FACTORS AFFECTING THE IMPLEMENTATION OF QUALITY MANAGEMENT PRACTICES IN CONSTRUCTION PROJECTS: THE CASE OF TRANSNET CAPITAL PROJECTS

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FACTORS AFFECTING THE IMPLEMENTATION OF QUALITY MANAGEMENT PRACTICES IN CONSTRUCTION PROJECTS: THE CASE OF TRANSNET CAPITAL PROJECTS

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DECLARATION

I, the undersigned, hereby declare, unless otherwise stated that the work presented in this thesis is my own. I also declare that this dissertation has not been submitted simultaneously, or at any other time, for a degree at any other university or higher learning institution.

30/11/2020

Pearl Lucky Mokwena **Date**

DEDICATION

I dedicate this dissertation to my mother, Jeany Hlobodisang Mogane, my husband Elias Mokwena, my son Kwena Mokwena and my two siblings, Tshepo and Katlego. For your love, care, prayers, motivation, and moral support, thank you

APPROVAL FOR SUBMISSION

I certify that this project report entitled 'Factors Affecting the Implementation of Quality Management Practices in Construction Projects: The case of Transnet Capital Projects' was prepared by Pearl Lucky Mokwena and has met the required standard for submission in fulfilment of the requirements for the award of Master of Philosophy (M.Phil) Quality Management at the Durban University of Technology.

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ABSTRACT

This study examined the factors affecting the implementation of Quality Management Practices in construction projects at Transnet Capital Projects (TCP). The study sought to establish the factors determining success in delivering quality at TCP and identify the barriers to quality policy implementation at TCP. The study further sought to establish the degree to which top management drives quality at the project sites and to discover project managers' perceptions of Quality Management Systems at TCP.

This study employed a quantitative approach for data collection. A questionnaire was administered to respondents who participated in the survey. Participants were selected using a stratified random sampling technique. The data was analysed using SPSS 25.0, and statistics were generated for analysis and interpretation. The factors affecting the implementation of quality management practices including the inherent challenges in the QMS in construction projects in the TCP Waterberg coal line were identified, together with the role played by key players, such as management and employees. Thus, the objectives set for the study were satisfactorily achieved.

This research revealed that TCP management is very committed to the promotion of quality in projects by ensuring that a QMS is always available. However, other challenges require attention, such as the lack of project compliance monitoring (regular inspections and audits) and assessment of technical competence of subcontractors to assure that projects are completed on time and at the expected quality level. Quality Management Systems (QMS) are implemented in the construction industry to improve organisational effectiveness and ensure company objectives.

The study recommends that the TCP management conduct regular project meetings to instil and enforce a quality culture amongst all employees; offer employees who properly follow the quality management practices rewards or awards; make sure that compliance inspections and audits are done as regularly as required; constantly provide resources to facilitate QMP and improve clients' involvement in quality management practices. Above all, management must follow-up on all the QMP strategies to see if they are being implemented as is expected.

The study recommended that project stakeholders apply critical quality management practices to ensure that projects are completed timeously and that all requirements critical to ensuring the quality in project management are met. Also, it recognised the need to enforce gender parity since males appeared to dominate management positions. Another significant recommendation was to engage staff in continuous professional development training. Amid the Fourth Industrial Revolution starting point, training, retraining, and reskilling are paramount in the growth of an organisation. The study finally recommends further research in exploring other factors that affect the implementation of quality management practices, such as, organisational culture and communication and their influence on TQM, organisational performance, and customer satisfaction.

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LIST OF DEFINITIONS

- **Quality**: 'Quality is meeting the customer requirements, and this is not restricted to the functional characteristics of the product or service' (Oakland 2014: 17).

- **Quality Management**: 'Quality management process co-ordinate activities to direct and control an organisation about quality' **(**Dale et al., 2016:25).

- **Quality Management system**: 'Quality Management system (QMS) is defined as a set of procedures an organisation needs to follow in order to meet its objectives' (Hoyle 2018:115).

- **Project**: 'Project is a temporary endeavour undertaken to create a unique product, service, or result' (PMBOK Guide 2013:1). However according to Gido et al. (2018:5) 'a project is an endeavour to accomplish a specific objective through a unique set of interrelated activities and effective utilisation of resources.'

- **Project management**: 'Project Management is planning, organising, coordinating, and controlling resources to accomplish the project objective' (Gido et al., 2018:15)

LIST OF ABBREVIATIONS

BOQ Bill of qualities

BTS Bulk Terminal Services

CIDB Construction Industry Board

CIIS Construction Industry Indicators

EC Emergency contractors

FEL Front-end loading

GDP Gross Domestic Product

ISO International Organisation for Standardisation

KZN KwaZulu-Natal

OHSAS Occupational Health and Safety Management Standards

PDCA Plan, Do, Check and Act

PEP Project Execution Plan

PMI Project Management Institutes

PPP Project Procurement Plans

QA Quality Assurance

QMP Quality Management Practices

QMS Quality Management System

RIOS Recycling Institute of Organisational Standards

RME Rehabilitation Maintenance and Emergency

SME Small Medium Enterprises

SPSS Statistical Package of Social Sciences

TCP Transnet Capital Projects

TIMS Transnet Integrated Management Systems

TQM Total Quality Management

US The United States

CHAPTER ONE

INTRODUCTION AND BACKGROUND

1.1 Introduction

The purpose of this study is to examine the factors affecting the implementation of Quality Management Practices in construction projects at Transnet Capital Projects (TCP). The study revisits quality theories applicable to TCP and relevant project management literature. The following sections of this chapter discuss the background and the context of this study and the research problem. It also details the aim, objectives, and research questions and outlines the methodology for the study. This chapter also highlights the significance and delimitation of the study and concludes with an outline of the chapters comprising the dissertation. A schematic flowchart of this chapter is presented after the conclusion (see Figure 1.2).

1.2 Context of the research

The construction industry is inherently complex by virtue of the huge differences between the significant classifications of construction that include housing, non-residential buildings, massive highways, utilities, industrial projects, and public work projects, such as roads, highways, bridges, tunnels, overpasses, and utility plants (Ramohlale and Daniel 2015). The timeous completion of a project within a specific budget and meeting the project's technical requirements are some of the success parameters for any project. To meet technical requirements, quality is a central element throughout the whole process, addressing compliance (Foss and Deceuster, 2017; KPMG Ireland 2017: i).

In the construction industry, most projects need formalised quality control and quality assurance systems and with the workforce, tending to be transient, quality management becomes a challenge (Lakshmi 2015). Most contractual documentation pertaining to construction management and project management on a global scale incorporate quality as a clause (CESA 2011). ISO 9001 certification, to some extent, addresses quality in project management, making it an essential entry requirement before considering an organisation's tender or quotation (Spears et al., 2015: 2).

Steenkamp (2012:11) describes quality as a dynamic aspect involving products, services, processes, people, and environments meeting or exceeding expectations. Redman (2016) maintains that quality is the responsibility of everyone in the company. However, issues that affect the implementation of Quality Management Practices (QMP) in construction projects at the TCP in Waterberg have not been previously determined in terms of employee commitment or their inclination to improve quality through the accredited on-site Quality Management System (QMS).

Hoyle (2018: 66) suggests that the adoption of an accredited quality management system should be a strategic decision of an organisation. In certain instances, the aspects of quality need to be communicated between individuals, specifically with the first line supervision to progress to the basic level of involvement of quality. Hoyle (2018: 812) affirm that management should instil these perceptions to lay the groundwork for improving quality within the sites. Hoyle (2018: 812) also recommends that top management should assign responsibility and authority for reporting opportunities for improvement.

The size of a project will naturally influence its requirements, as larger projects face a greater number of uncertainties in terms of project outcomes (Spears et al., 2015). This uncertainty faced by larger projects is mainly due to design and construction complexity, the presence of more interest groups (owner, consultants, suppliers, and contractors), resources (workforce, funds, equipment, and materials) availability, environmental factors, the economic and political milieu and legal regulations (Spears et al., 2015: 2).

In consideration of the above, the focus of this study is to determine the factors affecting the implementation of quality management practices at the project execution stage, due to the high number of negative quality issues reported. The Project Procurement Plan (PPP) establishes a procurement framework and identifies items to be obtained during the tendering phase, the types of contracts that will be used for the project, the process that will be put in place for the approval of the contract, the decision criteria, and the quality (Henry 2018:73). All these elements form part of the planning process, and tenderers (service providers) are inclined to comply with all quality deliverables at the tendering stage. However, TCP still experiences quality challenges at the execution phase.

1.2.1 Background of Transnet Construction and Project Management

Transnet Capital Projects (TCP) has experienced increased commodity traffic on the existing Waterberg rail corridor between Waterberg areas (Limpopo Province) and Richards Bay KwaZulu-Natal (KZN Province). A Front-end loading (FEL) study was conducted earlier that focused explicitly on the coal expansion, taking into account the effect of the other existing commodity traffic (Transnet Capital Project Report 2017:12). Coal is transported between various origin-destination routes, with a critical focus on coal, ferrochrome, and chrome transported to the Bulk Terminal Services (BTS) at Richards Bay for export purposes. The coal line between the Waterberg area and Richards Bay is currently undergoing expansion. This construction project, undertaken by TCP, is scheduled to be completed in 2023 and will increase its current capacity of twenty-four (24) million tons per annum, to an expected twenty-six (26) million tons per annum (Transnet Capital Project Report 2015:95).

During tendering, TCP initiates either an open or a closed tender category as per internal tendering procedure, and a closed tender is awarded to the Rehabilitation, Maintenance, and Emergency (RME) division, which is a Transnet Operating Division (Transnet Corporate Report 2018:1). The TCP's procurement department establishes a Project Procurement Plan to set the framework for projects, according to which services are to be procured by the RME division, the type of contracts to be used, the process for the approval of the contract, and the decision criteria and quality deliverables are clearly defined (Transnet Corporate Report 2018:3). Final checks are made to ascertain whether RME can deliver according to the contract before one is awarded (Transnet Corporate Report 2018:3).

The Construction Industry Institute (CII) measures the performance of the construction industry, focusing on clients, consultants, and contractors (The Construction Industry Indicators 2017:1). This is consistent with (KPMG Ireland 2017: 1) who argued that it pays the construction industry to reinvent its approach to governance, people, and technology. The CII indicates that a recorded R827 billion is earmarked for the development of infrastructure in South Africa over the next three years with the Construction Industrial Development Board (CIBD) report stipulating that 50% of all construction tenders be evaluated on quality, price, and preference (KPMG Ireland 2017: 1). Hence, the trajectory of new project activity would be on the increase, and quality during execution would be paramount.

1.2.2 Rationale for focusing on the research area.

The rationale of this study is to offer adequate grounds for quality in project management operations and to explore the main factors that affect the implementation of quality management practices in construction projects at TCP. The research also outlines critical issues around QMS, enablers of quality implementation (in other words, key success factors - KSF), and the contribution that quality training models would make if promoted effectively by TCP.

1.3 Research Problem

Quality management is an integral part of project planning and the successful execution of a project (Hornby 2015). The *Matlabas loop* project failure, for example, is characterised by project delays, leadership changes, and a deferred project scope, seek quality management interventions for the benefit of the entire project (Basson 2009:21). Depending on the nature of the project, the volume of work, and capacity, RME outsources some of the small scopes of works, which cannot be executed by itself. The Project Procurement Plan (PPP) sets a procurement framework, the intent of which is to determine the types of contracts to be used in the project, the process for contract approval, the decision criteria, the items that need to be procured, and the expected quality that is to be assured as part of the process (National treasury 2016). While many project managers may dislike the costs incurred in implementing quality management practices, the reality is that TCP still experiences quality issues that result in increased unjustified project costs (Arkinson 2008). It is in the interest of TCP to provide quality products and services, and it is, therefore, essential to establish the factors that affect the implementation of quality management practices during the execution phase of construction projects at Transnet.

1.4 Aim and Objectives of the Research

1.4.1 The study aim was to:

Establish the factors that affect the implementation of quality management practices, during the execution phase, in construction projects at Transnet SOC Ltd.

1.4.2 The main research question sought to:

Determine what factors can enhance the implementation of quality management practices in construction projects at Transnet?

1.4.2.1 The Secondary research questions sought to address:

1. Why are some projects successful and others not?
2. What are the barriers to quality policy implementation?
3. What is the extent to which top management determines quality at project sites?
4. What are the project manager's perceptions of Quality Management Systems at TCP?
5. What are the flaws in the current quality training model at TCP?

1.4.2.2 The main objectives were to:

1. To establish the success factors for delivering quality at TCP.
2. To identify the barriers to quality policy implementation at TCP.
3. To establish the degree to which top management determines quality at the project sites.
4. To ascertain project managers' perceptions of Quality Management Systems at TCP.
5. To establish the flaws in the current quality training model at TCP.

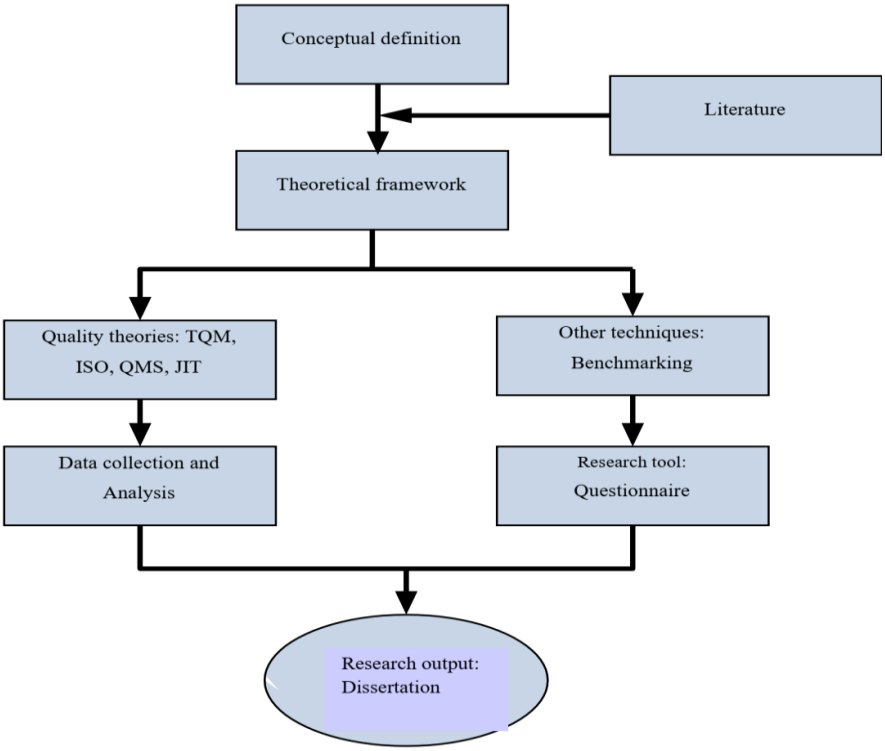
1.4.2.3 Importance of the Study

The study is essential as it has the potential to address the lack of quality initiatives, awareness, and training driven by the functional quality department. It will help in developing, implementing, and maintaining quality management practices. Transnet Capital Projects, short-term projects, stakeholders, and suppliers will therefore benefit from the study. Equally so, researchers who investigate the quality and capital projects will find this study to be very interesting as a contribution to research.

1.4.2.4 Research Process and Theoretical Framework

Figure 1.1, presents the schematic representation of the research process and the theoretical framework of the study. It begins with conceptual definitions. The theoretical framework comprises of quality theories and related principles.

Figure 1.1: Schematic representation of the research process



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1.5 Research Methodology

In this section, the following aspects of the research methodology are briefly discussed: design, research approach, target population, sample size and method, questionnaire design, data collection method, data analysis, and reliability and validity.

1.5.1 Research design and methodology

Myers (2013: 19) defines research design as a road map that provides clear guidelines and procedures intended for accomplishment. Accordingly, the primary purpose of a research design is to assist the researcher in planning an appropriate research process that will maximise the validity of results. A crucial element in this design is the research methodology applicable to the study. The study was cross-sectional and quantitative approaches were adopted. A Survey was conducted to collect the primary data by administrating a questionnaire.

1.5.2 Target population

Wegner (2012: 5) states that the target population includes all the possible people who are considered for the research. The target population for this study comprised construction employees at Transnet and freelancers working at the Waterberg coal line. The population included employees, senior project managers, project managers, construction managers, site supervisors, and other individuals involved for longer than three years.

1.5.3 Sampling Framework

There were one hundred and two (102) individuals actively involved in primary project construction activities (internal and external), thus comprising the population for this study. The positions occupied by the various individuals, as extracted from company records are listed in Table 1.1

Table 1.1: Classification of the population in terms of positions

Position	**Number**
Principal Project Managers	2
Senior Project Managers – Project Managers	21
Construction Managers	52
Site Supervisors	19
Other employees	8
Total	**102**

Source: Transnet Group Capital Project Organogram

Table 1.1 lists the population targeted for this research, with their occupational positions. Managers represent the largest group of the participants, followed by senior project managers, followed by a few principal project managers and other employees. For anonymity and confidentiality reasons, the names of those who appear on the list are not disclosed.

1.5.4 Sampling method

Alvi (2016) discusses sampling and explains that it refers to how participants are selected from the population. In the context of this study, a sample size of 98 is representative enough for a population of 102 as validated by Sekaran and Bougie's (2013) sample to population calculation. The stratified random sampling method was chosen for this research.

1.5.5 Stratified sampling

This research used stratified sampling technique to select the sample. The population was grouped according to employee positions and based on these groups; the method chosen to select respondents was the proportional stratified sampling method.

1.5.6 Survey instrument

The researcher compiled a survey questionnaire as the measuring instrument for this study. To facilitate the process, the questionnaires were administered electronically through emails. However, hard copies were provided to participants who did not have regular access to computers. In addition to the survey, participants received a cover letter that provided relevant details of the study and an invitation to participate voluntarily as well as consent forms.

1.5.7 Questionnaire design

The questionnaire designed for this study contained two sections (see Appendix B: Questionnaire). The first section was introductory and required respondents to provide general and biographical information. The second section required respondents to list critical factors, project management techniques, and factors that have an impact on implementing quality management practices in construction projects, in particular in Transnet Capital Projects. The questionnaire included a statement that measured the respondents' views on each of the SQ rated dimensions. The scale of measurement is a five-point Likert Scale consisting of statements that respondents have to indicate whether they: strongly disagree - 1, disagree - 2, neither agree nor disagree - 3, agree - 4, and strongly agree - 5.

1.5.8 Data analysis

After the data from the questionnaires was captured, it was analysed using the Statistical Package for Social Sciences (SPSS Version 25) program. The data were analysed using descriptive and inferential statistics. Johnson, Freund, and Miller (2011: 2) indicate that descriptive statistics comprise of tables and charts, whereas inferential statistics allow inferences to be made about the population and implications to be explained.

1.5.9 Pretesting

The questionnaire was piloted among some Construction Managers, Project Managers,Site

Supervisors and other construction employees that were not part of the sample in order to make sure that the questions were not ambiguous. These employees were able to give feedback regarding the clarity and ease of interpreting the items in the questionnaire. The information from these questionnaires did not contribute to the study.

1.5.10 Delimitations/scope

Delimitations are the elements that decide the parameters or extent of the study. This study focused only on the participants actively involved in primary project construction activities (internal and external). The study focused on construction management, and project management processes applied in the TCP, with specific reference to the Waterberg program coal line expansion project.

1.5.11 Limitations of the study

The limitations or restrictions of a study are the factors or shortcomings that affect the interpretation of the study findings. In the interests of transparency and for generalizability, the works of Brutus, Aguinis, and Wasmer (2013:2) have informed the following limitations, described below:

- Data was collected through a self-administered questionnaire, which makes control over the response rate difficult;
- Even though respondents' anonymity was guaranteed, they may have found it difficult to answer honestly;
- The research was conducted during a busy period of construction, and that might have led to inadequate responses and the reason why some respondents were late in returning their questionnaires. This was a barrier to speedy data collection and therefore additional time was allocated by the researcher to collect all the questionnaires personally from the distribution point; and
- Only five main objectives of this study were formulated for this study because of the limited time and available resources.

1.5.12 Validity

Sekaran and Bougie (2016:220) explains that validity is achieved when the process, technique, or instruments used, measures the concept it intended to measure. For this study, face validity and content validity was ensured by relying on the literature review and input from peers and academics. The researcher notes that validity is necessary. Still, not a sufficient condition to test the reliability of a measure as a measure should not only be valid but also reliable, as a reliable measure provides consistent results (Sekaran and Bougie, 2016:221).

1.5.13 Reliability

Reliability is the consistency of measurement or the degree to which an instrument is measured each time and under the same conditions giving the same results (Jahanshahi et al., 2011). In addition a measuring instrument must be consistent and yield the same results when the measurement is repeated (Leedy et al., 2014). In this study, the Cronbach's alpha coefficient was calculated for all sections using the Likert Scale.

1.5.14 Ethical considerations

The Faculty of Management Sciences Research Ethics Committee Faculty at the Durban University of Technology (DUT) approved the proposal for this study. An important aspect of ethical considerations is obtaining permission before administering questionnaires to employees and management. Participants were furnished with a letter of information and consent forms together with the questionnaires. The researcher adhered to all the ethical standards and guidelines set by the DUT.

1.5.15 Anonymity and confidentiality

Anonymity and confidentiality were maintained throughout the study, and thus, respondents were not required to record their names or contact details on the questionnaire. The hard copies of the completed questionnaires will be safely stored by the researcher, under lock and key, for three years, and will be shredded accordingly. All electronic copies will be delinked from return email addresses, stored using password protection for three years, and subsequently deleted.

1.6 Structure of dissertation chapters

The dissertation is structured as follows:

Chapter One presents the rationale for the study, the research problem, the research objectives, and a brief description of the research methodology. The context of the study is discussed, and the chapter concludes with a chapter-by-chapter description of the dissertation.

Chapter Two presents the literature review. Literature surrounding definitions, principles and practices with respect to Quality, Total Quality Management, and ISO 9001 quality management systems are discussed and critically appraised. The chapter also discusses organisational/behavioural concepts relevant to the study, such as leadership, perception, communication, culture, and motivation.

Chapter Three presents the methodology used in this research, which includes the research design, data collection, data analysis, validity, reliability, bias, and ethical considerations.

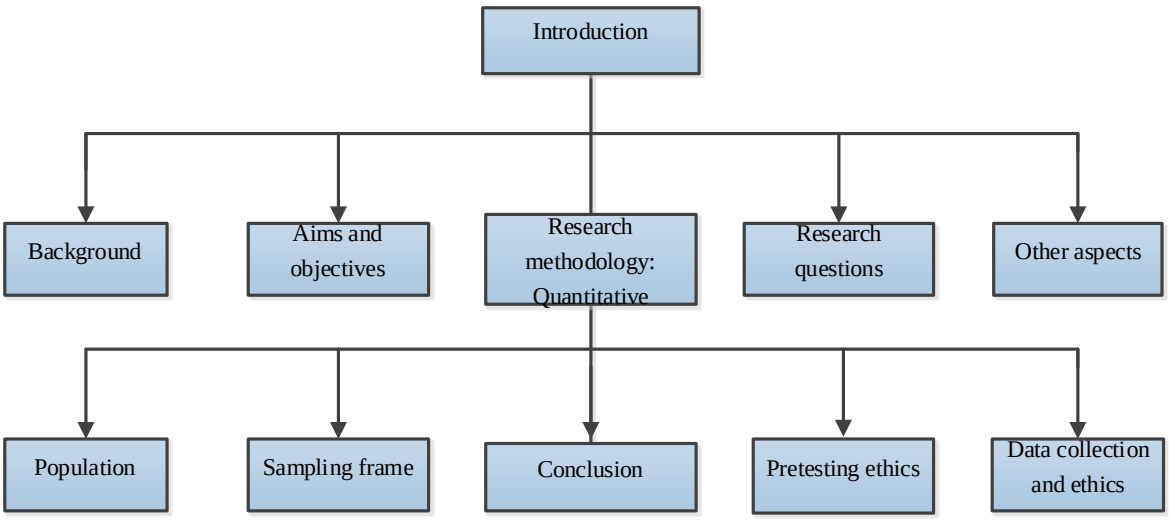
Chapter Four presents data analysis and interpretation.

Chapter Five presents the overall conclusions obtained from the research, recommendations for Transnet Capital Projects Waterberg Programme Current coal line expansion project, and scope for further research.

1.7 Conclusion

This chapter introduced the context of the study and the research problem. The scope of the study, including the aim and objectives of the study are presented and the scope of the literature review has been explained. The methodology has also been summarily clarified.

Figure 1.2: Chapter one flowchart



Source: Researcher Constructed

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a literature review relevant to the implementation of quality management in construction projects, and the factors affecting the implementation of quality management practices in construction projects. An examination of quality, by its nature, requires the unpacking of the following: quality, Quality Management Practices (QMP), and Total Quality Management (TQM) philosophy. An in-depth discussion of Total Quality Management and quality management practices is presented in this chapter.

2.2 Definitions of quality

It is difficult to find a common definition for quality, most definitions of quality centres on meeting customer expectations. Despite these views, the gurus who pioneered and developed the quality movement, such as Deming, Juran, Crosby, Feigenbaum, Taguchi, and others, offered various definitions of quality which have been summarised by Goetsch and Davis (2014:1) as follows:

- Quality is 'meeting the standard of performance expected by the customer.'
- Quality is 'meeting the customer's needs the first time and every time.'
- Quality is 'providing our customers with product and services that consistently meet their needs and expectations.'
- Quality is 'doing the right thing the first time, always striving for improvement; and always satisfying the customer.'

In conclusion of the above summary, a common theme emerge implying that satisfaction of customers' needs is central to addressing quality, as confirmed by (Carnerud, 2018; Neyestani, and Juanzon, 2016). The (PMBOK Guide 2015b:556) also resonates with the same theme wherein quality is defined as the 'degree to which a set of inherent characteristics fulfils customers' requirements'.

A different approach to quality is that which describes quality as conformance to specifications in terms of products and services (Ganachaud 2002:32). Basu (2004:6 -7) explains that the quality of a product or service is defined according to the extent to which the design quality and

product or service specifications meet customer needs and conforms to the specification. The degree to which products or services conform to the intent of the designers is a determinant of quality. Still, significant weakness is that conformance to specification is less likely to achieve quality than buy-in or commitments to quality and excellence from employees, as employees are a source of ideas and innovation (Oakland 2014:423). A managerial view of quality is offered by Kelemen (2003:1) as follows:

- The product-based approach: focus on quality as a precise and measurable attribute;
- The manufacturing-based approach: considers quality as the conformance to a specification as the degree to which a specific product conforms to a design or specification;
- The value-based approach: defines quality as a variable relative to the price paid for the service or good(s); and
- The user-based approach; views quality as focuses on goods or services satisfying customer preferences.

According to Goetsch and Davis (2014), several business executives adopt the attitude that quality is a commendable concept until difficulties are experienced, necessitating cost-cutting measures. During difficult periods, quality initiatives are often the first function to disappear (OECD 2013). However, when assessing services and goods, clients weigh both quality and price (Triatmanto et al, 2016). When quality is improved without the price increasing, it results in value for money for customers, a view that has been corroborated by (De Feo and Gryna, 2015:14).

Customers determine quality as a result of experiences with the product or service evaluated in terms of the customer's needs or expectations (Watson and Howarth, 2011:2). This customer evaluation may be stated or unstated, operational or subjective, fully aware or only sensed, and shifting and difficult to pinpoint in a competitive market.

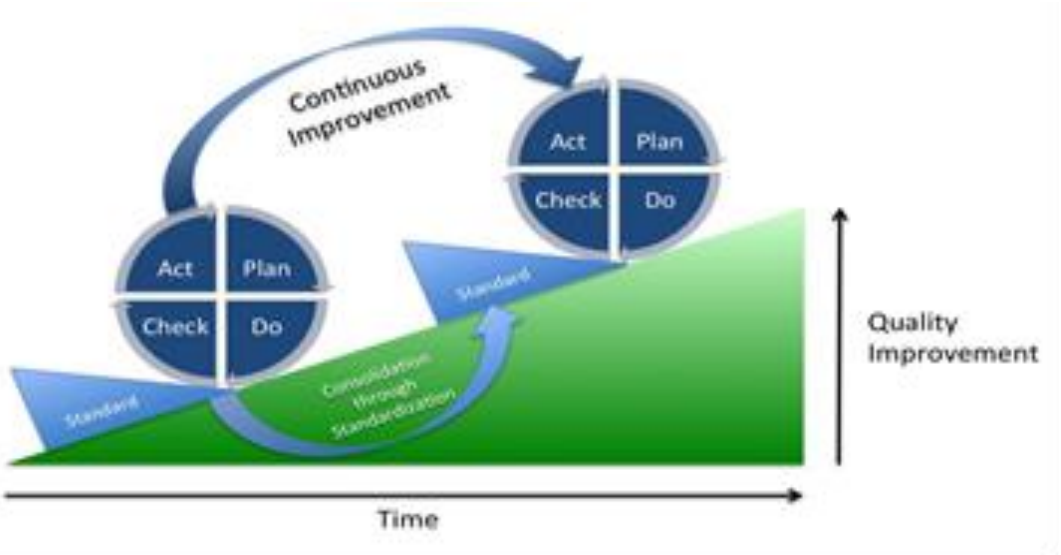
Goetsch and Davis (2014:1), resolve that quality is implemented through design checking and customer feedback. Customer feedback, however, is complex, and challenging, and costly to measure (Wilkinson et al., 1998:18). Nguyen et al (2018) identified the following critical success factors to guide companies on quality matters, these are:

- Design for quality.
- Quality data and reporting.
- Continuous improvement.

2.3 Continuous improvement

Figure 2.1 illustrates the continuous quality improvement cycle with the help of the well renowned Deming cycle - the Plan, Do Check and Act (PDCA) (Rakhmanova and Bouchet 2017). Gryna, Chua, and Defeo (2007:175) previously referred to this as the Plan, Do, Study, and Act (PDSA).

Figure 2.1: Continuous quality improvement model



Source: Rakhmanova and Bouchet (2017)

Figure 2.1 shows that quality improvements can be measured, and standards need to be in place. The organisation must ensure work is planned, actions are taken, and monitoring and evaluations are conducted, while 'improvement' is a continuous activity (Bulsuk 2009:1). Improved quality at a reasonably low price can be achieved when the personnel deploys their best efforts to work daily (Sugimori, Kusunoki, Cho, and Uchikawa 2015).

Similarly, when the requirements of consultants, constructors, customers, and other stakeholders involved in production or services in the construction industry are met, quality could be improved, thus ensuring project requirements are met. Mosadeghrad (2012) elaborates on what needs to be done to enforce quality, such as developing elaborate QMS strategies and

having action plans in place to monitor implementation progress in an effective way. There is a need for companies to address quality and avoid risk-taking were necessary and therefore it is crucial for organisations to deal with suppliers who implement continuous improvement programs as they do themselves (Hornby 2015:5). A good relationship implies trust and that the supplier may be willing to improve processes to reduce the cost for the client, thus minimising project delays and benefitting both the supplier and the company (Rizza 2015:1).

Continuous improvement in the context of Kaizen seeks to eliminate waste (Choudhury 2017). The cost of quality is to be considered, and doing things right the first time is a saving for the company. Motivated people prove to be more successful in producing improved quality, introducing quality management practices. In this regard, O'Connor and Kleyner (2012: 399) suggest quality cycles must be organised with care and after proper training, fully supported by both middle and senior management.

2.4 Quality standards

Challenges facing government and non-governmental organisations indicate that stipulating ISO standards, and addressing quality in project management, as an essential entry requirement before contracting is of paramount importance (Steyn et al., 2015). To this end, Terlaak and King (2005: 580) draws attention to the several standards such as the OHSAS 18001 Occupational Health and Safety Management Standard, the ISO 14001 Environmental Management Standard, as well as the ISO 9001 Quality Management Standard that have the intent of delivering quality while ensuring health and safety while at the same time protecting the environment.

According to North and Kumta (2018), the introduction of ISO 9001 organizes all management processes, including the finance department, and coordination is critical to its effectiveness. Its implementation is complementary to a project management approach. The PMBOK Guide (2013: 227) explains that project quality management uses policies and procedures to implement quality within the context of project management. It is held that ISO 9001focuses on elements believed to translate into quality for the customer. These elements include the determination of quality by the customer; the freedom from flaws; thinking of solutions before problems arise; satisfying the customer; optimal use of equipment for productivity improvement; doing it right the first time, and more on achieving efficiency in the operations

(ISO 9001:2015).

Before implementing a Quality Management System (QMS), it is crucial to understand the fundamental concepts of quality to benefit fully from QMS as a strategic management tool. The next section discusses the dimensions of quality.

2.5 Dimensions and spiral of quality

The seminal works of Garvin (1987) highlight the following eight dimensions of product quality:

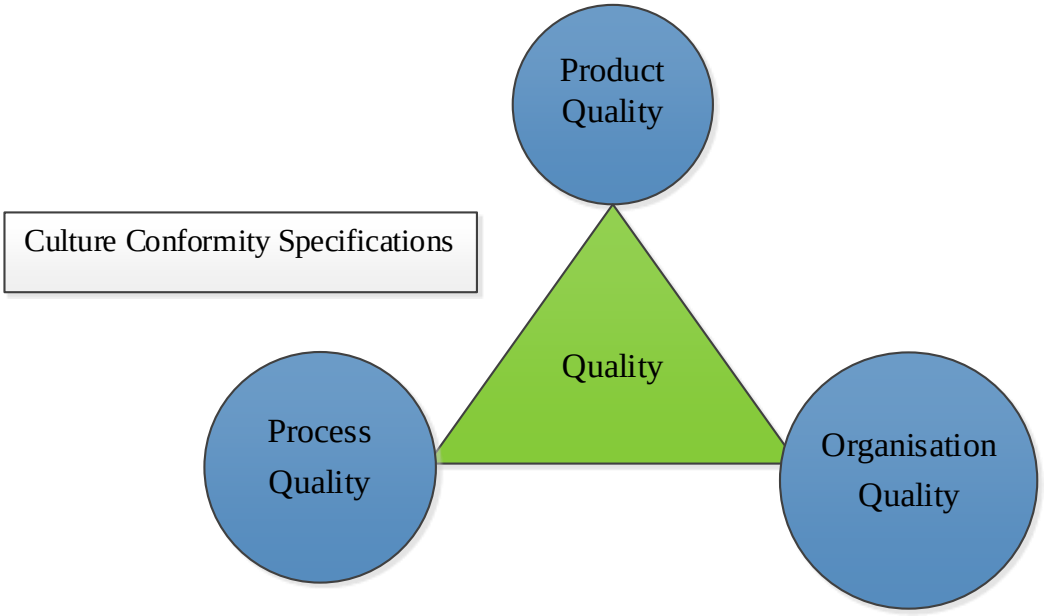
- **Performance**: how efficiently a product attains its purpose;
- **Features**: the attributes added to a product's basic performance;
- **Reliability**: a product's propensity to perform consistently during its design life;
- **Conformance**: the most traditional definition of quality and refers to a product or service satisfying the product or service specifications;
- **Durability**: the extent to which a product can resist stress or force without failing;
- **Serviceabilit**y: describes how easily and inexpensively a product can be repaired or service;
- **Aesthetics**: describes the attractive qualities in terms of sensory perceptions such as appearance, sound, or smell; and
- **Perceived quality**: this is based on customers' judgment.

Further to the above-mentioned dimensions of product quality, Basu (2004:7) posited that quality is fulfilled when quality in the product, quality in the process, and quality as the culture in the organisation are fulfilled, as depicted in Figure 2.2. Product quality pertains to properties involving numeric specifications and perceived dimensions as elucidated above (Garvin's dimensions of product quality). Process quality includes criteria for satisfactory service to measure whether requirements are met, and organisational quality describes a sustainable culture of quality which is linked to a commitment by senior management, continuous evaluation of whether performance and agreed outcomes are aligned, use of key performance indicators (KPIs), and a culture of teamwork (Basu 2004:7).

Quality is believed to be the responsibility of all the personnel. Thus the promotion of a corporate quality culture becomes paramount for organisations and realisable through information sharing and delegating responsibility, for instance, on quality system maintenance

to suitably qualified personnel (Quality Management System Template n.d).

Figure 2.2: Three dimensions of quality



Source: Basu (2004:7)

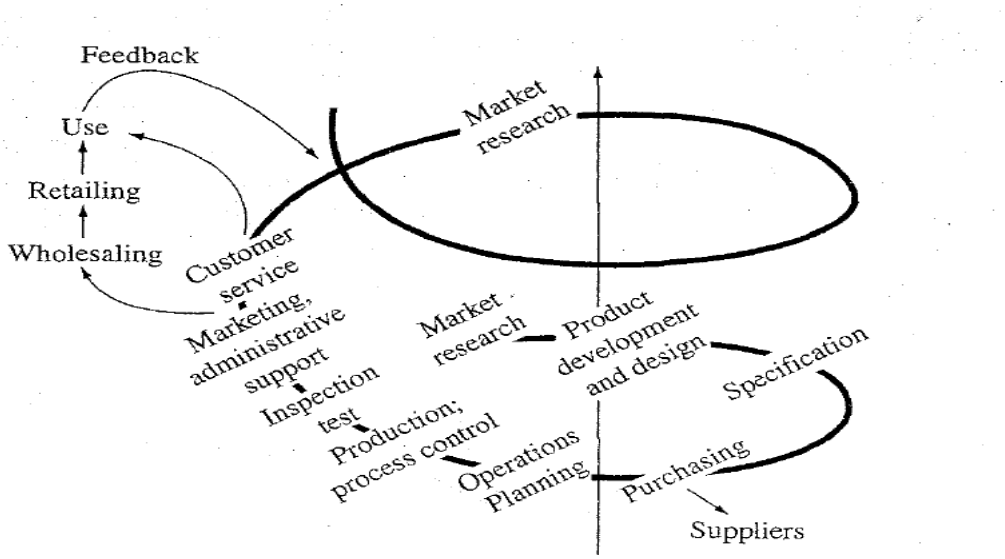
While top management can drive quality at project sites as they have a direct influence on the image through corporate communication, none of these principles can indeed be effective without understanding that companies and individuals must work together for their mutual benefit (Rosenbaum-Elliott, Percy and Pervan 2018:320). The principles are based on management principles that senior management can adopt for organisational improvement (Jarvis and Palmes 2016: 155).

According to Mane and Patil (2015) a completed construction project can approximate to a final product often a properly functioning building or structure that meets the quality standard as prescribed by the client. According to Oakland (2014:8), quality needs to be managed and not neglected in favour of time and cost savings. Mane and Patil (2015) add that performing work correctly at the outset saves time and money that would otherwise be wasted on rework. It would therefore be natural that improving quality would avoid errors and thus reduce the

need to repeat and correct tasks, thereby also reducing wastage and controlling project costs. Furthermore, an atmosphere of quality improves worker morale and productivity, which will contribute to the company's competitive edge. Nguyen, Phan, and Matsui (2018:1) demonstrated the positive effect of quality management practices on economic performance and environmental performance but indicated there was a low effect on social performance.

Pyzdek and Keller (2013) describe the quality function presented in Figure 2.3 as a 'spiral of progress in quality,' which depicts various activities and tasks that must be carried out to meet customer expectations and achieve loyalty. Similarly, Gryna et al. (2007:16) refer to this as a quality function with an entire collection of activities through which we achieve customer satisfaction and loyalty, no matter where these activities are performed. Gryna et al. (2007) also offer two different views of quality, thus providing a logical comparison of quality listed below in Table 2.1.

Figure 2.3: Spiral of progress in quality



Source: Gryna et al. (2007:15)

Gryna et al. (2007) provides an explanation of quality activities as follows: The traditional scope of quality activities is undergoing a radical and exciting change from a historical emphasis on quality of physical products in manufacturing industries (little Q) to what is now emerging as the application of quality concepts to all products, all functional activities and all industries (big Q). The concepts of little Q and big Q, offers the conventional internal perspective and the modern external perspective on quality. (p.16)

Table 2.1: Two views of quality

Internal view	Customer-focused view
The product is measured against specifications	The product is measured against the competition and the best available
Get the product to pass inspection	The product should meet expectations during the product life
Prevent defects in the plant and the field	Meet customer requirements in terms of goods and services
Focus on manufacturing	All functions must be covered
Quality is based on internal measures	Quality measures are customer-based
Quality is seen as a technical issue	Quality is seen as a business issue
The quality manager manages efforts	Efforts are directed by upper management

Source: Gryna et al. (2007:22)

2.6 Managerial perspectives on quality

This section looks at quality from a management perspective thorough review of quality management and critical perspectives that consider cultural aspects as proposed by Kelemen (2003:88). From a management perspective, quality is measured by technical and operational accomplishment and from a critical perspective quality is seen 'as a complex and contested social and political phenomenon, which acquires its meaning via processes of inter-subjective communication in which organisational and societal power of configurations plays a substantial role' (Kelemen 2003:1). In addition, Kelemen (2003) speaks of a slogan approach, which views quality as a motivational slogan communicated by management to promote a culture of quality as a society-wide concern in the company. There are strong similarities between the management quality perspectives and those held by Wilkinson, Redman, Snape and Marchington (1998), which include the:

- **Transcendental approach***:* according to which quality equates excellence;
- **Socio constructivist approach**: measures quality products or services against feedback from customers, senior management or quality standards certification from relevant institutions; and

- **Discursive approach***:* focuses on the relationship between language, power and reality, and views language as a crucial element in the social construction of quality.

2.7 Quality in the construction industry

The construction industry provides the physical infrastructure necessary for the development and is large, complicated and varied (Ladzani et al., 2010:45). It is diverse with huge differences between the significant classifications of construction that include residential and non-residential buildings, utility plants and industrial projects, and public work projects such as roads, streets, highways, tunnels, bridges, and overpasses (Ramohlale and Daniel 2015). According to Lakshmi (2015:29), despite the distinctive nature of features in the construction industry, it is seen as a service industry. It is second only to the agricultural sector in terms of contributing to the Gross Domestic Product (GDP). As such, it is vital to the national economy, accounting for about twelve percent of the Gross Domestic Product (Marx 2012:2).

The construction industry was more delayed in implementing quality in project management, primarily as a result of the construction industry's nature and a reluctance to transform, relying on management techniques that have been around for a long time as well as being driven by the bureaucracy and a top-down approach to decision-making (Akhmetova 2017: 43). Construction companies have increasingly been adopting quality management in an attempt to solve quality shortcomings and to meet customer needs (Hoonakkera *et* al., 2010: 953-969).

According to Fondahn et al. (2016:53), 'Quality is Free,' improving quality should not cost and may reduce cost as 'quality is the price of non-conformance.' Quality in the construction industry is desirable at the implementation stage of any project as it is fundamentally vital to project success (Gardner 2015:114). Project success is measured by timeous completion within budget and meeting the technical requirements making quality a prerequisite throughout the project (CESA 2011). The construction industry traditionally works well with subcontractors. However, construction companies frequently look for discount on price from subcontractors, compromising quality at a cost (Abbasianjahromi et al., 2013: 158-168). According to Spears et al. (2015: 155), quality does not apply to the finished product only, but is also affected by quality. It is, therefore, essential to align the end product with employees' perception of quality (Potts and Ankrah 2013:97).

EI-Reedy (2014:21) contrasts construction projects, as these differ in terms of size and value with the degree of quality varying, depending on project size and type but affirms that quality should remain constant throughout all the stages of construction. Foster (2017:121) noted that quality is essential when implemented correctly, to enable the production of a high quality product or service. Quality control is primarily adopted to define the level of supervision required at the outset and ensure that every part and phase of the project is executed according to required specifications so that buildings and structures are delivered as closely as possible to the project specifications (Hoonakkera et al., 2010: 953–969).

2.8 Project management

According to Walker (2015) project management is the application of processes, methods, skills, knowledge and experience to achieve specific project objectives according to the project acceptance criteria within agreed parameters. Project management has final deliverables that are constrained to a finite timescale and budget. Wells and Kloppenborg (2015:2) define a project as a one-time undertaking that will result in a new product, event, or way of doing things. It will have a defined start and finish, although a project's duration could approximately take a few hours to many years. This is further supported by Gido et al. (2018:5), who describes a project as an endeavour to accomplish a specific objective through a unique set of interrelated activities and effective utilisation of resources. Much discussion exists concerning what a *project* actually is, this study makes use of the description below:

- Projects are temporary, non-repetitive, non-routine, unique activities, aimed at achieving specific objectives defined in terms of performance, time, and cost (Lester 2014:7).
- Projects' features differ from one another evidenced by their complexity (demonstrated by the magnitude, unfamiliarity, and heterogeneity of effort) and digitised (Lester 2014:7).

While the above includes the fundamental criteria of time, cost, and performance, the operative word, as far as the management aspect is concerned, is motivation. A project will not be successful unless all or at least most of the participants are not only competent but also motivated to produce a satisfactory outcome, and that defines project management (Lester 2014:7).

Projects are not anything new; however, the nature of projects, the environment in which they are executed, and the size of the project has an impact on its requirements as uncertainties in terms of project outcomes increase as the size of the project increases (Spears et al., 2015). In larger construction projects environments are uncertain due to factors such as increased complexity in terms of planning, design and construction; a more significant number of interest groups, such as owner(s), contractors, suppliers and consultants; more resources are required, including funds, workforce, equipment, and materials (Spears et al., 2015:2). Other factors affecting project outcomes are legal requirements and environmental, economic, and political factors (Spears et al., 2015: 2).

According to Verzuh (2016:1), every project has a start and finish, and every project is unique. Projects are inherently collaborative efforts, and at the heart of every project is the project manager, who set task is to balance all the elements of a project; namely, time, cost, scope, risks and stakeholders. While factors such as increasing complexity, uncertainty in the project environment and shorter lead-times impact on the success of a project, ultimately, the success of a project depends on the effectiveness of the project manager (Thomas 2015:40). Each project is unique, and for projects to be successful, they need to be managed to ensure the success of the project. Many projects fail as a consequence of the client embarking on the project without considering the implications (Gardner 2015:39). Successful projects have a clear vision and a sound delivery strategy from the outset and to accomplish this, the features that classify an action or range of actions as a project may be listed (Newton 2015).

Different efforts are required for different projects in Construction Project Management which entails the planning, coordination and control of a project from conception to completion, including commissioning on behalf of a client (Walker 2015:11). This involves the identification of the client's objectives in terms of utility, function, quality, time and cost; the establishment of relationships between resources such as integrating, monitoring and controlling the contributors to the project and their output; and evaluating and selecting alternatives in pursuit of the client's satisfaction with the project outcome (Walker 2015:11). Oorganizations cannot, therefore, execute projects using the same strategic approach, as the project dynamics and requirements are always unique (Kerzner 2013:8).

According to Thomas (2012:40), uncertainty in the project environment and shorter lead-times impact the success of a project but ultimately, the success of a project depends on the effectiveness of the project manager, and careful note should be taken of the following:

- Increased levels of complexity of projects results in increased time and resource commitments;
- In general, there is a level of uncertainty in one or two dimensions in most projects, but more often, there is uncertainty in all three dimensions of projects with a high level of complexity;
- Projects with a high degree of similarity to previous projects had less uncertainty due to a learning curve gained by previous projects; and
- When a project's uncertainty reached near zero, and it was repeated a large number of times, the effort was no longer considered to be a project.

The various approaches to managing projects include the: traditional project management approach; functionality management approach; information processing approach and relationship approach which have permeated the many of the dimensions for managing projects, such as allocating resources to projects and monitoring project performance and motivation (Newton 2015: 6-19).

2.8.1 Freight rail transportation

In the early nineteenth century, South Africa lacked in industries, with there being just a few large urban areas, and agriculture was pastoral. The transport of goods and people has been at the forefront of technology, participating in its historical advances and revolutions (Gilbert and Perl 2012). The complexity of transport derives its construction from multiple elements; therefore, it is essential to distinguish the infrastructure from linear to nodal infrastructure for a clearer separation between infrastructure and services, especially for railways (Savy and Burnham 2013:1-15). Freight rail is one aspect of the logistics chain and refers to a train that runs on a railway line and transports cargo from a producer or other shipper to its destination.

In South Africa, navigable areas are long, and railways offer the means of mass transport with there being approximately 40 000km of rail line in operation in Transnet (Van Amsterdam 2014:176). The transport of freight, associated with locomotive power, is divided into three

main types: electric (introduced in 1925), non-electric (fuel power, such as steam, gasoline, and diesel) and hybrids with the Waterberg railway corridor focusing on diesel fuel (Monios and Bergqvist 2017:38-39).

2.8.2 Transnet capital projects – Waterberg railway corridor

Transnet Capital Projects (TCP) faced traffic jams on the existing Waterberg rail corridor from the Waterberg areas (Limpopo Province) to Richards Bay (KwaZulu-Natal Province). This was revealed in the Front-end loading (FEL) study, which focused specifically on coal expansion, taking into account the effects of the other existing commodity traffic (Ramohlale and Daniel, 2015:3). Coal transportation is moved between various origin-destination routes, with a critical focus on coal, ferrochrome and chrome for transport to the BTS at Richards Bay for export purposes (Transnet Capital Project Report 2015:33). The coal line between the Waterberg area in Limpopo and Richards Bay in KZN is undergoing expansion, which is due to be completed in 2023 (Transnet Capital Project Report 2015:95). Currently, the capacity of the Waterberg coal line is 24 million tons per annum of coal a year and this is expected to change after the completion of the second phase of the Waterberg coal line's expansion, TCP are expected to increase the rail capacity to six million tons a year (Transnet 2015). Transnet's activities aid and contributes to industrial development, improves competitiveness, employment equity, and black economic empowerment as mandated by the labour laws of South Africa (Transnet Corporate Report 2015:1).

2.9 Project implementation

Clients' demands for timeous delivery of construction projects, together with frequent delays in delivery and cost overruns have attracted the attention of researchers, who have sought to identify the primary cause and nature of project delays (Akinsiku and Akinsulire 2012). Kikwasi (2012) suggests that project delays are a measure of Emerging Contractors (EC's) performance. Akinsiku and Akinsulire (2012) maintain that delays occur at specific periods, in particular after an activity or project. A study undertaken in the Free State found that due to contractors suspending, or not completing work within the contract or extended period, or abandoning work altogether, 50% of construction projects failed (Greyling 2012:1). The same study also showed that contractors fail to meet contractual requirements, quality deliverables and conditions (Greyling 2012:1).

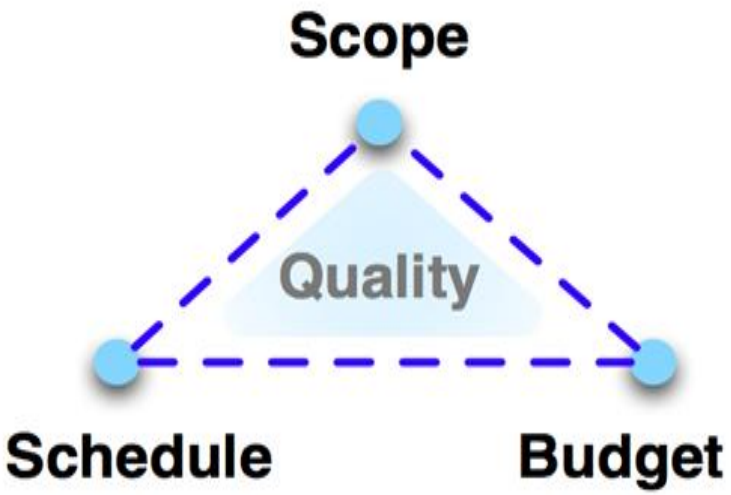
Quality implementation at the execution of the Waterberg stage two (2) to three (3) *Matlabas* loop project has been a challenge. The Project Procurement Plan (PPP) has been established to set a procurement framework for this project, identifying and detailing items to be procured during the tendering phase, the types of contracts of the planning process and tenderers pass all quality deliverables at the tendering process, however, at execution phase TCP experiences quality issues (Foster 2017:121).

The *Matlabas* loop project failure, project delays, leadership changes and a deferred project scope seek quality management intervention for the benefit of other projects, with the TCP leadership and clients acknowledging the significant role quality management plays in project planning and execution and that project management is part of the procurement and delivery context (Hornby 2015:1).The learning experience from the failure of the *Matlabas* loop project has highlighted the need to adopt technical requirements to assure quality, in planning, rather than improvising during the execution phase (Sommer 2010:151). The quality issues in the project management of the *Matlabas* loop project has resulted in good benefits, and quality in project management of Waterberg where, for example, 'quality' has become part of project planning and the services are outlined in the Bill of Quantities (BOQ's) and project scheduling (Sommer 2010: 151).

2.10 Project Quality Trilogy

According to Rumane (2018:9), quality in construction can be challenging to define, as meeting a whole range of performance criteria is required by various stakeholders who interact with one another. Emerging Contractors (EC) are required to adhere to legal and regulatory compliances including regulations pertaining to health and safety factors, which affect the construction business performance that may affect the construction cost, time of delivery and essential characteristics of quality. The phenomenon of these three components can be called "construction project trilogy" as depicted in Figure 2.4 (Rumane 2018:9).

Figure 2.4: Construction project trilogy



Source: Rumane (2018:9)

2.10.1 Excessive bureaucracy

The Construction Industry Board (CIBD) oversees sustainability and development in the South African construction industry, including the development of ECs. However, Greyling (2012) is of the view that ECs have excessive 'red tape' when it comes to the registration process. ECs (Grade 1-6) lack the financial records of accomplishment required to register the higher financial grades (7-9) moreover the registration is not mandatory, ECs view the grading system as expensive and inconvenient and lacking in value. According to Greyling (2012), Rehabilitation, Maintenance and Emergency (RME) is currently being assigned as a Transnet Operating Division, therefore closed tender gets awarded to the RME and CIDB registry and not as criteria for closed tender awarding.

2.10.2 Health and safety factors

The main contractors in a construction project are responsible for health and safety compliance, and as such, are often contractually required to bear the compliance costs (CIDB 2013). Also, some of the main contractors have communicated that their sites had been shut down due to non-compliance or poor performance (CIDB 2013). Shutting down of sites impacts negatively on schedules and the financial feasibility of projects. Conversely, the RME has not received penalties for non-compliance or poor performance, which may explain the sub-standard performance of RME in the construction circle (Transnet Corporate Report 2018:1).

According to Balagué and Saarti (2011:78), procedures specify how to carry out an activity or a process. Procedures are useful to ensure that tasks are tackled with consistency, economy, repeatability, and uniformity. Systems need to be followed in quality implementation, as this reportedly saves money for the company, and the cost of redoing things is high. It is better to do things right the first time than to have to keep repeating them. Clients in construction want their projects delivered on time, on budget, free from defects, efficiently, right the first time, safely, and by profitable companies. Regular clients expect continuous improvement from their construction team to achieve year-on-year reductions in project cost and project time (CIDB 2015:1).

2.10.3 Strategic planning and governance

The construction industry faces tough competition and unforeseen problems in an ever-changing environment. Strategic management is vital to avoid severe threats to organisational stability and to ensure a competitive edge in the industry (Henry 2018:8). Business level strategies that include cost and leadership can ensure that the business conducts a Strength, Weakness, Opportunities, Threats (SWOT) analysis. This analysis is to identify its strengths and weaknesses, identifying external threats and opportunities, which is a powerful tool used by Transnet's Chief Executive Officer (CEO). The management established strategic decisions identifying gaps by developing and implementing Transnet Integrated Management Systems (Henry (2018:77).

The TIMS programme seeks to integrate the management systems in areas such as safety, health, environment, risk, security, quality and compliances to reach training. Thus, this brings awareness in gaps within the system to ensure adherence to International and National Standards and regulatory requirements. This has enabled Transnet to work as a single unit with a unified objective through a complete framework (Transnet Corporate Report 2018:1). These initiatives shall ensure that RME complies accordingly when required to be awarded a closed tender process (Adendorff, Appels and Botha, 2011).

TCP's successful construction projects may be attributed to RME's use of joint venture and diversification strategies. Adendorff, Appels and Botha (2011) suggest that TCP should

implement an effective and dynamic management strategy to secure adequate growth and remain competitive in the construction sector.

2.11 The culture-based quality management systems in construction

2.11.1 Culture change

Foster (2017:43) believes that different cultures (everyday manifestation underlying values and traditions) have differences in taste and preferences, and other cultures may approach quality differently. As such, attitudinal changes are required at all organisational levels to attain quality, and to facilitate individuals becoming quality ambassadors to others. Goetsch and Steenkamp (2013:5), suggests a culture-based QMS to improve implementation framework meant at guiding Transnet to develop and transform its organisational culture and enhance its quality practices and procedures contained in its QMS and quality values. During the preliminary engagement session at the Waterberg project site, it was noted that:

- There was a lack of 'quality awareness' aligned with the organisational culture among management;
- Employees in the Carlton Centre – Gauteng Region acknowledged that their understanding; of corporate culture was inadequate; and
- RME employees realised that their organisational cultures were poorly developed and not aligned with Transnet SOC LTD.

In the same way, as organisational culture has different meanings, so to the term 'culture change' have many different meanings. Van de Ven and Poole (2005) refer to culture change as being intimately bound up with the process of organisational change and is necessary to effectively implement QMS in the construction organisation. Key personnel need to facilitate the transformation of processes, strategies and beliefs within the organisation.

2.11.2 Barriers facing the implementation of quality management systems

Several studies in QMS implementation maintain that ISO 9001 is not a suitable standard to use in construction firms (Neyestani 2016). According to Rashed and Mohammad (2015:2), quality in the construction industry is generally considered very costly, and Quality Control (QC) or Quality Assurance (QA) in organisations is established only because of contractual requirements. The pledge to implement QMS implementation must be undertaken and

developed at the strategy stage as part of the Project Execution Plan (Transnet Capital Project Report 2018:49). Morris (2013:99) points out that the Project Execution Plan (PEP) is often viewed as the project strategy document and only address the project implementation strategy.

According to the Transnet Capital Project Report (2018:49), the planned work was to be performed after capital expenditure had been authorised involves a separate development strategy plan. This plan sets the strategy for the project manageability, given that every project's contracts, specifications, and practices are unique and specific to the project. Gillett, Jan, et al. (2015:192) noted that ISO 9001 presents an opportunity and offers acceptable practices for initiating a QMS, and an outstanding foundation for a company, but product and services outcomes are different, and as such challenging to incorporate fully within a generic system such as ISO 9001.

Furthermore, Evans and Lindsay (2011:82) noted that even though developing a certified QMS requires extensive written documentation and a great deal of time, many diverse organisations have realised the significant benefits of ISO 9001 implementation, and the large role it has played in assisting with process standardisation across the company, productivity improvement, market benefits and improved financial performance. Watson and Howarth (2011) summarise the challenges surrounding QMS issues in general as follows:

- Management purpose and attitude;
- Implementation by consultants;
- Powerless management representative;
- Insufficient resources;
- Failure to improve; and
- Overly complicated.

From the above, it is clear that issues surrounding the attitudes and views of the management, and the lack of commitment, are the biggest obstacles to the effective implementation of the ISO 9001 in many organisations. A further issue related to these problems is the differences in cultural perceptions within organisations and the effect these may have on effectively implementing ISO 9001. Watson and Howarth (2011) concede that incompatible quality corporate cultures are a recognised obstacle to the successful implementation of ISO 9001 in the construction industry. Considerable effort is required to realise the advantages gained by the successful implementation of QMS practices.

2.11.3 Advantages of quality management systems

ISO 9001 (ISO 9001: 2015) shows the advantages of using a QMS, linked to consistency and customer satisfaction, while Deysher (2015), shares views on risk minimisation:

- Consistency: QMS assists with the establishment of, and consistency of the ensuing production of goods and services through quality systems and quality standards. QMS application indicates that the data is consistent with the stipulated QMS requirements, contributing to customer satisfaction and meeting statutory and regulatory requirements

- Customer satisfaction: QMS ensures customer satisfaction by ensuring that they receive goods and services that comply with requirements, are readily available and reliable. As such, it is to the organisation's advantage to implement

- Risks minimisation: Implementing QMS minimises risk in construction projects by reducing defective works, reconstructive work and rejection

2.11.4 Disadvantages of QMS

The disadvantages of quality management systems include:

- Too much paperwork: the biggest obstacle to employees implementing QMS is an increase in paperwork which consists of the recording of work procedures and instructions, quality periodicals and checklist forms that may require daily usage on-site (Anup, Arun, Kumar, and Saghi, 2015). Employees may be resistant to adopting QMS as a result of the additional workload;

- Time-consuming: To ensure quality when implementing a quality management system (QMS), effort and time are required; and

- Requirements for quality management system implementation: General requirements used to identify and describe the process, which include establishing, implementing, maintaining and improving quality management systems can be quite onerous as depicted in Table 2.2 (Watson and Howarth, 2011). Table 2.2 elucidates the requirements for the implementation of QMS as espoused by (Watson and Howarth (2011).

Table 2.2: Requirements for Implementation of Quality Management Systems

Requirement	Description
Operation	Conduct early inspections and test incoming materials. Conduct in-process inspections and test semi-completed work according to the project quality plan. Maintain signed-off recording and testing. Separate and indicate the conformance or non-conformance of work. Verify that the work meets specified requirements. After repair, inspect and test again.
Performance evaluation	Schedule internal quality audits. Designate independent personnel to perform internal audits. Conduct follow-up audits if required.
Improvement	Employ statistical methods to identify the need for improving a new project in quality control.
Documentation	A considerable amount of documentation to serve as guidelines and a record. A statement of quality policy and a quality objective provided by senior management. A quality manual and project quality plan by the site contractor for on-site work. Procedures and work instructions. Quality records and checklists for quality assurance and continuous QMS improvement.
Management responsibility	The scope of QMS should be defined by the organisation and publicised. Documented procedures should be prepared and executed effectively. Prepare a project quality plan. Communicate the relationship between parties and the organisation's responsibility and Authority. Identify and provide efficiency and adequate resources. Employ a quality manager to monitor quality. The quality system must be frequently monitored and reviewed.
Leadership	Identify staff requirements and provide training. Issue instructions and supervise clearly.
Planning	Plan for risks and opportunities. Carry out changes, and the consequence of change effectively with available resources. A clear, communicated, measurable, monitored, updated, resourced plan must be prepared.
Support	Competence. Awareness. Communication.

Source: Watson and Howarth (2011)

Ahmed, Coffey, and Xia (2017: 183-191) explains that QMS in the construction industry are often implemented to ensure that sufficient efforts are made by companies to achieve the required levels of quality for clients. Attainment of these quality levels can result in greater customer satisfaction, which is fundamental to ensure long-term competitiveness for construction companies. Quality itself is closely related to several different expectations, such as durability and reliability (Watson and Howarth. 2011:75). However, due to the relative lack of acceptance of the benefits of these systems among industry stakeholders, as well as other barriers related to implementing them, the construction sector is still lagging behind other industries in terms of its successful adoption of QMS. Moreover, Table 2.2 provides the requirements for implementing QMS in construction projects to maintain the quality of executed works at the required standards, as well as obtaining customer satisfaction, which may fundamentally establish longer-term competitiveness and ensure business survival for the company.

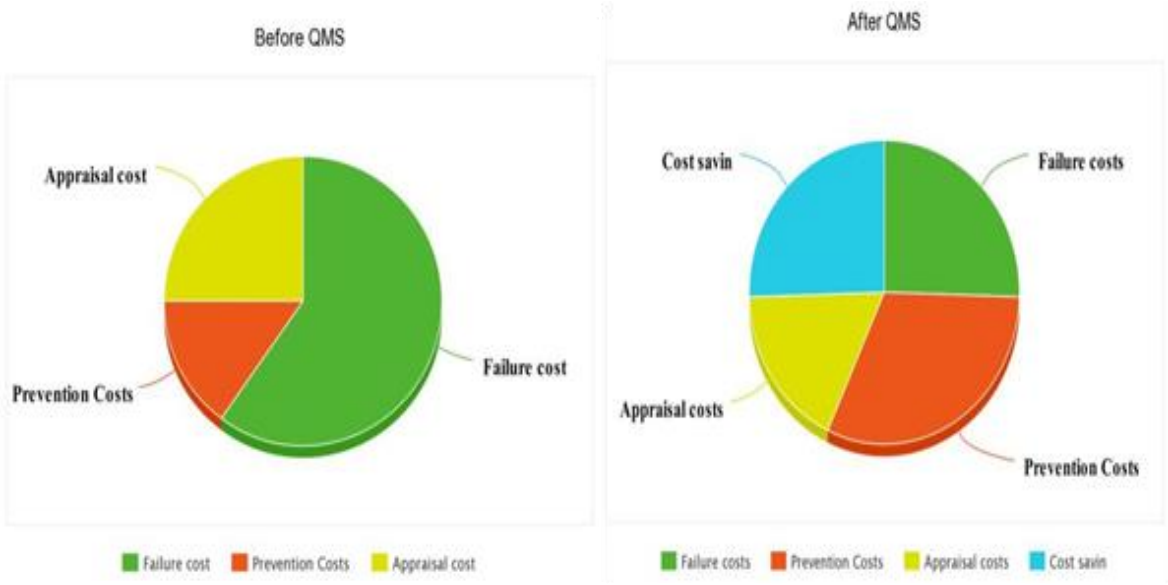
2.12 QMS Benefits

According to Albert (2013:84) a project would bear criticism and consequently failure if the set budget does not meet the specified quality or performance criteria. In the construction industry, quality is very costly (Rashed and Othman 2015). Nevertheless, QMS in construction lies in the advantages and activities of the overall project management intending to assess quality objectives and actions. Sahidah Samsudin et al. (2012:38) highlighted the many benefits and advantages that could be obtained from the implementation of QMS, such as:

- Improving communication and increasing mutual understanding within the project team;
- Increasing certification image amongst certificates holders;
- Improving and raising clients confidence
- Gaining clients' interest;
- Improving construction organisation competitiveness and open greater market share; projects being contracted due to construction company capabilities in providing excellent services;
- Reducing inefficiencies and waste before, during and after project implementation;
- Wide-scale failure prevention programme that results in company cost saving;
- Improving construction work implementation practice;
- Providing the project to the certified contractors;

- Becoming a valuable marketing and promoting tool in project biding; and
- Encouraging the organisation to make continuous improvement in quality performance.

Figure 2.5: Illustrates the cost savings of QMS



Source: Kaziliūnas (2010)

Sahidah Samsudin et al. (2012:39) suggests that all these benefits are achieved through the implementation of QMS, which should be perceived as a wide-scale failure prevention programme that will lead to costs savings. QMS assists organisations in reducing failure costs and increasing financial effectiveness (Sahidah Samsudin et al., (2012:39).

2.13 Quality management systems and continuous improvement

Mora (2014:117), in discussing continuous improvement strategies, suggests that customers expect improved quality products with faster delivery times. According to Transnet (2015a), Transnet SOC Limited strives to deliver goods to every corner of South Africa to meet customer demands by providing high quality according to schedule. Van Aartsengel and Kurtoglu (2013: 7) are of the view that the business needs to be continuously improving and transforming.

Formento et al. (2013) suggests that continuous improvement plays an important role in ISO 9000 norms and excellence models, including factors that are not quantifiable, such as

consensus, culture, internal communications, and self-reflection. In addition, Mrugalska and Tytyk (2015: 2730) emphasise the importance of technology in quality control and link it to performance improvement in companies.

Transnet has been positioning itself as a champion of a green economy, although there is still a long way to go before declaring victory in this field. Transnet's commitment to building a green industrial base in South Africa involves: increasing investment in the green economy, enhancing renewable energy procurement, the development of biofuels, clean coal initiatives, promoting energy efficiency across the economy, waste recycling, reducing carbon emissions through improved public transport and a shift in moving freight from road to rail (Transnet 2013: 14). A move in this direction always has a bearing on quality policy implementation in the organisation.

The Transnet Integrated Report (2015) stated that the company has expanded into other parts of Africa. Although this is still at an embryo stage, it is intended to serve as a proactive enabler of economic growth, together with a commitment to enforcing QMS elsewhere, as in South Africa.

2.13.1 Documentation requirements

Implementing a quality management system (QMS) entails a great deal of documentation to serve as a guide and as a record. Hence, quality records and checklists are documentation prerequisites for quality assurance and for the quality management system to improve continuously (Watson and Howarth 2011). According to Watson and Howarth (2011), documentation requirements include:

- A statement of quality policy and a quality objective set by top management;
- A quality manual and a project quality plan compiled by the site contractor, to aid in achieving quality work on-site; and
- Meticulous organisation, process checks, and work directives are required for effective and efficient planning, execution, and process control for work instruction.

2.13.2 Management requirements

Management requirements include aspects such as commitment, responsibility, authority, planning, good communication, quality policy, customer focus, and a management review. The

quality policy is central to construction organisation's purpose to facilitate the implementation of effective QMS, especially if the organisation is committed to instilling an ethos of quality in their team members to achieve quality (Hoyle, 2018:303).The project manager or quality manager plans the establishment, documentation and implementation of QMS for every individual project. To improve customer satisfaction, customer needs are identified (Watson and Howarth 2011).

According to PMBOK Guide (2013: 264), the roles and responsibilities of every team member in the organisation are stipulated, and team members are responsible for their work to ensure higher quality of work with legitimate authority, which facilitates effective communication. The overall implementation of QMS needs consistent review to examine its effectiveness and achieve continuous improvement (Watson and Howarth 2011).

2.13.3 Resource management requirements

Requirements for resource management include human resources, infrastructure, and the work environment. Companies must procure and maintain resources and continuously improve QMS practices (Boys and Wilcock 2014).The standard emphasises that people performing work need to be competent, and this is judged through a combination of education, training, skills and experiences that are required, by the company's definition, to do an assigned job adequately.

2.14 Total Quality Management

Total Quality Management (TQM) is promoted as proven systematic approach that enhances the organisation's overall business processes, including their products and services (Jehangiri 2017). Similarly, Kelemen (2003), suggests that attending to quality naturally gravitates towards continuous improvement. TQM can be used in conjunction with other quality standards to be effective, especially if safety improvement is the main aim (RIOS 2006; ISRI Safety Report 2007). In this way, for example, Anglo-coal initiated a strategy to reinforce safety practices in their operations by using analogy techniques (Christensen 2011).

TQM can also be used together with performance measurement tools to ascertain value-adding operations. Essential performance measurement techniques include Balance Score Cards, Performance Measurement and Cost of Quality (Basu 2011). In support of TQM, Stamatis (2002:5) suggests that an innovative approach could be used to ensure sustainable productivity,

when implementing a quality system. In addition, TQM techniques can assist to determine which workers can be retained, based on their talents and scarce skills (Dale et al., 2016:278). A vital aspect of this is making full use of the skills and knowledge of all employees to the benefit of the individuals and the organisation (Dale et al., 2016:278). It is also essential to consider environmentally friendly practices when deciding on quality techniques to be used with TQM in operations (Christensen 2011). Finally, Dubey and Kumar (2017) suggest that presently, modern organisations are those that shift from Total Quality to Learning Organisation. Dubey and Kumar (2017) also state that flexibility is critical in adapting to change on quality objectives.

2.15 Management System Standards

Management systems standards are vital to improving quality in operations, and the most popular ones include the SA 8000 Labour Management Standards, the OHSAS 18001 Occupational Health, as well as Safety Management Standards, the ISO 14001 Environmental Management Standards, and the ISO 9001 Quality Management Standards (Terlaak and King, 2005: 580). Hoyle (2018:1) explains that the adoption of ISO 9001:2015 assists in improvement of organisational performance and increases competitive advantage benefits. The goal is to give the organisation the capability to satisfy its customers, and labels such as ‘quality improvement’ or ‘customer first’, send out appropriate signals (Hoyle, 2018:66). This approach represents the company's QMS as a management system tool, ensuring quality activities and managing competitiveness allowing the company to ensure its stability (Leontyuk et el., 2019:1). Rijnen (2008) states that there must be a balance between quality and clients affordability and when this balance is achieved, staff motivation increases, work improves and this makes it possible to achieve excellence in the operations (Antony and Preece 2002:5; Basu 2011). Dale et al. (2016:186) present the following benefits of management system standards:

- Reduction in errors, customer complaints and non-conforming products, services and costs and the retention of customers;
- Assistance with the liberalisation of trade through common rules and language;
- Responsibility for quality issues is placed with the supplier and not the customer;
- Reduction in the number of customer audits and assessments and reduction in the time taken, leading to a saving in resources needed for such activities;

- Identification of ineffective and surplus procedures and documents and other forms of waste.
- Better working environment. On the other hand, several difficulties, problems and shortcomings have been reported and discussed;
- Applicability of the standards to specific situations, particular sectors of business, and management styles; and
- Interpretations of various sections of the standard and understanding the requirements of the standards.

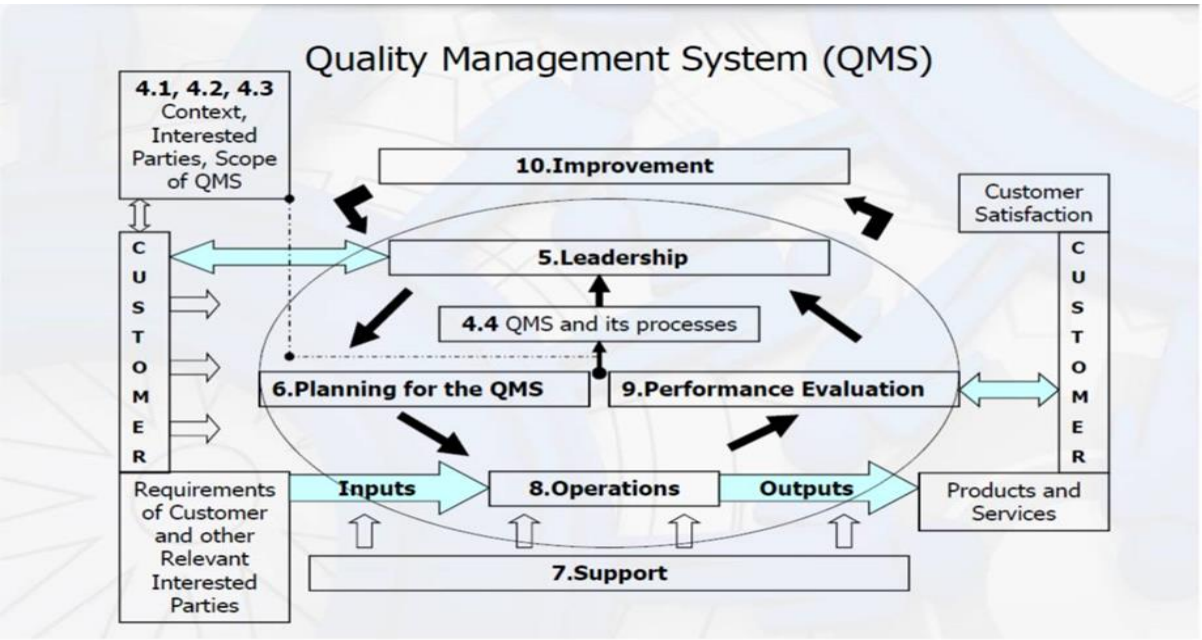
2.16 Quality management system (QMS)

Hoyle (2018:124) describes the QMS as a systematic view of an organisation from the perspective of how it creates and retains its customers. Dale et al. (2016:174) state that QMS is depicted by ISO 9000 (2015) as a management system to support businesses and organisations to be more efficient and to improve customer satisfaction.

Leontyuk et al. (2019:2), points out that a QMS is comprehensive and effective to cover activities, aspects and development concerning the company's corporate strategy. QMS apply to and interact with all processes in the organisation (Oakland 2014:245). It also embraces quality management objectives, policies and organisation procedures. In addition, a QMS is believed to provide an effective managerial framework to build a company-wide approach process in continuous improvement leading to customer satisfaction (Dale et al., 2016:175).

With the increased complexities of entities and their relationships being considered in quality management, has led to documentation and activities for mutual trust between partners becoming necessary resulting in the ISO 9000 series being created (Weckenmann et al., 2015: 281). Figure 2.6 illustrates a model for a process-based quality management system and details a network of suppliers and industrial customers to build trust in the quality-oriented performance of a partner. The significant advances of quality management over former paradigms have not been accomplished by issuing new techniques or methods, but by generating a common harmonised and internationally accepted framework of standards and accredited certification agencies, aiding mutual trust and better partnerships between enterprises (Weckenmann et al., 2015: 281).

Figure 2.6: Model of a process-based quality management system



Source: ISO 9001:2015

2.17 Challenges on quality

Language barriers may present a challenge since effective communication is vital in quality operations, and it is, therefore, essential that a language is used that the workforce can understand (Evans and Dean 2003). Other drawbacks include inadequate infrastructure, a lack of machinery, insufficient cash, system inefficiencies, and a lack of much-needed scarce skills required by SMEs.

2.18 Other quality improvement instruments

According to Fondahn et al. (2016:30), Quality improvements (QI) means achieving a better performance level by changing the system and processes. QI should be the goal of every organisation, to give the organisation the capability to satisfy its customers (Hoyle, 2018:66). QMS are instrumental in helping an organisation achieve efficiency in their operations, and the construction industry often implement OI to ensure that sufficient effort is made by companies to achieve the required levels of quality for clients. Attaining these quality levels can result in greater customer satisfaction, which is fundamental to ensure long-term competitiveness for construction companies (Hoyle, 2018:66).

However, the construction sector is still lagging behind other industries in terms of its successful adoption of QMSs, due to the relative lack of acceptance of the benefits of these instruments among industry stakeholders, as well as from other barriers related to implementing those (Ahmed et al., 2017:183)

2.19 Lean manufacturing

Lean Manufacturing is presently referred as Lean (Bradley 2015:3). Lean manufacturing is the production of goods using fewer resources compared to mass production and reduces waste, human effort, manufacturing space, investment in tools, and engineering time to develop a new product. Lean manufacturing is a generic process management philosophy derived mostly from the Toyota Production System (TPS), as well as other industry best practices Wang (2011:1). According to Jaccard (2013:247), the use of the term Lean is often associated with two researchers at Massachusetts Institute of Technology (MIT) International Motor Vehicle Program (a program, now international, involving American, European and Asian universities), James P. Womack and John Krafcik, undertook an investigation in 1987 to determine why the Toyota Production System (TPS) was more efficient than that of US companies, and the results indicate the advantages of the TPS, as follows:

- Requires less human resources for products and services;
- Requires less investment for an equivalent production capacity;
- Allows vehicles to be manufactured with a reduction in low quality;
- Needs fewer suppliers;
- Has less stock;
- Takes less time and human resources to manage the process from concept to commercialisation of new products, but also from order to delivery; and
- Have a much lower number of work accidents.

Oakland (2014:320) explains that the organisation that implements Lean tends to focus on six key phases, as represented in Table 2.3.

Table 2.3: Six-phase approach to Lean

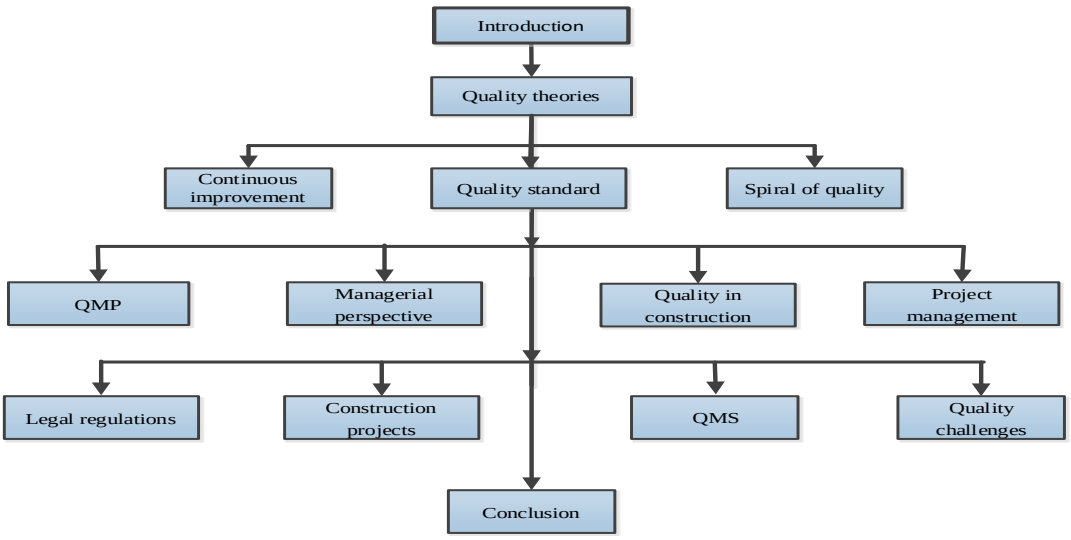
1. Define	Define the scope of the improvement project in terms of customers and organisation goals.
2. Review	Map the current process and measure its performance to understand how it adds value and when it doesn't
3. Investigate	Analyse the gap between current and desired performance identifying problems and prioritising opportunities
4. Verify	Generate and validate improvement solutions to realise the opportunities
5. Execute	Implement the improved process to sustain performance improvement
6. Reinforce	Learn the lessons and continuously improvement

Source: Oakland (2014: 423

2.20 Conclusion

This chapter commenced with a discussion on the definitions of quality. The context of the study was reviewed, and the concept of quality management, total quality management and quality management systems were discussed. The next chapter discusses the research methodology adopted for the study. Figure 2.7 illustrates the flow of chapter 2.

Figure 2.7: Chapter 2 flow chart



Source: Researcher Constructed

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The previous chapter presented a review of the literature that underpins the study. This chapter focuses on the research design and details the research methodology. The sample population is described, and the sampling strategy is discussed, explaining the data collection procedure, the research instruments and data analysis techniques. A flowchart (Figure: 3.1) depicting the schematic representation of the research methodology process is presented at the end of the chapter. The chapter concludes with drawing attention to the ethical aspects of the study.

3.2 Research design

Myers (2013: 19) defines research design as a road map of the research that entails clear guidelines and procedures with regard to what is intended to be done and when. The study was cross-sectional in nature employing a quantitative approach.

3.3 Research Methods

The research was exploratory. Primary data, for the quantitative study, were collected from a sample of respondents from the population. Leedy et al. (2014) suggest that the quantitative approach is suitable if there is only limited time available as the study can be executed over a short period. The data can be analysed using statistical software over a short period. In contrast, a qualitative approach is a method of conducting research using the content or thematic analysis to extract meaning from the recording of interviews, texts or even images (Leedy and Ormrod 2014).

3.4 Target population

Wegner (2012: 5) states that the population refers to the entire group of people who are the target of the study. In this instance, the target population includes senior project managers, project managers, construction managers, site supervisors and other parties involved in the construction at TCP for longer than three years constituted the target population. The target population comprised 102 potential participants. Respondents in the survey represent the different echelons in the targeted population in the company under investigation.

3.5 Sampling strategy

According to Singh et al. (2015:2), a sample in research is a selected subset of a population that is used for making an inference about the entire population and the results gathered from the sample to generalise about the whole population.

3.5.1 Sampling designs

There are two major sampling approaches recognised by (Leedy et al., 2014), these are:

i. Probability sampling: where all members of the population have a known chance of being included in the sample; and
ii. Non-probability sampling: where the sample is constituted in such a manner that it does not necessarily give all the individuals in the population equal chances of being selected in the sample.

Probability sampling was used in this study because it allows each element of the population to an equal chance to be represented in the sample without bias.

3.5.2 Sampling framework

The staff working at Transnet SOC Limited for the Waterberg project constituted the population for this study. The sampling framework is presented in Table 3.1.

Table 3.1: Structure of the sample framework

Position	**Population**	**Sample size**
Principal Project Managers	2	2
Senior Project Managers – Project Managers	21	20
Construction Managers	52	50
Site Supervisors	19	18
Other employees	8	8
Total	**102**	**98**

Source: Compiled by the researcher (from the Waterberg TCP Employees)

The population comprised 102 employees with just over half being construction managers and 23 being project managers and 19 being site supervisors. Thus, the population consisting of

personnel holding relatively senior positions with the necessary experience to provide accurate and reliable information. For selecting the sample size, Leedy et al. (2014) recommends that researchers should use samples that are representative of the target population for more accurate results. Stratified random sampling was used to select 98 employees to participate in the survey. According to Sekaran and Bougie (2016), a sample size of 98 is considered to be appropriate for a population size of 102. Thus, the chances for the sample mean and standard deviation to be representative of the population's mean and standard deviation are high.

3.6 Measuring instruments

According to Wegner (2012:17), the advantages of surveys include the following:

- All respondents receive the same questions;
- Surveys are cheaper to process;
- Surveys offer a means of gathering quantitative data from a large sample;
- The anonymous nature of surveys makes it easier for respondents to answer questions honestly without any threat, and
- Surveys make it easier to reach out-of-reach respondents.

A questionnaire was used to conduct the survey for this study. The questionnaire was structured in two sections. The first section elicits general biographical and demographic information. The second section was composed of a five-point Likert Scale type of statements requiring respondents to strongly disagree - 1, disagree - 2, neither agree nor disagree - 3, agree - 4 and strongly agree - 5. The statements were pitched around critical factors, project management techniques, and factors that have an impact on implementing quality management practices in construction projects, in particular in Transnet Capital Projects. The items in the questionnaire were informed by the literature review and by previously developed questionnaires used in similar studies. The language used in the questionnaire was English as all participants were deemed to have a good command of English and no difficulties were experienced in the pilot study in this regard. There were 59 items in the research instrument, with a level of measurement at a nominal or an ordinal level. The questionnaire (Appendix A) was divided into two sections (A and B), comprising items grouped in accordance with the objectives set for the study as illustrated in Table 3.2 below.

Table 3.2: Questionnaires sections, themes and sub-themes

A	General and Biographical Data
B	Project Management Techniques
B1	**Objective 1** - To establish the success factors for delivering quality at TCP
B2	**Objective 2** - To identify the barriers to quality policy implementation at TCP
B3	**Objective 3** - To establish the degree to which top management drives quality at the project sites.
B4	**Objective 4** - To ascertain project managers' perceptions of Quality Management Systems at TCP
B5	**Objective 5** -To establish the gaps in the current quality awareness training at TCP.

Section A comprised of four biographical questions designed to capture the demographics of the respondents. Section B comprised of questions that were designed to capture respondents' perceptions in accordance with the five specific objectives that were set for the study.

3.7 Administration of the questionnaire

According to Aaker et al. (2013:262), a survey's physical format impacts on whether respondents find the questionnaires attractive and comfortable to complete. This is especially true for self-administered questionnaires, where factors such as the appearance, quality of the paper, and clarity are essential. The questionnaire was piloted among some Construction Managers, Project Managers, Site Supervisors and other construction employees that were not part of the sample in order to make sure that the questions were not ambiguous. The few issues that emerged were resolved prior to the administration of the questionnaire to the sample. Participants also received a consent form and information letter (a cover letter) disclosing the relevant details of the study and an invitation to participate voluntarily (see Appendix A).

The questionnaires were either administered electronically via email or hand-delivered, when it was not possible to use email. Leedy and Ormrod (2010: 198-199) advises that in the case of electronic questionnaires, the return rate could be maximised provided all the respondents have access to internet/emails. These methods were chosen because they were convenient for the researcher and minimised waiting time from respondents and to avoid duplication from research participants. A total of 98 questionnaires were distributed as per the sample size. The electronic to manual distribution is reflected in Table 3.3.

Table 3.3: Electronic versus manual distribution of questionnaires

Position	Sample Size	Electronically Distribution	Manual Distribution
Principal Project Managers	2	2	0
Senior Project Managers – Project Managers	20	11	9
Construction Managers	50	6	44
Site Supervisors	18	7	11
Other employees	8	3	5
Total	98	29	69

Source: Compiled by the researcher (from the Waterbery TCP Employees)

In order to ensure a high response rate, the respondents were allowed to choose the type of questionnaires they preferred, Table 3.3 presents the number of participants who preferred electronically questionnaires versus those who preferred manually distributed. The following steps were taken to improve the response rate:

- Respondents were assured that they would remain anonymous;
- The covering letter appealed to respondents to participate;
- The questionnaire was kept to a minimum length; and
- Respondents were phoned to remind them to complete the questionnaires.

3.8 Data interpretation and analysis

After the data collection was completed, the next stage was data analysis. The data gathered from the questionnaire were analysed using statistical data techniques. These techniques provide a perspective and set of tools to search for clues and patterns. Data was translated into information and explained statistically with descriptive statistics, frequencies and inferences using SPSS version 25.0. Descriptive statistics are made of tables, figures and charts, whereas inferential statistics are about inferences and explanation thereof (Johnson, Freund and Miller 2011:2).

3.8.1 Descriptive analysis

Armstrong and Kotler (2011:135) stated that the purpose of descriptive research is to expound on raw data gathered during the investigation, which is transformed by rearranging and manipulating it into rational descriptive information that is understandable to readers. The descriptive analysis presents the data using charts and tables, the purpose of which is to present information gained in a more coherent and integrated manner.

3.8.2 Inferential analysis

Taylor (2017:128) describes inferential analysis as the practice or technique used to form judgments about the characteristics parameters of the population based on a statistic calculated from a random sample of that population. According to Leedy et al. (2014), the inferential analysis enables the researchers to make educated guesses about the numerical characteristics like the mean of a population and techniques that allow predictions, estimations, judgements, and conclusions to be drawn from the collected data. The results obtained from examining the sample are presumed to be that of the whole population, if and only if the sample is representative of the population.

3.8.3 Reliability analysis

Reliability is the consistency of measurement or the degree to which an instrument is measured each time and used under the same condition giving the same results (Jahanshahi et al., 2011). Leedy et al (2014) also state that the measuring instrument must be consistent and therefore, it must yield the same results when the measurement is repeated. Reliability analysis was carried out to measure the consistency of ranking scale data or ordinal data under section B, C and D in the survey questionnaire. In this study, the Cronbach's alpha coefficient was calculated for all sections using the Likert Scale.

3.8.3.1 Cronbach's alpha test

Cronbach's alpha test is the most frequently used reliability test and measures the scale of internal consistency for designing survey questionnaires. It is usually applied when, as in this study, a Likert Scale is used to determine the data's reliability and accuracy and whether it is free from random error (Tavakol and Dennick 2011:53-54). Clow and James (2014:269) recognised the advantage of using Cronbach's alpha as the correlation with other variables that

are low on items that are not a good measure of a model.

3.8.5 Factor Analysis

Factor Analysis was used in the study to analyse and indicate the measurement of the group variable. Factor analysis is used to decrease large numbers of variables to a smaller number, or a specified group as a method of data reduction which aids in restructuring the data (Robin 2012). It is also used to reveal and summarise the internal correlation among the variables. The main object of factor analysis is data reduction (Pearce 2013: 79-81) which is used to summarise data so that relationships and patterns can easily be made sense of. It is a statistical technique usually used to regroup variables into a reduced set of clusters based on shared variance and assists with isolating constructs and concepts. In this study, factor analysis was conducted using Kaiser-Meyer Olkin (KMO) and Bartlett's test, Communalities and Rotated Component Matrix for data reduction and analysis.

3.8.5.1 Kaiser-Meyer Olkin (KMO) and Bartlett's test

The Kaiser-Meyer Olkin (KMO) test was carried out in this research to establish the appropriateness of factor analysis and the measure of sampling adequacy, which depends on the index analysed by SPSS software. That is, the Kaiser-Meyer-Olkin measure of sampling adequacy value should be greater than 0.500 and Bartlett's test of sphere city sig., the value should be less than 0.05.

3.8.5.2 Rotated Component Matrix

A rotated component matrix is the main output of Principal Components Analysis (PCA), which involves appraising and estimating the correlations between every single variable with variables being grouped into a few components (Chetty and Datt 2015).The correlation between variables is based on component loading, which is computed by SPSS. It allows the researcher to name the component to interpret the result.

3.9 Delimitations/scope

The study focused on the construction management and project management processes applied in the TCP, with specific reference to the Waterbeg programme coal line expansion project. Time and budget constraints were also a factor in this research.

3.10 Limitations of the study

Limitations are different from delimitations and present the gaps applicable to the study:

- Data collection through a self-completed, closed response questionnaire, did not allow for control of the response rate;
- Even though respondents were assured that they would remain anonymous, they may have found it challenging to be completely honest when answering the questions; and
- The research was conducted during a busy period of construction, and that might have led to poor responses.

3.11 Validity

Sekaran and Bougie (2016:220) explains that validity as the measure to which the process, technique, or instruments used to measure the concept it is intended to measure or claims to examine. According to Leedy et al (2014), there are four main types of validity, these are:

- Face validity (a subjective judgement of whether the study appears to measure what it set out to);
- Criterion-related validity (a judgment of whether the measurement is based on the standards that have been set);
- Content validity (an instrument's accuracy in measuring the factors or situations understudy);
- Construct validity (whether the study's conclusions are unbiased); and
- External validity (whether the study's findings can be generalised and applied in other cases).

According to de Vaus (2014: 95), a question is valid when it measures what we think it does. For this study, face validity and content validity was ensured by relying on the literature review and input from peers and academics. The researcher notes that that validity is a necessary, but not a sufficient condition to test the reliability of a measure as a measure should not only be valid but also reliable, as a reliable measure provides consistent results (Sekaran and Bougie, 2016:221). For this study, face validity and content validity was ensured by relying on the literature review and input from peers and academics.

3.12 Ethical considerations

Faculty of Management Sciences Research Ethics Committee at the Durban University of Technology (DUT) approved the proposal for this study. An important aspect of ethical considerations is obtaining permission before administering questionnaires to employees and management. Participants were furnished with a letter of information and consent forms together with the questionnaires. Stringent techniques were used to reduce the extent to which prejudice may occur (Keeble 2013:4). The researcher adhered to all the ethical standards and guidelines set by the DUT. The necessary gatekeeper's letter was obtained (see Appendices B and C) and clearance for the research is appended as (Appendix D).

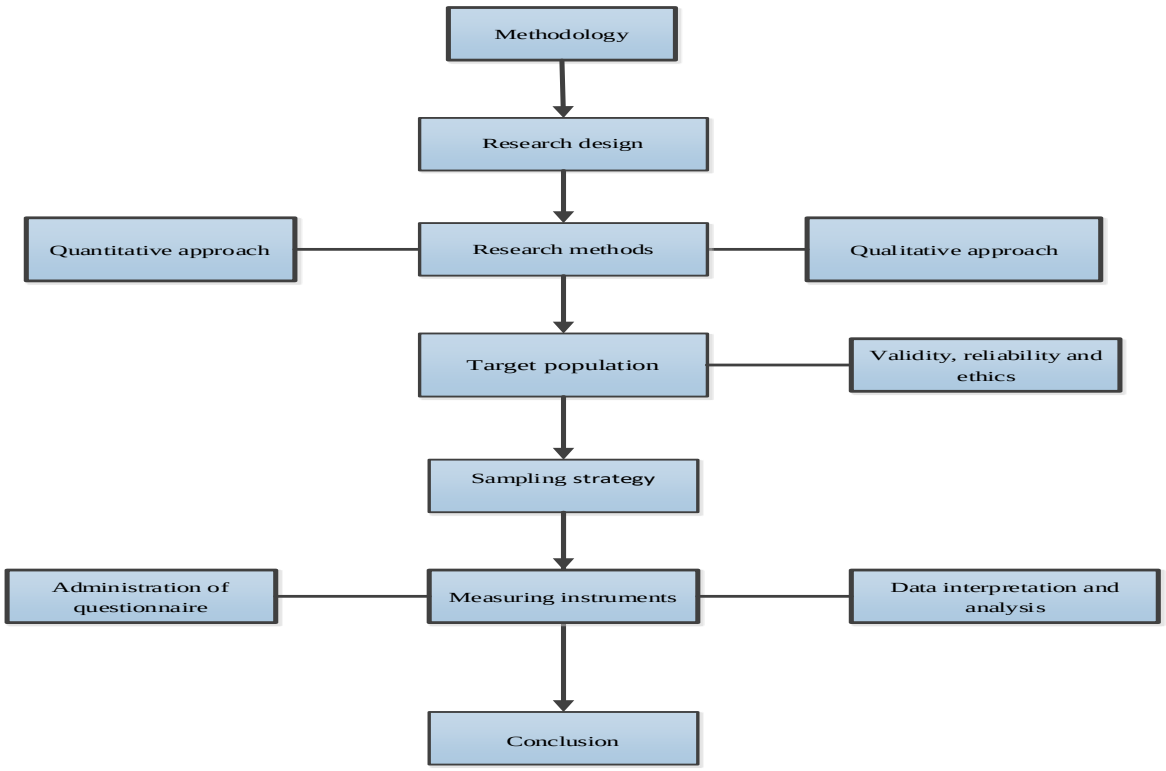
3.13 Anonymity and confidentiality

Anonymity and confidentiality were maintained throughout the study, and thus, respondents were not required to record their names or contact details on the questionnaire. The hard copies of the completed questionnaires will be safely stored by the researcher, under lock and key, for three years, and after that will be shredded. All electronic copies will be delinked from return email addresses, stored using password protection for three years and after that deleted.

3.14 Conclusion

This chapter presented the research methodology that was used in this research. The study was designed to be quantitative. The research instrument that was selected to collect data was a questionnaire. Measures to ensure the reliability and validity of the questionnaire were discussed and ethical protocols that were followed was detailed. The next chapter presents the data, the findings and interpretation.

Figure 3.1: Chapter 3 flow chart



Source: Researcher Constructed

CHAPTER FOUR

INTERPRETATION AND DISCUSSION OF THE PRIMARY DATA

4.1 Introduction

This chapter presents the results and discusses the findings obtained from the questionnaires in this study. The questionnaire was the primary tool that was used to collect data and was distributed to 98 participants. The data collected from the responses were analysed with SPSS version 25.0. The results present the descriptive statistics in the form of graphs, cross tabulations and other figures for the quantitative data that was collected. Inferential techniques include the use of correlations and Chi-square test values; which are interpreted using the p-values.

4.2 The sample

In total, 98 questionnaires were despatched, and 98 were returned, which gave a 100% response rate. This sample of 98 is taken from a population of 102 individuals.

4.3 Questionnaire response rate

The average response rate was calculated using the following formula:

Questionnaire response rate = questionnaires received x 100 ÷ (total questionnaires administered). Questionnaire response rate = 98 x 100 ÷ 98 = 100%. The response rate according to positions held is depicted in Table 4.1. The average questionnaire response rates according to the different positions held were considered to be perfectly satisfactory to proceed with statistical analysis of the data.

Position	**Sample size (No.)**	**Response rate (%)**
Principal Project Managers	2	100
Senior Project Managers – Project Managers	20	100
Construction Managers	50	100
Site Supervisors	18	100
Other employees	8	100
Total	**98**	**100**

Table 4.1: Response rate according to positions held

4.3.1 The Research Instrument

The research instrument consisted of 59 items, with a level of measurement at a nominal or an ordinal level. The questionnaire was divided into seven sections which measured various themes as illustrated below:

Table 4.2: Biographical data

Section A:	**General and Demographic Information**
	Biographical data
Section B:	**Project Management Techniques**
Objective 1	To establish the success factors for delivering quality at TCP
Objective 2	To identify the barriers to quality policy implementation at TCP
Objective 3	To establish the degree to which top management drives quality at the project sites
Objective 4	To ascertain project managers' perceptions of Quality Management Systems at TCP
Objective 5	To establish the gaps in the current quality training model at TCP

4.3.2 Reliability Statistics

The two most important aspects of precision are reliability and validity. Reliability is computed by taking several measurements on the same subjects. A reliability coefficient of 0.60 or higher is considered as 'acceptable' for a newly developed construct (Ursarchi et al., 2015). Table 4.3 reflects the Cronbach's alpha score for all the items that constituted the questionnaire. The reliability scores for all sections exceed the recommended Cronbach's alpha value of 0.60. This indicates a degree of acceptable, consistent scoring for these sections of the research.

Table 4.3: Cronbach's alpha score for items that constituted the questionnaire

		No. of Items	Cronbach's Alpha
Objective 1	To establish the success factors for delivering quality at TCP	8	0.603
Objective 2	To identify the barriers to quality policy implementation at TCP	11	0.610
Objective 3	To establish the degree to which top management drives quality at the project sites	12	0.751
Objective 4	To ascertain project managers' perceptions of Quality Management Systems at TCP.	9	0.667
Objective 5	To establish the gaps in the current quality training model at TCP.	6	0.625

4.3.3 Factor Analysis

Factor analysis is a statistical technique where the main goal is data reduction. A typical use of factor analysis is in survey research, where a researcher wishes to represent several questions with a small number of hypothetical factors. For example, as part of a national survey on political opinions, participants may answer three separate questions regarding environmental policy, reflecting issues at the local, state and national level. Each item, by itself, would be an inadequate measure of attitude towards environmental policy, but *together* they may provide a better estimate of the attitude. Factor analysis can be used to establish whether the three measures do measure the same thing. If so, they can then be combined to create a new variable, a factor score variable that contains a score for each respondent on the factor. Factor techniques are applicable to a variety of situations.

A researcher may want to know if the skills required to be a decathlete are as varied as the ten events, or if a small number of core skills are needed to be successful in a decathlon. You need not believe that factors exist to perform factor analysis. Still, in practice, the elements are usually interpreted, given names, and spoken of as real things. The matrix tables are preceded by a summarised table that reflects the results of KMO and Bartlett's Test. The requirement is that *Kaiser-Meyer-Olkin Measure of Sampling Adequacy* should be greater than 0.50 and *Bartlett's Test of Sphericity* less than 0.05. In all instances, the conditions are satisfied, which allows for the factor analysis procedure. Factor analysis is done only for the Likert Scale items. Certain components divided into finer components. This is explained below in the rotated component matrix. Table 4.4 presents the results for the KMO and Bartlett's Test.

Table 4.4: KMO and Bartlett's Test

		Kaiser-Meyer-Olkin Measure of Sampling Adequacy	Bartlett's Test of Sphericity		
			Approx. Chi-Square	df	Sig.
Objective 1	To establish the success factors for delivering quality at TCP	0.614	132.786	45	0.000
Objective 2	To identify the barriers to quality policy implementation at TCP	0.578	289.655	78	0.000
Objective 3	To establish the degree to which top management drives quality at the project sites	0.595	362.486	66	0.000
Objective 4	To ascertain project managers' perceptions of Quality Management Systems at TCP.	0.611	240.300	36	0.000
Objective 5	To establish the gaps in the current quality training model at TCP.	0.555	183.498	21	0.000

All of the conditions are satisfied for factor analysis. That is, the Kaiser-Meyer-Olkin Measure of Sampling Adequacy value should be greater than 0.500 and Bartlett's Test of Sphericity sig. value should be less than 0.05. Table 4.5 presents the rotated component matrix for items relating to objective one.

Table 4.5: Rotated Component Matrix for objective 1

Objective 1	Component			
	1	2	3	4
The TCP have a project management process in place for the management of the Waterberg programme coal Line expansion Project	0.004	0.068	0.066	0.768
The teams participate in the development of the project quality management documentations	0.282	0.391	0.113	0.646
There is a lack of communication between teams about major project milestones	-0.092	-0.208	-0.213	0.535
The project governance structure includes quality assurance	-0.177	0.699	0.062	0.114
The management system implementation is of an acceptable standard	0.104	0.731	0.110	-0.094
Project managers and contractors do understand the differences between quality control and quality assurance	0.484	0.585	-0.214	0.089
The Project risk management plan is in place	0.835	-0.009	-0.037	-0.014
Positive and negative risks are communicated	0.837	0.034	0.174	0.058
The employees are loyal to the project as they initiate quality related ideas	0.385	0.042	0.713	-0.093
Recognition awards are given to employees who promote a quality culture	-0.157	0.061	0.862	0.044

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalisation. Rotation converged in 6 iterations.

The ten items relating to success factors for delivering quality has been sorted into four overlapping groups. The first group (brown) identifies a construct that can be named communication. The second group (green) identifies a construct that can be named quality management. The third group (yellow) identifies a construct that can be named risk management and lastly fourth group (blue) which indicates a construct of employee centeredness. Table 4.6 presents the rotated component matrix for items relating to objective 2.

Table 4.6: Rotated Component Matrix for objective 2

Objective 2	Component				
	1	2	3	4	5
The tender clarification processes clearly define the scope of work, services and deliverables	-0.095	0.080	0.198	0.763	-0.049
The problems related to the Waterberg programme coal line expansion project are caused by the contractor using unskilled labour	0.119	0.066	-0.249	0.188	0.781
The Project execution plans formulate major project constraints for overall project execution strategy	-0.060	-0.196	0.313	-0.195	0.709
The project deliverables are verified against customer's specifications to ensure customer's satisfaction	-0.213	0.018	0.678	0.284	-0.011
Scope deviations are a major project milestone's concern	0.158	0.039	0.847	-0.145	-0.021
Project failure is characterised by poorly structured documents	0.099	0.529	0.413	0.054	0.322
The environment is conducive to promote a quality improvement culture	-0.045	0.861	0.097	-0.048	-0.083
Project monitoring is measurable in terms of compliance with specified project format	0.085	0.828	-0.120	0.111	-0.102
The quality management plan includes customer requirements	0.641	-0.176	-0.054	0.236	0.339
Quality management systems are communicated to the contractors involved in the project	0.371	0.007	-0.149	0.738	0.117
There is a quality management system policy in place	0.691	-0.071	-0.312	0.422	0.094
There is sufficient administration support given to customers	0.763	0.050	0.126	0.036	-0.127
The Lack of client's involvement in the project holds back quality achievements	0.652	0.290	0.027	-0.251	0.038

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalisation.
a. Rotation converged in 10 iterations.

The thirteen statements relating to barriers to quality policy implementation at TCP, seven overlapping groups were found. The first group (peach) identifies a sub-theme that can be named tender clarification process. The second group (grey) identifies a sub-theme that can be named execution and recruitment plan. The third group (blue) identifies a sub-theme that can be named deliverables and the fourth group (lime), which indicates a sub-theme of project documentation and environment. The fifth theme (yellow) suggests customer requirements, the sixth group (orange) is communication and lastly the last group (green) indicate administration client involvement. Table 4.7 presents the rotated component matrix relating to items for objective three.

Table 4.7: Rotated Component Matrix for objective 3

Objective 3	Component			
	1	2	3	4
Projects are administered properly (reference to project controls, engineering, construction, commissioning and quality assurance)	-0.387	0.232	0.226	0.685
Projects are implemented on time	0.154	0.852	-0.135	0.027
Strategic project management best practices are implemented to improve quality	0.267	0.673	0.039	0.356
The Project is properly planned	-0.195	0.694	0.271	0.062
The project executive team is supportive towards the success of the project	0.265	0.462	0.370	-0.117
The inspection and test hold points of the project milestone are critical to ensure that quality standards are being met	0.044	-0.050	0.907	-0.050
Quality control plan may include the requirement for "witnesses' inspection" of critical items for the project	0.057	0.193	0.847	0.068
Strategic plans are implemented to improve quality	0.532	0.221	0.189	0.466
Employee's creates quality circles or discussion for the success of the project	0.248	0.089	-0.191	0.634
The employees have the responsibility of carrying out project's activities	0.360	-0.084	-0.010	0.718
New employees are assigned to work with experienced employees for job instruction	0.871	0.076	-0.073	0.112
The employees participate in the inspection of the quality related deficiency	0.753	0.100	0.180	0.170

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalisation. Rotation converged in 6 iterations

The twelve items relating to drivers to quality at project sites have been sorted into six overlapping groups. The first group (peach) identifies a sub-theme that can be named administration. The second group (lime) identifies a sub-theme that can be named strategy. The third group (blue) identifies a sub-theme that can be named quality control, the fourth group (orange), which indicates a sub-theme of implementation. The fifth group (purple) show employee quality circles and the last group (yellow) is teamwork. Table 4.8 presents the rotated component matrix for items relating to objective 4.

Table 4.8: Rotated Component Matrix for objective 4

Objective 4	Component		
	1	2	3
The quality management plan is clearly communicated during gate review process	0.652	0.055	0.140
The quality management team adopts an open door policy allowing the contractor to ask quality related questions	0.865	0.026	0.103
The quality management plan defines the goals, critical factors and metrics to measure project success	0.842	0.045	0.126
Quality assurance is everyone's responsibility	0.394	0.574	-0.301
The TCP view quality assurance as a continuous improvement tool	0.141	0.781	-0.067
In a quality management information system, there is a need to collect data	-0.112	0.851	0.192
The collection of information should be part of project process	-0.120	0.553	0.625
Most project quality problems are the results of poor quality training	0.229	-0.029	0.706
There should be the verification of deliverables against customer's specifications to ensure customer satisfaction is achieved	0.186	-0.046	0.861

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalisation. Rotation converged in 6 iterations.

The nine items relating to quality management systems have been sorted into three overlying groups. The first group (yellow) identifies a sub-theme that can be named communication. The second group (green) identifies a sub-theme that can be named quality assurance. The third group (blue) identifies a sub-theme that can be named project process. Table 4.9 presents the rotated component matrix for items relating to objective five.

Table 4.9: Rotated Component Matrix for objective 5

Objective 5	Component		
	1	2	3
All stakeholders are in attendance at relevant meetings to contribute to ideas	0.682	0.175	0.248
Approved change management processes have been identified for the project and communicated to the project teams	0.907	-0.057	-0.004
The project steering committee has been introduced effectively	0.902	0.007	-0.026
The technical competency by the contractors affects the project completion	0.138	0.063	0.841
The project resource plan is clearly communicated	0.204	0.778	-0.138
Lessons learned from other successful projects within Transnet Capital Projects are available at archives for Waterberg programme coal line expansion project	0.049	0.628	-0.600
A different quality management model needs to be developed for the success of the project i.e. TQM	-0.138	0.818	0.231

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalisation. Rotation converged in 4 iterations

The seven items relating to gaps in the current quality training model at TCP has been sorted into three overlapping groups. The first group (yellow) identifies a sub-theme that can be named stakeholder management. The second group (blue) identifies a sub-theme that can be named contractor technical competence. The third group (blue) identifies a sub-theme that can be named process improvement.

A typical use of factor analysis is in survey research, where a researcher wishes to represent a number of questions with a small number of hypothetical factors. With reference to the Tables 4.5 to 4.9 above:

- The principal component analysis was used as the extraction method, and the rotation method was Varimax with Kaiser Normalisation. This is an orthogonal rotation method that minimises the number of variables that have high loadings on each factor. It simplifies the interpretation of the elements.
- Factor analysis/loading show inter-correlations between variables.
- Items of questions that loaded similarly imply measurement along with a similar factor. An examination of the content of items loading at or above 0.5 (and using the higher or highest loading in instances where items cross-loaded at more significant than this value) effectively measured along with the various components.

It is noted that the variables that constituted the other objectives loaded along 3 to 5 components (sub-themes). This means that respondents identified different trends within the section. Within the section, the splits are colour coded.

The following are the sub-themes obtained for each of the objectives as detailed below:

Objective 1: communication, quality, risk management and employee centeredness
Objective 2: tender clarification, execution and recruitment, deliverables, documentation and environment, customer requirements, communication and administration and client involvement.
Objective 3: administration, strategy, quality control, implementation, employee quality circles and teamwork
Objective 4: communication, quality assurance and project process
Objective 5: stakeholder management, technical competence and communication and process improvement.

4.3 Section A: Biographical Data

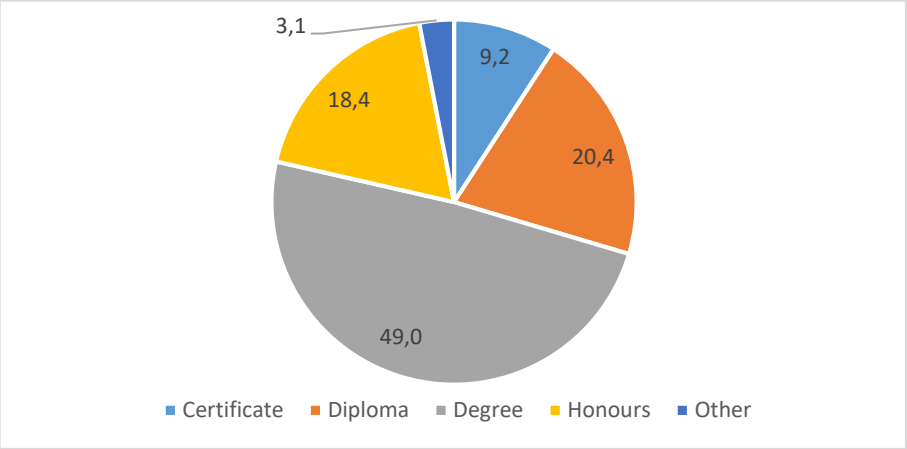
This section summarises the biographical characteristics of the respondents. Table 4.10 describes the overall gender distribution by age.

Table 4.10: Cross tabulation between Age group and gender

			Gender		Total
			Male	Female	
Age Group (years)	19 – 24	Count	13	13	26
		% within Age Group	50.0%	50.0%	100.0%
		% within Gender	24.1%	29.5%	26.5%
		% of Total	13.3%	13.3%	26.5%
	25 – 34	Count	32	25	57
		% within Age Group	56.1%	43.9%	100.0%
		% within Gender	59.3%	56.8%	58.2%
		% of Total	32.7%	25.5%	58.2%
	35 – 44	Count	9	6	15
		% within Age Group	60.0%	40.0%	100.0%
		% within Gender	16.7%	13.6%	15.3%
		% of Total	9.2%	6.1%	15.3%
Total		Count	54	44	98
		% within Age Group	55.1%	44.9%	100.0%
		% within Gender	100.0%	100.0%	100.0%
		% of Total	55.1%	44.9%	100.0%

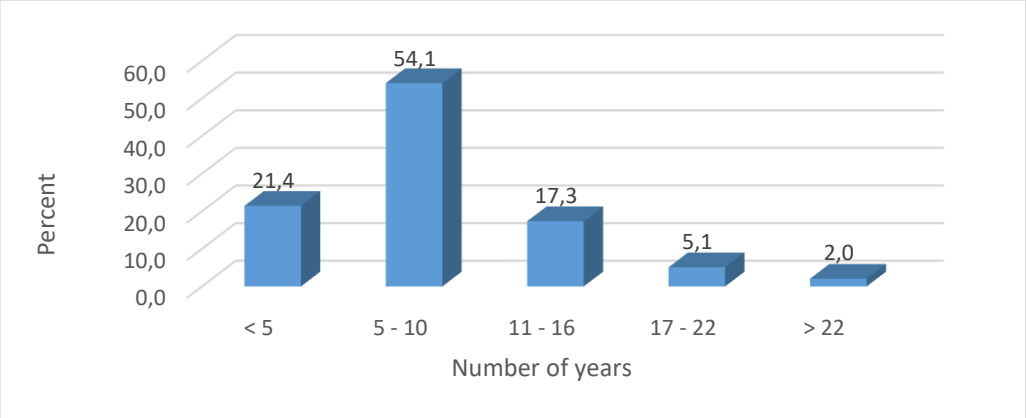
Overall, the ratio of males to females is approximately 5:4 (55.1%: 44.9%) ($p = 0.312$).Within the age category of 25 to 34 years, 56.1% were male. Within the category of males (only), 59.3% were between the ages of 25 to 34 years. This category of males between the ages of 25 to 34 years formed 32.7% of the total sample. There is a significant difference in the spread by age ($p < 0.001$). 26 of those surveyed were in the 19 to 24 age category. Of this cohort, 50% were male, and the rest were female. For the 35 to 44 age bracket, over half of the respondents (60%) were male, and 40% were female.

Figure 4.1: Education levels of the respondents



Approximately half of the respondents (49.0%) had a degree qualification; with nearly one-fifth of the respondents (18.4%) had a postgraduate degree. Only 20.4% of those who were surveyed have a diploma qualification, and hardly any of the respondents have other qualifications as recorded by 3.1%. This is a useful statistic as it indicates that a fair proportion of the respondents have a higher qualification. This shows that the responses gathered would have been from an informed (learned) source.

Figure 4.2: Showing respondent's years of experience



Nearly 80% of the respondents had been in the industry for more than 5 years ($p < 0.001$). This implies that respondents had been in employ for a while, and this is also a useful fact as it indicates responses from experienced workers.

4.4 Section B: Analysis

This section analyses the scoring patterns of the respondents per variable per section. The results are first presented using summarised percentages for the variables that constitute each section. Results are then further analysed according to the importance of the statements.

4.4.1 Objective 1: To establish the success factors for delivering quality at Transnet Capital Projects TCP). This section deals with finding the success factors necessary for delivering quality at TCP. Table 4.11 details the frequency, percentage and Chi-Square statistics as they relate to objective 1.

4.4.1.1 Scoring Patterns of Objective 1

The discussion regarding the scoring patterns per statement is presented below based on the data in Table 4.11.

Table 4.11: Summary of the scoring patterns for objective 1

		Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		Chi-Square
		Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count
The TCP have a project management process in place for the management of the Waterberg programme coal Line	B1	3	3.1%	2	2.0%	7	7.1%	51	52.0%	35	35.7%	0.000

expansion Project												
The teams participate in the development of the project quality management documentations	B2	0	0.0%	7	7.1%	16	16.3%	61	62.2%	14	14.3%	0.000
There is a lack of communication between teams about major project milestones	B3	1	1.0%	14	14.3%	20	20.4%	55	56.1%	8	8.2%	0.000
The project governance structure includes quality assurance	B4	0	0.0%	16	16.5%	10	10.3%	55	56.7%	16	16.5%	0.000
The management system implementation is of an acceptable standard	B5	1	1.0%	12	12.4%	21	21.6%	51	52.6%	12	12.4%	0.000
Project managers and contractors do understand the differences between quality control and quality assurance	B6	2	2.1%	15	15.5%	12	12.4%	53	54.6%	15	15.5%	0.000
The Project risk management plan is in place	B7	0	0.0%	5	5.2%	11	11.3%	68	70.1%	13	13.4%	0.000
		Strongly Disagree		**Disagree**		**Neutral**		**Agree**		**Strongly Agree**		**Chi-Square**
		Count	**Row N %**	**Count**	**Row N %**	**Count**	**Row N %**	**Count**	**Row N %**	**Count**	**Row N %**	**Count**
Positive and negative risks are	B8	0	0.0%	10	10.3%	19	19.6%	60	61.9%	8	8.2%	0.000

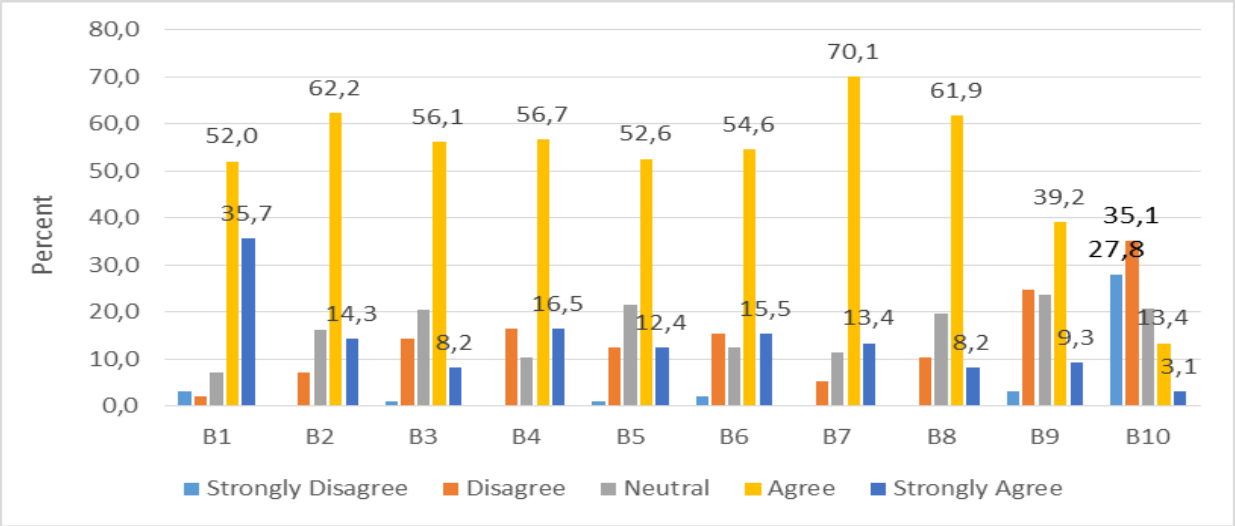
communicated												
The employees are loyal to the project as they initiate quality related ideas	B9	3	3.1%	24	24.7%	23	23.7%	38	39.2%	9	9.3%	0.000
Recognition awards are given to employees who promote a quality Culture	B10	27	27.8%	34	35.1%	20	20.6%	13	13.4%	3	3.1%	0.000

Table 4.11 determines whether the scoring patterns per statement were significantly different per option, a Chi-square test was done. The null hypothesis claims that similar numbers of respondents scored across each option for each statement (one statement at a time). The alternate states that there is a significant difference between the levels of agreement and disagreement. The results are shown in the Table 4.11. The highlighted sig. values (p-values) are less than 0.05 (the level of significance); it implies that the distributions were not similar. That is, the differences between the ways respondents scored were significant.

4.4.1.2 Success Factors

Figure 4.3 presents a graphical representation of the degree to which respondents agreed or disagreed with the statements pitched in this section.

Figure 4.3: Scoring pattern for success factors for delivering quality



As inferred from Figure 4.3, the respondents mostly agree to all the questions they were asked. However, there is heterogeneity among respondents in terms of recognition awards. Some employees feel they are not recognised, whereas some do. This could mean that the rewards are targeted to a certain group/ class in or targeted to a specific ask fulfilment that some may not be able to do. The following patterns are observed:

- Some statements show (significantly) higher levels of agreement whilst other levels of agreement are lower (but still greater than levels of disagreement);
- One statement (B10) indicates higher levels of disagreement; and
- The significance of the differences is tested and shown in Table 4.11

There was a lack of communication between teams about major project milestones (B3). The graph reveals that 8.2% of respondents strongly agree and 56.1% agree, indicating that the majority of the participants viewed the statement positively. In other words, 64.3% agree or strongly agree that there was a lack of communication between teams about major project milestones. Positive and negative risks are communicated (B8) yielded 0% as none strongly disagreed and only 10.3% of the participants just disagreed, showing an agreement rate of 61.9% and a strongly agreed rate of 8.2%. The results also indicate that 70% of the respondents were in favour of the statement, indicating that effective communication on risk took place in the organisation. A different situation is thus visible in this case of B9 where 24.7% disagreed with the statement, 39.2% agreed and 9.3% strongly agreed. Another important fact is that 23.7% of the participants chose to be neutral concerning the statement. Thus, employees do not

initiate quality related initiatives.

The factor analysis performed earlier (Table 4.5: Rotated Component Matrix for Objective 1) identified the following sub-themes: communication, quality management, risk management and employee centeredness. The two areas that need to be improved upon is communication and employee centeredness. One of the success factors to deliver quality service is that of communication, particularly in a project environment. Muszynska (2015) suggested that effective communication in a project contributes positively to the success of the project. Employee loyalty and reward are interlinked and there is room for development in this area at TCP. On a positive note the results indicate that project risk management is in place. Nguyen et al.(2015) as well as Zwikael and Smyrk (2015) suggest that quality in governance matters is a significant determinant of project success and in this study moderate levels of agreement (B4-B6) have been noted.

4.4.2 Objective 2: To identify the barriers to quality policy implementation at TCP. In this section, barriers to quality policy implementation were identified so that the necessary action could be taken to overcome such obstacles.

4.4.2.1 Scoring Patterns of Objective 2

The discussion regarding the scoring patterns per statement for objective 2 is presented below based on the data in Table 4.12.

Table 4.12: Summary of the scoring patterns for objective 2

		Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		Chi-Square
		Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	p-value
The tender clarification processes clearly define the scope of work, services and deliverables	B11	0	0.0%	1	1.0%	14	14.3%	67	68.4%	16	16.3%	0.000

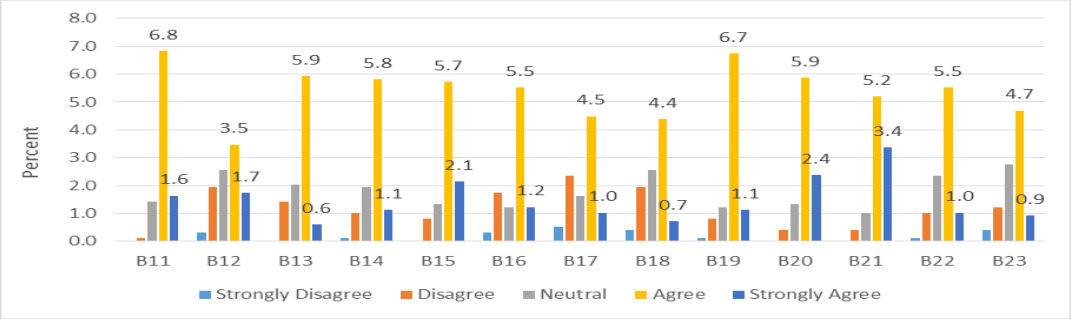
The problems related to the Waterberg programme coal line expansion project are caused by the contractor using unskilled labour	B12	3	3.1%	19	19.4%	25	25.5%	34	34.7%	17	17.3%	0.000
The Project execution plans formulate major project constraints for overall project execution strategy	B13	0	0.0%	14	14.3%	20	20.4%	58	59.2%	6	6.1%	0.000
The project deliverables are verified against customer's specifications to ensure customer's satisfaction	B14	1	1.0%	10	10.2%	19	19.4%	57	58.2%	11	11.2%	0.000
Scope deviations are a major project milestone's concern	B15	0	0.0%	8	8.2%	13	13.3%	56	57.1%	21	21.4%	0.000
Project failure is characterised by poorly structured documents	B16	3	3.1%	17	17.3%	12	12.2%	54	55.1%	12	12.2%	0.000
The environment is conducive to promote a quality improvement culture	B17	5	5.1%	23	23.5%	16	16.3%	44	44.9%	10	10.2%	0.000
Project monitoring is measurable in terms of compliance with specified project format	B18	4	4.1%	19	19.4%	25	25.5%	43	43.9%	7	7.1%	0.000
The quality management plan includes customer requirements	B19	1	1.0%	8	8.2%	12	12.2%	66	67.3%	11	11.2%	0.000
Quality management systems are communicated to the contractors involved in the project	B20	0	0.0%	4	4.1%	13	13.4%	57	58.8%	23	23.7%	0.000
There is a quality management system policy in place	B21	0	0.0%	4	4.1%	10	10.2%	51	52.0%	33	33.7%	0.000
There is sufficient administration support given to customers	B22	1	1.0%	10	10.2%	23	23.5%	54	55.1%	10	10.2%	0.000
The Lack of client's involvement in the project holds back quality achievements	B23	4	4.1%	12	12.2%	27	27.6%	46	46.9%	9	9.2%	0.000

To determine whether the scoring patterns per statement were significantly different per option, a Chi-square test was done. The significance of the differences is tested and shown in Table 4.12. The highlighted sig. values (p-values) are less than 0.05 (the level of significance); it implies that the distributions were not similar. That is, the differences between the ways respondents scored were significant.

4.4.2.2 Barriers to policy implementation at TCP

Figure 4.4 presents a graphical representation of the degree to which respondents agreed or disagreed with the statements pitched in this section.

Figure 4.4: Scoring pattern for barriers to policy implementation at TCP



The results for barriers to policy implementation at TCP indicate that respondents mostly agreed to each of the items that they were asked about. Most disagreement was noted on items B17, which enquires if the environment is conducive to promote a quality improvement culture.

The following patterns are observed:

Some statements show (significantly) higher levels of agreement whilst other levels of agreement are lower (but still greater than levels of disagreement). High levels of indecision (neutral) was noted in B12, B18 and B22. There was greater agreement among the respondents when asked if the tender clarification processes clearly define the scope of work, services and deliverables (B11). A total of 84.7% respondents affirm that the tender process is clearly defined. There was a low level of agreement (52%) that the problems related to the Waterberg programme coal line expansion project are caused by contractors using unskilled labour. There

was moderate level of agreement (65.3%) that the project execution plans formulate major project constraints for overall project execution strategy. While there was a moderate level of agreement that project failure is characterised by poorly structured documents (B16), the were notably low levels of agreement that the environment is conducive to promote a quality improvement culture (B17) and that project monitoring is measurable in terms of compliance with specified project format (B18). There was a moderate level of agreement regarding the lack of client's involvement in the project (B23). There were high levels of agreement with regards to the remaining items

In the factor analysis performed earlier (Table 4.6), the seven sub-themes for this section were found to be tender process, execution and recruitment plan, deliverables, documentation and environment, client requirements, communication and administration and client involvement. The findings by Worku (2016), underscore that if the tender process is not transparent, then the projects cannot be successful. This has not been identified as a short coming at TCP. However execution and recruitment is noted an area for improvement, pointing to the fact that having a flawed recruitment plan and not doing due diligence in the verification process become obstacles to quality implementation at TCP. Other areas that needs improvement is that of documentation, an environment to promote quality improvement and more client involvement.

4.4.3 Objective 3: To establish the degree to which top management drives quality at the project sites.

4.4.3.1 Scoring Patterns of Objective 3

The discussion regarding the scoring patterns per statement for objective 3 is presented below based on the data in Table 4.13.

Table 4.13: Summary of the scoring pattern for objective 3

		Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Chi-Square**

		Count	Row N %	Count	Row N %	Count	Row N %	t	Row N %	Count	Row N %	Count
Projects are administered properly (reference to project controls, engineering, construction, commissioning and quality assurance)	B24	0	0.0%	8	8.2%	14	14.3%	62	63.3%	14	14.3%	0.000
Projects are implemented on time	B25	13	13.3%	40	40.8%	12	12.2%	29	29.6%	4	4.1%	0.000
Strategic project management best practices are implemented to improve quality	B26	6	6.1%	32	32.7%	18	18.4%	35	35.7%	7	7.1%	0.000
The Project is properly planned	B27	3	3.1%	9	9.2%	17	17.3%	59	60.2%	10	10.2%	0.000
		Strongly Disagree		**Disagree**		**Neutral**		**Agree**		**Strongly Agree**		**Chi-Square**
		Count	**Row N %**	**Count**	**Row N %**	**Count**	**Row N %**	**Count**	**Row N %**	**Count**	**Row N %**	**Count**
The project executive team is supportive towards the success of the project	B28	1	1.0%	14	14.3%	20	20.4%	55	56.1%	8	8.2%	0.000
The inspection and test hold points of the project milestone are critical to ensure that quality standards are being met	B29	0	0.0%	2	2.0%	8	8.2%	58	59.2%	30	30.6%	0.000

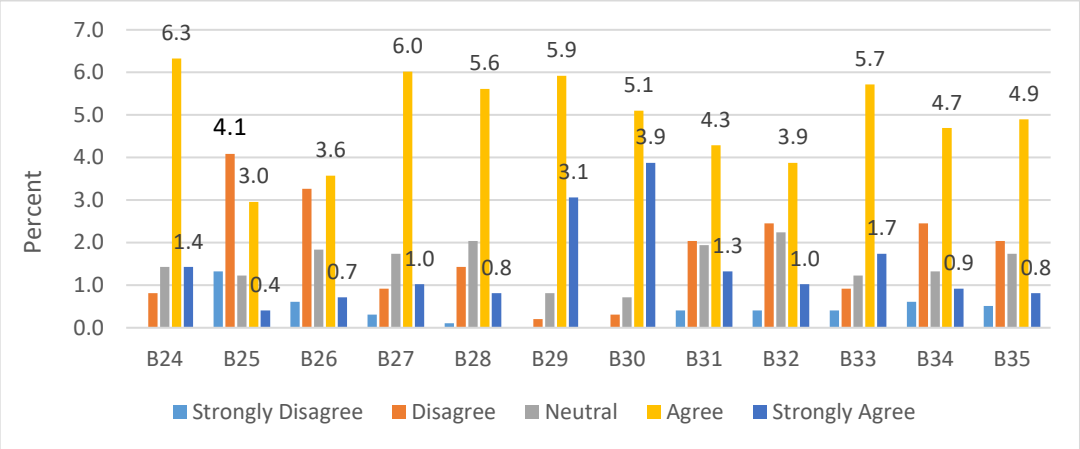
Quality control plan may include the requirement for “witnesses’ inspection” of critical items for the project	B30	0	0.0%	3	3.1%	7	7.1%	50	51.0%	38	38.8%	0.000
Strategic plans are implemented to improve quality	B31	4	4.1%	20	20.4%	19	19.4%	42	42.9%	13	13.3%	0.000
Employee’s creates quality circles or discussion for the success of the project	B32	4	4.1%	24	24.5%	22	22.4%	38	38.8%	10	10.2%	0.000
The employees have the responsibility of carrying out project’s activities	B33	4	4.1%	9	9.2%	12	12.2%	56	57.1%	17	17.3%	0.000
New employees are assigned to work with experienced employees for job instruction	B34	6	6.1%	24	24.5%	13	13.3%	46	46.9%	9	9.2%	0.000
The employees participate in the inspection of the quality related deficiency	B35	5	5.1%	20	20.4%	17	17.3%	48	49.0%	8	8.2%	0.000

To determine whether the scoring patterns per statement were significantly different per option, a Chi-square test was done. The significance of the differences is tested and shown in the Table 4.13. The highlighted sig. values (p-values) are less than 0.05 (the level of significance); it implies that the distributions were not similar. That is, the differences between the ways respondents scored were significant.

4.4.3.2 Barriers to policy implementation at TCP

Figure 4.5 presents a graphical representation of the degree to which respondents agreed or disagreed with the statements pitched in this section.

Figure 4.5: Scoring pattern for driving quality in project sites



The following patterns were observed:

- Some statements show (significantly) higher levels of agreement whilst other levels of agreement are lower (but still greater than levels of disagreement);
- B29 and B30 statements indicate higher levels of agreement than disagreement;
- B25 shows higher levels of disagreement than agreement; and
- B26 shows similar levels of agreement and disagreement.

The results for the scoring pattern for driving quality in project sites show high levels of ageement (70.4%) that the project is properly planned (B27) and a moderate level of agreement (64.3%) that the project executive team is supportive towards the success of the project (B28), there is disagreement (54.1%) that projects are implemented on time (B25).

There is also a low level of agreement that strategic project management best practices are implemented to improve quality (B26).

The majority of the participants agreed (89.8%) that the inspection and test hold points of the project milestone are critical to ensure that quality standards are being met (B29) and the majority agreed (89.8%) that quality control plan may include the requirement for 'witnesses' inspection' of critical items for the project (B30). This is a positive finding in view of Mane and Patil's (2015) assertion that that quality control is very pivotal in achieving acceptable performance.

While there is a high level of agreement that employees have the responsibility of carrying out project's activities (B33) there is low level of agreement on the creation of quality circles or discussion for the success of the project (B32). With regards to teamwork, there is a low level of agreement that new employees are assigned to work with experienced employees for job instruction (B34) and that employees participate in the inspection of the quality related deficiency (B35)

In the factor analysis performed earlier in (Table 4.7: Rotated Component Matrix for objective 3) sub-themes that emanated include: administration, strategy, quality control, implementation, quality circles and good teamwork. The areas that require improvement have been identified to include: timely project implementation, quality circles and teamwork. As put forward by Zuo et al. (2018), teamwork is central in emotional intelligence and that of driving project quality.

4.4.4 Objective 4: Quality Management Systems at TCP. This section examined the Quality Management Systems at TCP. Factors that affect or promote quality were explored.

4.4.4.1 Scoring Patterns of Objective 4

The discussion regarding the scoring patterns per statement for objective 4 is presented below based on the data in Table 4.14.

Table 4.14: Summary of the scoring patterns for objective 4

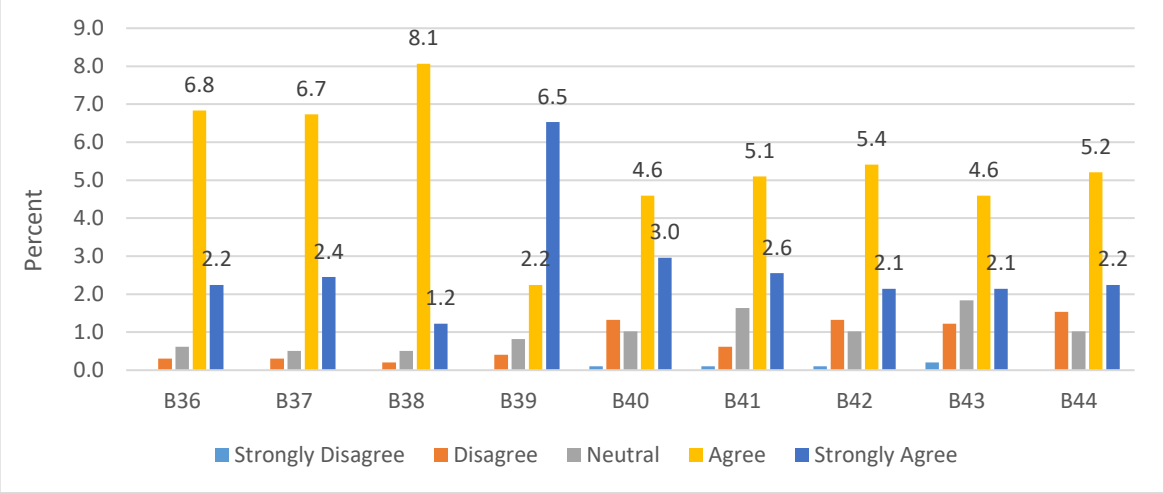
		Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		Chi-Square
		Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	p-value
The quality management plan is clearly communicated during gate review process	B36	0	0.0%	3	3.1%	6	6.1%	67	68.4%	22	22.4%	0.000
The quality management team adopts an open door policy allowing the contractor to ask quality related questions	B37	0	0.0%	3	3.1%	5	5.1%	66	67.3%	24	24.5%	0.000
The quality management plan defines the goals, critical factors and metrics to measure project success	B38	0	0.0%	2	2.0%	5	5.1%	79	80.6%	12	12.2%	0.000
Quality assurance is everyone's responsibility	B39	0	0.0%	4	4.1%	8	8.2%	22	22.4%	64	65.3%	0.000
The TCP view quality assurance as a continuous improvement tool	B40	1	1.0%	13	13.3%	10	10.2%	45	45.9%	29	29.6%	0.000
In a quality management information system, there is a need to collect data	B41	1	1.0%	6	6.1%	16	16.3%	50	51.0%	25	25.5%	0.000
The collection of information should be part of project process	B42	1	1.0%	13	13.3%	10	10.2%	53	54.1%	21	21.4%	0.000
Most project quality problems are the results of poor quality training	B43	2	2.0%	12	12.2%	18	18.4%	45	45.9%	21	21.4%	0.000
There should be the verification of deliverables against customer's specifications to ensure customer satisfaction is achieved	B44	0	0.0%	15	15.3%	10	10.2%	51	52.0%	22	22.4%	0.000

To determine whether the scoring patterns per statement were significantly different per option, a Chi-square test was done. The highlighted sig. values (p-values) are less than 0.05 (the level of significance); it implies that the distributions were not similar. That is, the differences between the ways respondents scored were significant. Figure 4.6 presents a graphical representation of the responses to items relating to quality management at TCP.

4.4.4.2 Barriers to policy implementation at TCP

Figure 4.6 presents a graphical representation of the degree to which respondents agreed or disagreed with the statements pitched in this section.

Figure 4.6: Quality management at TCP



The following patterns are observed: overall all statements show (significantly) higher levels of agreement whilst other levels of agreement are lower (but still greater than levels of disagreement). The results depicted in Figure 4.6 show that majority (92.9%) of the respondents agreed that the quality management plan defines the goals, critical factors and metrics to measure project success (B38). Almost the same level of affirmation (91.8%) was revealed in B37 that enquired if the quality management team adopts an open door policy allowing the contractor to ask quality related questions. Similarly, 90.8% agreed that the quality management plan is clearly communicated during gate review process (B36).

There were high levels of agreement for each of the statements: Quality assurance is everyone's responsibility; The TCP view quality assurance as a continuous improvement tool; and in a quality management information system, there is a need to collect data. There was a moderate level of agreement (67.3%) on the item enquiring whether project quality problems are the results of poor quality training.

4.4.5 Objective 5: To establish the gaps in the current quality training model at TCP. This section details the gaps in the current quality training model at TCP.

4.4.5.1 Scoring Patterns of Objective 4

The discussion regarding the scoring patterns per statement for objective 5 is presented below based on the data in Table 4.15.

Table 4.15: Summary of the scoring patterns for objective 5

		Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		Chi-Square
		Count	Row N %	Count	Row N %	Count	Row N %			Count	Row N %	Count
All stakeholders are in attendance at relevant meetings to contribute to ideas	B45	6	6.1%	33	33.7%	20	20.4%	29	29.6%	10	10.2%	0.000

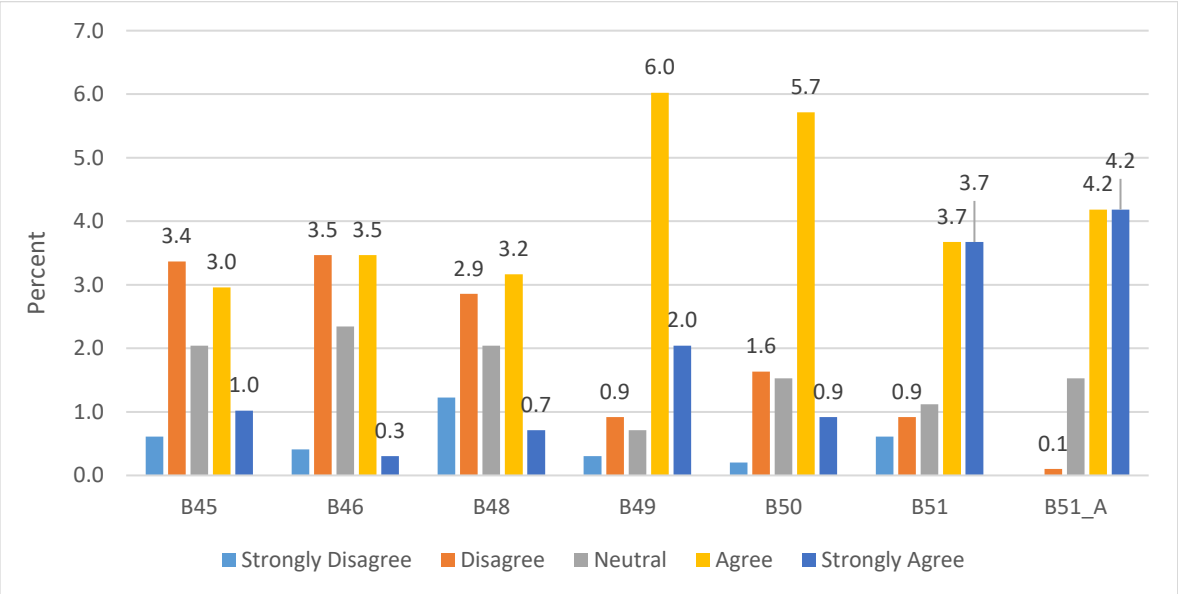
Approved change management processes have been identified for the project and communicated to the project teams	B46	4	4.1%	34	34.7%	23	23.5%	34	34.7%	3	3.1%	0.000
The project steering committee has been introduced effectively	B48	12	12.2%	28	28.6%	20	20.4%	31	31.6%	7	7.1%	0.000
The technical competency by the contractors affects the project completion	B49	3	3.1%	9	9.2%	7	7.1%	59	60.2%	20	20.4%	0.000
The project resource plan is clearly communicated	B50	2	2.0%	16	16.3%	15	15.3%	56	57.1%	9	9.2%	0.000
Lessons learned from other successful projects within Transnet Capital Projects are available at archives for Waterberg programme coal line expansion project	B51	6	6.1%	9	9.2%	11	11.2%	36	36.7%	36	36.7%	0.000
A different quality management model needs to be developed for the success of the project i.e. TQM	B51-A	0	0.0%	1	1.0%	15	15.3%	41	41.8%	41	41.8%	0.000

To determine whether the scoring patterns per statement were significantly different per option, a Chi-square test was done. The significance of the differences is tested and shown in the table 4.25. The highlighted sig. values (p-values) are less than 0.05 (the level of significance); it implies that the distributions were not similar. That is, the differences between the ways respondents scored were significant. Figure 4.7 presents a graphical representation for the scoring pattern for items relating to objective 5.

4.4.5.2 Barriers to policy implementation at TCP

Figure 4.7 below presents a graphical representation of the degree to which respondents agreed or disagreed with the statements pitched in this section.

Figure 4.7: Scoring pattern for gaps in quality training



The following patterns were observed:

- Some statements show (significantly) higher levels of agreement whilst other levels of agreement are lower (but still greater than levels of disagreement);
- Some statements show (significantly) higher levels of disagreement than agreement; and
- B49 and B51_A indicates higher levels of agreement.

Figure 4.7 above reveals a higher disagreement of 40.8% compared to agreement on item B48 that enquired if the project steering committee has been introduced effectively. A disagreement of 39.8% is shown in B45 were respondents were asked if all the stakeholders are in attendance at relevant meetings to contribute to ideas and disagreed the same way 38.8%, that asked if the approved change management processes have been identified for the project and communicated to the project teams. There were high levels of agreement on B49-B51.

Further analysis, as extracted from factor analysis, show that gaps are in management linked to stakeholders and committees, technical competence and in the communication and model development. Further analysis shows that the absence of stakeholders at meetings and a poor steering committee can be a severe gap in the training models at TCP.

4.5 Cross tabulations

The traditional approach to reporting a result requires a statement of statistical significance. A **p-value** is generated from a **test statistic.** A significant result is indicated with "$p < 0.05$". A second Chi-square test was performed to determine whether there was a statistically significant relationship between the variables (rows vs columns). The null hypothesis states that there is no association between the two. The alternate hypothesis indicates that there is an association. The table summarises the results of the Chi-square tests. (Appendices E). For instance, (see line 478) the p-value between the *project governance structures* includes quality assurance and *please indicate your highest tertiary education level* is 0.007. This means that there is a significant relationship between the variables highlighted in yellow. That is, the education level of the respondent did play a significant role in terms of how respondents viewed the inclusion of quality assurance. All p-values more than 0.05 do not have a significant relationship. (That is, for example, the biographical factor did not affect how respondents scored.)

4.6 Correlations

Bivariate correlation was also performed on the (ordinal) data. The results are found in the appendix (see excel sheet: Correlations; table too large to put here). The results indicate the following patterns. Positive values indicate a directly proportional relationship between the variables, and a negative value indicates an inverse relationship. All significant relationships are indicated by a * or **. There is statistical evidence of a correlation between objective 1 through to 5. However, the strength of this correlation weakens from objective 1 to 5.

In all the correlations, the results showed that directly related proportionality. The correlation of 0.562 between objective 1 and 2 is worth noting since objective 1 is about establishing success factors for delivering quality at TCP and the second being that identifying barriers to quality policy implementation. Respondents indicate that the greater the success factors, the more easily barriers are identified, and vice versa. Again the weakening of the strength of the correlation is objective 2 to 5. Remarkably the positive correlations show exciting patterns. For example, identifying barriers to quality positively correlates with quality management drivers and quality management systems. Further conclusions can be gleaned from the statement by statement correlations. For instance, having a project management process in place significantly correlates with teams participating in the documentation of the project, standard project implementation system, critical inspection hold points, quality assurance, clear communication and use of Primavera. In all these correlates, the correlation was positive and significant $p < 0.05$. This implies that these variables have the same effect on each other.

4.7 Chapter Conclusions

This chapter provided an analysis of the survey data collected. Both a descriptive and inferential statistics was used to present and analyse the data. Cronbach's alpha was calculated, followed by biological or demographic information about the participants in this study. The section then proceeded to present the data in tabular form, or in charts and figures, which were accordingly explained and matched with the discussed literature. It was found that gender did not influence how data was interpreted or how research questions were responded to. Supporting the findings, it was found that all the assigned objectives were achieved satisfactorily. Several rotated matrices were also used to support the findings. Cross tabulations where patterns were derived served the purpose of this study very well.

In conclusion, the work has established some success factors necessary for delivering quality at TCP. Some of which is good risk management and employee centeredness, among other factors. The analysis also identified barriers to quality policy implementation. To this end, findings show that the verification process and the other six factors pose a hindrance to policy implementation. The chapter that follows concludes the study, while at the same time providing recommendations emanating from this research.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of the findings and draws conclusions and recommendations. The conclusions emanate from the findings of the survey data that is linked to the research objectives. The recommendations section highlights the practical implications of quality management practices and suggests areas for further research. Quality is linked with TQM and is a continuous process and only when quality problems are identified and solved those final answers can be established (Foster 2017: 121).

5.2 Research Conclusions

The main aim of this study was to determine the factors affecting the implementation of Quality Management Practices in construction projects at Transnet Capital Projects (TCP), with specific objectives as outlined below:

1. To establish the success factors for delivering quality at TCP;
2. To identify the barriers to quality implementation at TCP;
3. To establish the degree to which top management drives quality at the project sites;
4. To ascertain project managers' perceptions of Quality Management Systems at TCP; and
5. To establish the gaps in the current quality awareness training at TCP.

The primary measure of reliability used in this research was the Cronbach's alpha test since the questionnaire used a Likert Scale. Cronbach's alpha measured the scale of internal consistency and the significance of the survey questionnaire to determine the reliability and accuracy of the data. After running the test on the sets of items relating to each objective, it was noted that the threshold value was reached for all items. Factor analysis was used to analyse and indicate the measurement of a group variable by making use of Kaiser-Meyer Olkin (KMO) and Bartlett's test, communalities and rotated component matrix to measure data reduction and analysis validity.

5.2.1 Conclusions based on establishing the success factors for delivering quality at TCP

From the analysis, it is noted that TCP has a project management process in place to help manage quality management practices. Furthermore, the project risk management plan was in place to help identify project risks across all the project stages, and to initiate an excellent project governance structure. Another success factor or parameter is the timeous completion of projects within the budget (CESA, 2011) when effective and efficient quality management practices are initiated and adopted precisely. This corroborates with Nguyen, Phan and Matsui (2018), who identified quality design, quality data and reporting, and continuous improvement, as critical success factors. However, the two areas that need to be improved upon is communication and employee centeredness. As highlighted in the literature review, employees' recognition awards/rewards as a strategy to motivate all employees to participate in the implementation of quality practices need to be actively rewarded (Kelemen 2003).

5.2.2 Conclusions based on identifying the barriers to quality at TCP

Quality can be hindered by several challenges, one of which is cost (Steyn et al., 2014). In order to reduce costs contractors could use unskilled/ low skill labour at the expense of quality. This has been identified as a short coming at TCP and recruitment is noted as an area for improvement. As alluded to in the literature review, Mane and Patil (2015) points out that work done correctly at the outset saves time and money that would otherwise be wasted on rework. Another area that needs improvement is that of documentation and an enabling environment to promote quality improvement. Finally, it was found that there is a lack of client involvement. The lack of client involvement in quality management practices holds back quality achievements, since there is a lack of coordination between key stakeholders as alluded to by Hornby (2015:5) in the literature review.

5.2.3 Conclusions based on establishing the degree to which top management drives quality at project sites

Quality is the degree to which a set of inherent characteristics fulfil requirements by training, or getting management involved in doing the work (PMBOK Guide 2013: 556). It was found that management at Transnet was highly involved in addressing quality issues, such as designing quality control plans and quality inspection/audit checklists. It was also found that teams communicated on project milestones, with the majority of the participants agreeing that

communication took place on the issue of risk in the company. The areas that require improvement have been identified to include: timely project implementation and best practice, quality circles and teamwork. It was found that project tasks are commonly not implemented/completed on time, and strategic management practices that offer diverse ways of managing the quality of projects are not implemented.

5.2.4 Conclusions based on ascertaining project managers' perceptions of Quality Management Systems at TCP

QMS and TQM were described as being very important in project management. It was found that almost three-quarters of the participants were qualified, with at least a diploma, for their management posts at Transnet. It was also found that top management communicates quality plans and that they have an open door policy for contractors to ask quality related questions. They also provide all stakeholders with precise quality management goals, metrics and critical factors required in managing project quality. Javis and Palmes (2016) stressed that top management must also prioritise principles of continuous improvement in their bid to promote quality culture at the workplace. There is a need for management to provide better quality training, reskilling and development of all employees to facilitate the effective implementation of quality related issues across all facets of a project.

5.2.5 Conclusions based on establishing the gaps in the current quality awareness training at TCP

The findings showed that the majority of respondents agree that the technical competence of contractors affects project completion and that different quality models must be developed and implemented for the improved success of TQM execution and control as suggested by Phillips (2012: 171). Morumudi (2017) also argued that customers' requirements aided management in identifying gaps in quality service delivery. As highlighted in the literature review by Deming (2017) and Bulsuk (2009), all project stakeholders must attend relevant TQM meetings to keep themselves updated about key dynamic quality elements like the PDCA or Deming cycle. Such quality elements are pivotal in identifying suitable change management process gaps in TQM, effective TQM communication gaps, and suitable training needs and appropriate models (Deming 2017). The gaps in the current quality awareness training at TCP are management, technical competence and communication and process

improvement.

5.3 Recommendations

The TCP plans to increase the capacity of the Waterberg rail line, which currently carries two million tons of coal a year, to a capacity of six million tons a year after the second phase of the coal line's expansion is complete. This study offers insights to management for improving the efficiency and effectiveness of quality management practices, and an opportunity to address issues that impact on as far as the Transnet Capital Projects are concerned.

It is recommended that:

- Project stakeholders apply critical quality management practices to ensure that projects are completed timeously and that all requirements vital to ensuring the quality in project management are met. Making use of several forms of project progress meetings are recommended as best practice;
- Quality systems such as ISO 9000 should be adopted and service providers should be encouraged to obtain certification with the purpose of improving the quality of outputs;
- The adoption of TQM principles is recommended. While there was strong support for this by the respondents, on a cautionary note, careful implementation will be necessary to achieve the expected benefits. Several resources offering guidelines for TQM implementation are available to address the fragmentation prevalent in the construction industry;
- Training programs to promote quality management practices in project management must be taken seriously, with management leading the way to conduct follow-ups of the necessary or suggested implementation strategies;
- The engagement of staff in continuous professional development training is critical. Amid the Fourth Industrial Revolution, training, retraining and reskilling are paramount in the growth of an organisation. This recommendation is contextualised by the finding that there are still employees with only a certificate and some managers with a diploma as the highest level of qualification. It is imperative to upgrade the human resources capacity to perform and more training opportunities should be made available;
- A more focused approach needs to be adopted to continuous professional developments. As a start the training could kick-off by unpacking standards relating to

QMS to resolve elements that appear to be vague or ambiguous so as to prevent perceived miss-understanding or miss-interpretations;

- An Internal Quality Audit (IQA) is conducted to ensure that proper QMS documentation systems are in place, the extent of QMS understanding is improved, new construction technology usage is promoted;
- Effectual and adaptable systems for communication be put in place to facilitate an easy flow of quality information at all levels of the project; and
- Gender parity be addressed as males appeared to dominate management positions.

5.4 Recommendations for future research

Further studies may be done to explore other factors which affect the implementation of quality management practices, such as, organisational culture and communication and their influence on TQM, organisational performance and customer satisfaction. Further related studies on quality management methods, such as ISO standards and statistical quality control, may also be undertaken.

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APPENDICES

Appendix A: Cover letter for the filling in of the questionnaire

Durban University of Technology

Faculty of Management Science

Operation and Quality Management Department

ML Sultan Road, Greyville Campus

Durban, 4001

Dear Participant,

I am a postgraduate student (Student No.: 21752118) studying Masters of Philosophy in Quality Management under Postgraduate School of Operation and Quality Management at Durban University of Technology - Durban. I would like to invite you to participate in this research by completing the online survey. The research topic is "FACTORS AFFECTING THE IMPLEMENTATION OF QUALITY MANAGEMENT PRACTICES IN CONSTRUCTION PROJECTS- The case of Transnet Capital Projects". Every person's response contributes to a better understanding to the challenges facing the construction projects in a Quality Management context. All responses count equally.

Your completion of this survey is voluntary. Your responses and participation are however valuable to us and we would appreciate your assistance. While the collated results of the study may be published, your individual responses will be kept anonymous and confidential at all times.

It should take no longer than 15 minutes of your time to complete the survey. Your response will be highly appreciated. Do not hesitate to contact the following personnel should you wish to know the results of this research project.

Kindly contact Mrs Pearl. L. Mokwena on 0835739072 or at Pearl.Mokwena@transnet.net / LPMokwena@gmail.com. Alternatively contact Dr Manduth Ramchander on 0744004400 or at Manduthr@dut.ac.za

Thank You

Regards

Pearl Mokwena

Appendix B: Questionnaire

Factors affecting the implementation of Quality Management Practices in Construction Projects– The case study of Transnet Capital Projects (TCP)

The Information is gathered through the administration of questionnaire for research purposes only and no individual or organisation will be compromised in any way. No TCP employee or Contactor will be

identified in the final report.

Instructions:

In each of the statements in the section below, please use the scale1-5, 1=strongly disagree, 2=disagree, 3=neither agree, 4=agree and 5=strongly agree, to indicate your answer. Please mark the appropriate box with an ("X").

O Please read through each statement carefully before giving your opinion.

O Please mark "X" in one box for each statement.

O Please do not discuss statements with anyone.

O Please return the questionnaire after completion.

Section A: General and Demographic Information

A1. Please indicate your gender.

Male	
Female	

A2. Please indicate to which of the following age group you belong.

19- 24		**25- 34**		**35- 44**		**45- 54**		**55–65**	

A3. How long have you been in a project management and construction industry? **Please mark X in the correct box only once.**

< 5 years ☐ 5-10 years ☐ 11-16 years ☐ 17-22 years ☐ > 22 years ☐

A4. Please indicate your highest tertiary education level

Certificate		Diploma		Degree		Honours		Other (specify)	

Section–Project Management Techniques

In each of the statement in the section below, please use the scale, based on your experience, please mark **(X)**in the appropriate box that indicates the level of understanding of each Project

Objective 1-To establish the success factors for delivering quality at TCP, using a survey.

	SD	D	N	A	SA
B1. The TCP have a project management processing place for the management of the Waterberg programme coal Line expansion Project.					
B2. The teams participate in the development of the project quality Management documentations.					
B3. There is a lack of communication between teams about major project milestones.					
B4. The project governance structure includes quality assurance.					
B5. The management system implementation is of an acceptable standard.					
B6. Project managers and contractors do understand the differences between quality control and quality assurance.					
B7. The Project risk management plan is in place.					
B8. Risks are communicated.					
B9.The employees are loyal to the project as they initiate quality related ideas					
B10.Recognitionawards are given to employees who promote a quality culture.					

Objective 2-To identify the barriers to quality policy implementation at TCP, using a survey.

	SD	D	N	A	SA
B11.The tender clarification processes clearly define the scope of work, services and deliverables.					

B12.The problems related to the Waterberg programme coal line expansion project are caused by the contractor using unskilled labour.					
B13.The Project execution plans formulate major project constraints for overall project execution strategy.					
B14.The project deliverables are verified against customer's Specifications to ensure customer's satisfaction.					
B15.Scope deviations are a major project milestone's concern.					
B16.Project failure is characterised by poorly structured documents.					
B17.The environment is conducive to promote a quality improvement culture.					
B18. Project monitoring is measurable in terms of compliance with specified project format.					
B19.The quality management plan includes customer requirements.					
B20.Quality management systems are communicated to the contractors involved in the project.					
B21. There is a quality management system policy in place.					
B22. There is sufficient administration support given to customers.					
B23. The Lack of client's involvement in the project holds back quality achievements.					

Objective3-To establish the degree to which top management drives quality at the project sites, using a survey

	SD	D	N	A	SA
B24.Projects are administered properly (reference to project controls, engineering, construction, commissioning and quality assurance)					
B25.Projects are implemented on time					
B26. Strategic project management are best practices?					
B 27. The Project is properly planned.					

B28. The project executive team is supportive towards the success of the project.					
B29. The inspection and test hold points of the project milestone are critical to ensure that quality standards are being met.					
B30. Quality control plan may include the requirement for 'witnesses' inspection" of critical items for the project.					
B31. Strategic plans are implemented to improve quality.					
B32. Employee's creates quality circles or discussion for the success of the project.					
B33. The employees have the responsibility of carrying out project's activities.					
B34. New employees are assigned to work with experienced					
B35. The employees participate in the inspection of the quality related deficiency.					

Objective4-To ascertain project managers' perceptions of Quality Management Systems at TCP, using a survey.

	SD	D	N	A	S
B36. The quality management plan is clearly communicated during gate review process.					
B37. The quality management team adopts an open door policy allowing the contractor to ask quality related questions.					
B38. The quality management plan defines the goals, critical factors and metrics to measure project success.					
B39. Quality assurance is every one's responsibility.					
B40. The TCP view quality assurance as a continuous improvement tool.					
B41.In a quality management information system, there is a need to collect data.					
B42.The collection of information should be part of project process.					
B43.Most project quality problems are the results of poor quality training.					
B44.There should be the verification of deliverables against customer's specifications to ensure customer satisfaction is achieved					

Objective5-To establish the gaps in the current quality awareness training at TCP

	SD	D	N	A	SA
B45. All stakeholders are in attendance at relevant meetings to contribute to ideas.					
B46. Approved change management processes have been identified for the project and communicated to the project teams.					
B47. The project steering committee has been introduced effectively.					
B48. The technical competency by the contractors affects the project					
B49. The project resource plan is clearly communicated.					
B50. Lessons learned from other successful projects withinCP are available at archives for Waterberg programme coal line expansion project.					
B51. A different quality management model needs to be developed for the success of the project i.e. TQM					

THANK YOU FOR YOUR PARTICIPATION

Appendix C: Gatekeeper Letter

Transnet SOC Ltd
Registration Number
1990/000900/30

Carlton Centre
150 Commissioner Str.
Johannesburg
2001

P.O. Box 72501
Parkview
South Africa, 2122
T +27 11 308 4701

TRANSNET

MEMORANDUM www.transnet.net

To: Ms Pearl Mokwena
Quality Officer, Coal Portofolio, TGC

From: Ms Corli Van Rensburg, General Manager, TGC Capital Governance and Controls

Date: 26 July 2017

SUBJECT: **REQUEST FOR PERMISSION TO CONDUCT RESEARCH**
Proposed research study topic:
Perceptions of Quality Management in the Transnet Capital Project.

Dear Pearl

Your request to conduct the research on the above topic in Transnet Group Capital and the non-disclosure agreement refers.

I am delighted to inform you that your request for this study has been approved on the following conditions:

- Transnet will receive a presentation outligning the key findings of the study and recommendations to address these findings.
- All data colletion will be conducted and ensure confidentiality of the data and the identity of the participants.
- A non-disclosure agreement be signed by relevant parties

This being in order, I would like to take this opportunity to wish you everything of the best with your study.

Do not hesitate to communicate any additional assistance you may require.

Kind Regards,

Corli Van Rensburg, General Manager,
Transnet Group Capital
Capital Governance and Control
Date: 28/7/17

Page **1** of **1**

Appendix D: Frequency Table and Chart

Age Group * Gender Cross tabulation

			Gender		Total
			Male	Female	
Age Group (years)	19 - 24	Count	13	13	26
		% within Age Group	50,0%	50,0%	100,0%
		% within Gender	24,1%	29,5%	26,5%
		% of Total	13,3%	13,3%	26,5%
	25 - 34	Count	32	25	57
		% within Age Group	56,1%	43,9%	100,0%
		% within Gender	59,3%	56,8%	58,2%
		% of Total	32,7%	25,5%	58,2%
	35 - 44	Count	9	6	15
		% within Age Group	60,0%	40,0%	100,0%
		% within Gender	16,7%	13,6%	15,3%
		% of Total	9,2%	6,1%	15,3%
Total		Count	54	44	98
		% within Age Group	55,1%	44,9%	100,0%
		% within Gender	100,0%	100,0%	100,0%
		% of Total	55,1%	44,9%	100,0%

Appendix E: Chi-Square Test

	Chi-Square	df	Asymp. Sig.		
Gender	1,02	1	0,312		A1
Age Group	29,041	2	0,000		A2
How long have you been in a project management and construction industry?	84,041	4	0,000		A3
Please indicate your highest tertiary education level	61,082	4	0,000		A4
The TCP have a project management process in place for the management of the Waterb	100,367	4	0,000		B1
The teams participate in the development of the project quality management documentati	74,327	3	0,000		B2
There is a lack of communication between teams about major project milestones	90,061	4	0,000		B3
The project governance structure includes quality assurance	52,979	3	0,000		B4
The management system implementation is of an acceptable standard	74,701	4	0,000		B5
Project managers and contractors do understand the differences between quality control	78,619	4	0,000		B6
The Project risk management plan is in place	106,67	3	0,000		B7
Positive and negative risks are communicated	73,103	3	0,000		B8
The employees are loyal to the project as they initiate quality related ideas	39,031	4	0,000		B9
Recognition awards are given to employees who promote a quality culture	29,959	4	0,000		B10
The tender clarification processes clearly define the scope of work, services and deliveral	103,714	3	0,000		B11
The problems related to the Waterberg programme coal line expansion project are cause	26,49	4	0,000		B12
The Project execution plans formulate major project constraints for overall project executi	65,102	3	0,000		B13
The project deliverables are verified against customer's specifications to ensure custome	97,51	4	0,000		B14
Scope deviations are a major project milestone's concern	57,51	3	0,000		B15
Project failure is characterised by poorly structured documents	80,673	4	0,000		B16
The environment is conducive to promote a quality improvement culture	47,204	4	0,000		B17
Project monitoring is measurable in terms of compliance with specified project format	49,959	4	0,000		B18
The quality management plan includes customer requirements	141,082	4	0,000		B19
Quality management systems are communicated to the contractors involved in the projec	66,423	3	0,000		B20
There is a quality management system policy in place	57,347	3	0,000		B21
There is sufficient administration support given to customers	88,02	4	0,000		B22
The Lack of client's involvement in the project holds back quality achievements	59,449	4	0,000		B23
Projects are administered properly(reference to project controls, engineering, constructio	77,51	3	0,000		B24
Projects are implemented on time	43,327	4	0,000		B25
Strategic project management best practices are implemented to improve quality	37,612	4	0,000		B26
The Project is properly planned	104,041	4	0,000		B27
The project executive team is supportive towards the success of the project	90,061	4	0,000		B28
The inspection and test hold points of the project milestone are critical to ensure that qual	78,816	3	0,000		B29
Quality control plan may include the requirement for "witnesses' inspection" of critical iten	65,347	3	0,000		B30
Strategic plans are implemented to improve quality	40,265	4	0,000		B31
Employee's creates quality circles or discussion for the success of the project	35,673	4	0,000		B32
The employees have the responsibility of carrying out project's activities	89,041	4	0,000		B33
New employees are assigned to work with experienced employees for job instruction	53,939	4	0,000		B34
The employees participate in the inspection of the quality related deficiency	59,245	4	0,000		B35
The quality management plan is clearly communicated during gate review process	106,816	3	0,000		B36
The quality management team adopts an open door policy allowing the contractor to ask	104,694	3	0,000		B37
The quality management plan defines the goals, critical factors and metrics to measure p	163,796	3	0,000		B38
Quality assurance is everyone's responsibility	92,204	3	0,000		B39
The TCP view quality assurance as a continuous improvement tool	62	4	0,000		B40
In a quality management information system, there is a need to collect data	76,388	4	0,000		B41
The collection of information should be part of project process	81,592	4	0,000		B42
Most project quality problems are the results of poor quality training	51,898	4	0,000		B43
There should be the verification of deliverables against customer's specifications to ensu	41,184	3	0,000		B44
All stakeholders are in attendance at relevant meetings to contribute to ideas	27,816	4	0,000		B45
Approved change management processes have been identified for the project and comm	48,224	4	0,000		B46
The project steering committee has been introduced effectively	21,286	4	0,000		B48
The technical competency by the contractors affects the project completion	107,102	4	0,000		B49
The project resource plan is clearly communicated	90,878	4	0,000		B50
Lessons learned from other successful projects within Transnet Capital Projects are a va	46,388	4	0,000		B51
A different quality management model needs to be developed for the success of the proje	48,449	3	0,000		B51_A
Project monitoring is measurable in terms of compliance with specified project format	81,347	3	0,000		B52
The teams participate in the development of the project quality management documentat	100,939	3	0,000		B53
Primavera is a very important software tool	152,286	3	0,000		B54
I know how to use the Primavera software	235,873	4	0,000		B55

Appendix F: Summarised Correlations

	Summarised Correlations						
Correlations							
		Objective 1	Objective 2	Objective 3	Objective 4	Objective 5	Objective 6
Objective 1	Pearson Correlation	1					
	Sig.(2-tailed)						
	N	98					
Objective 2	Pearson Correlation	.562**	1				
	Sig.(2-tailed)	0,000					
	N	98	98				
Objective 3	Pearson Correlation	.432**	.501**	1			
	Sig.(2-tailed)	0,000	0,000				
	N	98	98	98			
Objective 4	Pearson Correlation	.365**	.437**	.318**	1		
	Sig.(2-tailed)	0,000	0,000	0,001			
	N	98	98	98	98		
Objective 5	Pearson Correlation	.346**	.330**	.308**	0,091	1	
	Sig.(2-tailed)	0,000	0,001	0,002	0,375		
	N	98	98	98	98	98	
Objective 6	Pearson Correlation	0,130	0,166	.224*	0,139	0,081	1
	Sig.(2-tailed)	0,201	0,102	0,026	0,173	0,429	
	N	98	98	98	98	98	98
**.Correlation is significant at the 0.01 level (2-tailed).							
*.Correlation is significant at the 0.05 level (2-tailed).							

Appendix G: Research Clearance

MANAGEMENT SCIENCES: FACULTY RESEARCH ETHICS COMMITTEE (FREC)

29 November 2017
Student
No:
21752118
FREC REF:
160/17

Dear Ms P. L Mokwena

MASTERSOF PHILOSOPHY: QUALITY

TITLE: Factors Affecting the Implementation of Quality Management Practices in Construction Projects: The case of Transnet Capital Projects.

Please be advised that the FREC Committee has reviewed your proposal and the following decision was made: **EthicalLevel2**

Date of FRC Approval: 29 November 2017

Approval has been granted for a period of two years (from the date above), after which you are required to apply for safety monitoring and annual recertification. Please use the form located at the Faculty. This form must be submitted to the FREC at least 3 months before the ethics approval for the study expires.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the FREC according to the FREC SOP's. Please note that ANY amendments in the approved proposal require the approval of the FREC as outlined in the FREC SOP's.

Yours Sincerely

Prof JP Govender
Deputy Chairperson: FREC

Appendix I: Turnitin Report

Factors Affecting the Implementation of Quality Management Practices in Construction Projects: The case of Transnet Capital Projects.

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Approved by:

Student: Date: 30/11/2020

Supervisor: Date: 2/05/21

Appendix J: Editor Report

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29 November 2020

DECLARATION OF PROOF-EDITING

Title of dissertation: Factors affecting the implementation of quality management practices in construction projects: The case of Transnet Capital Projects.

This is to certify that I have proof-edited, the Master of Philosophy dissertation by Ms. Pearl Lucky Mokwena, and the candidate has been advised to make the recommended changes.

Dr S. Jugmohan

BTech, MTech, DTech