improvement processes.
Q20:	Top management is committed to continual improvement.
What are the barriers to a sustainable QMS implementation?	
Q21:	The implementation of ISO 9001 (2008) is sustainable.
Q22:	Senior management is strongly involved with the ISO 9001 drive.
Q23:	Sufficient quality training to staff was given during the ISO 9001 implementation.
Q24:	All employees fully understand the concept of quality.
Q25:	The staff fully understands the ISO 9001 requirements.

4.7. CONCLUSION

This chapter elaborated on the different types of research methodologies theoretically and how they are applied in research. Based on the theory and application of each research method, the research method best suited for this study was revealed. The research methodology to be used in order to meet the research objectives was a case study methodology using a research questionnaire.

The next chapter will describe data collection criteria, theories and their applications, which will indicate the data collection method to be used for this research study. Furthermore, it will discuss data validity and reliability. The data analysis and interpretation of the data collected will form the rest of this chapter.

CHAPTER 5: DIFFUSION OF A QMS: DATA COLLECTION, ANALYSIS AND INTERPRETATION OF THE RESULTS

5.1. INTRODUCTION

Research data can be collected using a variety of methods. Researchers choose their method according to their research paradigm and the type of data it typically produces, but it is common to combine methodologies traditionally used for a particular paradigm.

This chapter will elaborate on the following:

- Data collection criteria.
- Data collection method and application.
- Data collection method used for this study.
- Data validity and reliability.
- Data analysis.
- Conclusion.

5.2. DATA COLLECTION CRITERIA

In this section, the data collection methods are discussed according to the following criteria:

- Unit of analysis.
- Variables.
- Sample and sample types.

5.2.1. Unit of Analysis

Nuri (1993:1) and Huberman and Miles (1994), describe the unit of analysis as “the major entity that is being analysed in the study. It is the 'what' or 'whom' that is being studied”. Thus the unit of analysis, according to Mouton (2014:51) and Saunders *et al.* (2003:272), could refer to the following:

- An individual (Business manager or customer).
- An event (Organisational change, project failure).
- An object (Product, service, process).

- A body of individuals (project team, working group, department, operational unit).
- A relationship (relationship between two or more individuals or bodies, buyer and seller).
- An aggregation (undifferentiated individuals or bodies with no internal structure).

5.2.2. Variables

Saunders *et al.* (2003:287) and Adams, Khan, Raeside, and White (2007:175), found that a variable is an attribute of the entity which was chosen as the unit of analysis. Variables like gender, skin colour, social background are non-numerical attributes and are referred to as 'qualitative variables'. A 'quantitative variable' is a numerical value of an individual or object like age, weight, etc.

5.2.3. Sample and Sample Type

The research of Saunders *et al.* (2003:150) and Finke (2002), states that a 'sample' consist of elements of a target population. The target population is the body from which data is gathered. A 'sampling frame' is a record from a population used to extract sampling units.

The studies of Mouton (2014:101), Finke (2002) and Adams *et al.* (2007: 89), reveal that there are two categories of sampling, 'probability sampling' (when the researcher knows that all areas of the population are present in the sample) and 'non-probability sampling' (the researcher cannot determine that all areas of the population will be reflected by the sample). Probability sampling methods include:

- **Simple Random Sample:** A random sample occurs when a selection is made from a particular population: each unit is selected with known probability and the method of selection is specified.
- **Stratified Random Sampling:** This type of sampling is applicable to samples that are uniform in nature and so can be drawn equally.

- **Systematic (Quasi-random) Sampling:** This type of sampling is mostly used as it ensures that a unit cannot be sampled multiple times. The units are selected by ranging through the target population and choosing every n-th unit.
- **Cluster (Multistage) Sampling:** Cluster sampling consists of a sample of heterogeneous clusters that is homogeneous within the cluster. An example of this is sampling for a nation-wide survey.
- **Sequential (Multiphase) Sampling:** when using Sequential (Multiphase) Sampling, the researcher is allowed to draw samples on more than one occasion. This technique is used in industry to ensure product quality.

Non-probability sampling includes:

- **Convenience Sampling:** Convenience sampling involves collecting non-probability samples with no restrictions. This is the easiest and cheapest method to use but may not be the most reliable. For example, a researcher conducts interviews with whomever they choose based on a very general issue like the public transport service.
- **Purposive Sampling:** Non-probability sampling conducted according to criteria is called purposive sampling. Purposive sampling consists of two types, judgement and quota sampling. Judgement sampling is a cross-section of a sample that conforms to some criteria and quota sampling occurs when certain relevant traits describe the dimensions of the population. More than one control dimension is used in quota sampling.
- **Snowball (Network or Chain) Sampling:** This type is sampling is used when it is difficult to identify the respondents and a referral network is used to locate them. Researchers often initially assemble a small group to interview, who themselves nominate others in their network to be interviewed as well.

5.3. DATA COLLECTION METHOD AND APPLICATION

The types of data collection methods discussed according to the above criteria are:

- Questionnaires,
- Accounts and diaries,
- Conducting interviews,
- Observations.

The framework used that leads to the selection of the particular data collection method for this research is: the theory of various data collection methods will be explored; the application of these data collection methods will be explored. Based on the theory and application of these data collection methods, the most appropriate method will be used for this research.

5.3.1. Questionnaires

Gillham (2008) and Adams *et al.* (2007:135), states that a common method used to collect data is asking questions that can yield both qualitative and quantitative data. The tool is a questionnaire and the method is called a survey. The following will be discussed regarding questionnaires:

- Questionnaire defined.
- Types of questionnaires.
- When to use a questionnaire.

5.3.1.1. Questionnaire defined

Kothari (2004:100) and Dawson (2002:93), point out that in a survey, data is collected by using the questionnaire to ask questions and receive replies without actually talking to the respondent. The unit of analysis for this type of data collection is normally an individual or group, or the relationship between individuals or groups. Using a questionnaire as a data collection tool has many advantages, including having a structured

format, being easy to respond to, being cheap to administer to a large population, and being free of researcher-influence on the respondent.

Gillham (2008) and Dawson (2002:93), found that the variables identified when using this type of study could be non-numerical or numerical, depending on the research done. Its disadvantages are that it requires a lot of time to construct, the questions cannot be complex, and not everyone likes filling out questionnaires.

5.3.1.2. Types of questionnaires

The research of Kothari (2004:101), found that there are two types of question associated with questionnaires, namely open format and closed format questions. A closed format question is when the respondent is asked to select an answer to a question from a given set of answers. This type of question format is easier to code and answer as it requires no writing from the respondent, but it is limited by the range of possible answers provided.

Open format questions are those when the respondent has the option to answer the question in their own way. This results in the respondent's providing more detailed information about the subject, but the interpretation of the answer is left up to the researcher. This type of question is more difficult to answer and to code.

When designing a questionnaire, the following needs to be considered:

- Questions should be short and understandable.
- The respondent should produce the desired information based on the question.
- Do not use leading or loading questions.
- Make certain the respondent will have the knowledge or information to answer the question.
- Do not ask questions that are sensitive in nature.
- Test the questionnaire before distribution.

- **Developing the questionnaire layout:** The questionnaire should have a heading, a brief introduction or short introductory letter, return contact details and a unique number for that form. This will be useful at the analysis stage.

The introductory letter introduces the questionnaire and should include an assurance of confidentiality, the researcher's details, and guidelines on how to complete the questionnaire, including what measuring scale is used. If possible, it is advisable physically to show the respondent how to complete the questionnaire (Dawson, 2002:93; Saunders *et al.*, 2003:304).

- **Select the questionnaire type to be used:** Dawson (2002:93), notes that different types of questionnaires are used in research, including multiple choice (listed questions) and open questions. Open questions are commonly used in in-depth and semi-structured interviews where detail in your response is required. A listed question is one for which the respondent has to choose from a list of possible responses. It is important when using this type of question that the respondent has a clear understanding of what the responses mean.

5.3.1.3. When to use a questionnaire

Tari and Juana-Espinosa (2007:604-616) and Rowley (2014:308-330), shows that a case study is recommended if “how” and “why” questions are asked in the research objectives. In order to answer these questions, various data collection methods can to be used, including questionnaires. When developing the questionnaire, there should be a clear link between the research objectives, research problem, research questions, investigative questions and the actual questions on the questionnaire for the respondent to answer. The most important element in questionnaire design is ensuring that the respondent understands the question being asked, and making sure that there is no chance of misunderstanding or misinterpretation.

Many researchers ask the question: “why should I use a questionnaire for my research?” Rowley (2014:309) and Synodinos (2003:221), explains that the use of questionnaires is a common practice when profiling a sample according to numbers or counting the frequency of occurrences of opinions, experiences, attitudes, behaviours and predictions. The purpose of a questionnaire is to collect data from large populations. This is done by choosing a sample that represents the larger population and soliciting answers from the respondents by means of the questionnaire.

The research of Rowley (2014:309) and Synodinos (2003:221), is of the opinion that a questionnaire should be used when:

- the research centres on determining the profile of the situation;
- enough is known about the situation to compile the questionnaire;
- the respondents can be identified; and
- the questionnaire suits both the researcher and respondents.

It is good to use a questionnaire when the research to be done is aimed at surveying and profiling a situation to determine the prevailing patterns, and when enough is known about the environment to enable the formulation of meaningful questions that the respondents are willing to answer.

5.3.2. Accounts and diaries

Bhattacharjee (2012:103) and Kothari (2004:95), are of the opinion that the most open form of questionnaire is when data is collected from people keeping a diary or giving an account of a situation. This method of data collection falls within the qualitative arena and takes cognisance of people’s actions and feelings to account for their interpretation of the event. The following questions regarding accounts and diaries will be addressed:

- Accounts and diaries defined.
- When to use accounts and diaries.

5.3.2.1. Accounts and diaries defined

These take the form of documented behaviour, spoken words, letters or diaries, as long as the source is authentic. Analysis can be performed by coding the working documents, which are derived from the accounts of the respondents.

5.3.2.2. When to use accounts and diaries

Radcliffe (2013:163-180), claims that collecting data from written accounts and diaries is a method that works well in a dynamic environment. The method is, however, time consuming and only works well if the participant is dedicated to recording what is needed in the diaries. This type of research falls within the qualitative domain. Challenges associated with using this type of data collection method include:

- **Effective recording:** This challenge deals with the quality of the data recorded in diaries and whether it can satisfy the researcher's objectives.
- **Participant commitment:** The participant should be dedicated and committed to the study, especially when it comes to recording specific data at a required frequency.
- **Accuracy:** Accuracy is one of the challenges when using diaries to collect data. This is especially true when participants are busy and complete the diary retrospectively after an interval of time.
- **Ethical issues:** using diaries to collect data may impose on the participant's privacy and can raise ethical issues.

While using diaries to collect data can be challenging, it does have its place as a data collection method, especially in dynamic environments.

5.3.3. Conducting interviews

Saunders *et al.* (2003:145), describe an interview as consisting of two or more people discussing something meaningful. An interview helps the

researcher to gather information relevant to the research questions and objective.

5.3.3.1. What is conducting interviews for data collection

The research of Adams *et al.* (2007:111) and Rugg and Petre (2007:135), shows that the difference between using questionnaires and conducting interviews is significant in the data collection arena. Questionnaires are well-structured data gathering tools, although they lack the flexibility to gather additional needed information. This is where interviews are useful, as they provide a probing method of soliciting data, thus potentially widening its scope. Three types of interview are generally distinguished:

- **Structured interviews:** These contain a set of standard questions read out by the interviewer using an interview schedule. The responses may be mostly closed-format.
- **Unstructured interviews:** This method uses a flexible question guide and the questions are led by the interviewer. Probing for answers is used more in this method and no closed format questions are used.
- **Semi-structured interviews:** This method contains both structured and unstructured sections, with both standardised and open-type questions.

5.3.3.2. When to use interviews for data collection

The research of Rowley (2012:260-271) and Bryman and Cassell (2006:41-55), defines interviews as “face-to-face verbal exchanges in which one person, the interviewer, attempts to acquire information from and gain an understanding of another person, the interviewee”.

Rowley (2012:260-271), maintains that using interviews as a data collecting method is apt if one is wants to understand opinions, attitudes or behaviour. Another context in which to use interviews is when too little is known about the subject to use a simpler method like a questionnaire, and when the potential interviewees feel more comfortable being interviewed.

Interviewees are selected according to their profiles and the potential value they might contribute to the desired objective. They should generally be possessed of the knowledge and insight to comment on the relevant research topic.

Conducting interviews is a complex method of collecting data. Tensions exist in all interviews between the need to collect data on a subject and the focus on the actual event. An interview is invaluable when there is little or no information available on the topic and it is qualitative in nature.

5.3.4. Observations

Dawson (2002:93) and Kothari (2004:96), are of the opinion that observation is used when there is a need to not get involved with what is being observed. The ideal environment for conducting observation is one that promotes the “invisibility” of the observer through his or her being ignored by the study subjects. Observations can be used in both the qualitative and quantitative arenas of research.

5.3.4.1. What are observations for data collection

The data that could be collected by observation is data pertaining to the activity or event and the environment in which it occurs. Observation is commonly used in the natural, technical and social science research fields. It can be used to record how people react to a particular event or situation and can indicate whether it is different from what they say when being interviewed. An example is when someone physically demonstrates a process, as against their verbally explaining their knowledge of the process (Saunders *et al.*, 2003:137; Dawson, 2002:93).

Observations are not limited to the visual sense but can also involve all the other senses in the collection of data. It is one of the easiest ways to gain knowledge about something in order to make a decision about it. Observations can also be very time-consuming, especially in the event that the activity observed is not consistent. Sometimes to overcome this

issue, researchers make use of technology such as cameras to record the activity being researched. The challenge is to identify the variables being studied and concentrate only on them (Kothari, 2004:96).

5.3.4.2. When to use observations

Slack and Rowley (2000:10-16), explain that researchers should use this data collection method when subjects are performing tasks subconsciously. The skill of a research instrument's ability to observe is measured by its effectiveness in obtaining the desired objective. This effectiveness is measured in four areas, namely:

- **What:** The researcher understands what is being observed and is familiar with the environment in which it occurs.
- **Why:** The researcher is clear why observations are needed and what questions need to be answered by the observations.
- **How:** The need to understand what type of observations are needed to determine how to provide the data/information that is needed.
- **When:** The researcher needs to know the most effective time at which to conduct these observations.

Arumugam, Antony, and Douglas (2012:275-287) and Slack and Rowley (2000:10-16), are of the opinion that the observation approach should be taken into consideration when gathering data. The approach choice should depend on how best to answer the research objective, on access to the observation source and on the availability of that resource to conduct the research. Analysis of the data collected from observations should be conducted soon after the observation itself. This is critical as notes that were taken during the observation need to be analysed and put into context before the memory fades.

5.4. DATA COLLECTION METHOD USED FOR THIS STUDY

The data collection method used in this study is a questionnaire. This data collection method is based on the data needed to meet the following research objectives:

- to assess what effect a QMS has on a sustainable long-term solution for energy supply;
- to assess how a QMS contributes to the establishment of world-class processes and practices;
- to determine how a QMS affects quality culture;
- to determine how a QMS facilitates a continual improvement process and
- to determine what barriers hinder a sustainable QMS implementation.

This research centres on determining the profile of a situation (diffusion of a QMS). The data has to be collected from a large population. Enough is known about the situation to compile the questionnaire and respondents willing to answer the questionnaire can be identified. All of the above favours using a questionnaire as the means to collect data for this research study.

5.5. DATA VALIDITY AND RELIABILITY

Robson (2002) and Easterby-Smith, Thorpe and Lowe (2002), remind us that the credibility of research findings has always been an issue in research. The question “how do I know?” sums up the meaning of credibility when used in the research environment. To reduce the chance of producing an incorrect research answer, attention needs to be given to the following research design components:

- Reliability.
- Validity.
- Cronbach Alpha.

5.5.1. Reliability

Mouton (2014:100), Saunders *et al.* (2003:100) and Robson (2002), share the opinion that reliability is associated with the findings of the research. The reliability of findings can only be confirmed if the research is repeated and produces the same results.

Reliability can be assessed by asking the following three questions:

- Will the measure on other occasions produce the same results?
- Will other observers reach similar conclusions?
- Is it completely visible how the raw data was used to obtain the results?

Saunders *et al.* (2003:100), point out four threats to reliability:

- **Subject or participant error:** This is the effect of elements such as “time of day” that can influence the reliability of the outcome.
- **Subject or participant bias:** This can be explained by an example: an employee gives answers in an interview that they think their boss wants to hear.
- **Observer error and bias:** An example to explain this could be if a team of interviewers was inconsistent in their approach and interview questions. The interview results could be skewed.

5.5.2. Validity

Mouton (2014:100), Saunders *et al.* (2003:100) and Robson (2002), agree that validity can be defined in terms of whether the research findings are true, or truly represent what is happening.

There are three major forms of validity, according to Saunders *et al.* (2003:100):

- **Content validity:** If this validity is high it means that the instrument has provided a good description of the subject matter.

- **Criterion-related validity:** This reflects the success of the measures used for predictions or estimations. Any standard measure must be correct in terms of four qualities, namely:
 - **Criterion is relevant:** if the paradigm is characterised and scored in terms that we adjudge the correct measures of achievement.
 - **Freedom from bias:** When the standard gives every respondent a chance to score well.
 - **Reliability:** When a standard is stable and can be reproduced.
 - **Availability:** The data produced by an instrument must be accessible.
- **Construction validity:** This relates to the problem arising if a number of non-visible entities are posited, such as motivation, etc.

Saunders *et al.* (2003:100), are of the opinion that threats to validity include the following:

- **History:** For example, when data is measured or collected at the wrong time and this affects the research results.
 - **Testing:** When the person being tested believes that they will be affected negatively by the results.
 - **Instrumentation:** When the performance of the person being tested is altered due to the measuring activity.
 - **Mortality:** This is when participants drop out of the study during the data gathering stage.
 - **Maturation:** When an external entity has an effect on the participant's management, thereby altering the management style.
- Ambiguity about causal direction:** When the direction of the study is not clear in terms of what caused what; whether a certain phenomenon is a cause or an outcome.

In this study, the validity of the instrument used (a questionnaire) was tested by means of peer review by subject matter experts for each field concerned. There was also a trial run of the survey. The respondents used in the trial run were excluded from the sample for the actual study.

5.5.3. Cronbach Alpha

Tavakol and Dennick (2011) and Gliem and Gliem (2003), explains that the Cronbach Alpha test is a useful way of evaluating the reliability of data gathered for a research study.

Lee Cronbach developed the “Alpha” as a measure of the internal consistency of a test, which is expressed as a number between zero and one. Internal consistency means that all the elements in the test are associated with the same concept and with each other. To ensure validity, the internal consistency should be determined before conducting a research test (Tavakol & Dennick, 2011).

Some things to consider when using Cronbach Alpha are:

- Alpha is influenced by the test length and dimensionality.
- A low alpha appears if the assumptions that it follows the tau-equivalent approach are not met.
- A longer test expands the dependability of the test.

A high alpha value (>0.90) can suggest redundancy and indicates that the test be shortened. Table 5.1 illustrates a commonly accepted rule for describing the internal consistency of the alpha.

Table 5.1: Cronbach’s Alpha test table describing internal consistency rules.

(Source: Tavakol and Dennick, 2011)

Cronbach’s Alpha	Internal Consistency
$\alpha \geq 0.9$	Excellent
$0.9 \alpha \geq 0.8$	Good
$0.8 \alpha \geq 0.7$	Acceptable
$0.7 \alpha \geq 0.6$	Questionable
$0.6 \alpha \geq 0.5$	Poor
$.05 \alpha$ below	Unacceptable

5.6. DATA ANALYSIS

5.6.1. Introduction

De Vos (2002:339), describes data analysis as ‘the process of bringing order, structure and meaning to the mass of collection data’. This study aims to determine if the diffusion of a quality management system can improve the electricity supply industry by answering the following research questions:

- What effect does a QMS have on a sustainable long-term solution for energy supply?
- How does a QMS contribute to the establishment of world-class processes and practices?
- How does a QMS influence quality culture?
- How does a QMS ensure a continual improvement process?
- What factors affect a sustainable QMS implementation?

The data used for the analysis was obtained through the completed questionnaires. This analysis was conducted in two steps namely:

- **Data preparation:** Organising and cleaning the data to be used for the analysis.
- **Descriptive statistics:** A holistic description of the collected information using SPSS.

The following will be discussed in this section:

- Data format.
- Samples.
- Reliability testing.
- Descriptive statistics.
- Uni-variate graphs.

5.6.2. Data format

The questionnaire used to collect data was sent out via MS Outlook and MS InfoPath. This method allowed the respondent to complete and return the questionnaire within the sent email. The data was captured and

cleaned using SPSS and MS Excel. The questionnaire in MS InfoPath used a Likert Scale to record the respondent's response. The Likert scale was coded 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.

The recorded data was imported into SPSS via the MS Excel import tool and analysed by the researcher for this study.

5.6.3. Samples

The sample chosen for this research was based on the research objectives. Each research objective was assigned to a population group best suited to respond to that objective in Eskom Distribution in the Western Province. A list of the target populations was developed and an email with the questionnaire was sent to the respondents. Table 5.2, illustrates the research objective with its associated survey questions, target population and survey response.

The intended sampling strategy was to use the entire target population of the selected groups, as per Table 5.2. Denzin and Lincoln (2000) advise that this type of sampling falls under the rubric of Non-Probability sampling as it relies on the subjective judgement of the researcher. However, as the entire target population did not participate in the survey, the sampling method can be described as self-selected or non-random.

Table 5.2: Research objective with its associated survey questions, target population and survey response.

(Source: own)

Research Objective	Survey Questions	Target population	Population	Response
To assess what effect a QMS has on a sustainable long-term solution for energy supply.	1-5	<ul style="list-style-type: none"> Sustainable Development Group 	11	6 (50%)
To determine what QMS factors contribute to the establishment of world-class processes and practices.	6-10	<ul style="list-style-type: none"> Management Supervisors 	39	21 (53%)
To determine how a QMS influences quality culture.	11-15	<ul style="list-style-type: none"> Management Supervisors 	39	21 (53%)
To determine how a QMS facilitates a continual improvement process.	16-20	<ul style="list-style-type: none"> Management Supervisors QMS system owners Document controllers 	109	74 (67%)
To determine what critical success factors and barriers help or hinder a sustainable QMS implementation.	21-25	<ul style="list-style-type: none"> Management Supervisors QMS system owners Document controllers 	109	74 (67%)

5.6.4. Reliability testing

Reliability testing was conducted using the Cronbach Alpha test on almost all the data gathered, using SPSS software. A Cronbach Alpha test was not conducted on responses addressing the first research objective, “To assess what effect a QMS has on a sustainable long term solution for energy supply”, because of the low sample value (Gliem & Gliem, 2003).

For the remaining objectives, if the Alpha Coefficient was insufficient, certain questions were removed from the total in order to raise the Alpha

Coefficient figure. The Alpha Coefficient detail for each research objective is shown in Annexure E and a summary is provided in Table 5.3.

Table 5.3: Cronbach Alpha test for research summarised.

(Source: Own)

Research Question	Cronbach's Alpha	Internal Consistency
Questions 6 - 10	0.659	Questionable
Questions 11 - 15	0.699	Questionable
Questions 16 - 20	0.695	Questionable
Questions 21 - 25	0.619	Questionable

The reliability test was conducted on the data gathered for each research objective. The result of the initial Cronbach Alpha test for questions 6-10 was 0.427, which meant that internal consistency was unacceptable. After subtracting question 8, as shown in Annexure E, the Alpha Coefficient increased to 0.659, which indicated that the measuring instrument was questionable but still usable (Tavakol & Dennick, 2011).

The remaining research questions all yielded questionable but still usable instruments.

5.6.5. Descriptive statistics

This descriptive statistics section illustrates the analysis conducted for each research objective using the data collected by means of the questionnaire. The data used for this descriptive statistic is illustrated in annexure D (Descriptive Statistics Table).

5.6.5.1. Descriptive statistics for research objective 1

Table 5.4 illustrates that the standard deviations for questions 1-5 were low, except for question 5. This indicates there was noteworthy disagreement associated with question/statement 5. The most common answer to all the questions was Agree (2), as indicated by the mode of

questions 1-5. Using the coefficient of variation (CV) indicates there was a high variation of answers with respect to question 5.

Table 5.4: Descriptive statistics: Question 1-5.

(Source: Own)

Objective 1: QMS (ISO 9001:2008) effect on a sustainable long-term solution for energy supply.							
Question		N	Mean	Median	Mode	Std. Deviation	CV
		Valid					
1	The quality policy introduced by the QMS (ISO 9001:2008) supports Eskom's sustainable drive.	6	1.83	2.00	2	0.408	22%
2	The Eskom energy management programmes support the pillars of sustainability (Social, Environmental and Economic).	6	2.17	2.00	2	0.408	19%
3	The QMS (ISO 9001:2008) performance does impact the Eskom energy improvement programmes.	6	2.33	2.00	2	0.516	22%
4	The energy improvement programmes use continual improvement principles.	6	2.00	2.00	2	0.632	32%
5	The QMS (ISO 9001:2008) does support the monitoring of energy improvement initiatives.	6	2.33	2.00	2	1.033	44%

5.6.5.2. Descriptive statistics for research objective 2

Table 5.5 illustrates the standard deviations for the questions 6-10, which were low, except for question 8, indicating a strong disagreement with question/statement 8. The disagreement was confirmed by looking at the uni-variate graph in Figure 5.2. The most common answer to all the questions was Agree (2), as indicated by the mode of response to questions 6-10 – excluding question 8, which was Disagree (4). Using the coefficient of variation (CV) for this section, illustrates a high variation of answers with respect to question 8.

Table 5.5: Descriptive statistics: Question 6-10.

(Source: Own)

Objective 2: QMS (ISO 9001:2008) contribution to the establishment of world-class processes and practices.							
Question		N	Mean	Median	Mode	Std. Deviation	CV
		Valid					
6	Process improvement is directly related to the Quality Management System (ISO 9001:2008).	21	2.10	2.00	2	0.889	44%
7	QMS (ISO 9001:2008) process and systems approach leads to an improvement of processes in Eskom.	21	2.05	2.00	2	0.590	43%
8	All Eskom staff has been trained on the Eskom processes (Process Control Manuals).	21	3.24	4.00	4	1.261	68%
9	QMS (ISO 9001:2008) does provides us with tools to improve processes.	21	2.29	2.00	2	0.845	48%
10	Eskom has adopted the process and systems approach introduced by the QMS (ISO 9001:2008).	21	1.90	2.00	2	0.625	40%

5.6.5.3. Descriptive statistics for research objective 3

Table 5.6 illustrates that the standard deviations for questions 11-15 were low, except for question 15, which indicates a strong disagreement with the question/statement 15.

Table 5.6: Descriptive statistics: Question 11-15.

(Source: Own)

Objective 3: The effect of QMS (ISO 9001:2008) on quality culture.							
Question		N	Mean	Median	Mode	Std. Deviation	CV
		Valid					
11	A quality culture is when quality is embedded in every part of the business.	21	1.52	1.00	1	0.750	49%
12	Eskom does have a quality culture.	21	2.19	2.00	2	0.928	42%
13	Open and honest communication is part of Eskom's culture.	21	2.48	2.00	2	0.981	39%
15	Eskom does learn from past mistakes.	21	2.76	3.00	4	1.221	44%

The disagreement was confirmed by looking at the uni-variate graph in Figure 5.3. The most common answer to all the questions was Agree (2) as indicated by the mode of questions 12-13 excluding question 15, which was disagree (4) and question 11, which was strongly agree (1). The coefficient of variation (CV) indicates there was a high variation of answers with respect to all question.

5.6.5.4. Descriptive statistics for research objective 4

Table 5.7 shows that the standard deviations for questions 16-20 were low, except for questions 17, 19 and 20. This indicates a strong disagreement with statements 17, 19 and 20. The disagreement was confirmed by looking at the uni-variate graph, Figure 5.5. The most common answer to all the questions was Agree (2) as indicated by the mode of questions 16-20 – excluding question 18, which was undecided (3). Using the coefficient of variation (CV) indicates there was a high variation of answers with respect to all questions.

Table 5.7: Descriptive statistics: Question 16-20.

(Source: Own)

Objective 4: QMS effect on continual improvement process in an organisation.							
Question		N	Mean	Median	Mode	Std. Deviation	CV
		Valid					
16	Eskom's quality policy promotes continual improvement.	74	1.89	2.00	2	0.732	39%
17	Continual improvement introduced by QMS (ISO 9001:2008) is practiced within Eskom.	74	2.78	3.00	2	1.076	39%
18	Continual improvement practiced in Eskom is based on the PDCA cycle.	74	2.42	3.00	3	0.702	29%
19	Monitoring, measuring and analyses are performed on all continual improvement processes.	74	2.96	3.00	2	1.152	39%
20	Top management is committed to continual improvement.	74	2.39	2.00	2	1.004	42%

5.6.5.5. Descriptive statistics for research objective 5

Table 5.8 shows how the standard deviations for questions 21-25 indicated that there was some disagreement with all the questions/statements. The disagreement was confirmed by looking at the uni-variate graph, Figure 5.6. The most common answer to all the questions was disagree (4), as indicated by the mode of questions 21-25, but excluding questions 21 and 22, which was agree (2). Using the coefficient of variation (CV) indicates there was a high variation of answers with respect to questions 21, 22 and 23.

Table 5.8: Descriptive statistics: Question 21-25.

(Source: Own)

5. Barriers that affect a sustainable QMS implementation.							
Question		N	Mean	Median	Mode	Std. Deviation	CV
		Valid					
21	The implementation of ISO 9001:2008 is sustainable.	74	2.47	2.00	2	1.063	43%
22	Senior management is strongly involved with the ISO 9001:2008 drive.	74	2.64	2.00	2	1.067	40%
23	Sufficient quality training was given to staff during the ISO 9001:2008 implementation.	74	3.24	3.50	4	1.132	35%
24	All employees do fully understand the concept of quality.	74	3.51	4.00	4	0.983	28%
25	Eskom staff do fully understand the ISO 9001:2008 requirements.	74	3.50	4.00	4	1.010	29%

5.6.6. Uni-variate graphs

5.6.6.1. Graph for questionnaire “QMS (ISO 9001:2008) effect on a sustainable long-term solution for energy supply”

The designation of the respondents who answered the research questionnaire “QMS (ISO 9001:2008) effect on a sustainable long-term solution for energy supply”, are employees that work in the sustainable energy management environment. The result of the questionnaire is illustrated in Figure 5.1.

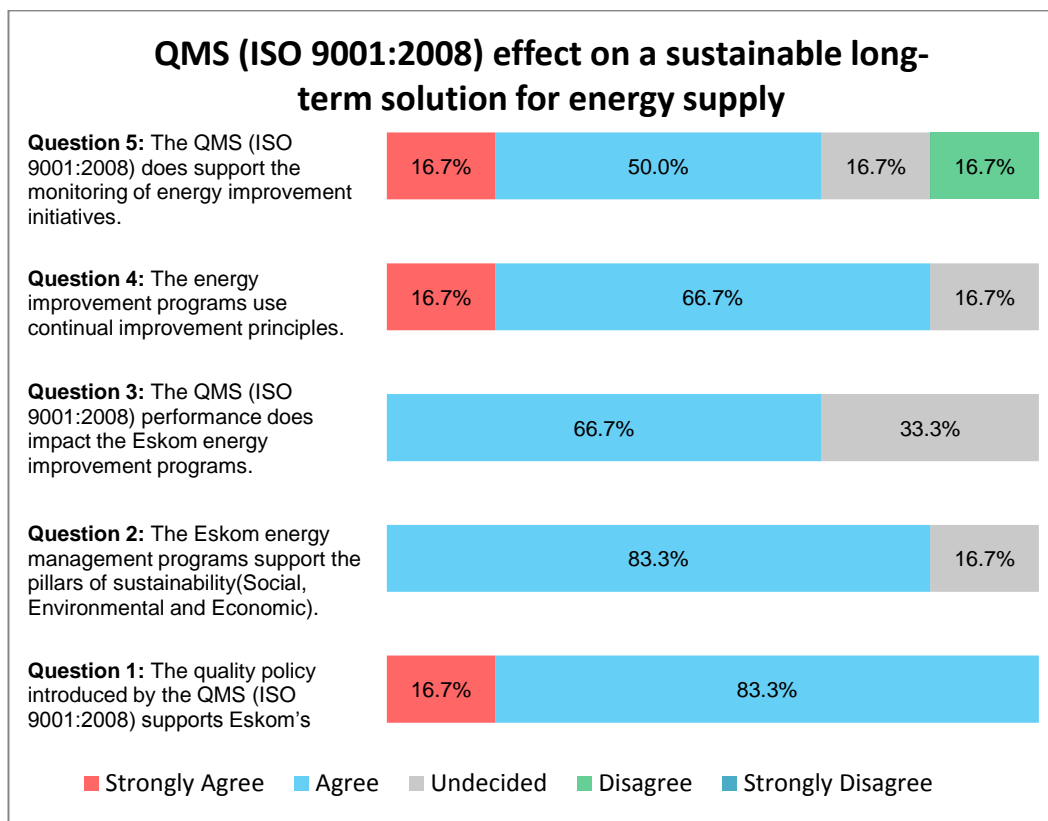


Figure 5.1: QMS (ISO 9001:2008) effect on a sustainable long-term solution for energy supply.

(Source: own)

Most of the respondents agreed or strongly agreed with the five statements:

- The quality policy introduced by the QMS (ISO 9001:2008) supports Eskom’s drive for sustainability (100% agree to strongly agree).

- Eskom energy management programmes support the pillars of sustainability (Social, Environmental and Economic) (83.3% agree).
- The QMS (ISO 9001:2008) performance does affect the Eskom energy improvement programmes (66.7% agree to strongly agree).
- The energy improvement programmes use the continual improvement principle introduced by the QMS (ISO 9001:2008) (83.3% agree and strongly agree).
- The QMS (ISO 9001:2008) does support the monitoring of energy improvement initiatives (66.7% agree to strongly agree).

5.6.6.2. Graph for questionnaire “QMS (ISO 9001:2008) contribution to the establishment of world-class processes and practices”

The respondents who answered the research questionnaire “QMS (ISO 9001:2008) contribution to the establishment of world-class processes and practices,” are employees appointed as management/supervisors in their respective sections. The results of the questionnaire are illustrated in Figure 5.2.

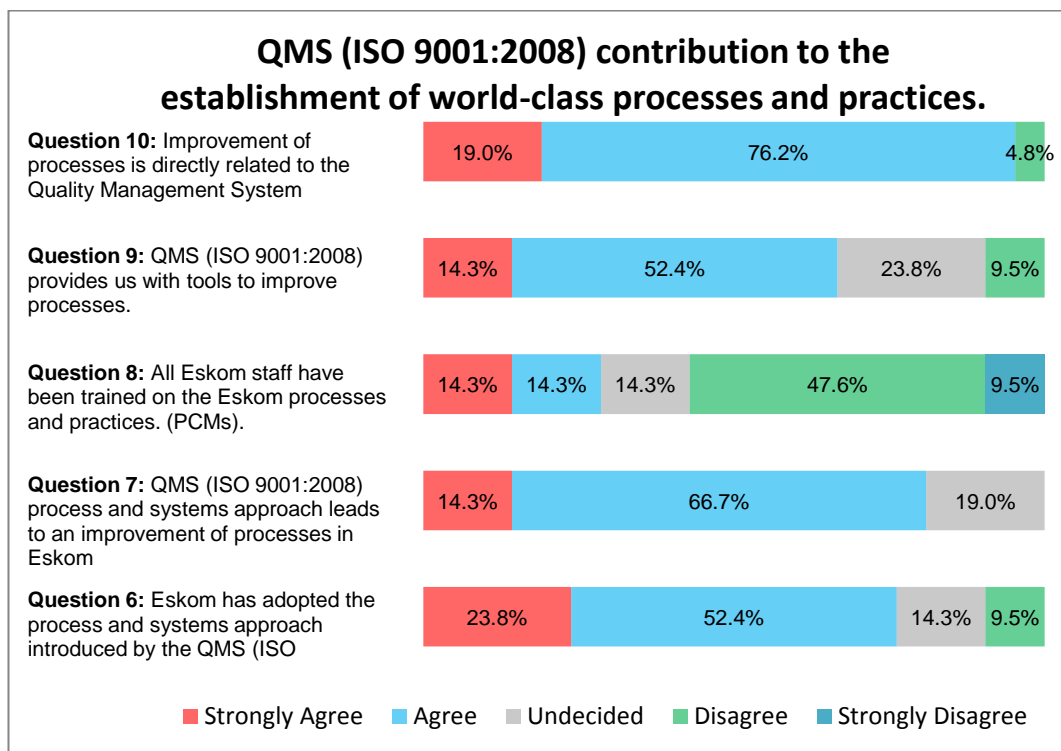


Figure 5.2: QMS (ISO 9001:2008) contribution to the establishment of world-class processes and practices. (Source: own)

Most of the respondents agreed or strongly agreed with four of the five statements:

- Eskom has adopted the process and systems approach introduced by the QMS (95.2% agree to strongly agree).
- The QMS (ISO 9001:2008) process and systems approach leads to an improvement of processes in Eskom (81% agree to strongly agree).
- Process improvement is directly related to the Quality Management System (76.2% agree to strongly agree).
- QMS (ISO 9001:2008) does provide us with tools to improve processes (66.7% agree to strongly agree).

Most of the respondents disagreed or strongly disagreed with the statement “All Eskom staff has been trained on the Eskom processes (Process Control Manuals)” (57.1% Disagree to strongly disagree).

5.6.6.3. Graph for questionnaire “The effect of QMS (ISO 9001:2008) on quality culture.”

The designation of the respondents who answered this research questionnaire are employees appointed as the management/supervisors in their respective sections. The results of the questionnaire are illustrated in Figure 5.3.

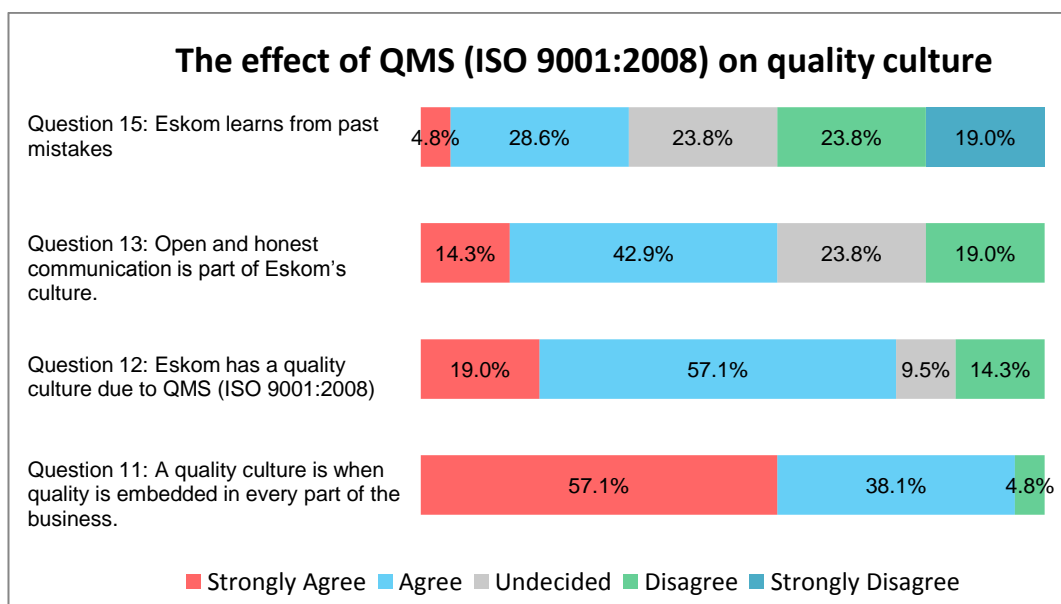


Figure 5.3: The effect of QMS (ISO 9001:2008) on quality culture. (Source: own)

The result of the respondents are as follows:

- A quality culture is when quality is embedded in every part of the business (95.2% agree or strongly agree).
- Eskom has a quality culture due to QMS (ISO 9001:2008) (76.1% agree or strongly agree).
- Open and honest communication is part of Eskom’s culture. (57.2% agree or strongly agree).
- Eskom learns from past mistakes (42.8% disagree or strongly disagree).

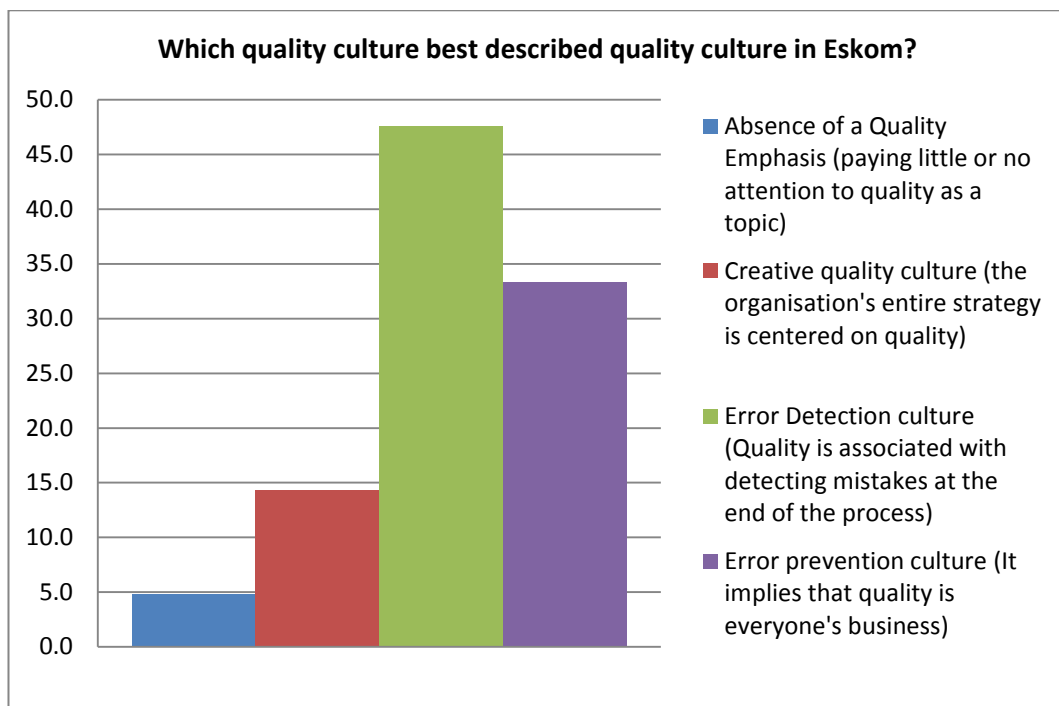


Figure 5.4: The quality culture that best describes quality culture in Eskom
(Source: own)

Regarding the question, “Which quality culture best describes quality culture in Eskom?” Figure 5.4 illustrates that most respondents identified “Error Detection Culture (quality is associated with detecting mistakes at the end of the process)” as the quality culture in Eskom.

5.6.6.4. Graph for questionnaire “QMS effect on continual improvement process in an organisation.”

The respondents who answered the research questionnaire “QMS effect on continual improvement process in an organisation” are employees appointed as the management/supervisors in their respective sections and the quality management representatives/document controllers.

The results of the questionnaire are illustrated in Figure 5.5.

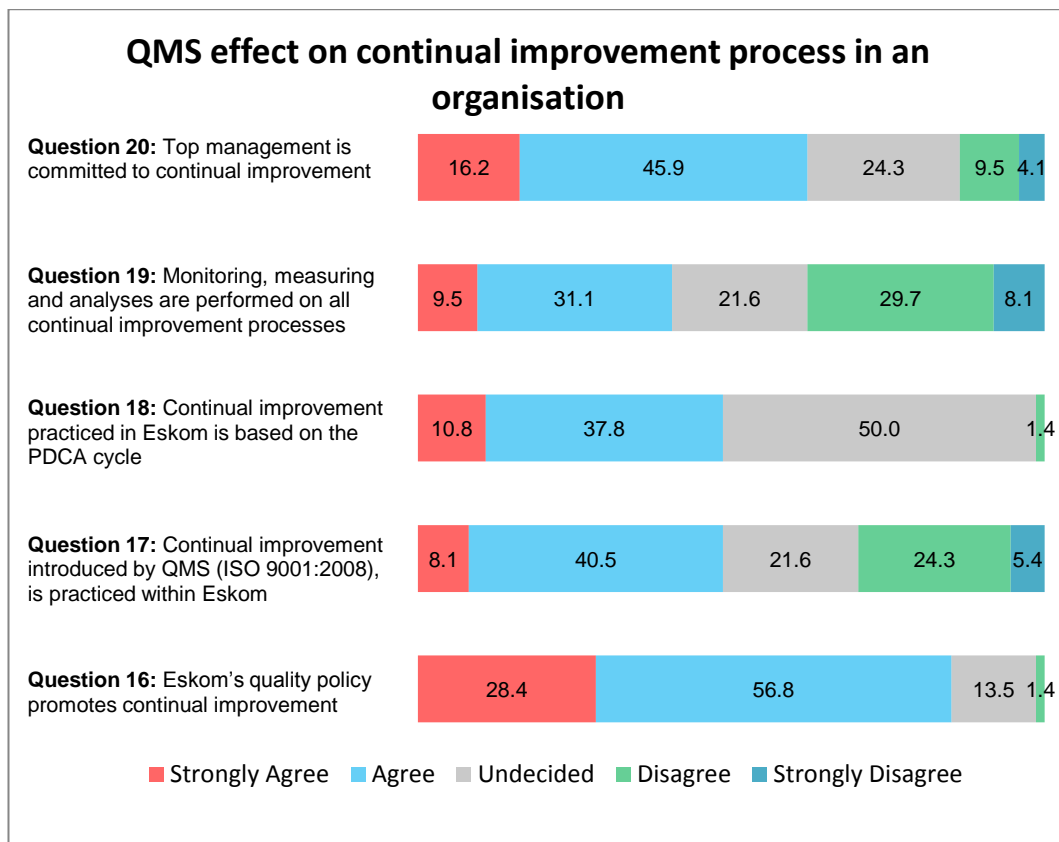


Figure 5.5: QMS effect on continual improvement process in an organisation.

(Source: own)

Most of the respondents agreed or strongly agreed with the statements:

- Eskom’s quality policy promotes continual improvement (85.2% agree or strongly agree).
- Top management is committed to continual improvement (62.1% agree or strongly agree).

- Continual improvement introduced by the QMS (ISO 9001:2008) is practiced within Eskom (48.9% agree to strongly agree).
- Monitoring, measuring and analyses are performed on all continual improvement processes (40.6% agree to strongly agree).

Half of the respondents were undecided on the statement “Continual improvement practised in Eskom is based on the PDCA cycle” (50% Undecided).

5.6.6.5. Graph for questionnaire “Barriers that affect a sustainable QMS implementation.”

The respondents who answered the research questionnaire “QMS effect on continual improvement process in an organisation” are the employees appointed as the management/supervisors in their respective sections and the quality management representatives/document controllers. The result of the questionnaire is illustrated in Figure 5.6.

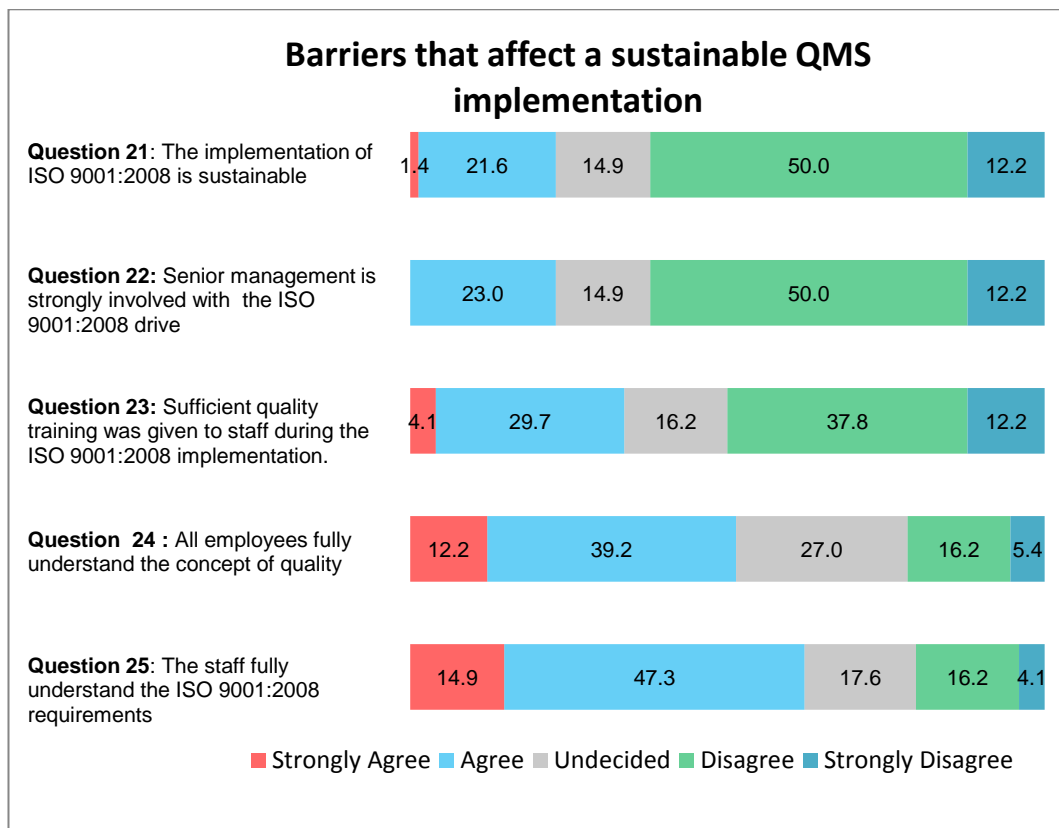


Figure 5.6: Barriers that affect a sustainable QMS implementation.

(Source: own)

Most of the respondents agreed or strongly agreed with the statements:

- The implementation of ISO 9001:2008 is sustainable (62.2% agree to strongly agree).
- Senior management is strongly involved with the ISO 9001:2008 drive (54.1% agree to strongly agree).

Most of the respondents disagreed or strongly disagreed with the following statements:

- Eskom staff does fully understand the ISO 9001:2008 requirements (62.2% disagree to strongly disagree).
- All employees do fully understand the concept of quality (62.2% disagree to strongly disagree).
- Sufficient quality training to staff was given during the ISO 9001:2008 implementation (50% disagree to strongly disagree).

5.7. SUMMARY OF FINDINGS

5.7.1. The effect a QMS has on a sustainable long term solution for energy supply

The following determinations can be made from this research regarding the effect of a QMS on a sustainable long-term solution for energy supply:

- The quality policy introduced by the QMS (ISO 9001:2008) supports Eskom's sustainability drive.
- The Eskom energy management programmes support the pillars of sustainability (Social, Environmental and Economic).
- The QMS (ISO 9001:2008) performance does affect the Eskom energy improvement programmes.
- The energy improvement programmes use the continual improvement principle introduced by the QMS (ISO 9001:2008).
- The QMS (ISO 9001:2008) does support the monitoring of energy improvement initiatives.

5.7.2. The QMS factors that contribute to the establishment of world-class processes and practices

From the research thus far, the following can be determined regarding the QMS factors that contribute to the establishment of world-class processes and practices:

- Eskom has adopted the process and systems approach introduced by the QMS.
- The QMS (ISO 9001:2008) process and systems approach leads to an improvement of processes in Eskom.
- Process improvement is directly related to the Quality Management System in Eskom.
- QMS (ISO 9001:2008) does provide Eskom with tools to improve processes.
- Not all Eskom staff has been trained in the Eskom processes (Process Control Manuals).

5.7.3. The influence of a QMS on quality culture in Eskom

The following is deduced about to the influence of a QMS on quality culture in Eskom:

- All staff agree on what defines a quality culture.
- Eskom has a quality culture due to QMS (ISO 9001:2008).
- Open and honest communication is part of Eskom's culture.
- Eskom does not learn from past mistakes.
- Error Detection Culture (quality is associated with detecting mistakes at the end of the process) best describes the quality culture in Eskom.

5.7.4. The effect of a QMS on the continual improvement process in an organisation

The effect of a QMS on a continual improvement process in Eskom is as follows:

- Eskom's quality policy promotes continual improvement.
- Top management is committed to continual improvement.

- Continual improvement introduced by QMS (ISO 9001:2008) is practised within Eskom.
- Monitoring, measuring and analyses are performed on all continual improvement processes.
- It is undecided whether continual improvement as practised in Eskom is based on the PDCA cycle.

5.7.5. Barriers to a sustainable QMS implementation

Concerning the barriers that affect the implementation of a sustainable QMS in Eskom, the following can be determined:

- The implementation of ISO 9001:2008 is sustainable.
- Senior management needs to be involved to ensure a sustainable QMS implementation.
- Eskom staff does not fully understand the ISO 9001:2008 requirements.
- All employees do not fully understand the concept of quality.
- Insufficient quality training was given to staff during the ISO 9001:2008 implementation.

5.8. CONCLUSION

In this chapter, the following was performed:

- A data collection method was chosen based on the theoretical and application of various data collection methods.
- The collected data was analysed for reliability by means of the Cronbach Alpha test.
- The data analysis was conducted through a statistical program called SPSS.
- Descriptive statistics was used to answer the research objectives based on the analysis of the data using SPSS.

The next chapter a comparison will be done between answering the research questions using the literature review and answering the research questions using the data analysis of this research. Thereafter, a summary

of the study and conclusions regarding how the diffusion of a QMS improves the electricity supply industry will be established.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1. INTRODUCTION

This chapter offers a summary of the study, together with certain conclusions and recommendations associated with the diffusion of a QMS in the electricity producing industry.

6.2. THE RESEARCH THUS FAR

Thus far, the research consists of:

- **Chapter 1:** This chapter introduced the research topic, why this topic was chosen for this research and the framework to be used to conduct the research. Stemming from above, it introduces the research problem statement, research questions and investigative research question with its associated objectives.
- **Chapter 2:** In this section, the context in which the research was executed. It consists of: the evolution quality management strategy adopted by Eskom; the drivers for adopting quality management in Eskom; the quality management strategy objective and goal; the Eskom internal ISO 9001 QMS audit and results which highlights a diffusion issue and the analysis which confirms that the existence of the business problem.
- **Chapter 3:** This literature review has established the context and theoretical framework in which the study was conducted in order to achieve the research objective. The context and theoretical framework evaluated in this chapter include: discussing the development of the ISO 9001 standard; the QMS factors that influence achieving a sustainable long-term provision for energy supply, which includes energy planning, review, performance and association to ISO 50001 energy management system; the elements of linking a QMS to current work practices and processes will result in aligning and adopting a process approach for business; the process approach that will result in improved business performance by creating linkages across departments in the organisation; the area that focuses on the

relationship between corporate culture and quality culture with the move towards a quality culture and the elements of the continual improvement concept brought about by means of the QMS and its effect on business.

- **Chapter 4:** Chapter 4 elaborated on the different types of research methodology theories and their application in research. Based on the theory and application of each research method, the research method best suited for this study was revealed. The research methodology used was a case study methodology using a research questionnaire.
- **Chapter 5:** In this chapter, a data collection method was chosen based on the theoretical and application of various data collection methods. The collected data was analysed for reliability by means of the Cronbach Alpha test. The data analysis was conducted through a statistical program called SPSS and descriptive statistics was used to answer the research objectives based on the analysis of the data using SPSS.
- **Chapter 6:** The final chapter of the study, in which conclusions are drawn and recommendations made regarding the research problem.

6.3. RESEARCH QUESTIONS ANSWERED USING THE DATA ANALYSIS

The research questions were answered using the research data analysis performed in Chapter 5. Descriptive statistics helped to develop the answers to these questions. Below is an answer to each question, based on the analysed data.

6.3.1. Research question: “What effect does a QMS have on a sustainable long-term solution to the problem of energy supply?”

The quality policy introduced by the QMS (ISO 9001:2008) supports Eskom’s sustainability drive and does impact the Eskom energy improvement programmes. The energy improvement programmes use the

continual improvement principle introduced by the QMS (ISO 9001:2008) including monitoring and measuring.

6.3.2. Research question: “How does a QMS contribute to the establishment of world-class processes and practices?”

Eskom has adopted the process and systems approach introduced by the QMS which leads to an improvement of processes in Eskom. The tools to improve processes do exist however, staff have not been trained in the Eskom processes (Process Control Manuals).

6.3.3. Research question: “How does a QMS influence quality culture?”

Eskom has a quality culture due to QMS (ISO 9001:2008) which includes open and honest communication. Eskom does not learn from past mistakes and has an Error Detection Culture (quality is associated with detecting mistakes at the end of the process).

6.3.4. Research question: “How does a QMS ensure a continual improvement process?”

Eskom’s quality policy promotes continual improvement and top management is committed to continual improvement. Continual improvement, which includes monitoring, measuring and analysis, introduced by QMS (ISO 9001:2008), is practised within Eskom. It is undecided whether continual improvement as practised in Eskom is based on the PDCA cycle.

6.3.5. Research question: “What factors affect a sustainable QMS implementation?”

The factors that affect a sustainable QMS implementation are: senior management involvement, full understanding of the ISO 9001:2008 requirements, fully understanding the concept of quality and quality training.

6.4. RESEARCH QUESTIONS ANSWERED USING THE LITERATURE

The research questions were answered using the literature review performed in Chapter 3. This literature review was done by reviewing journal articles, international standards, textbooks and online articles. A literature review was performed for each research question, which lead to developing the answers to these questions. Below is a detailed answer for each question based on the literature.

6.4.1. Research question: “What effect does a QMS have on a sustainable long-term solution to the problem of energy supply?”

International Standard ISO 50001 (2011) and Eccleston *et al.* (2011:300), highlight that using the ISO 50001 standard allows an organisation to infuse a QMS with a sustainable long-term solution for energy supply, while improving the organisation’s energy performance at the same time. Collins and Steiger (2009:2), state that a QMS contributes to proper planning for short- and long-term energy solutions when it is decided what level of quality the organisation desires, and a plan is formulated to attain that level.

Sustainable energy planning considers environmental factors and limits and their impact on energy consumption. It is a growing international trend for organisations to adopt targets for reducing greenhouse gasses for more sustainable energy production. Thus to produce a sustainable energy plan, one should look at the bigger picture regarding future energy needs (International Standard ISO 50001, 2011).

According to International Standard ISO 50001, energy review is necessary as it evaluates the use of energy, which leads to identifying areas of where energy performance can be improved.

6.4.2. Research question: “How does a QMS contribute to the establishment of world-class processes and practices?”

The reference to processes in the ISO 9001 (2008) standard is strong and clear. Sub clause 0.2, Process approach: “The application of a system of processes within an organisation, together with the identification and interactions of these processes, and their management to produce the desired outcome, can be referred to as the process approach” (International Standard ISO 9001, 2008).

It is good practice on the part of organisations to define the number and type of processes in the business. It is common for processes that form part of the QMS to exist in the organisation as well (ISO 9001, 2008).

Biazzo (2000) and Gryna *et al.* (2007), suggest that the process approach is an alternative view of business where value is added by introducing a horizontal management entity called a process. Businesses that use systems to form networks to operate are known to adopt a “systems approach” to management. In this system, the output of one process is the input into another, thus creating interlinking throughout the system.

6.4.3. Research question: “How does a QMS influence quality culture?”

Collins and Porras (2000:338) and Mullins (2010:780), maintain that an organisational culture exists when an organisation is distinguished by a shared meaning among its members.

Mullins (2010:783) and Naicker (2008), found that the notion of culture enables one to account for variations among organisations and managers. There is nothing incidental about social qualities and there is a relationship between an association’s society and its executive activities.

Naicker (2008), emphasises that corporate culture is one of the most important qualities of a successful company. In order to succeed in terms

of quality, a company needs to satisfy the customer's need with its products and services and develop a culture that puts quality at the heart of everything. A culture change takes years, not months, as quality requires trust rather than techniques.

6.4.4. Research question: “How does a QMS ensure a continual improvement process?”

The quality management modules all share the concept of continual improvement aimed at improving the organisation's efficiency and effectiveness (Govender, 2013:259-275; Larsen & Haversjo, 2000:226-237). The continual improvement concept helps with building quality into the process of production and provides a way to prevent the stagnation of systems after they have been implemented (Foster, 2010:129; Plura, 2000).

Foster (2010:134) and Plura (2000), explain that continual improvement is not just about using a set of tools and techniques, or of organising departments that focus on improvement and on training people. Improvement occurs after a change in the organisation. Continual improvement needs to focus on issues such as leadership, communication and other issues, regardless of the level of the organisation.

6.4.5. Research question: “What factors affect a sustainable QMS implementation?”

The research of Park *et al.* (2007:32-48), notes that most obstacles were experienced during and after the certification process. Issues such as a lack of leadership, lack of management support, lack of training, employees' inadequate perception of quality, resource constraints and employees' resistance to change were all identified as critical barriers to the successful implementation of ISO9001 (2008).

To summarise, to be obstructed by these barriers is indicative of a short-sighted motivation for seeking certification. It suggests that the standard

itself is expected to produce something more; that there is an absence of total commitment to the QMS and that the quest for certification is based merely on sector trend. (Zeng *et al.*, 2007:244-254; Bhuiyan & Alam, 2005:199-213; Chow-Chua *et al.*, 2003:936-953)

6.5. THE RESEARCH PROBLEM REVISITED

The research problem for this study is: “The diffusion of a quality management system does not improve the electricity supply industry”.

6.6. THE RESEARCH QUESTIONS REVISITED

The research question for this study is therefore: “how can the diffusion of a QMS bring improvement to the electricity supply industry?”

6.7. THE INVESTIGATIVE QUESTIONS REVISITED

The investigative questions associated with this research were:

- What effect does a QMS have on a sustainable long-term solution for energy supply?
- How does a QMS contribute to the establishment of world-class processes and practices?
- How does a QMS influence quality culture?
- How does a QMS ensure a continual improvement process?
- What factors affect a sustainable QMS implementation?

6.8. THE KEY RESEARCH OBJECTIVES REVISITED

The primary research objective reads as follows:

- To determine how the diffusion of a QMS can improve the electricity supply industry.

The key research objectives within the research study are:

- to assess what effect a QMS has on a sustainable long term solution for energy supply;
- to determine what QMS factors contribute to the establishment of world-class processes and practices;

- to determine how a QMS influences quality culture;
- to determine how a QMS facilitates a continual improvement process, and
- to determine what critical success factors and barriers hinder a sustainable QMS implementation.

6.9. THE RESEARCH DESIGN AND METHODOLOGY REVISITED

The research methodology used for this thesis was a case study using a survey as a data collection tool.

6.10. CONCLUSION AND RECOMMENDATIONS

The following conclusions are reached and recommendations made on the basis of the data analysis.

- **Conclusion 1:** Regarding the research question: “the effect of QMS (ISO 9001, 2008) on a sustainable long-term solution for energy supply”, it is accepted that a QMS does improve the chances of a sustainable long-term solution to the question of energy supply. However, the link between the sustainability drive and quality policy needs to be strengthened, as 16.7% of respondents disagreed with that statement.
- **Recommendation1:** Senior management must lead the quality policy and sustainability drive. It is recommended that training and awareness programmes be used to highlight the link between the quality policy and sustainability drive.
- **Conclusion 2:** There is a general acceptance that the QMS has a positive effect on processes and serves as a way to improve business. However, 57.1% of staff is of the opinion that there was insufficient training.
- **Recommendation 2:** Training all staff on processes is vital to the performance of the business. It is the foundation of a QMS and should be a continuous activity. Process training and the PDCA concept should be part of everyone’s work activities.

- **Conclusion 3:** The positive effect of a QMS on quality culture in the business is duly acknowledged. The area of concern here is that quality is not embedded in every part of the business. This is confirmed by the majority of respondents describing Eskom’s quality culture as an “error detection culture” (i.e., that quality is associated with detecting mistakes at the end of the process).
- **Recommendation 3:** Management needs to lead the drive to include quality in every activity in the business. This can be achieved by including quality considerations in any type of training programme in the business. The importance of quality and business culture needs to be emphasised because if the culture is strong, there is less need for formalised standards, processes, rules, etc. Incentivising good quality application and not only quality itself can increase the diffusion of quality in the business.
- **Conclusion 4:** It is generally accepted that the QMS leads to continual improvement in the business. However, 50.7% of respondents disagree or strongly disagree that continual improvement is practised in Eskom.
- **Recommendation 4:** The non-conformance process is a vital part of continual improvement. Management needs to lead this process to ensure continual improvement in the business. Credible business decisions can be made based on instances of non-conformance in Eskom.
- **Conclusion 5:** The barriers that affect sustainable QMS implementation in Eskom stem from the impression that insufficient quality training was given, which has led to employees not understanding the QMS and the quality concept.
- **Recommendation 5:** Continual quality training and the application of quality in every part of the Eskom organisation will ensure that employees achieve a better understanding of quality concepts and the role of the QMS.

The successful diffusion of a QMS is dependent on a few essential elements such as management’s commitment towards the QMS to drive

the current work culture towards a quality culture. QMS training is essential to empower employees to understand and adopt the quality way of life.

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ANNEXURE A: Research Design Framework

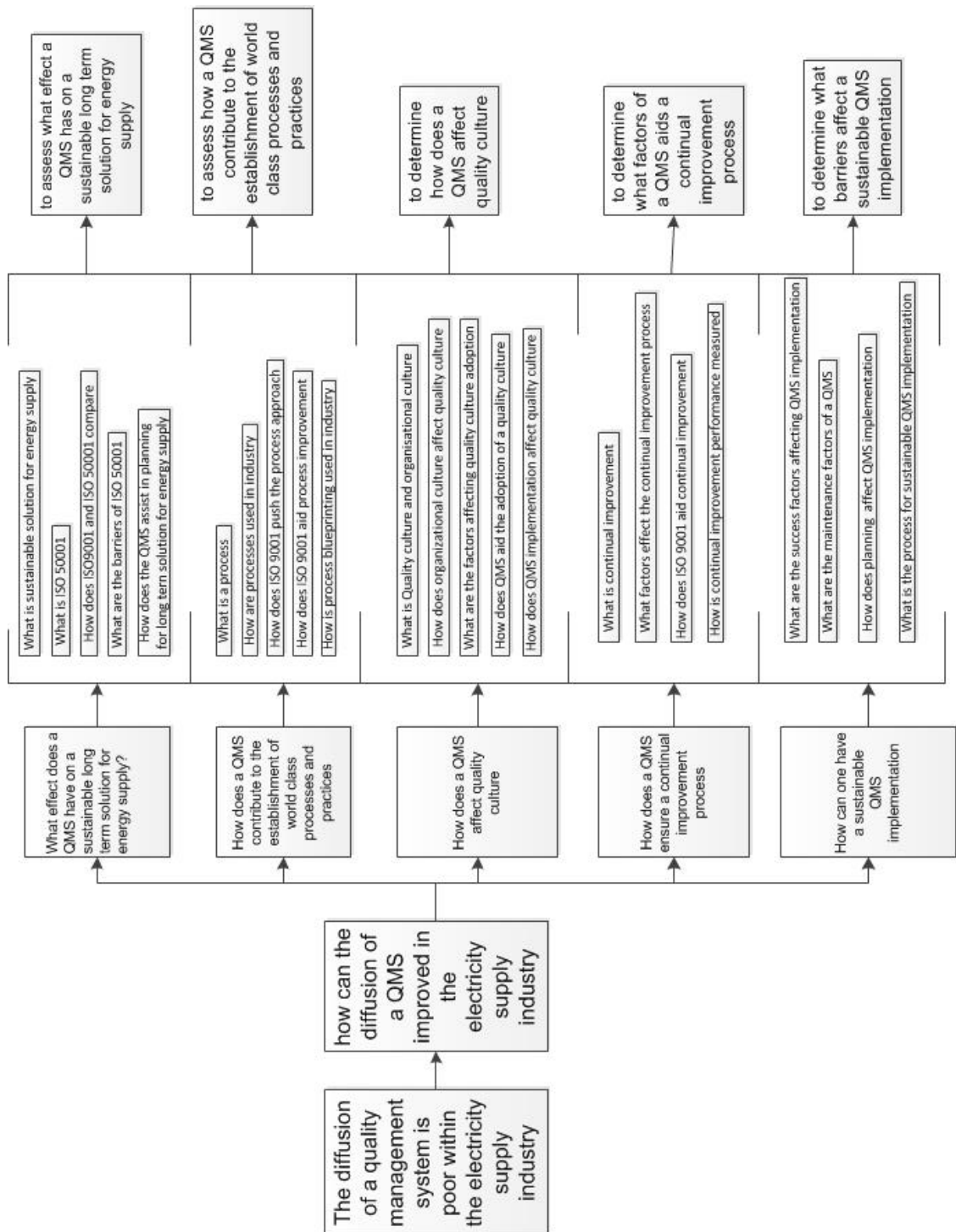
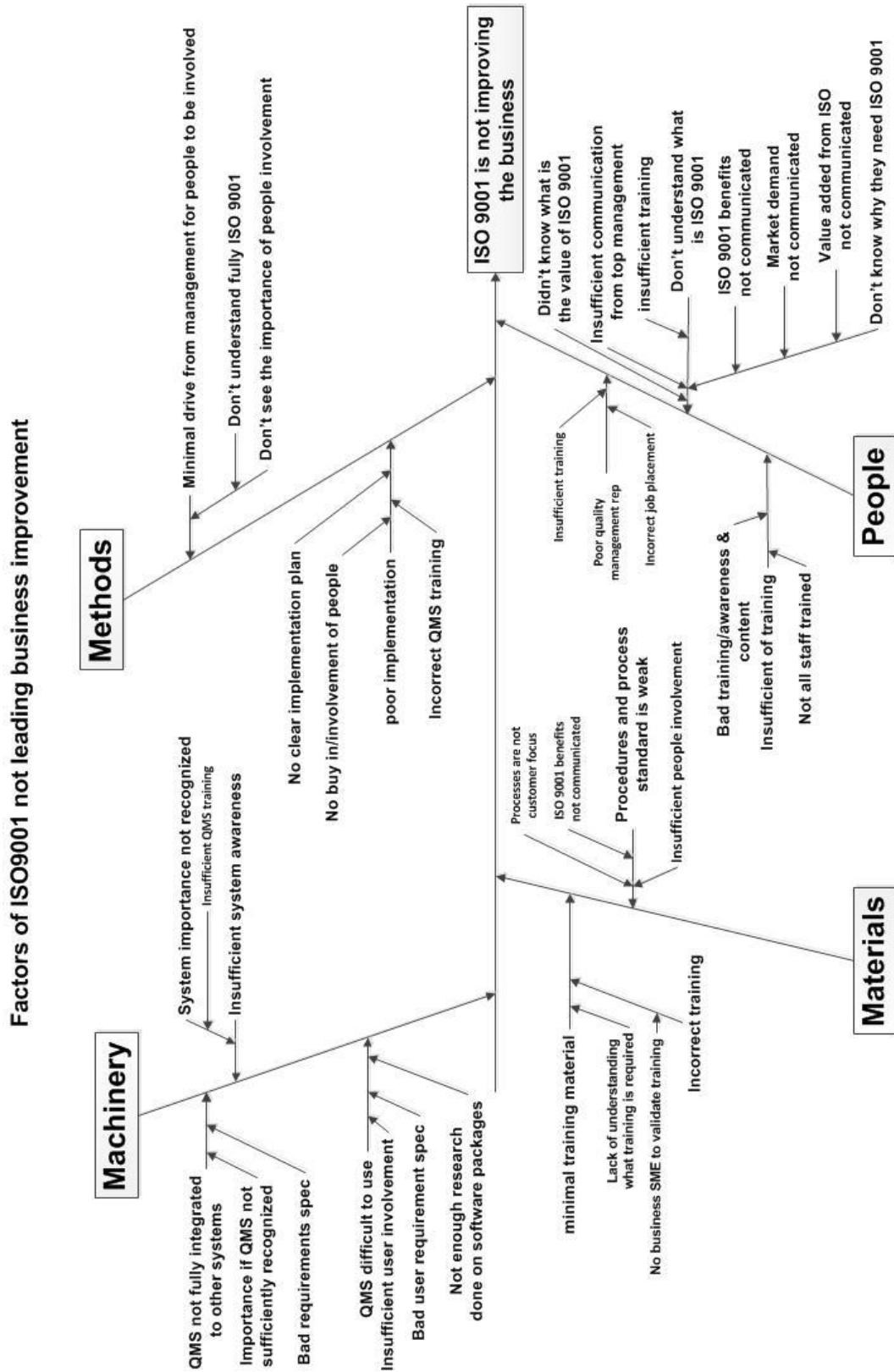


Figure 4: Research Design Framework (Source: own)

ANNEXURE B: Fishbone diagram: Factors of ISO9001 not leading business improvement



ANNEXURE C: Eskom QMS implementation plan

No	Plan	2010														
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	
1	Establish optimum quality management structures															
1.1	Create effective and sustainable QM structures															
1.2	Define interfaces between different functions															
1.3	Establish a governance process for performance reporting															
1.4	Establish a governance body for QM strategic direction															
2	Define quality roadmap															
2.1	ISO 9001 compliant BMS as a foundation															
2.2	Integrate common requirements into corporate documents															
2.3	Determine best approach to successfully integrate MS															
2.4	Outline Eskom quality roadmap with desired end state															
2.5	Establish key milestones to track progress															
3	Promote and entrench quality															
3.1	Commit to a quality management policy and communicate it															
3.2	Educate the organisation in quality concepts and methods															
3.3	Demonstrate management commitment in quality initiatives															
3.4	Focus attention on quality at all levels within the organisation															
3.5	Engage with suppliers, contractors and customers															
4	Measure and report on quality improvement															
4.1	Identify quantitative performance measures for quality in Eskom															
4.2	Perform regular self-assessments to identify gaps															
4.3	Develop an integrated reporting tool for NCR's and CAPA's															
5	Achieve continual improvement															
5.1	Identify key areas requiring improvement and prioritise CA															
5.2	Identify relevant continual improvement tools and techniques															
5.3	Partnerships and collaboration for benchmarking and research															
5.4	Regularly benchmark major operations for best practices															
5.5	Encourage innovation and best performance through R&A's															

ANNEXURE D: Descriptive Statistics Table

1. QMS (ISO 9001:2008) effect on a sustainable long-term solution for energy supply				
Variables	Categories	Frequency	Percent	Cumulative Percent
Question 1: The quality policy introduced by the QMS (ISO 9001:2008) supports Eskom's sustainable drive	Strongly Agree	1	16.7	16.7
	Agree	5	83.3	100.0
Question 2: The Eskom energy management programmes support the pillars of sustainability(.Social, Environmental and Economic)	Agree	5	83.3	83.3
	Undecided	1	16.7	100.0
Question 3: The QMS (ISO 9001:2008) performance does not impacts the Eskom energy improvement programmes.	Agree	4	66.7	66.7
	Undecided	2	33.3	100.0
Question 4: The energy improvement programmes use continual improvement principles	Strongly Agree	1	16.7	16.7
	Agree	4	66.7	83.3
	Undecided	1	16.7	100.0
Question 5: The QMS (ISO 9001:2008) does not support the monitoring of energy improvement initiatives	Strongly Agree	1	16.7	16.7
	Agree	3	50.0	66.7
	Undecided	1	16.7	83.3
	Disagree	1	16.7	100.0
2. QMS (ISO 9001:2008) contribution to the establishment of world-class processes and practices.				
Variables	Categories	Frequency	Percent	Cumulative Percent
Question 6: Process improvement is directly related to the Quality Management System (ISO 9001:2008).	Strongly Agree	5	23.8	23.8
	Agree	11	52.4	76.2
	Undecided	3	14.3	90.5
	Disagree	2	9.5	100.0
Question 7: QMS (ISO 9001:2008) process and systems approach leads to an improvement of processes in Eskom.	Strongly Agree	3	14.3	14.3
	Agree	14	66.7	81.0
	Undecided	4	19.0	100.0
Question 8: All Eskom staff has not been trained on the Eskom processes (Process Control Manuals).	Strongly Agree	3	14.3	14.3
	Agree	3	14.3	28.6
	Undecided	3	14.3	42.9
	Disagree	10	47.6	90.5
	Strongly Disagree	2	9.5	100.0
Question 9: QMS (ISO 9001:2008) does not provides us with tools to improve processes.	Strongly Agree	3	14.3	14.3
	Agree	11	52.4	66.7
	Undecided	5	23.8	90.5
	Disagree	2	9.5	100.0

Question 10: Eskom has adopted the process and systems approach introduced by the QMS (ISO 9001:2008).	Strongly Agree	4	19.0	19.0
	Agree	16	76.2	95.2
	Disagree	1	4.8	100.0

3. The effect of QMS (ISO 9001:2008) on quality culture.

Variables	Categories	Frequency	Percent	Cumulative Percent
Question 11: A quality culture is when quality is embedded in every part of the business.	Strongly Agree	12	57.1	57.1
	Agree	8	38.1	95.2
	Disagree	1	4.8	100.0
Question 12: Eskom does not have a quality culture.	Strongly Agree	4	19.0	19.0
	Agree	12	57.1	76.2
	Undecided	2	9.5	85.7
	Disagree	3	14.3	100.0
Question 13: Open and honest communication is part of Eskom's culture.	Strongly Agree	3	14.3	14.3
	Agree	9	42.9	57.1
	Undecided	5	23.8	81.0
	Disagree	4	19.0	100.0
Question 14: Which quality culture best described quality culture in Eskom:	Absence of a Quality Emphasis (paying little or no attention to quality as a topic)	1	4.8	4.8
	Creative quality culture (the organisation's entire strategy is centered on quality)	3	14.3	19.0
	Error Detection culture (Quality is associated with detecting mistakes at the end of the process)	10	47.6	66.7
	Error prevention culture (It implies that quality is everyone's business)	7	33.3	100.0
Question 15: Eskom does not learn from past mistakes.	Strongly Agree	4	19.0	19.0
	Agree	5	23.8	42.9
	Undecided	5	23.8	66.7
	Disagree	6	28.6	95.2
	Strongly Disagree	1	4.8	100.0

4. QMS effect on continual improvement process in an organisation.

Variables	Categories	Frequency	Percent	Cumulative Percent
Question 16: Eskom's quality policy promotes continual improvement.	Strongly Agree	21	28.4	28.4
	Agree	42	56.8	85.1
	Undecided	10	13.5	98.6
	Strongly Disagree	1	1.4	100.0

Question 17: Continual improvement introduced by QMS (ISO 9001:2008), is not practiced within Eskom.	Strongly Agree	6	8.1	8.1
	Agree	30	40.5	48.6
	Undecided	16	21.6	70.3
	Disagree	18	24.3	94.6
	Strongly Disagree	4	5.4	100.0
Question 18: Continual improvement practiced in Eskom is based on the PDCA cycle.	Strongly Agree	8	10.8	10.8
	Agree	28	37.8	48.6
	Undecided	37	50.0	98.6
	Disagree	1	1.4	100.0
Question 19: Monitoring, measuring and analyses are not performed on all continual improvement processes.	Strongly Agree	7	9.5	9.5
	Agree	23	31.1	40.5
	Undecided	16	21.6	62.2
	Disagree	22	29.7	91.9
	Strongly Disagree	6	8.1	100.0
Question 20: Top management is committed to continual improvement.	Strongly Agree	12	16.2	16.2
	Agree	34	45.9	62.2
	Undecided	18	24.3	86.5
	Disagree	7	9.5	95.9
	Strongly Disagree	3	4.1	100.0
5. Barriers that effect a sustainable QMS implementation				
Variables	Categories	Frequency	Percent	Cumulative Percent
Question 21: The implementation of ISO 9001:2008 is not sustainable.	Strongly Agree	11	14.9	14.9
	Agree	35	47.3	62.2
	Undecided	13	17.6	79.7
	Disagree	12	16.2	95.9
	Strongly Disagree	3	4.1	100.0
Question 22: Senior management is strongly involved with the ISO 9001:2008 drive.	Strongly Agree	9	12.2	12.2
	Agree	29	39.2	51.4
	Undecided	20	27.0	78.4
	Disagree	12	16.2	94.6
	Strongly Disagree	4	5.4	100.0
Question 23: Sufficient quality training was not given to staff during the ISO 9001:2008 implementation.	Strongly Agree	3	4.1	4.1
	Agree	22	29.7	33.8
	Undecided	12	16.2	50.0
	Disagree	28	37.8	87.8
	Strongly Disagree	9	12.2	100.0
Question 24: All employees do not fully understand the concept of quality.	Agree	17	23.0	23.0
	Undecided	11	14.9	37.8
	Disagree	37	50.0	87.8
	Strongly Disagree	9	12.2	100.0
Question 25: Eskom staff do not fully understand the ISO 9001:2008 requirements.	Strongly Agree	1	1.4	1.4
	Agree	16	21.6	23.0
	Undecided	11	14.9	37.8

	Disagree	37	50.0	87.8
	Strongly Disagree	9	12.2	100.0

ANNEXURE E: Reliability Statistics (Using SPSS)

Reliability: Question 6-10

Case Processing Summary			
		N	%
Cases	Valid	21	100.0
	Excluded ^a	0	.0
	Total	21	100.0
a. Listwise deletion based on all variables in the procedure.			
Reliability Statistics			
Cronbach's Alpha		N of Items	
.472		5	

Reliability: Question 6-10 (without Question 8)

Case Processing Summary			
		N	%
Cases	Valid	21	100.0
	Excluded ^a	0	.0
	Total	21	100.0
Reliability Statistics			
Cronbach's Alpha		N of Items	
.659		4	

Reliability: Question 11-15

Case Processing Summary			
		N	%
Cases	Valid	21	100.0
	Excluded ^a	0	.0
	Total	21	100.0
a. Listwise deletion based on all variables in the procedure.			
Reliability Statistics			
Cronbach's Alpha		N of Items	
.699		4	

Reliability: Question 16-20

Case Processing Summary			
		N	%
Cases	Valid	74	100.0
	Excluded ^a	0	.0
	Total	74	100.0
a. Listwise deletion based on all variables in the procedure.			
Reliability Statistics			
Cronbach's Alpha		N of Items	
.695		5	

Reliability: Question 21-25

Case Processing Summary			
		N	%
Cases	Valid	74	100.0
	Excluded ^a	0	.0
	Total	74	100.0
a. Listwise deletion based on all variables in the procedure.			
Reliability Statistics			
Cronbach's Alpha		N of Items	
.619		5	