



**The Use of Total Quality Management (TQM) Concepts in Public Sector
Infrastructure Project Delivery**

Research Report

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**A research report submitted to the Faculty of Engineering and the Built
Environment, University of the Witwatersrand, Johannesburg, in partial fulfilment
of the requirements for the degree of Master of Science in Building.**

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DECLARATION

I, **Emmanuel Marang Khomela**, declare that this research report is my own unaided work. It is submitted in partial fulfilment of the requirements for the degree of Master of Science Building in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.



Signature;

Sandton, Johannesburg

Signed at;

On the 27th day of October 2016

ABSTRACT

South African public sector clients use a variety of Total Quality Management (TQM) practice in infrastructure project delivery. However, there is a dearth of information on the impact of TQM on these projects. The three main drivers of public projects delivery are time, cost and quality. In many instances, the quality of the work is lacking and this in return hamper service delivery and consequently cost and time overruns are experienced. Furthermore, The public sector in the South African construction industry is the main employer of consultants, contractors and professionals in the construction fraternity, could lead from the front by bring the culture of quality in the construction industry.

The study is investigating the level of TQM adoption in the public sector and is motivated by the limited academic research that has been done locally in TQM with respect to construction industry, especially from the client's perspective. Internationally there have been extensive studies that were conducted on the subject. In general, there are ten elements of TQM, if practiced, there is an opportunity for positive results which can be attained both in short and long term basis.

A questionnaire was used to collect the qualitative data, from public sector engineers and technicians, Consulting engineers and Contractor, which is then analysed using a range of statistical techniques, tables and graphs.

In general, TQM concepts are used in the South African public sector infrastructure projects. There public sector should work towards quality management certifications, which will translate into standardised quality process. TQM can only be achieved if there are already process in place.

Keywords *TQM, Infrastructure projects, Project management, Service delivery Public sector, South Africa*

DEDICATION

This paper is dedicated to my mother, Violet Khomela
who encouraged me to study throughout my life, my partner Hloniphile
Shongwe who encouraged and picked me when the going was tough and to my
late brother, Khomela Khomela.

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LIST OF ACRONYMS

CAPEX – Capital Expenditure

CIDB – Construction Industry Development Board

EDA – Exploratory Data Analysis

ISO – International Organization for Standardization

MFMA – Municipal Financial Management Act

PM – Project Management

QA – Quality Assurance

QC – Quality Control

RDP – Reconstruction and Development Programme

SCM – Supply Chain management

TQM – Total Quality management

1 INTRODUCTION

1.1 Background to the Study

This study seeks to find how Total Quality Management (TQM) can benefit or, if it is already benefitting the South African public sector clients in infrastructure project delivery, acknowledging that quality management concepts systems and philosophies are already available in the country. TQM have benefits such as reduction of reworks, teamwork, quality culture, continuous improvement and customer satisfaction (Bryde *et al*, 2007; Harrington *et al*, 2012; Brown, 2013; Altayeb *et al*, 2014).

Traditional Project Management philosophy is mainly used to implement the projects in the public sector, where the three main drivers are time, cost and quality (the “iron/golden” triangle). In many instances the quality of the works is lacking and this in return hamper service delivery and consequently cost and time overruns are experienced (Bryde *et al* 2007).

In many instances, quality standards are required by clients as minimum requirements during tender stage but the question that remains is whether quality management programmes like TQM, Six Sigma, Lean Six Sigma, ISO 9001 and so forth being implemented on the projects. If implemented, are there any quality advantages that come with them?

If the TQM concepts can be adopted and used correctly, they can improve the delivery of the infrastructure to the communities

1.2 Problem Statement

South African public sector clients use a variety of Total Quality Management (TQM) concepts in infrastructure project delivery. However, there is a dearth of information on the impact of TQM concepts on these projects. The three main drivers of public projects delivery is time, cost and quality. In many instances, the quality of the works is lacking and this in return hamper service delivery and consequently cost and time overruns are experienced. If TQM can be introduced in the public sector which in the South African

construction industry is the main employer of consultants, contractors and professionals in the construction fraternity, it can in the long run bring the culture of quality in the industry as a results the projects could be completed with the desirable quality, which have long term benefits.

1.3 Research Question

Thus the primary research question can be stated as follows:

Are TQM concepts used in the infrastructure projects delivery within the South African public sector?

1.4 Research Sub-Questions

SQ1: What is the link between traditional Project Management (Time, Cost and Technical Quality) and Total Quality Management in execution of public infrastructure project?

SQ2: What measures are put in place to ensure that Quality Management is entrenched in the public infrastructure projects?

1.5 Objectives

The main objectives of the research are:

- To investigate the level of Total Quality Management (TQM) concepts adoption, while delivering the infrastructure projects, in the South African public sector;
- To investigate if the Project Management (PM) process have positive contribution towards the implementation of Total Quality Management (TQM) concepts.
- To investigate if there are process or procedures that are in place within the public sector to ensure quality management is brought forward on the infrastructure project delivery within the public sector.

1.6 Methodology

The research philosophy that is used in this research is Positivist which leads the research to take the philosophical position of natural scientist. The methodology that is used in the research is Mono-method Quantitative research designed and the data collected is used to test theory. The questionnaires were used to gather standardised information from the population that was targeted for the research.

The population of this study is made of, Clients (Public Sector), the Engineer (Consultants) and the Contractor (Main and Sub Contractors). The focus will only be on engineering disciplines personnel that are working with departments and entities that are mandated with the infrastructure projects delivery within the three metropolitan municipalities and their respective entities in Gauteng province, South Africa.

1.7 Hypothesis

Thus the hypothesis that would be tested are as follows:

H₀ : TQM concepts are used in the delivery of infrastructure projects in the South African public sector

1.8 Delineations

The study would improve quality management standards in the construction industry as a whole. The public sector is the main sponsor of most of the infrastructure. Total quality management concepts if adopted it will bring about significant cultural change, which will ultimately improve service delivery. Due to the time limits of completing the study, the research will target public infrastructure projects within Gauteng only. The focus will be to investigate if the TQM concepts are used in the infrastructure projects within the South African public sector. The study will be focusing on national and local Government organisations.

The study focuses on projects that were completed five years ago to date and on-going projects.

Quality concepts such as TQM, six sigma and lean are widely used and analysed. In this study, these concepts are not going to be compared or contrasted, the focus will only be TQM concepts how they can add value to the public sector.

Services delivery is a broad word covering wide range of activities. Akinboade *et al* (2012:189) defines service delivery as “the provision public activities, benefits or satisfactions to the citizens. Services delivery relates both to the provision of tangible public goods and intangible services”. In this study, the focus will only be on the provision of infrastructure by the public sector.

The population for data collection will be the skilled engineering personnel that work with the projects in the public projects and not the organisations. The organisations could be the population of the research, if the study was for instance measuring the impact of TQM in the organisation.

1.9 Limitations

The research is intended to be completed within a year. The given time frame on its own it is found to be a limitation, which may affect the on-going extent of the research.

Delivery and collection of questionnaires will be used to collect the data. The travel cost sky rocketed as the questioners will be hand delivered. Upon completion, the questionnaires will be collected from the respondents on a first-completed, first-picked basis so that data capturing was not delayed.

Late response or non-responsiveness by the respondents may affect the entire research time frame, To avoid this aspect, and to ensure that adequate data is received within the required time frame, a greater pool of respondents can be created so that more data can be collected and to be used in the research.

Three research questions could not be answered in this research and it was found to be a limitation of the study. There was no knowledge that could be used to support the assumptions that was put in the questions. The questions were found to be ethically not

considerate of the respondents. The list of the questions that were found to be limitation of the study can be found under Section 3.11, Table 3-1: Design of the instrument.

1.10 Assumptions

TQM will have financial benefits within the organisation if it is implemented properly. This can be realised through reduction of the rework, waste minimisation and opportunity to use infrastructure that have less defects.

Organisational culture is paramount to the implementation of TQM. Culture is one of the ten concepts of TQM. Therefore, quality management culture should be instilled in all levels of the organisation and all the relevant stakeholders.

The public projects have in general the following as the stakeholders; client, engineer, contractor, public and relevant authorities. The client will have its internal stakeholders who will operate the infrastructure, while the engineer will have a team of experts in the field. The public and its representatives will consist of political representatives and the community at large. The authorities in this context will be organisations who regulate the construction industry.

1.11 Literature Questions

1. Who should ensure that TQM concepts are implemented?
2. What are the challenges in the public sector that can make TQM implementation fail?

1.12 Purpose of the Study

The aim of the research is to investigate the use of Total Quality Management (TQM) concepts in infrastructure project delivery within the South African public sector. This comes as there is a dearth of information on the impact of TQM concepts on these projects. Though the traditional drivers of public projects delivery is still time, cost and quality. In many instances the quality of the works is lacking and this in return hamper service delivery and consequently cost and time overruns are experienced.

In order to solve this problem quality management in the public construction projects should be seen as a long term investment of ensuring that the Infrastructure development plan is not derailed. This is emphasised by Xiao *et al* (2002), “Clients long-term interest lie in the high quality of their projects. The work performed must conform to the specification established for the project. Low cost and speedy construction should not be achieved at the expense of the quality of the project”.

The reworks and reconstruction can results in more money being spent in the projects and eroding the opportunity of doing other projects. Which can translate into loss of revenue and increase in capital expenditure of future projects.

In the public sector projects are implemented under Capital budget, which comes as a loan, grant or both. If the projects are completed late, with bad quality that require rework, they can prolong the loan repayment or forfeit the opportunity of been allocated more grant in the future.

The public sector is externally audited by the Auditor General of South Africa. If the quality of the project is not desirable it can lead to the organisation having qualified audits. Cost overruns can also results in wasteful and fruitless expenditure which also amounts to qualified audit against the organisation.

1.13 Structure of the Research Report

1 Introduction: This section entails the overview of the research report. It states what the report is going to cover and what is going to be excluded.

2 Literature Review: This section entails the literature that have been covered (body of knowledge). Most of the material that was used is from the journals. In some cases the internet searches, books and magazines were used to extract the data for this research report.

3 Research Design: This section entails the research design that was adopted. Research philosophy, research approach, research methodology, research strategy, time horizon

and ethical consideration, data collection protocols is discussed in detail under this section.

4 Presentation of the Data and Analysis: This section entails all the data that have been collected and there analysis. The data is analysed in two ways, initially exploring data using both tables and diagrams and subsequently, using statistics. Summary of key findings of the research are also discussed in this section.

5 Conclusions and Recommendations: This section entails the conclusion of the study and the recommendations.

2 LITERATURE REVIEW

2.1 Introduction

Literature has proven that the South African government is the main client in the construction industry. The public sector accounts for 40% of the South African infrastructure development investment. Furthermore, the CIDB – Construction Quality in South Africa; A Client Perspective (2011:1) states that, “ ...The public sector accounts for around 80% of all civil works and around 20% of residential and non-residential building works, values and quality are particularly important to public sector clients”. Some of the projects are not completed with quality that was intended. These bring about a negative impact on the Infrastructure development plan, which eventually impacts on the service delivery that many desperately require. Akinboade *et al* (2012), state that of all the respondents to the study the proportion of the people satisfied by service delivery was found to be lower than those that are dissatisfied by service delivery. Therefore, implementation of quality management programmes in the construction industry can be an opportunity for value adding.

Some of the works that have been completed are of bad quality such that the works were demolished before it run its life span or it gets damaged mid-way their life span. Due to bad quality of the projects, the reconstruction and refurbishments results in the multimillion cost overruns per year and time delays that run into years. This was confirmed by CIDB’s report titled “Construction Quality in South Africa; A Client Perspective” (2011), during investigations and audits it was established that during financial year 2009/10 the government would spend R1,3 billion on rectifying Reconstruction and Development Programme (RDP) houses that were completed with poor quality and standards.

These consequently have negative socio-economic impact. As observed recently, there are many service delivery protests in South Africa. Some of the main issues that lead to the protests stem from non- delivery of the infrastructure that was initially planned to be implemented. Non-delivery comes to play when implementation was either late or the

budget was completely scrapped off in the current project and moved to other projects. Alternatively, the infrastructure developed was of such poor quality, that when it was handed over to the community, it crumbles down. Akinboade *et al* (2012) identified the reasons for the service delivery protest in South Africa in 2010 to include the following:

1. Lack of service delivery or poor service delivery by water, sanitation, electricity and solid management departments within the municipalities
2. Shortage of housing
3. Eviction from illegally occupied property
4. High unemployment rate
5. Lack of communication between the municipality and the community members
6. Corrupt dealings
7. Nepotism
8. Financial mismanagement
9. Maladministration of the municipalities by the office bearers.

This confirms that lack of service delivery or poor service delivery by municipalities does have effect on the communities and may lead to the protests.

Furthermore, Municipal IQ: Municipal Data and Intelligence, held the press release on the 7th of November 2014 and revealed that there were 176 major service delivery protests that were recorded in that year, which were the highest in ten years. It can be seen from figure 1 that since 2009 till October 2014, the service delivery protests have been on the rise.

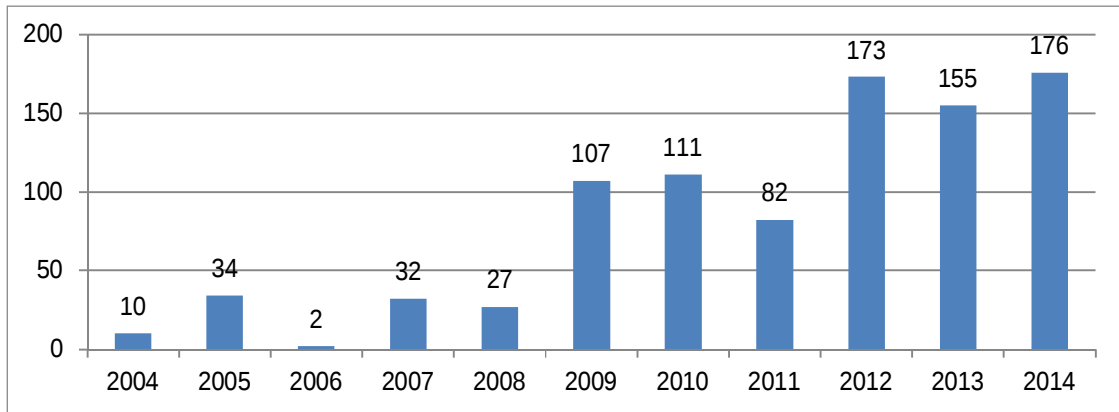


Figure 2-1: Major Service Delivery Protests, by Year (2004 – October 2014)

Source: Municipal IQ Municipal Data and Intelligence (2014)

The question that can be asked is, what is Total Quality Management (TQM)? The definition of Quality by American Society for Quality is as follows, “It is a management approach to long-term success through customer satisfaction. TQM is based on all members of an organisation participating in improving processes, products, services and the culture in which they work”.

In general the following can be regarded as the elements of TQM (Bryde *et al*, 2007; Harrington *et al*, 2012; Brown, 2013; Altayeb *et al*, 2014):

- Leadership and management commitment;
- Continuous improvement;
- Process improvement
- Customer satisfaction;
- Training
- Focus on employees (Empowerment)
- Communication
- Teamwork
- TQ and measurement
- Supplier involvement

These elements are the core of TQM, literature have proven that if they are practiced they can bring positive improvement into the organisation.

2.2 Literature Review of the Study

As stated under the purpose of the study, the problem that lead to this research is that, South African public sector clients use a variety of Total Quality Management (TQM) concepts in infrastructure project delivery. However, there is a dearth of information on the impact of these TQM concepts on these projects. The three main drivers of public projects delivery is time, cost and quality. Nonetheless, in many instances the quality of the works is lacking and this in return hamper service delivery and consequently cost and time over runs are experienced.

2.2.1 Implementation of TQM Philosophy to Achieve Quality in Construction Projects

Organisation culture is one paramount factor that can be used as a platform to implement TQM, Baird *et al* (2011) stated three cultural factors namely; outcome orientation, teamwork and innovation. One most important aspect that was highlighted was that management should ensure that conducive environment for TQM in the organisation is prepared by the management. Moreover, it was discovered that TQM can easily be implemented in work setup that promotes collaboration and cooperative behaviour. Therefore it is imperative that the management should instil a culture that would make TQM implementation before so as to minimise the chances of the philosophy being rejected by the employees.

Organisations differ from one another from point of business dealings, geographical location, products produced or sold, the personnel, to mention a few. This will also implies that TMQ culture can be seen differently from one organisation to the other. Nonetheless, the aim of all the organisation to achieve common objectives. These objectives been removal of waste, costs reduction, reputational gains and, at all times, the increase of market share (Harrington *et al*, 2012).

Joubert *et al* (2005) emphasised the viewpoint of Baird *et al* (2011) and (Harrington *et al*, 2012) stating that for TQM to be implemented, the quality culture needs to be instilled in the organisation. One of the challenges that was picked in the South African context is that people are generally afraid of change which, poses a challenge of TQM rejection.

Project management as a discipline is a common tool that is used to run the infrastructure projects in the public sector, as this activities “projects” have start and completion dates, the project management tools are found best suitable to run the projects smoothly. The study done by Bryde *et al* (2007) revealed two important factors in relation to the relationship of TQM and project management. Firstly, it was discovered that there is no link between TQM and level of focus on the traditional project management. Traditional project management is based on time, cost and quality, the so called “iron/golden” triangle. The iron/gold interprets project performance or quality management, to be specific, tactical viewpoint. It focuses on the project specifics not catering for the high level management and focus on the short term strategic imperatives. This is found to be reciprocal of the TQM elements. Secondly, there is a link between TQM programme and customer oriented practices. This agrees with TQM element of ‘customer satisfaction’.

Project Management (PM) is defined by (Project Management Institute, 2013) as the application of knowledge, skills, tools and techniques to project activities to meet the project requirement. The main objective of PM, like TQM, is to deliver the goods that are satisfactory to the customer.

The study done by Bryde *et al* (2007) have revealed that TQM is an antecedent of project management as one main leg of the traditional project management is quality. Therefore by using TQM concepts in the project management context it can improve the quality of the end product.

The study undertaken by Laszol (1999) on the quality management approach to Project Management revealed that “Project management can be applied to any set of activities and is no less than a universal management tool when it is considered in its generic form”. The study demonstrated that it is feasible and practical to apply project

management based on quality management. This confirms that quality management can be incorporated in the project life cycle as both have common goal – customer satisfaction.

The study done by Orwig et al (2000) revealed fundamentally, that both Total Quality Management (TQM) and Project Management (PM) are supported by the same principles namely, teamwork, continuous improvement and customer focus.

There are many stakeholders in public projects, it starts from the community, political leadership, public office bearer up to the private sector. Figure 2 illustrates how the political and administrative accountability flows in municipalities, based on Municipal Financial Management Act 56 of 2003 (MFMA.)



Figure 2-2: Political and Administrative Accountability

Source: National Treasury (2012)

The municipal council set the policy and direction of the how the municipality should be run and office bearers, headed by the Accounting Officer, takes the accountability of ensuring that the municipal offices are properly managed.

The study by Holt et al, (2000) identified the following as the stakeholders in the civil construction project in the UK which is no different to the South African setup;

- Government sector clients;
- Private sector clients;
- Professional advisors;
- Design teams;
- Project and construction managers; and
- Main contractors and specialist contractors.

Leadership and Management is one of the ten steps that lead to successful implementation of TQM and this was supported by Mosadeghrad (2014); Harrington *et al* (2012); Baird *et al* (2011); Joubert *et al* (2005); Holt *et al* (2000) who all share the same viewpoint that leadership or top management are to ensure that TQM concepts can be implemented in the organisation. They are the same people that can cultivate the culture of quality management. As much as the senior management is not in day to day operation of the activities of the organisation, they have to know quality management very well so that they can lead the pack from the front.

As mentioned previously, service delivery is at the heart of all the projects implemented by the public sector. Whereas surplus (profit) can be achieved through billing the users (community) of the infrastructure installed such as sewerage, water, refuse removal and treatment, tolled roads etc., none the less the primary objective is to give service to the communities. This was supported by Holt *et al* (2000, p.541) stating that, “The effective and efficient use of resources in public project management requires a commitment to driving down costs and exploiting value opportunities. In achieving this, public management, being a civil service, must also be aware of social, political and ethical requirements that can impinge upon strict economic reasoning. Opening public

management to market pressures has been criticised as potentially weakening concerns of social justice, but in areas like civil construction, it is vital if procurement, build and operation are to improve...”.

Having said this, the question that could be asked is, what is the impact of TQM in the service delivery in South Africa? Literature have proven that TQM can assist immensely in reducing waste, continuous improvement, cost effectiveness, minimising rework and instil customer focus (Harrington *et al*, 2012; Urban *et al*, 2012; Bryde *et al*, 2007; Xiao *et al*, 2002)

Traditionally project performance has been measured on delivery of project on time, within budget and to the desired quality. TQM emphasise on minimisation of rework and customer satisfaction. These will save on the time that the project should be completed. As mentioned earlier, the study by Bryde (2007) revealed that TQM is an antecedent to project management.

Joubert *et al* (2005) looking from the South African context is of the view that time is one of the barriers of quality as projects are expected to be completed on time within the set specification.

Public sector capital budget is set in a three year cycle. And many times some of the budget is returned to the National Treasury mainly because the budget was never spent. Reasons for failure to spend the allocated funds is because of poor planning or lack of competent team to manage the projects. Some of the TQM elements is training, top management involvement, long term view and quality culture within the organisation (Mosadeghrad, 2014).

One of the vital elements of TQM is training, the employees should be empowered on what they have to deliver. It is not about recording the failures of the employees but to ensure that the causes of failure are removed in the process and only focus on the customer satisfaction – which can only be achieved by employees who share the same visions as the top management through continuous improvement, education and training.

This plays a very big role in the long term view of the organisation (Altayeb *et al*, 2014; Graham *et al*, 2014; Pamfilie *et al*, 2012; Laszlo, 1999; Orwig, 2000).

Board Notice 86 of 2010, CIDB, Standard for Uniformity in Construction Procurement recommends that quality should be taken into consideration when procuring services for construction. These recommendations are enforced in the public projects.

Most of the projects in the public sector are awarded through tendering system, which they follow the Construction Industry Development Board guide lines (CIDB). CIDB recommends quality management in all the projects that are undertaken. Therefore it is imperative that the employees that prepare the bid documentation should be trained to ensure that they cover the aspects of quality when drawing up these documents.

Furthermore, the literature has revealed that the following quality management programmes are popular around the world;

- TQM
- Six Sigma
- Lean Six Sigma
- Just in Time (JIT)
- Lean Construction

As mentioned earlier the South African construction industry is not working in a silo, it is important that the good deeds by other industries locally and internationally in the context of quality management should be benchmarked and instilled in the South African culture of implementation of projects.

Literature have revealed that TQM concepts are widely used around the world. Although TQM concepts originated in manufacturing, they have been roped into the construction industry – South Africa included. The studies also show that quality management starts with attitude and interest of the senior management who can easily instil the culture of quality as the base.

In the South African context, it is highly possible that TQM can be implemented as some of the companies have quality certifications such as ISO 9000, which literature regard it as a good direction to attaining TQM. However, some studies reveal that there is no correlation between ISO 9000 and quality performance.

The South African construction industry also needs to differentiate Quality Assurance (QA) and Quality Controls (QC) from TQM. And this can be attained by training those that are involved in doing projects.

2.2.2 Financial Benefits of Implementation of TQM

For most businesses to keep afloat they have to account for all the monies that are injected into the business. It is of utmost importance to know if applying TQM in the business could have financial benefits. Sampaio *et al* (2011) indicates that many studies have been carried out to relate the implementation of quality management systems and organisational performance and the results of these studies show that there are still mixed feelings on whether organisations that have implemented quality management systems can have financial edge over those that have not. This makes the decision to implement TQM concepts to be the discretion of the organisations, depending on their viewpoint regarding the financial benefits.

Ilkay *et al* (2012), share the same sentiments with Sampaio *et al* (2011) by mentioning that in the existing literature there is no correlation between ISO 9000 and quality performance. This clearly shows that authors in the field have different viewpoints, mainly because reverse cause-effect correlation is being tested.

The study done by Andersson *et al* (2006) in the USA and Europe revealed that a fifth or at most a third of the TQM programmes have achieved improvements in financial benefits and competitiveness.

Organisations must be competitive to distinguish themselves from the rivals for them to control a bigger market share. This can be realised by insuring customer satisfaction at all time so that they can be called again or referred to other clients. Furthermore, total cost of

quality can be reduced if the cost of poor quality is minimised (Joubert *et al*, 2005). Therefore the capital budget set will be saved immensely and as a result raising an opportunity to do more projects and consequently service delivery anticipated by many achieved.

2.2.3 Challenges that can Lead to TQM Implementation Failure

Mosadeghrad (2014) gave the following reasons as the main issues that lead to failure of TQM and this is also found to be relevant to factors that may lead to the failure of TQM in the public sector;

- Lack of employees involvement;
- Lack of top management support;
- Inadequate resources;
- Lack of a quality-oriented culture;
- Poor communication;
- Lack of customer focus;
- Lack of long-term view;
- Lack of government support;
- Political uncertainty and behaviours;
- Employee shortage and increased work load;
- Difficulties in changing organisational culture;
- Lack of employee trust in senior management;
- Bureaucracy and paperwork;
- Lack of organisational flexibility;
- Lack of physical resources; and
- Lack of information systems

Joubert *et al* (2005) investigated the reasons for poor quality in the South African construction industry. The study revealed that, “there is gross negligence in the South African construction. The theories and full methodologies for implementing quality systems are available, both internationally and locally. The international community has

gone past quality management as a control system to Total Quality Management as a management system and a culture and even beyond to Six Sigma...” (*ibid.*) This clearly shows that the industry has the potential to do better as theories and methodologies do exist in the country.

South Africa is not working in isolation and it is imperative to bench mark the quality management with other countries that are at advanced stage like, Japan, China, United Kingdom and the United States. This can help the local construction industry immensely. The study done by Xiao *et al* (2002) showed that Japanese construction industry experiences less rework and defective work and this is mainly because there culture of quality management is well entrenched in the industry of Japan. Since the quality theories and methodologies are already used in South Africa it will add value if the good done by the Japanese, in terms of quality, can be copied and implemented this side of the world or modified to meet the South African culture.

Joubert *et al* (2005) revealed that quality management is still lacking in the construction industry, which disadvantages the local companies from international projects competition.

2.2.4 Summary of the Key Literature Findings

Literature has covered most theories around implementation of TQM, in general, but in the context of the public sector it is realised that some of the elements of TQM will be difficult to implement; for instance, supplier involvement, which encourages the use of one or selected few suppliers in all the procurement of goods. The benefit of one or few suppliers is that in the long run trust and confidence is built. This also reduce the turnaround time of supplies. Unfortunately, in the public sector all tenders have to go through open tender because all those who are allowed to supply should be given equal and transparent opportunity. All is not lost though as the National Treasury allows for 3 year contracts but there after the contract cannot be extended. Therefore, the contract has to go through open tender and there is no guarantee that the supplier who was working with the organisation will be successful again.

Literature highlights that there are mixed feelings, whether implementation of TQM can have financial benefit. This on its own can influence organisations not to implement TQM as most objectives of organisations is to drive costs down. The public sector should emphasis total quality since the supply network as both the initiator and the custodian of the productive activity is there role (Holt *et al*, 2000).

Most public projects are undertaken based on the traditional project management, where time, cost and quality have to be managed. This study will determine whether TQM concepts are used by the respondents of the questionnaire.

While there is mixed views that there is no link between TQM and Traditional Project Management (TPM), there are revelations that quality management can be incorporated in the project life cycle as both have a common goal of customer satisfaction. The public sector's main object is service delivery to the communities, which is a form of customer satisfaction. This study will determine whether there is any link between TQM and TPM in the context of the public sector.

Leadership and Management plays a great role in implementation of TQM. In most cases the strategy and vision of the organisation is influenced by them. Leadership is one of the ten steps that lead to successful implementation of TQM. This study will find out if the public sector considers quality management as a top priority in the public infrastructure projects?

3 RESEARCH DESIGN

3.1 Introduction

This section provides a detailed account of the research design that is adopted in undertaking this study. Specific focus will be given to the research philosophy, research approach, research methodology, research strategy, time horizon and ethical consideration.

3.2 Research Philosophy

The research philosophy that is used in this research is Positivist which leads the research to take the philosophical position of the natural scientist. The data collected is about observed reality and/or experience of the personnel who, on daily basis, work with the infrastructure projects within the public sector (Saunders et al, 2012). The personnel targeted were project managers, project engineers, planners, and heads of departments and units who run the infrastructure project in the public sector.

3.3 Research Approach

The deductive approach have been taken in this research. Like positivism, the deductive approach is natural science and this is supported by Saunders et al (2012) who states that “...it is the dominant research approach in the natural science, where laws present the basis of explanation, allow the anticipation of phenomena, predict their occurrence and therefore permit them to be controlled”

Blaikie (2010) listed the six steps which a deductive research approach will follow:

1. The tentative idea, a premise, a hypothesis or set of hypotheses to form a theory;
2. Using existing literature or setting conditions under which the theory are expected to hold, deducing a testable proposition(s);
3. Examination of the premises and the logic of the argument;
4. Testing the premises by collecting appropriate data to measure the concepts or variables and analysing the data;

5. If inconsistency is realised the test is considered to have failed, therefore the theory is false and must be either rejected or modified and the test process been started and;
6. If the results of the analysis are consistent with the premises then the theory is corroborated.

The above 6 steps from Blaikie (2010) have been adopted as the research approach.

3.4 Research Methodology

Research methodology can be described as a technique that is used to solve the research problem in a systematic manner. In this research, there are a various steps that are adopted generally in solving the research problem (Kothari, 2004).

The methodology that is used in this research is Mono-method Quantitative research design and the data collected is used to test the theory. Saunders et al (2012) stated the characteristics of quantitative research examination of variables, and they are measured numerically and analysed using a range of statistical techniques, tables and graphs. This was also seen in the respective research methodologies that were done by Bryde *et al* (2007); Graham *et al* (2014); Altayeb *et al* (2014); Xiao *et al* (2002) and Ilkay *et al* (2012). Furthermore, these statistical techniques incorporate controls to ensure validity and reliability of the data. In the study done by Graham et al, (2014) Cronbach's α , Bartlett's test of sphericity was used to validate the results that were obtained. The validity methods will also be used in this research.

As stated under section 3.2, the research philosophy that have been adopted to solve the research problems is Positivists philosophy. This philosophy is found to lead the research to take philosophical position of natural scientist. In that regards, Mono-method qualitative research design was found to be relevant, especially intertwined with the deductive approach. As stated else where the data collected will be used to test theory. This was supported by Saunders *et al* (2012), stating that qualitative research is in many instances is linked with positivism.

Initially, the data will be analysed using a range of graphs and tables and this will be further supported by a range of statistical techniques, which will be used to analyse the relationships between variables. The reason for this approach is to test if the data collected will be consistent with the premises of the theory as described in the literature review and the hypothesis.

3.5 Research Strategy

The strategy that has been adopted is the survey strategy. As stated by Sanders *et al* (2012), this strategy is in most cases associated with deductive research approach, this is in line with the adopted research approach as stated in section 3.3. The questionnaire is used since it provides one the opportunity to gather information that is standardised from a sizeable population in an economic manner (Saunders *et al*, 2012). The questionnaire consists of a fixed number of structured questions, which will be the same to all the respondents for consistency purposes and standardisation. Since the data will be collected in the same manner, it will be ensured that the questionnaires are clear so that they are understood in the same manner, which will further assist in generalizability which helps to bring in another element of quality in the research. To test the questionnaires, a sample of the questionnaires was sent to a few respondents to test its validity. The variance would be used to measure the reliability and the dependability of the questionnaire.

The following was found to be the advantages of using the questionnaire as opposed to other research strategies;

1. It is cheaper to use the questionnaire. This is supported by Sanders *et al* (2012) and Kothari (2004).
2. The respondents are given sufficient time to complete, in the case of this research, roughly two (2) months was given to the respondents. This is mainly because of the time constraints to finish the course in University of the Witwatersrand, Johannesburg regulated time.
3. The respondents, which are not easily accessible or approachable due to time constraints and availability, can be drawn to complete the questionnaire as it can

be dropped in their offices in their absence, and they can complete it at their spare time as there is sufficient time to complete the questionnaire.

4. The results can be made reliable and dependable, as large samples can be achieved. This is also supported by Kothari (2004).

3.6 Population

The population of this study is made of, Clients (Public Sector), the Engineer (Consultants) and the Contractor (Main and Sub Contractors). The focus will only be on engineering disciplines personnel that are working with departments and entities that are mandated with the infrastructure projects delivery within the three metropolitan municipalities and their respective entities in Gauteng province, South Africa. The personnel that constitute the population are only skilled work force such as, civil engineers, electrical engineers, mechanical engineers and engineering technicians working on the public infrastructure projects. The three metropolitan municipalities namely are, Ekurhuleni Metropolitan Municipality, City of Johannesburg Metropolitan Municipality and City of Tshwane Metropolitan Municipality.

3.7 Population Sampling

The sample of the population was targeting skilled personnel that are involved in the public infrastructure projects. Since all the projects are done by both the public and private sector, the sample covered all involved in the infrastructure projects within the public sector. The targeted sample include the following;

1. Public Servants – Project managers, Quantity Surveyors, Engineers, Technicians, Planners, Project Departments Heads
2. Consultants Involved in the Public Projects – Engineers, Project Managers, Technicians
3. Contractors Involved in the Public Projects – Engineers, Project Managers, Technicians, Quantity Surveyors, Clerk of Works

This sample is found to represent the whole population in a meaningful manner (Saunders *et al*, 2012). The reason for including the private sector in the population and

the sample is mainly because, the public sector utilise the services of the engineers (consultants) and contractors (main and sub-contractors) to provide some services for one reason or the other. For example, lack of capacity in the public sector to do certain work can lead to such work to be contracted to the private sector. In many instances they are appointed through the tendering system as per allowable framework of Municipal Financial management Act (MFMA) and/or other relevant regulatory processes..

3.8 Time horizon

The research time horizon that is implemented in this work is the cross-sectional studies as the research would be focusing on completed and ongoing infrastructure projects within the past 5 years. This is found to be relevant as it describes the incidence of a phenomenon (Saunders *et al*, 2012).

3.9 Ethical Considerations

Saunders *et al* (2012, p. 226) defines ethics as “the standards of behaviour that guide your conduct in relation to the right of those who become the subject of your work, or affected by it”. University of the Witwatersrand, Johannesburg uses the term ‘research participants’ in place of ‘human subjects’ to clearly show that the research is not done under bio-medical science where the term ‘research subject’ is appropriate.

The whole research will be guided by the University of the Witwatersrand, Johannesburg’s code of ethics. Before any research participants could be contacted an application to Human Research Ethics Committee (HREC Non-Medical) was completed and approved. The research has gone through the Guidelines for Human Research Ethics Clearance Application /non-medical (a separate document available is on the following web site <http://web.wits.ac.za/Academic/Research/Applications.htm> and I have familiarised myself with the ethical guidelines specific to my discipline. An application for ethical clearance was made as soon as the completed questionnaires were approved by the supervisor, Professor David Root. Some of the reasons for seeking ethical clearance before one can proceed with the research work is to ensure that no harm is done to the

research participants, the researcher and/or the reputation of the University. See Appendix A, Clearance certificate, Protocol Number CEM/15/12/05/MRR. Also see data collection protocol below, where the ethics risks and mitigations are discussed.

3.10 Data Collection Protocol

Data was collected through the use of questionnaires only, these were hand delivered to the respondents. The respondents were given sufficient time to complete the questionnaires. As soon as the questionnaires were completed by the respondents, they were collected from the respondents. The reason for the questionnaire to be collected by hand as opposed to be emailed was to improve the confidentiality of the participants. This agreed ethical access was maintained throughout the data collection period.

Consent letters were attached to accompany the questionnaires. Therefore, any changes to the content of the questionnaire after collection of data would mean that ethics will be breached. No questionnaire would be changed or modified after data collection, only spelling mistakes or grammar can be rectified, but this will not have to change the initial context of the questionnaire. If need be, the whole data will be discarded and the new questionnaire will be taken through the clearance process of the University again and sent to the research respondents. The disadvantage of restarting the process is that it will delay the completion of the research.

Power relationship between the researcher and participants can also pose ethical issues and the integrity of the research can be compromised. Before the researcher's subordinates and all those working close to the researcher in infrastructure projects could respond to the questionnaire, they will be requested to be impartial on completing the questionnaire, since failure to do so would compromise the integrity of the research and above all, contravene the ethics of the University.

There is a risk of bias in this study. As a mitigation factor, confidentiality will also be adhered to, no material(s), details of the person(s) or any goods that I was granted to use for the purpose of this research would be given to any third party or distributed in any

form. Participants or their respective organisations will only be allowed to view the results.

3.11 The Design of the Instrument

Table 3-1 contains all the questions that have passed the paucity filter during the research methodology stage. This gives guidance on how the question will be used in the research on its entirety.

Table 3-1: Design of the instrument

Questions that Passed the Paucity Filter	Questions Answered in this Research
Question B3	Total Quality Management (TQM) have positive attribute to the service delivery in South Africa construction industry?
Question B4	Total Quality Management (TQM) concepts positively improve the project time (schedule) of the public projects?
Question B5	Total Quality Management (TQM) concepts positively improve the spending of capital budget of the public projects?
Question B6	How often does employees involved with the infrastructure projects in your organisation taken for training?
Question B7	How often do you attend Quality Management Training?
Question B8	Quality Management is incorporated in the tender contractual documentation?

The questions in table 3-1 above are six (6) questions which were asked as sub questions. This sub questions that are in Table 3-1, there intended purpose is to assist in extracting empirical evidence from the people whom are dealing with public infrastructure projects.

3.12 Summary of the Key Findings of Research Design

The research design was tailor made of the data that is required for this particular research. The research philosophy, research approach, research methodology, research strategy, time horizon and ethical consideration was elaborated in detail in the body of this research design. This have been found vital as it gives a clear direction on how data will be collected, processed, feedback and also to protect all participants and their respective organization.

4 PRESENTATION OF THE DATA AND ANALYSIS

4.1 Introduction

As stated in chapter one (1), the study seeks to find how Total Quality Management (TQM) can benefit or, if it is already benefitting the South African public sector clients in infrastructure project delivery, acknowledging that quality management concepts systems and philosophies are already available in the country.

This is an exploratory study where the data was gathered using a questionnaire, analysed and answer the research question and its sub questions, which are laid out in chapter 1.

The objectives of this study are;

- To investigate if Total Quality Management (TQM) is practiced in the South African public sector projects and,
- To investigate what impact it can bring to the public sector so as to improve service delivery?

4.1.1 Questionnaire Pilot Testing and validation

Ten (10) questionnaires were printed and delivered to ten (10) people so that they can assess its validity and if the questionnaire was arranged properly. Bell (2010) as cited by Saunders *et al* (2012) suggested the following pointers to be used to guide somebody who is reviewing the questionnaire:

- How long did the questionnaire take to complete
- Are instructions clear for respondents
- Are there questions that are not clear or they are ambiguous
- Any questions that the respondents felt uneasy on answering
- Major topic omissions
- Clarity and attractiveness of the questionnaire layout
- Any other related comments that will bolster the questionnaire.

The above suggestions from Bell (2010) was used in refining the questionnaire and the Table 4-1 below represents the highlights that were achieved through the exercise;

Table 4-1: Questionnaire validity and testing results:

Questions	Feedback/Comments
How long did the questionnaire take to complete	On average it took respondents 8 minutes to complete the questionnaire. In the consent for 10 minutes was allocated
Are instructions clear for respondents;	There was no comments on clarity.
Are there questions that are not clear or they are ambiguous;	There were spelling errors that were encountered and corrected, And spelling errors due to computer auto change, this was also corrected
Any questions that the respondents felt uneasy on answering	None
Major topic omissions;	None
Clarity and attractiveness of the questionnaire layout;	The questionnaire was found to be simple and straight forward and attractive
Any other related comments that will bolster the questionnaire	None

4.1.2 Question Coding

All the questions in the questionnaire were not coded until during the analysis of the questionnaire. Microsoft Excel was used to do the exploratory data analysis (EDA). EDA have been used in the whole of Section 4.2. In Section 4.3, statistical methods were used. The reason for coding during analysis was purely based on minimising the risk of respondents not understanding the questionnaire or using the numbers that are used for coding which can make the questionnaire none responsive. The questions B3 and B5 are used below to illustration how the coding was done:

Question B3

Total Quality Management (TQM) have positive attribute to the service delivery in South Africa construction industry.

Strongly agree	Agree	Not sure	Disagree	Strongly disagree
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Question B4

Total Quality Management (TQM) concepts positively improves the project time (Schedule) of the public projects.

Strongly agree	Agree	Not sure	Disagree	Strongly disagree
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

4.1.3 Response Rate

As stated by Saunders et al (2012), the probability sampling should exactly represent the population it was taken from. Below is the calculation of Total Response Rate and Active Response Rate. When calculating this, all the eligible respondents were considered, while ineligible and unreachable respondents were deducted from the total sample. All the respondents that returned the questionnaire responded to all the questions.

Table 4-2: Summary of the responses achieved

Description	Totals
Total number of responses	43
Total number in sample	80
Ineligible sample	10
Unreachable samples	16

Due to time constraint to finish this research report, it was stated in the cover letter of the questionnaire that the completed questionnaires should be submitted on or before 27th of

January 2016, therefore all the questionnaire that arrived after the said date were taken to be ineligible. Some of the questionnaires were handed late while other respondents were unreachable and the questionnaires were never collected.

$$\textbf{Total response rate} = \frac{\text{total number of responses}}{\text{total number in sample} - \text{ineligible}}$$

$$\textbf{Total response rate} = \frac{43}{80 - 10} = \textbf{61.4\%}$$

$$\textbf{Active response rate} = \frac{\text{total number of responses}}{\text{total number in sample} - (\text{ineligible} + \text{unreachable})}$$

$$\textbf{Active response rate} = \frac{43}{80 - (10 + 16)} = \textbf{79.6\%}$$

The total response rate and active response rate is 61.4% and 79% respectively. This is found to be higher than anticipated considering the short period that was allowed to collect data. The data collection was done immediately after receiving the University ethical clearance certificate (See Annexure A) which was on the 11th of December 2015 until the 27th of January 2016. This period most of the people were going on Christmas break and the construction holidays in South Africa was commencing on the same date.

4.2 Exploratory Data Analysis (EDA)

The EDA is found to be very useful at this stage of the research, see Sanders *et al* (2012) stated this elsewhere. Since this method emphasises the use of diagrams to analyse the data, as the research progress, it gives the opportunity to choose the best suitable statistical analysis techniques.

This method was further found to assist with flexibility to introduce unplanned analyses to respond to new finding where required. Therefore, other relationships in the data would be explored as the data is been analysed in this sub section.

In this section, individual variables would be analysed as stated by Sparrow (1989) as cited by Saunders *et al* (2012), the key aspects that will be checked will include but not limited to;

- specific values;
- highest and lowest values;
- trends over time;
- proportions;
- distributions.

This section will lead to using appropriate statistical analysis in Section 4.3. At this stage comparisons, relationships between variables, and relationship within variables will be explored. The key aspects been the following;

- conjunctions;
- totals;
- interdependencies;
- relationships

4.2.1 Years of Experience in Procurement in the Construction Industry

The experience of the respondents was required to be stated in the questionnaire. This was to test if the respondents are skilled in engineering. Eighteen (18) respondents were in the range of “0 to less than 5 years”, 10 respondents were in the range of “5 to less than 10 years”, eleven (11) respondents were above 10 years but less than 20 years of experience and lastly, only four (4) respondents had 20 years and above wealth of experience. Refer to *Figure 4-1* below.

58% of the respondents have more than 5 years of experience in procurement in the construction industry. At this level one have to

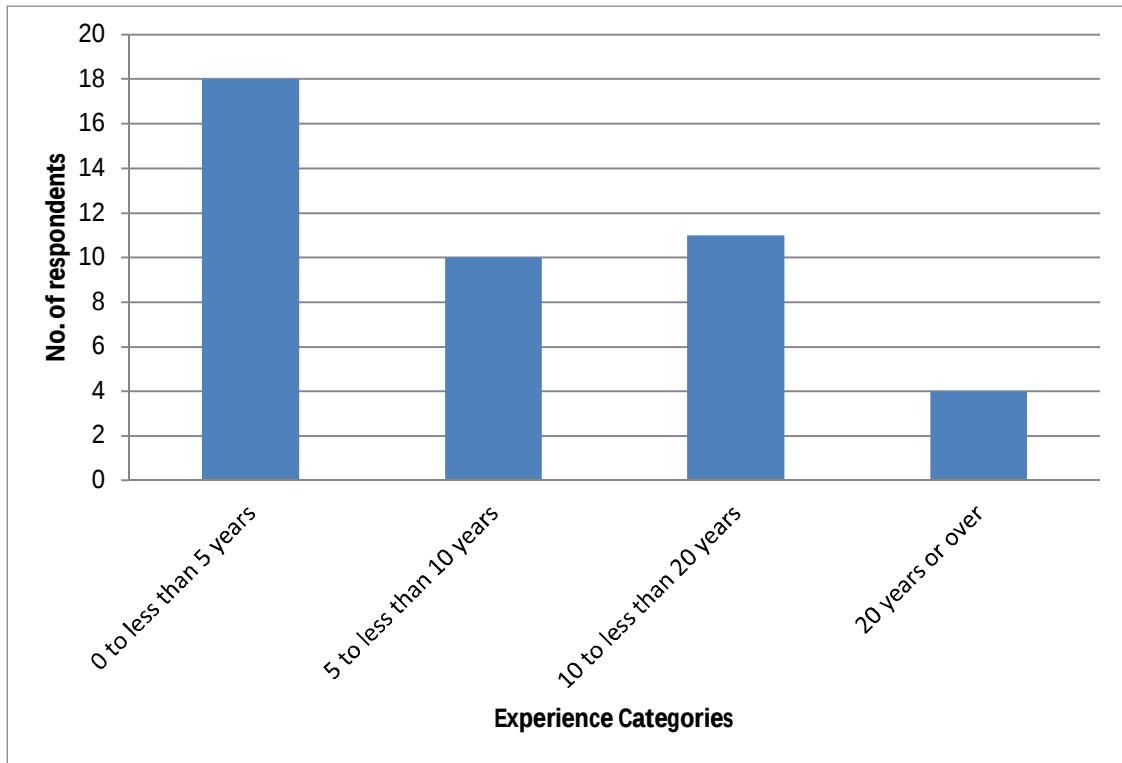


Figure 4-1: Work Experience of the Respondents in Years

4.2.2 Project Stakeholders

Of the 43 respondents only one did not respond to this question. Twenty three (23) were working as the client in the chosen project. Seventeen (17) as the Engineering Consultants and only Two (2) as the contractor. See Figure 4-2 below.

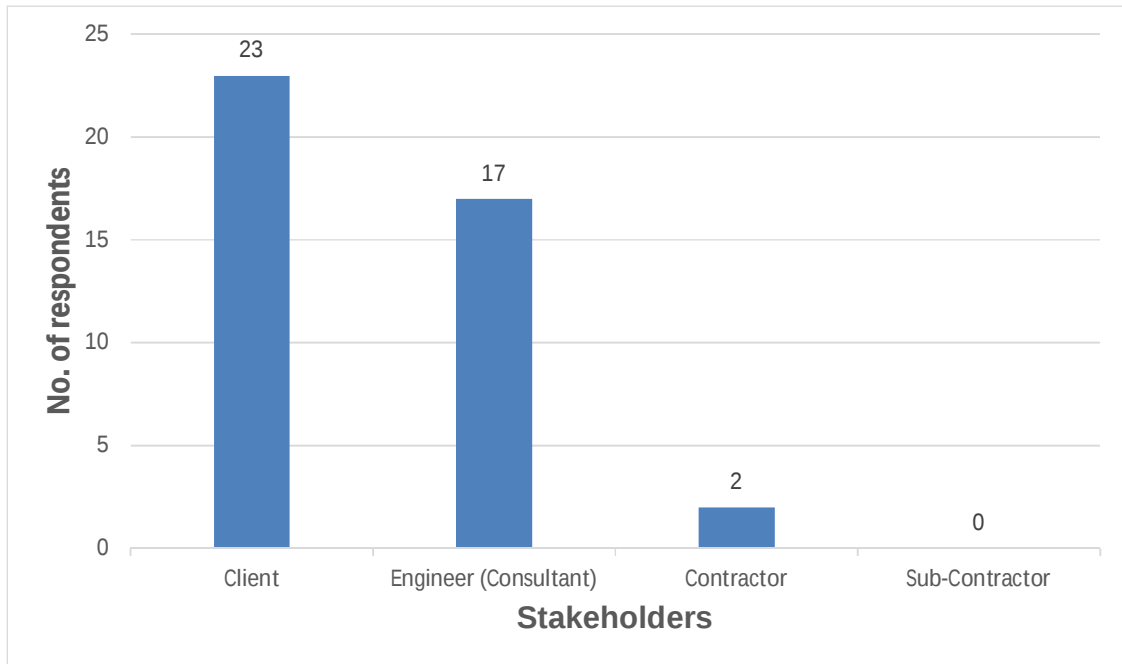


Figure 4-2: Stakeholders Position in the Chosen Project

4.2.3 Role(s) in the Project

Figure 4-3 is the illustration of the roles that were played by the respondents in the chosen project. Most of the respondents were Project Managers and the list role was of the principal agent. This illustrates that the people that are involved in the public infrastructure are qualified enough to understand the importance of quality management programs such as TQM.

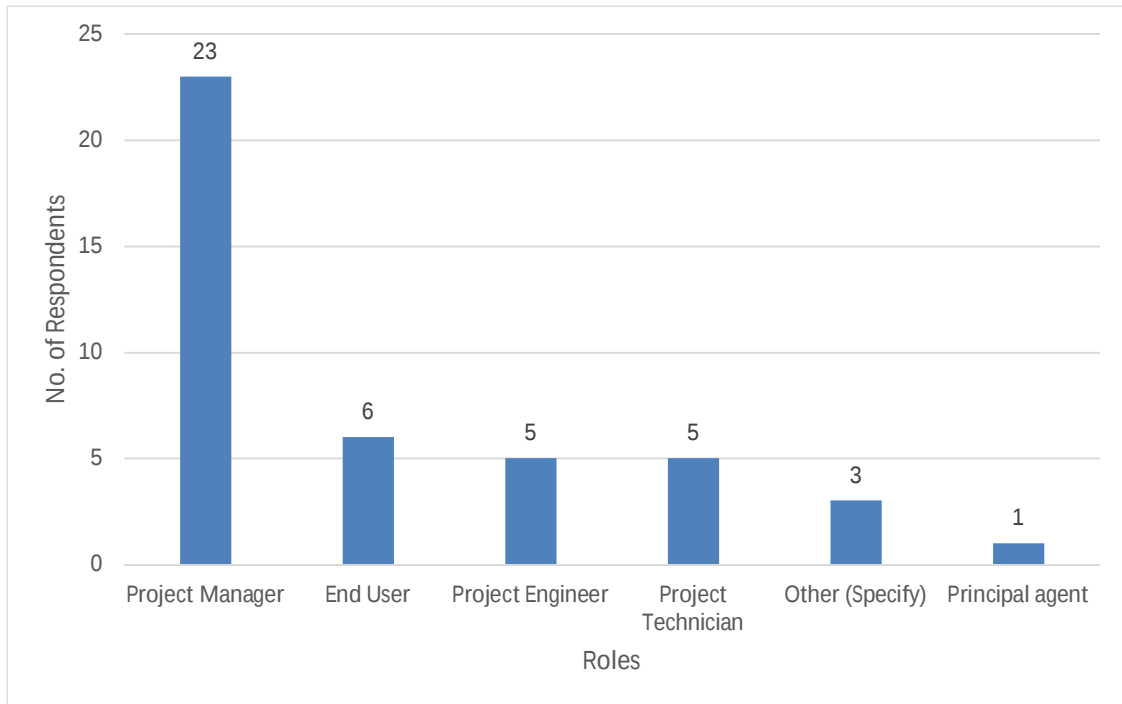


Figure 4-3: Roles Played in the Project

4.2.4 Engineering Disciplines

Figure 4-4 illustrates the disciplines that the respondents had to choose from, the projects that most respondents were involved in are civil engineering projects with 54% followed by Electrical Engineering (24%), Mechanical engineering (15%) and Others (7%). The disciplines of the respondents that choose “Others” category were primarily from the following disciplines: control and instrumentation, process engineering and IT systems.

As highlighted above, this illustrates that the people that are involved in the public infrastructure are qualified enough to understand the importance of quality management programs such as TQM.

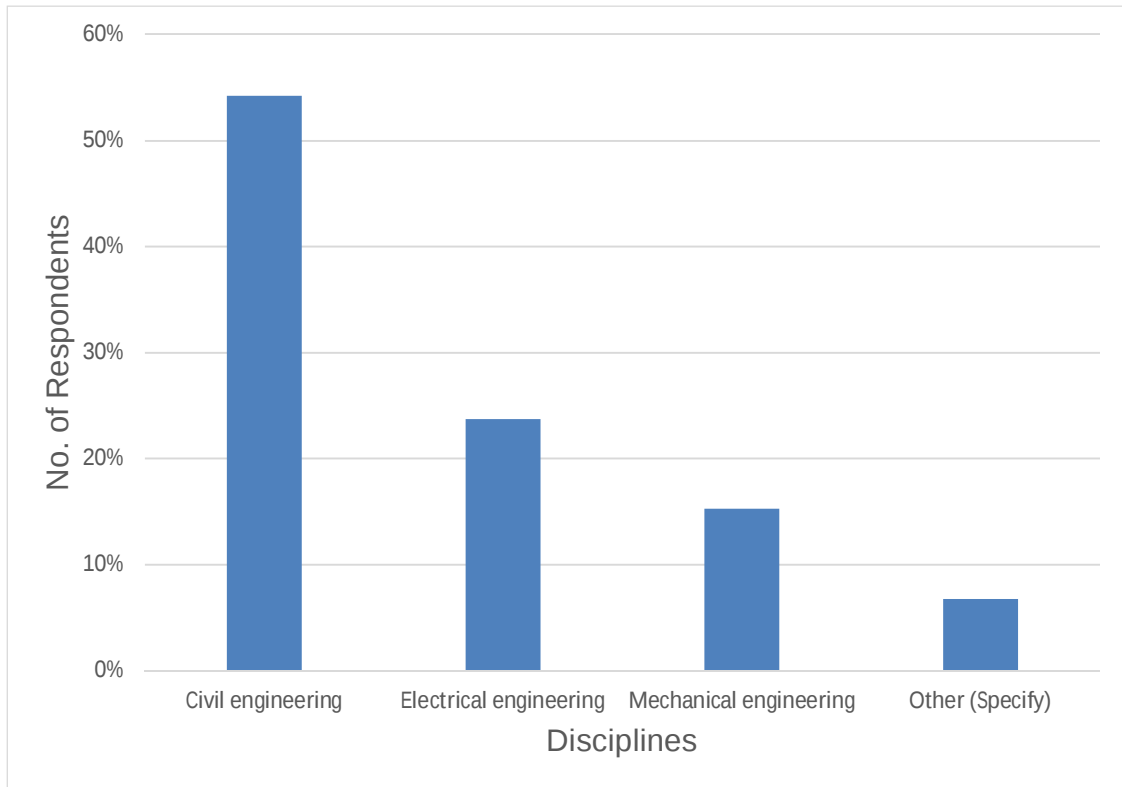


Figure 4-4: Types of Projects (Engineering Disciplines)

4.2.5 Current and Previous Projects

The respondents were required to indicate whether the project was done and completed in the past 5 years or it was currently ongoing. The purpose of this specific question is to establish whether the projects that are considered reflect on historical data or on the current situation. The majority of the respondents used the On-going project. Figure 4-5 illustrate that respondents who based their response on projects that were completed in the past 5 years amounted to 31% and the on-going projects amounted to 69%.

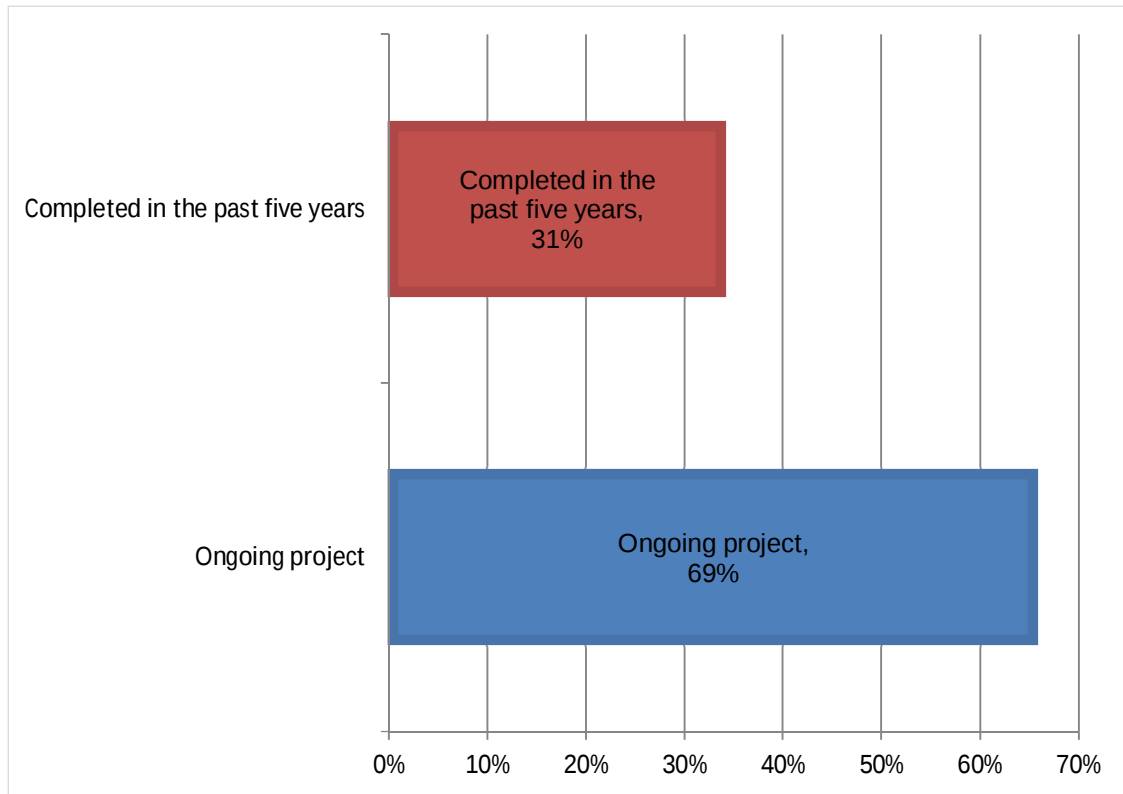


Figure 4-5: Ongoing vs. Completed Projects in the Past 5 years

4.2.6 Select all the TQM Concepts that You Applied in the Chosen Project

Bryde *et al* (2007), Harrington *et al* (2012), Brown (2013), Altayeb *et al* (2014), regarded the following as elements of TQM. Leadership and management commitment;

- Continuous improvement;
- Process improvement
- Customer satisfaction;
- Training
- Focus on employees (Empowerment)
- Communication
- Teamwork
- TQ and measurement
- Supplier involvement

The ten (10) elements were listed in the questionnaire and the respondents were permitted to choose all the elements that they practised in the project that they worked on. The results are illustrated in Figure 4-6.

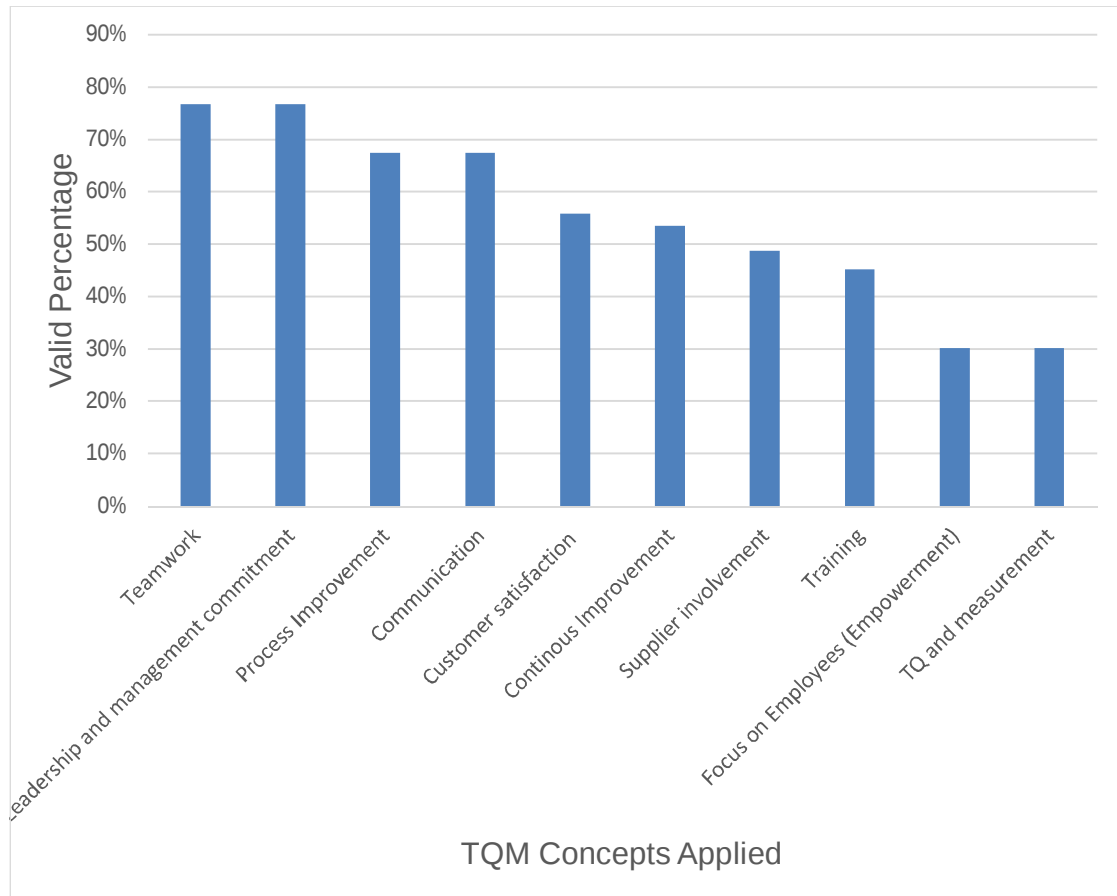


Figure 4-6: Applied TQM Concepts per Project

The TQM concepts that scored high with 77% were, 1. Teamwork and 2. Leadership and management commitment. This was supported by Baird *et al* (2011) findings that, first, TQM is easily implemented in working environments that encourage collaboration and cooperative behaviour. Secondly, managers should recognize the influence that is brought about by the employees and in that sense they should establish an organisational atmosphere that encourage and enhance extensive use of the TQM practices by motivating their employees to contribute their skills and wisdom towards the business process.

The results shows that Teamwork and Leadership Commitment goes hand in hand. The respondents have illustrated that this two elements are the most used and practised in the public projects.

Process Improvement, Communication, Customer Satisfaction and Continuous Improvement respectively scored 67%, 67%, 56% and 53%. This four elements are found to be above the 50% mark. Six (6) of the Ten (10) TQM concepts were scored above 50%. The result gives hope that if TQM is taken seriously in the managing of infrastructure projects, positive gains may arise as this highlights that respondents are adequately informed about TQM concepts.

The results below 50%, consist of Supplier Involvement (49%), Training (45%), Focus on employees (30%) and TQ and Measurement (30%). These results are discussed below

Supplier Involvement in the public sector is borne of contention in the sense that the supply chain management encourages transparency and most of the time suppliers are procured by the Supply Chain Management (SCM) Unit. The project team start contact with the suppliers after tender award. So contractually they are managed by SCM. Harrington *et al* (2012, p. 358) states that *“TQM recognizes that the quality of any stage in a process is dependent on the quality of the previous stage. [...] Maintain close and long-term relationships with suppliers or vendors of both labour and materials. Maintaining a close and long-term relationship with suppliers result in achieving the best economy and quality. Having close working relationships with a small number of suppliers means that each supplier can be given bigger orders, which win their loyalty.”*

Harrington *et al* (2012, p. 358) cited that Deming emphasised the importance of maintaining special relationships with suppliers when he stated that;

“End the practice of awarding business on the basis of price tag alone. Instead, minimise total cost by working with a single supplier.”

It is permitted to have a database of suppliers in the public sector. However, that does not mean that the same people from the database will always be awarded the tenders.

Different suppliers from this database must compete against each other for any procurement that has to be transacted, so loyalty will not be a guarantee that the same suppliers will be awarded the tenders. National Treasury (2008, p. 85) under the learner guide of unit standard ID 116353 states that *“An effective system of supply chain management requires an accounting officer...to ensure that the resources required to support the strategic and operational commitments of an institution are properly budgeted for and procured at the right time. Planning for the procurement of such resources must take into account the period required for the competitive bidding process. It must therefore be emphasised that a lack of planning does not constitute a reason for dispensing with the prescribed bidding process.”* This statement basically shows that for any procurement to fruition, fair and transparent process should take place, where the bid can be awarded to the highest scoring bidder.

The results on Focus on employees and Leadership commitment are way apart. If there is leadership commitment and is sitting at 77%, and as stated by Harrington *et al* (2012), training is a fundamental requirement for implementation of quality management programs. Training in this instance in Figure 8 was scored 45%. For continuous improvements to be successful, the employees should be taken for training on a regular basis so that employees keep up with developments in their respective career paths. These also suggest that majority of the respondents are not taken for training. The participating respondents, therefore, feel that there is very little focus employees.

Focus on Employees (Empowerment) is a very important element of TQM as employees are considered internal customers. Therefore employees should be satisfied in the working environment at all times. After all, employees are the ones who drive TQM within the organisation. This enables the Management and employees to interact and bring forward suggestions on how processes such as quality, safety, day to day operation of the organisation can be improved. Harrington *et al* (2012, p. 357) said “Management should encourage suggestions and make the working environment open, so honest comments can be made without fear of punishment. More specifically, management should implement a procedure for taking in suggestions.” All these suggestions should be

considered to improve the working conditions and the process of the organisation. The results of 30% in figure 8 above then shows that employees are not given ample opportunity to bring forward suggestions to perfect the process that they work with on daily basis.

TQ and measurement enables the organisation to reflect on the positives and negatives that are experienced in the project. This is emphasised by Harrington *et al* (2012) stating that for the organisation to discover the results of deploying quality programs and the areas of future development, construction-related measures are found to be necessary. In the public sector the reporting is done on a quarterly basis. This is, however project specific and consequently it does not give the individuals who are running the projects to give their feedback on challenges they experience on the day to day running of the projects. As a result, a gap between the employees and the top management is prevalent. The gap between employees and top management highlights a negative impact that is never addresses and is therefore repeated with the commencement of new projects. If measurements were done on the projects it could provide the baseline of quality of the projects and new projects will benefit from this baseline as it will be used as a bench mark.

4.2.7 Total Quality Management (TQM) have Positive Attribute to the Service Delivery in South Africa Construction Industry.

From Figure 4-7 below, 54% strongly agree and 37% agree, all in all, this amounts to 91% of individuals in agreement that service delivery has a positive attribute to service delivery. This is despite the fact that majority of the respondents are either rarely or never taken for TQM training (49% of respondents are rarely taken for training and 21% have never been taken for TQM training). This shows how the population of this study believe that TQM can be of much benefit to the public infrastructure projects.

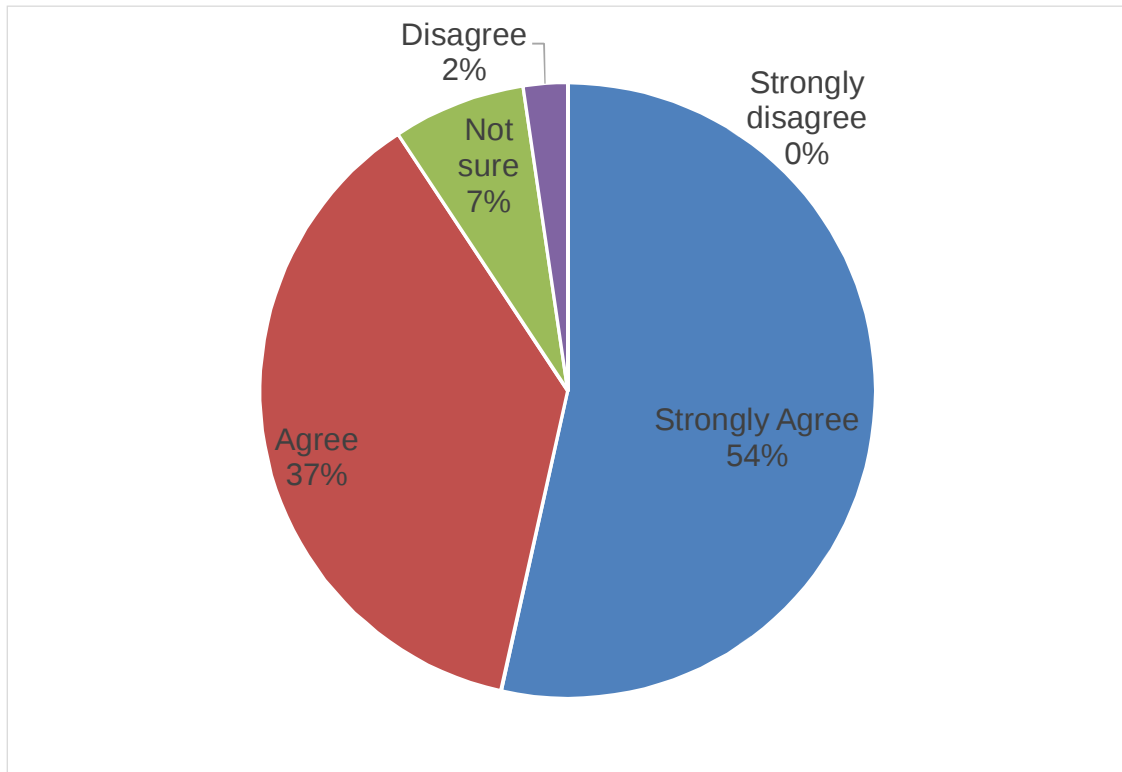


Figure 4-7: TQM has positive attributes to the service delivery in the South African construction industry

One of the main objectives of the public sector is to provide services to communities, hence every time when the communities are dissatisfied with the service delivery members of the aggrieved communities protest. Figure 1 shows a rise in major service delivery between 2004 and October 2014. This is further emphasised by the study done by Akinboade et al (2012) when the majority of the respondents in that particular study were more dissatisfied by service delivery.

The infrastructure projects such as road, portable and waste water, refuse removal and treatment are such examples of services that lead to protest. This was supported by Holt et al (2000, p. 541) stating that *“The effective and efficient use of resources in public project management requires a commitment to driving down costs and exploiting value opportunities. In achieving this, public management, being a civil service, must also be aware of social, political and ethical requirements that can impinge upon strict economic reasoning [...]”*, this is because though there is a need to make profits by the public

sector to be able to support its self, there is also a requirement of the Constitution of the Republic of South Africa that people should be provided with certain services irrespective of their financial position.

4.2.8 Total Quality Management (TQM) Concepts Positively Improves the Project time (Schedule) of the Public Projects.

Figure 4-8 shows that 93% of the respondents are in the agreement with the statement that TQM concepts positively improves the project time (schedule) of the public project. 42% of the 93% strongly agreeing.

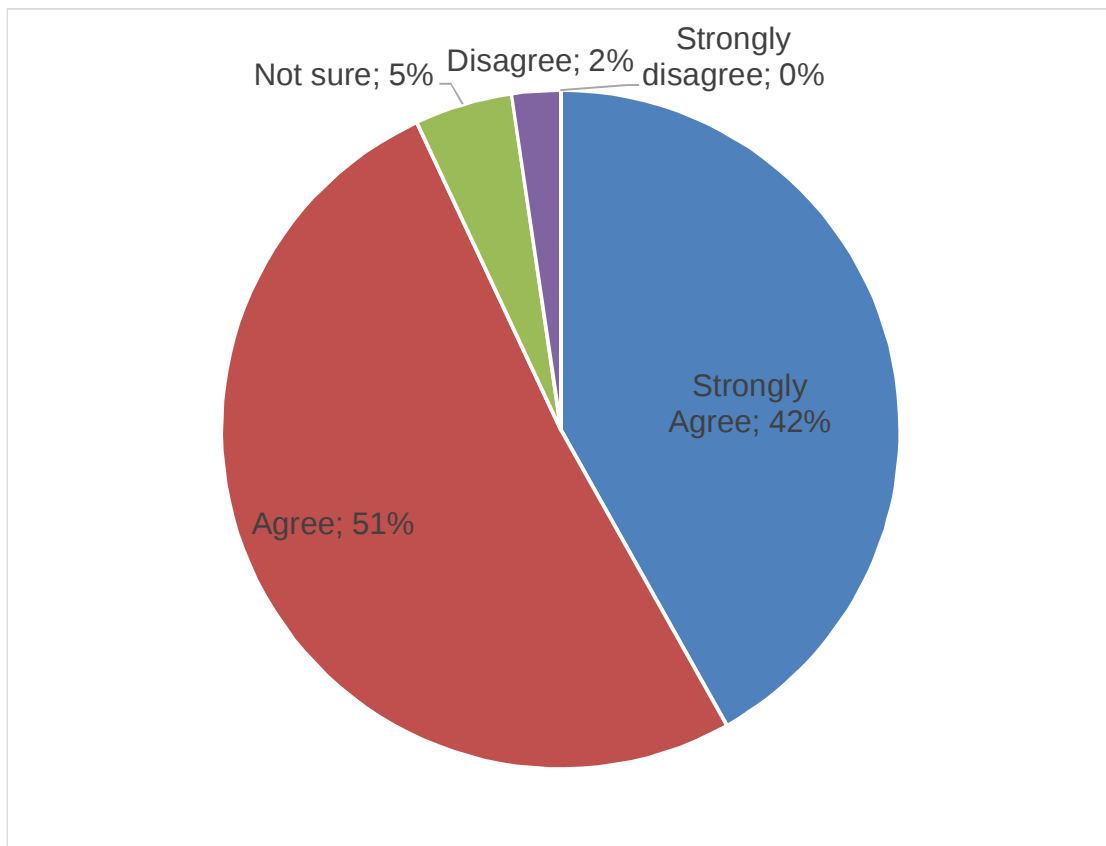


Figure 4-8: TQM Concepts Positively Improves the Project Time (Schedule) of the Public Projects

As stated elsewhere in the report TQM is an antecedent of project management. Moreover, project management and TQM have one common objective which is customer satisfacti

on through reducing waste, continuous improvement, cost effectiveness, minimising rework and to instil customer focus. This can improve the time that is taken on the public projects.

Nonetheless, in many instances, quality is compromised when projects are rushed or extremely tight deadlines are set. The delays are in many cases due to poor planning and this results in projects starting late. Because the capital budget has to be spent within a stipulated time, the project team is rushed to complete the work, which then compromises the quality of work done because more focus of the project team is rushed to be placed on the cost and time. This is supported by Verster (1998) as cited by Joubert *et al* (2005) stating that tight time constraints is an obstacle to quality in project delivery.

4.2.9 Total Quality Management (TQM) Concepts Positively Improves the Spending of Capital Budget of the Public Projects.

Figure 4-9 shows that respondents do not totally agree that TQM concepts positively improve the CAPEX spending with the result for both 'Strongly Improves the Slity in projec' amounting to 21%. On the extreme ends are result for both 'Strongly Improves the', each amounting to 5%. In the centre of the bar chart is a sturdy 49% of the respondents stating that TQM concepts are 'neither improves nor worsens' the bar chart for both 'Strongly Improves the' the majority of the respondents have mixed feelings about the statement. This upholds the existing literature, as stated in chapter 2, the literature review, Sampaio *et al* (2011) indicates that many studies have been carried out to relate the implementation of quality management systems and organisational performance and the results of these studies show that there are still mixed feelings on whether organisations that have implemented quality management systems can have financial edge over those that are not. This makes the decision to implement TQM concepts to be the discretion of the organisations as depending on their viewpoint regarding the financial benefits.

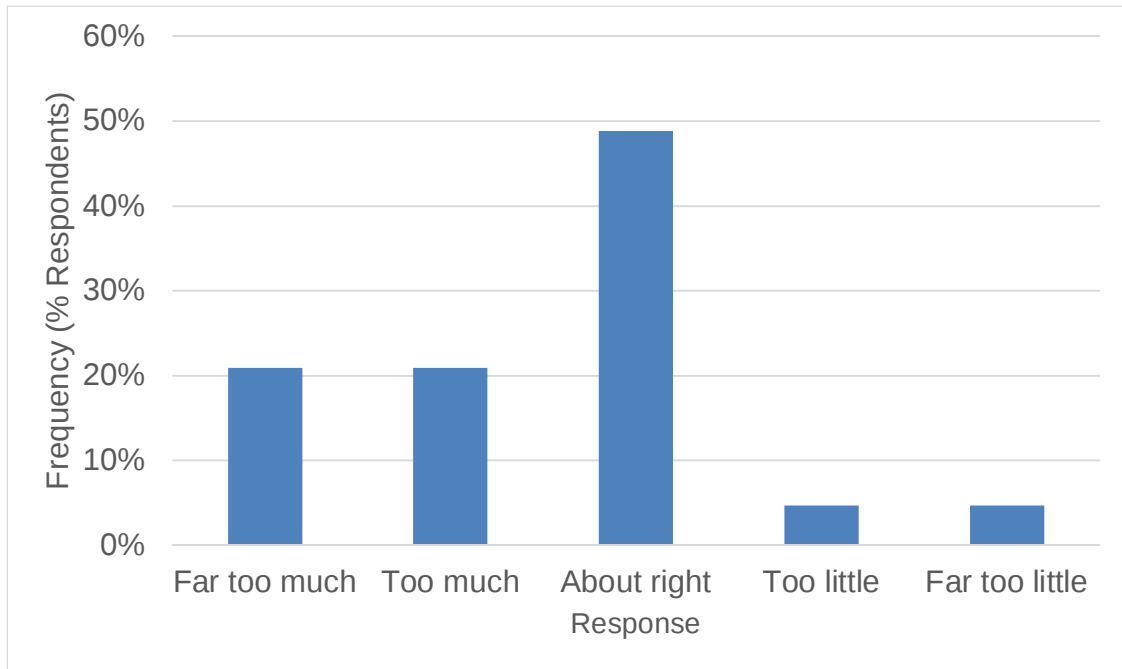


Figure 4-9: TQM Concepts Positively Improves CAPEX Spending in Public Projects

4.2.10 Training of the Personnel Involved with the Infrastructure Projects

The results in Figure 4-10 shows that employees who go for training all the time and those that frequent training makes up joint percentage of only 26% of the total sample. While 74% of employees attend training sometimes or rarely. Training has long term rewards as it contributes towards continuous improvement of the individual, level of education and training and above all, the individual growth of the employees which can increase team spirit and morale.

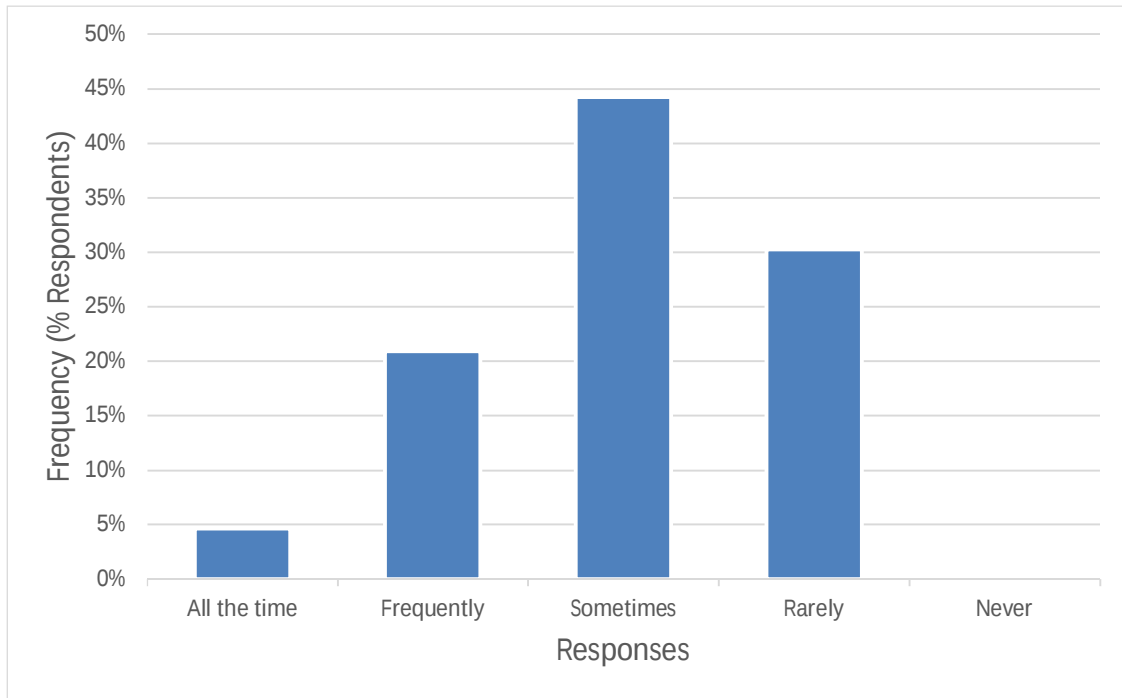


Figure 4-10: Frequency of Training Employees Involved with the Infrastructure Projects

4.2.11 Quality Management Training

The results as illustrated in Figure 4-11 reveal that TQM training moves from sometimes to never as the percentage total 98%. The remaining 2% is that of the respondents who always attend the TQM training. Training is one of the ten (10) elements of TQM. Where training is lacking, like in this scenario, it makes it difficult to implement TQM. This significance of training was emphasised by Harrington *et al* (2012, p. 354) as quoted *“Training is a fundamental element for any successful quality management program. All of the current band of “quality experts” or “gurus,” along with many chief executive officers who have successfully implemented TQM in their organisations, unanimously recognise the importance of training. The training must target everyone’s responsibility. All employees from top management to labour should understand, the need for TQM, understand what TQM is, how TQM works, and its payoff”*.

Graham *et al* (2014) in conclusion advised that top management should ensure that employees do what they are trained for, they are coached and encouraged and where

there is change in the process the employees should be taken along so that they can embrace the changes with easy.

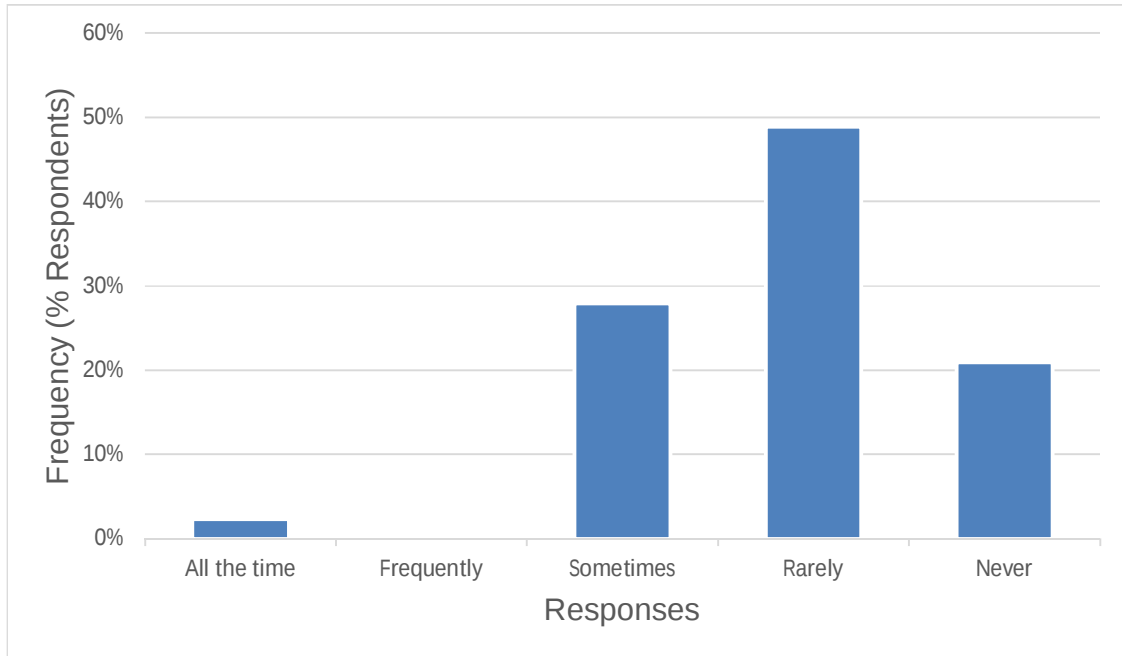


Figure 4-11: Frequency of Training Employees Involved with the Infrastructure Projects

In Figure 4-12 the results of Frequency of General Training versa TQM Training was compared and it shows that personnel that is involved in the infrastructure projects are taken for other training more than they do for TQM trainings. This should be expected as in the public sector like any other organisations, there are other skills and knowledge that are required especially when the personnel moves towards managerial positions.

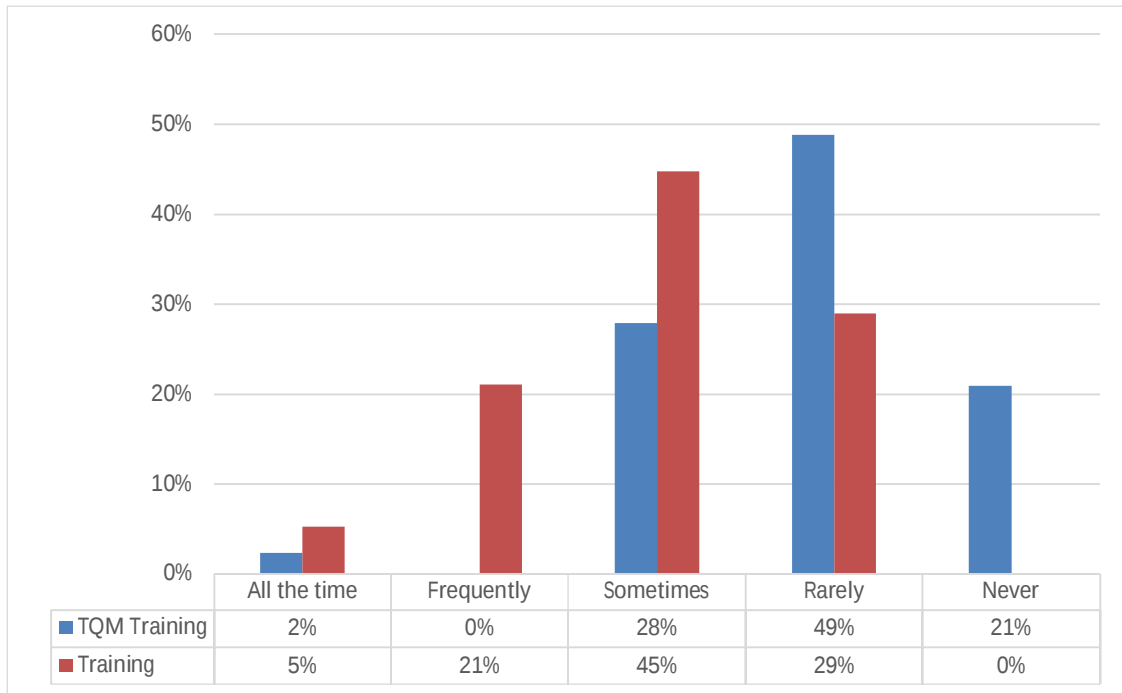


Figure 4-12: General Training Vs. TQM Training

4.2.12 Quality Management is incorporate in the Tender Contractual Documentation

Of all the 43 respondents that took part in the survey, 65% of the respondents at minimum they agreed that quality management should be incorporated in the contractual documentation. 23% were not sure and 12% disagreed. See Figure 4-13. From this percentage, it can be assumed that majority of the respondents consider quality management, therefore it is imperative to standardise. There should be a uniform quality standard that is followed by all involved in the infrastructure projects such as ISO 9000, Lean Six Sigma or TQM. This is supported by Baird *et al* (2011); Sila (2007) stated that there is no certification for TQM. Gotzamani and Tsiotras (2001) alluded that the success of the companies that are ISO 9000 certified are using TQM elements and in that regard it can be said that ISO quality standard is a proxy for adoption of TQM. This was further supported by Joubert *et al* (2005) stating that ISO 9000 should not be taken as a replacement of TQM and stating that organisations should not cap themselves to ISO 9000. ISO should be taken as step toward achieving TQM.

Since the majority of the respondents agree that quality management is incorporated in the tender contractual documentation, it is of paramount importance to ensure that they are trained so that they can enforce and monitor the quality during the implementation of the projects which in the long run it will bring about customer satisfaction and continuous improvement.

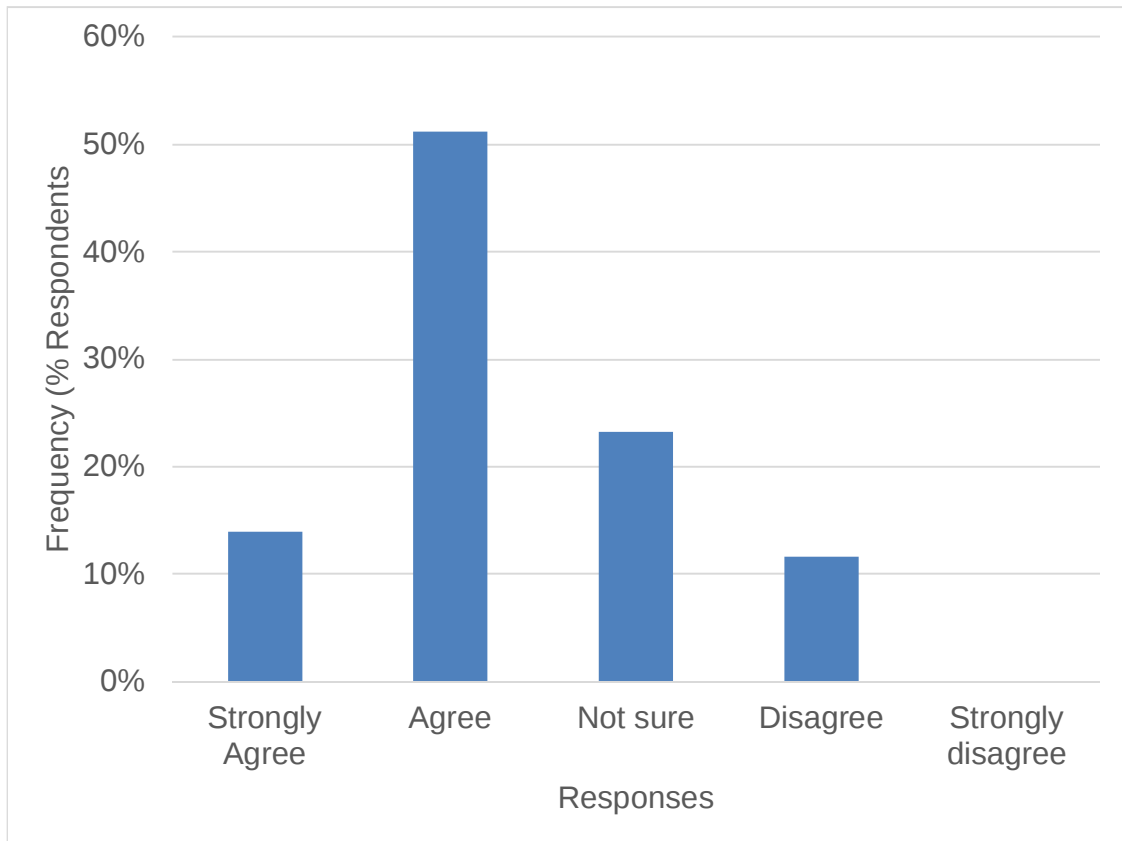


Figure 4-13: Quality Management Incorporated in Contractual Documents

4.3 Statistical Data Analysis

The descriptive statistics is used in this study to describe and compare variables numerically.

As stated in section 4.2 above, appropriate statistical analysis is used to compute comparisons, relationships between variables, and relationship within variables also is been explored.

The statistics in table 4.3 have been found to be relevant for this study. The main objective is to examine relationships, differences and trends by data type.

Table 4-3: Summary of the statistic used to test the data

What is been Tested?	Statistic Used
Normality of a distribution	Shapiro-Wilk test, Anderson-Darling test
Whether two variables are associated or not	Kolmogorov-Smirnov test
Whether three or more groups (categories) are different	One-way Analysis of variance (ANOVA), Tukey (HSD) and Dunnet (two sided)

4.3.1 Test of Normality of a Distribution

Questions B3 (QB3) through to Question B8 (QB8), was tested for normality independently. Section B of the questionnaire, is focused on the core of the research report, while Section A is mainly on the general question, and focused on the interviewee.

The following are the results and analysis of each question:

Summary statistics (Data)

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
QB3	43	0	43	1.000	4.000	1.581	0.731
QB4	43	0	43	1.000	4.000	1.674	0.680
QB5	43	0	43	1.000	5.000	2.512	1.032
QB6	43	0	43	1.000	4.000	3.000	0.845
QB7	43	0	43	1.000	5.000	3.860	0.833
QB8	43	0	43	1.000	4.000	2.326	0.865

Shapiro-Wilk test (QB3):

W	0.738
p-value (Two-tailed)	< 0.0001
alpha	0.05

Test interpretation:

H0: The variable from which the sample was extracted follows a Normal distribution.

Ha: The variable from which the sample was extracted does not follow a Normal distribution.

As the computed p-value is lower than the significance level $\alpha=0.05$, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.01%.

Anderson-Darling test (QB3):

A ²	4.639
p-value (Two-tailed)	< 0.0001
Alpha	0.05

Test interpretation:

H0: The variable from which the sample was extracted follows a Normal distribution.

Ha: The variable from which the sample was extracted does not follow a Normal distribution.

As the computed p-value is lower than the significance level $\alpha=0.05$, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H_0 while it is true is lower than 0.01%.

Shapiro-Wilk test (QB4):

W	0.749
p-value (Two-tailed)	< 0.0001
alpha	0.05

Test interpretation:

H_0 : The variable from which the sample was extracted follows a Normal distribution.

H_a : The variable from which the sample was extracted does not follow a Normal distribution.

As the computed p-value is lower than the significance level $\alpha=0.05$, one should reject the null hypothesis H_0 , and accept the alternative hypothesis H_a .

The risk to reject the null hypothesis H_0 while it is true is lower than 0.01%.

Anderson-Darling test (QB4):

A^2	4.503
p-value (Two-tailed)	< 0.0001
Alpha	0.05

Test interpretation:

H_0 : The variable from which the sample was extracted follows a Normal distribution.

H_a : The variable from which the sample was extracted does not follow a Normal distribution.

As the computed p-value is lower than the significance level $\alpha=0.05$, one should reject the null hypothesis H_0 , and accept the alternative hypothesis H_a .

The risk to reject the null hypothesis H_0 while it is true is lower than 0.01%.

Shapiro-Wilk test (QB5):

W	0.857
p-value (Two-tailed)	< 0.0001
Alpha	0.05

Test interpretation:

H_0 : The variable from which the sample was extracted follows a Normal distribution.

H_a : The variable from which the sample was extracted does not follow a Normal distribution.

As the computed p-value is lower than the significance level $\alpha=0.05$, one should reject the null hypothesis H_0 , and accept the alternative hypothesis H_a .

The risk to reject the null hypothesis H_0 while it is true is lower than 0.01%.

Anderson-Darling test (QB5):

A^2	2.739
p-value (Two-tailed)	< 0.0001
Alpha	0.05

Test interpretation:

H_0 : The variable from which the sample was extracted follows a Normal distribution.

H_a : The variable from which the sample was extracted does not follow a Normal distribution.

As the computed p-value is lower than the significance level $\alpha=0.05$, one should reject the null hypothesis H_0 , and accept the alternative hypothesis H_a .

The risk to reject the null hypothesis H_0 while it is true is lower than 0.01%.

Shapiro-Wilk test (QB6):

W	0.849
p-value (Two-tailed)	< 0.0001
Alpha	0.05

Test interpretation:

H_0 : The variable from which the sample was extracted follows a Normal distribution.

H_a : The variable from which the sample was extracted does not follow a Normal distribution.

As the computed p-value is lower than the significance level $\alpha=0.05$, one should reject the null hypothesis H_0 , and accept the alternative hypothesis H_a .

The risk to reject the null hypothesis H_0 while it is true is lower than 0.01%.

Anderson-Darling test (QB6):

A^2	2.712
p-value (Two-tailed)	< 0.0001
Alpha	0.05

Test interpretation:

H_0 : The variable from which the sample was extracted follows a Normal distribution.

H_a : The variable from which the sample was extracted does not follow a Normal distribution.

As the computed p-value is lower than the significance level $\alpha=0.05$, one should reject the null hypothesis H_0 , and accept the alternative hypothesis H_a .

The risk to reject the null hypothesis H_0 while it is true is lower than 0.01%.

Shapiro-Wilk test (QB7):

W	0.829
p-value (Two-tailed)	< 0.0001
Alpha	0.05

Test interpretation:

H_0 : The variable from which the sample was extracted follows a Normal distribution.

H_a : The variable from which the sample was extracted does not follow a Normal distribution.

As the computed p-value is lower than the significance level $\alpha=0.05$, one should reject the null hypothesis H_0 , and accept the alternative hypothesis H_a .

The risk to reject the null hypothesis H_0 while it is true is lower than 0.01%.

Anderson-Darling test (QB7):

A^2	2.901
p-value (Two-tailed)	< 0.0001
Alpha	0.05

Test interpretation:

H_0 : The variable from which the sample was extracted follows a Normal distribution.

H_a : The variable from which the sample was extracted does not follow a Normal distribution.

As the computed p-value is lower than the significance level $\alpha=0.05$, one should reject the null hypothesis H_0 , and accept the alternative hypothesis H_a .

The risk to reject the null hypothesis H_0 while it is true is lower than 0.01%.

Shapiro-Wilk test (QB8):

W	0.851
p-value (Two-tailed)	< 0.0001
Alpha	0.05

Test interpretation:

H_0 : The variable from which the sample was extracted follows a Normal distribution.

H_a : The variable from which the sample was extracted does not follow a Normal distribution.

As the computed p-value is lower than the significance level $\alpha=0.05$, one should reject the null hypothesis H_0 , and accept the alternative hypothesis H_a .

The risk to reject the null hypothesis H_0 while it is true is lower than 0.01%.

Anderson-Darling test (QB8):

A^2	2.959
p-value (Two-tailed)	< 0.0001
Alpha	0.05

Test interpretation:

H_0 : The variable from which the sample was extracted follows a Normal distribution.

H_a : The variable from which the sample was extracted does not follow a Normal distribution.

As the computed p-value is lower than the significance level $\alpha=0.05$, one should reject the null hypothesis H_0 , and accept the alternative hypothesis H_a .

The risk to reject the null hypothesis H_0 while it is true is lower than 0.01%.

Summary

Variable\Test	Shapiro-Wilk	Anderson-Darling
QB3	< 0.0001	< 0.0001
QB4	< 0.0001	< 0.0001
QB5	< 0.0001	< 0.0001
QB6	< 0.0001	< 0.0001
QB7	< 0.0001	< 0.0001
QB8	< 0.0001	< 0.0001

The results from both Shapiro-Wilk test and Anderson-Darling test on QB3 to QB8 shows that the data is not normally distributed. This is found to satisfy the observations done on Section 4.2, where the charts and graphs resembled non symmetric results.

4.3.2 Test of Whether Two Groups Are Associated or Not

Since, from the normality test it was found that the data in QB3 – QB8 the data is Non-parametric. The Kolmogorov-Smirnov test is used to check if there are questions that have association.

4.3.2.1 QB3 Vs. QB4

The Two-sample Kolmogorov test is used below to test if there is significant association statistically between the following questions;

- i. Total Quality Management (TQM) have positive attribute to the service delivery in South Africa construction industry, and
- ii. Total Quality Management (TQM) concepts positively improves the project time (Schedule) of the public projects

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
QB3	43	0	43	1.000	4.000	1.581	0.731
QB4	43	0	43	1.000	4.000	1.674	0.680

Two-sample Kolmogorov-Smirnov test / Two-tailed test:

D	0.116
p-value	0.933
alpha	0.05

An approximation has been used to compute the p-value.

Test interpretation:

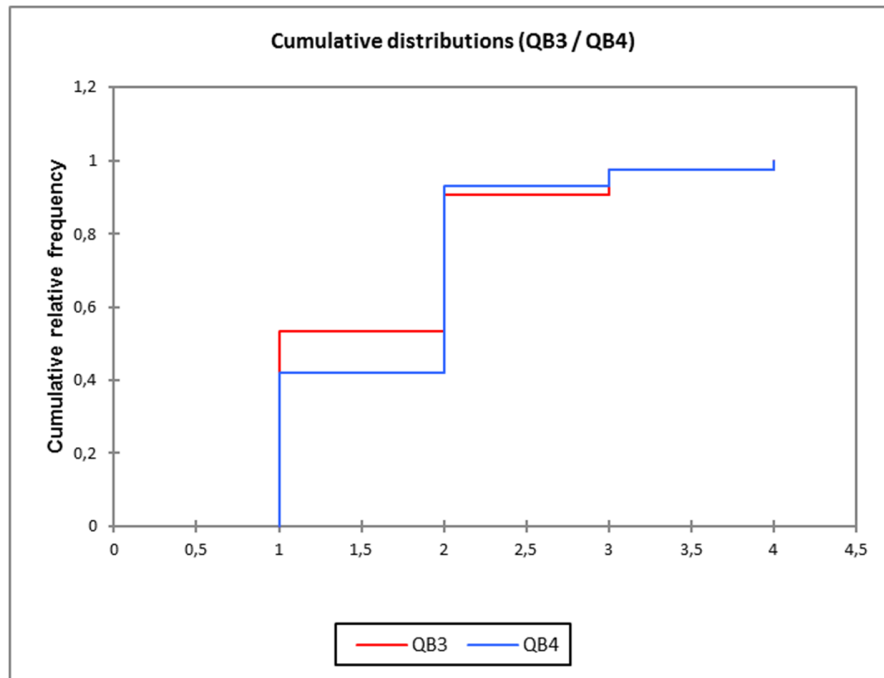
H0: The two samples follow the same distribution.

Ha: The distributions of the two samples are different.

As the computed p-value is greater than the significance level $\alpha=0.05$, one cannot reject the null hypothesis H0.

The risk to reject the null hypothesis H0 while it is true is 93.33%.

Ties have been detected in the data and the appropriate corrections have been applied.



The computed analysis reveals that there is association between TQM concepts improving project time in the public projects and service delivery in the South African construction industry. As stated elsewhere in the report, traditionally project performance has been measured on delivery of project on time, within budget and to the desired quality. TQM emphasise on minimisation of rework and customer satisfaction. These will save on the time that the project should be completed. As mentioned earlier, the study by Bryde (2007) revealed that TQM is an antecedent to project management.

4.3.2.2 QB3 Vs. QB5

The Two-sample Kolmogorov test is used below to test if there is significant association statistically between the following questions;

- i. Total Quality Management (TQM) have positive attribute to the service delivery in South Africa construction industry, and
- ii. Total Quality Management (TQM) concepts positively improves the spending of capital budget of the public projects

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
QB3	43	0	43	1.000	4.000	1.581	0.731
QB5	43	0	43	1.000	5.000	2.512	1.032

Two-sample Kolmogorov-Smirnov test / Two-tailed test:

D	0.488
p-value	< 0.0001
alpha	0.05

An approximation has been used to compute the p-value.

Test interpretation:

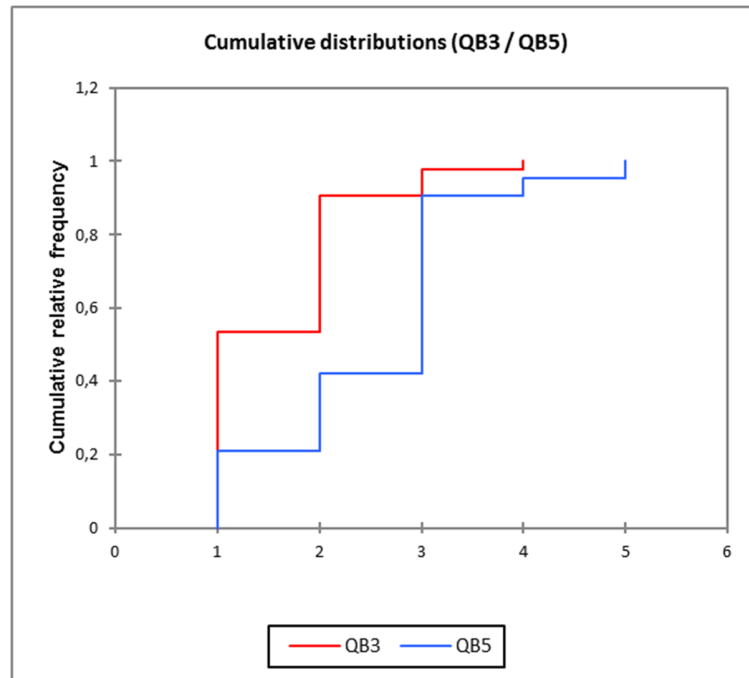
H0: The two samples follow the same distribution.

Ha: The distributions of the two samples are different.

As the computed p-value is lower than the significance level $\alpha=0.05$, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.01%.

Ties have been detected in the data and the appropriate corrections have been applied.



From the cumulative distribution above, it clearly shows that there is no association or link between TQM concepts improving the spending of capital budget of the public projects and service delivery. This is supported by the exploratory data, on TQM concepts positively improves the spending of capital budget of the public projects results where, the respondents do not totally agree that TQM concepts positively improve CAPEX spending (refer to 4.2.9 of this report). This further, upholds Sampaio *et al* (2011) that there is mixed feelings on whether the companies that have implemented TQM have financial edge on the ones that they did not.

4.3.2.3 QB3 Vs. QB6

The Two-sample Kolmogorov test is used below to test if there is significant association statistically between the following questions;

- i. Total Quality Management (TQM) have positive attribute to the service delivery in South Africa construction industry, and
- ii. How often does employees involved with the infrastructure projects in your organization taken for Training?

Summary statistics

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
QB3	43	0	43	1.000	4.000	1.581	0.731
QB6	43	0	43	1.000	4.000	3.000	0.845

Two-sample Kolmogorov-Smirnov test / Two-tailed test

D	0.651
p-value	< 0.0001
alpha	0.05

An approximation has been used to compute the p-value.

Test interpretation:

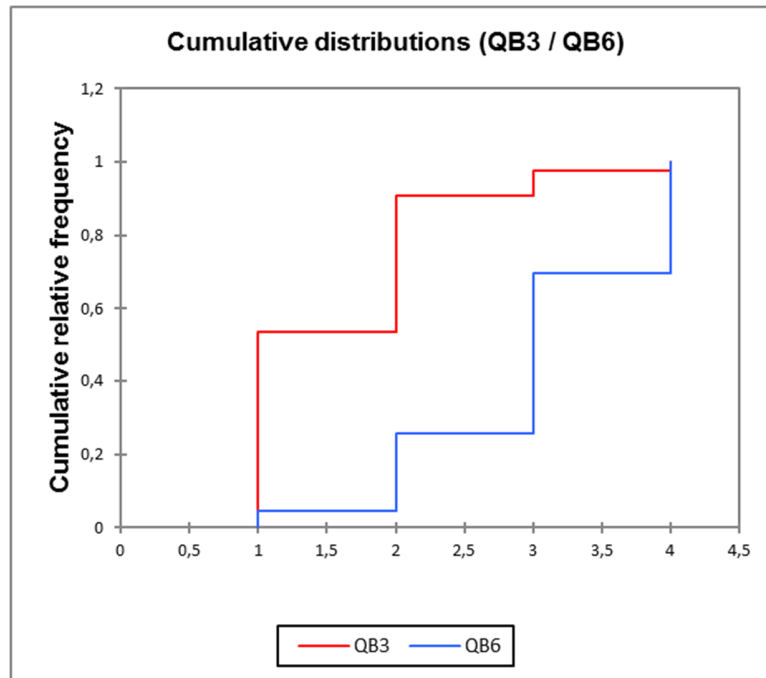
H0: The two samples follow the same distribution.

Ha: The distributions of the two samples are different.

As the computed p-value is lower than the significance level $\alpha=0.05$, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.01%.

Ties have been detected in the data and the appropriate corrections have been applied.



The results show that there is no association between data collected on employees involved with the infrastructure projects within the organization taken for Training and service delivery in the South African construction industry. This is expected based on the exploratory data on section 4.2.10. 74% of the response are taken for training sometimes and rarely. Where 44% is sometimes taken for training and 30% are rarely taken for training.

4.3.2.4 QB3 Vs. QB7

The Two-sample Kolmogorov test is used below to test if there is significant association statistically between the following questions;

- i. Total Quality Management (TQM) have positive attribute to the service delivery in South Africa construction industry, and
- ii. How often do you attend Quality Management Training?

Summary Statistics

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
QB3	43	0	43	1.000	4.000	1.581	0.731
QB7	43	0	43	1.000	5.000	3.860	0.833

Two-sample Kolmogorov-Smirnov test / Two-tailed test:

D	0.884
p-value	< 0.0001
alpha	0.05

An approximation has been used to compute the p-value.

Test interpretation:

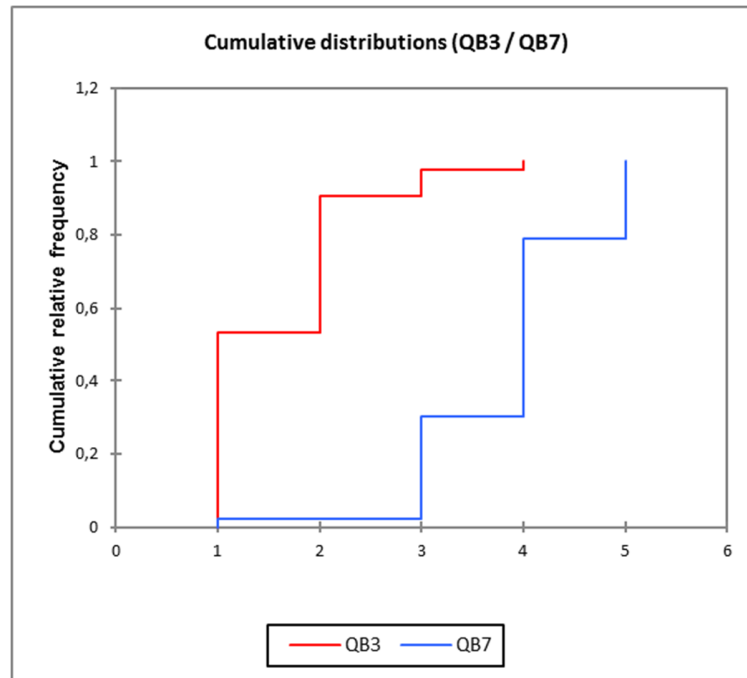
H0: The two samples follow the same distribution.

Ha: The distributions of the two samples are different.

As the computed p-value is lower than the significance level $\alpha=0.05$, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.01%.

Ties have been detected in the data and the appropriate corrections have been applied.



The results show that there is no association between data collected on employees involved with the infrastructure projects within the organization taken to attend quality management Training and service delivery in the South African construction industry. This is expected based on the exploratory data on section 4.2.11. 98% of the respondents are not taken for quality management, this is shown by the exploratory data where the majority respondents taken for quality management training ranges from sometimes (28%), rarely (49%) and Never (21%). Only 2% of the respondents reported that they are taken for training all the time.

4.3.2.5 QB3 Vs. QB8

The Two-sample Kolmogorov test is used below to test if there is significant association statistically between the following questions;

- i. Total Quality Management (TQM) have positive attribute to the service delivery in South Africa construction industry, and
- ii. Quality management is incorporate in the tender contractual documentation?

Summary statistics

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
QB3	43	0	43	1.000	4.000	1.581	0.731
QB8	43	0	43	1.000	4.000	2.326	0.865

Two-sample Kolmogorov-Smirnov test / Two-tailed test:

D	0.395
p-value	0.002
alpha	0.05

An approximation has been used to compute the p-value.

Test interpretation:

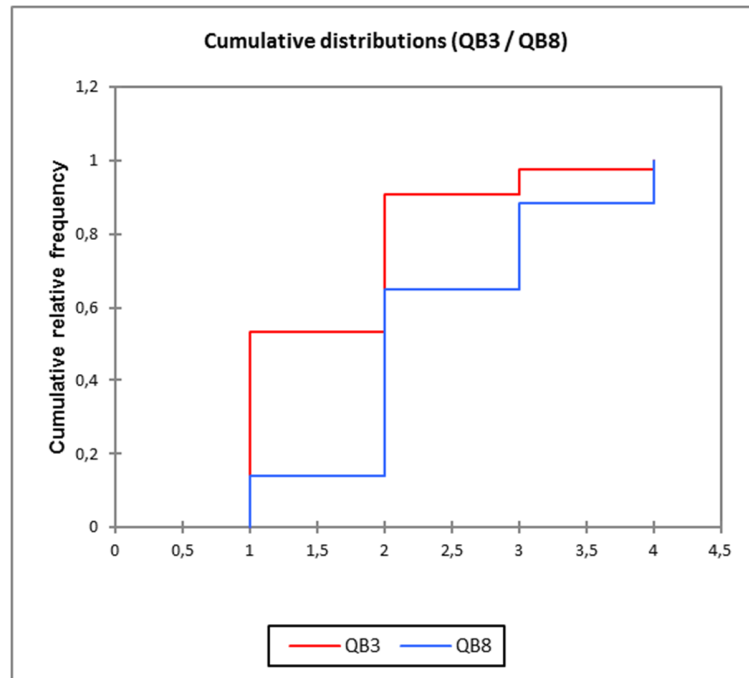
H0: The two samples follow the same distribution.

Ha: The distributions of the two samples are different.

As the computed p-value is lower than the significance level $\alpha=0.05$, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.24%.

Ties have been detected in the data and the appropriate corrections have been applied.



Though 65% of the respondents agree that quality management is incorporated in the contractual documentation. It bears no evidence that quality management have any association with service delivery in the South African construction industry

4.3.3 Test of Variance

Analysis of variance (ANOVA) is a technique to test simultaneously if the means of two or more populations are significantly different. As stated by Saunders et al (2012), ANOVA is used to analyse the variance within and between groups of data by comparing means. If the F statistic is small, it implies that the differences between groups occurring by chance alone is high and vies versa. The other two test that were used to verify the variance with and between the groups were Tukey's HSD (honest significant difference) and the Dunnett (two sided). These two methods are post-hoc test, so as to bring in the element of integrity into the statistics. The Tukey's HSD have a benefit of showing the specific groups which have significant difference, while the ANOVA can only show that there is significant difference but it will not show the specific groups. The last test is the Dunnett (two sided) which is used to determines the confidence of elements of the group that are in comparison.

Summary statistics (Quantitative data):

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
TQM have positive attribute to service delivery in RSA Construction industry	42	0	42	1.000	4.000	1.595	0.734

Summary statistics (Qualitative data):

Variable	Categories	Counts	Frequencies	%
Leadership and management commitment	0	10	10	23.810
	1	32	32	76.190
Continuous Improvement	0	20	20	47.619
	1	22	22	52.381
Process Improvement	0	14	14	33.333
	1	28	28	66.667
Customer satisfaction	0	19	19	45.238
	1	23	23	54.762
Training	0	23	23	54.762
	1	19	19	45.238
Focus on Employees (Empowerment)	0	30	30	71.429
	1	12	12	28.571
Communication	0	14	14	33.333
	1	28	28	66.667
Teamwork	0	10	10	23.810
	1	32	32	76.190
TQ and management	0	30	30	71.429
	1	12	12	28.571
Supplier involvement	0	21	21	50.000
	1	21	21	50.000

Correlation matrix:																					
	Leadership and management commitment-0	Leadership and management commitment-1	Continuous Improvement-0	Continuous Improvement-1	Process Improvement-0	Process Improvement-1	Customer satisfaction-0	Customer satisfaction-1	Training-0	Training-1	Focus on Employees (Empowerment)-0	Focus on Employees (Empowerment)-1	Communication-0	Communication-1	Teamwork-0	Teamwork-1	TQ and management-0	TQ and management-1	Supplier involvement-0	Supplier involvement-1	TQM have positive attribute to service delivery in RSA Construction industry
Leadership and management commitment-0	1	-1.000	0.139	-0.139	0.316	-0.316	0.390	-0.390	0.059	-0.059	0.106	-0.106	0.435	-0.435	0.213	-0.213	0.354	-0.354	0.112	-0.112	-0.073
Leadership and management commitment-1	-1.000	1	-0.139	0.139	-0.316	0.316	-0.390	0.390	-0.059	0.059	-0.106	0.106	-0.435	0.435	-0.213	0.213	-0.354	0.354	-0.112	0.112	0.073
Continuous Improvement-0	0.139	-0.139	1	-1.000	0.135	-0.135	0.283	-0.283	0.292	-0.292	0.392	-0.392	0.034	-0.034	0.251	-0.251	0.286	-0.286	0.191	-0.191	0.006
Continuous Improvement-1	-0.139	0.139	-1.000	1	-0.135	0.135	-0.283	0.283	-0.292	0.292	-0.392	0.392	-0.034	0.034	-0.251	0.251	-0.286	0.286	-0.191	0.191	-0.006
Process Improvement-0	0.316	-0.316	0.135	-0.135	1	-1.000	0.575	-0.575	0.034	-0.034	0.224	-0.224	0.250	-0.250	0.198	-0.198	0.447	-0.447	0.303	-0.303	0.116
Process Improvement-1	-0.316	0.316	-0.135	0.135	-1.000	1	-0.575	0.575	-0.034	0.034	-0.224	0.224	-0.250	0.250	-0.198	0.198	-0.447	0.447	-0.303	0.303	-0.116
Customer satisfaction-0	0.390	-0.390	0.283	-0.283	0.575	-0.575	1	-1.000	0.057	-0.057	0.151	-0.151	0.372	-0.372	0.166	-0.166	0.469	-0.469	0.239	-0.239	-0.152
Customer satisfaction-1	-0.390	0.390	-0.283	0.283	-0.575	0.575	-1.000	1	-0.057	0.057	-0.151	0.151	-0.372	0.372	-0.166	0.166	-0.469	0.469	-0.239	0.239	0.152
Training-0	0.059	-0.059	0.292	-0.292	0.034	-0.034	0.057	-0.057	1	-1.000	0.378	-0.378	0.135	-0.135	0.171	-0.171	0.166	-0.166	0.239	-0.239	0.284
Training-1	-0.059	0.059	-0.292	0.292	-0.034	0.034	-0.057	0.057	-1.000	1	-0.378	0.378	-0.135	0.135	-0.171	0.171	-0.166	0.166	-0.239	0.239	-0.284
Focus on Employees (Empowerment)-0	0.106	-0.106	0.392	-0.392	0.224	-0.224	0.151	-0.151	0.378	-0.378	1	-1.000	0.000	0.000	0.230	-0.230	0.533	-0.533	0.316	-0.316	0.083
Focus on Employees (Empowerment)-1	-0.106	0.106	-0.392	0.392	-0.224	0.224	-0.151	0.151	-0.378	0.378	-1.000	1	0.000	0.000	-0.230	0.230	-0.533	0.533	-0.316	0.316	-0.083
Communication-0	0.435	-0.435	0.034	-0.034	0.250	-0.250	0.372	-0.372	0.135	-0.135	0.000	0.000	1	-1.000	0.553	-0.553	0.335	-0.335	0.202	-0.202	-0.371
Communication-1	-0.435	0.435	-0.034	0.034	-0.250	0.250	-0.372	0.372	-0.135	0.135	0.000	0.000	-1.000	1	-0.553	0.553	-0.335	0.335	-0.202	0.202	0.371
Teamwork-0	0.213	-0.213	0.251	-0.251	0.198	-0.198	0.166	-0.166	0.171	-0.171	0.230	-0.230	0.553	-0.553	1	-1.000	0.354	-0.354	0.112	-0.112	-0.073
Teamwork-1	-0.213	0.213	-0.251	0.251	-0.198	0.198	-0.166	0.166	-0.171	0.171	-0.230	0.230	-0.553	0.553	-1.000	1	-0.354	0.354	-0.112	0.112	0.073
TQ and management-0	0.354	-0.354	0.286	-0.286	0.447	-0.447	0.469	-0.469	0.166	-0.166	0.533	-0.533	0.335	-0.335	0.354	-0.354	1	-1.000	0.422	-0.422	-0.062
TQ and management-1	-0.354	0.354	-0.286	0.286	-0.447	0.447	-0.469	0.469	-0.166	0.166	-0.533	0.533	-0.335	0.335	-0.354	0.354	-1.000	1	-0.422	0.422	0.062
Supplier involvement-0	0.112	-0.112	0.191	-0.191	0.303	-0.303	0.239	-0.239	0.239	-0.239	0.316	-0.316	0.202	-0.202	0.112	-0.112	0.422	-0.422	1	-1.000	0.164
Supplier involvement-1	-0.112	0.112	-0.191	0.191	-0.303	0.303	-0.239	0.239	-0.239	0.239	-0.316	0.316	-0.202	0.202	-0.112	0.112	-0.422	0.422	-1.000	1	-0.164
TQM have positive attribute to	-0.073	0.073	0.006	-0.006	0.116	-0.116	-0.152	0.152	0.284	-0.284	0.083	-0.083	-0.371	0.371	-0.073	0.073	-0.062	0.062	0.164	-0.164	1

Regression of variable TQM have positive attribute to service delivery in RSA

Construction industry:

Goodness of fit statistics (TQM have positive attribute to service delivery in RSA

Construction industry):

Observations	42.000
Sum of weights	42.000
DF	31.000
R ²	0.395
Adjusted R ²	0.199
MSE	0.432
RMSE	0.657
MAPE	29.407
DW	1.872
Cp	11.000
	-
AIC	26.015
SBC	-6.900
PC	1.035

Analysis of variance (TQM have positive attribute to service delivery in RSA

Construction industry):

Source	DF	Sum of squares	Mean squares	F	Pr > F
Model	10	8.730	0.873	2.021	0.065
Error	31	13.389	0.432		
Corrected Total	41	22.119			

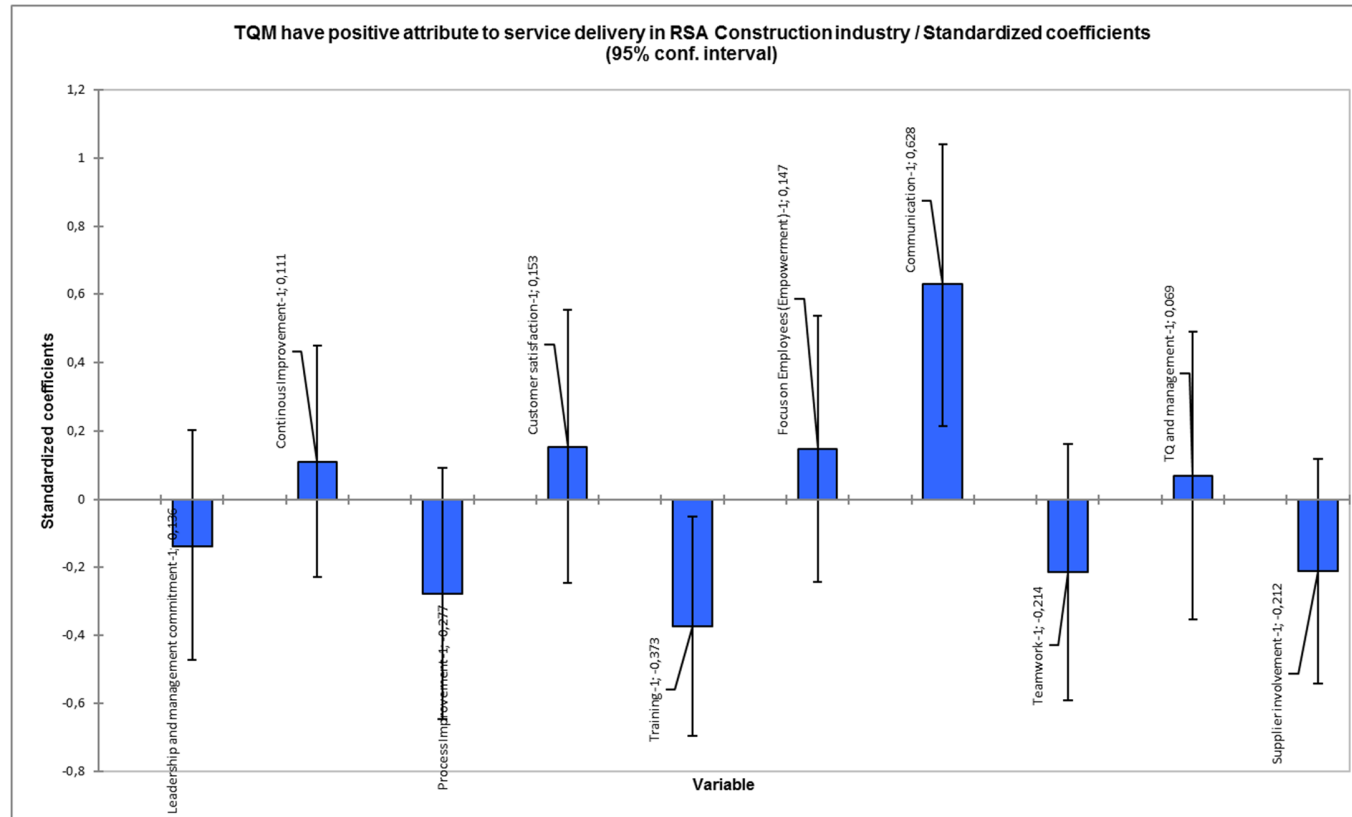
Computed against model $Y = \text{Mean}(Y)$

Model parameters (TQM have positive attribute to service delivery in RSA Construction industry):

Source	Value	Standard error	t	Pr > t	Lower bound (95%)	Upper bound (95%)
Intercept	1.784	0.295	6.044	< 0.0001	1.182	2.386
Leadership and management commitment-0	0.000	0.000				
Leadership and management commitment-1	-0.231	0.282	-0.819	0.419	-0.807	0.344
Continous Improvement-0	0.000	0.000				
Continous Improvement-1	0.161	0.241	0.669	0.509	-0.331	0.653
Process Improvement-0	0.000	0.000				
Process Improvement-1	-0.427	0.279	-1.531	0.136	-0.996	0.142
Customer satisfaction-0	0.000	0.000				
Customer satisfaction-1	0.223	0.286	0.779	0.442	-0.360	0.806
Training-0	0.000	0.000				
Training-1	-0.543	0.231	-2.354	0.025	-1.014	-0.073
Focus on Employees (Empowerment)-0	0.000	0.000				
Focus on Employees (Empowerment)-1	0.236	0.307	0.771	0.447	-0.389	0.862
Communication-0	0.000	0.000				
Communication-1	0.966	0.312	3.096	0.004	0.330	1.602
Teamwork-0	0.000	0.000				
Teamwork-1	-0.365	0.315	-1.158	0.256	-1.007	0.278
TQ and management-0	0.000	0.000				
TQ and management-1	0.111	0.332	0.334	0.741	-0.566	0.787
Supplier involvement-0	0.000	0.000				
Supplier involvement-1	-0.307	0.235	-1.308	0.200	-0.787	0.172

Standardized coefficients (TQM have positive attribute to service delivery in RSA Construction industry):

Source	Value	Standard error	t	Pr > t	Lower bound (95%)	Upper bound (95%)
Leadership and management commitment-0	0.000	0.000				
Leadership and management commitment-1	-0.136	0.166	-0.819	0.419	-0.473	0.202
Continous Improvement-0	0.000	0.000				
Continous Improvement-1	0.111	0.166	0.669	0.509	-0.228	0.449
Process Improvement-0	0.000	0.000				
Process Improvement-1	0.277	0.181	-1.531	0.136	-0.647	0.092
Customer satisfaction-0	0.000	0.000				
Customer satisfaction-1	0.153	0.196	0.779	0.442	-0.247	0.553
Training-0	0.000	0.000				
Training-1	0.373	0.158	-2.354	0.025	-0.695	-0.050
Focus on Employees (Empowerment)-0	0.000	0.000				
Focus on Employees (Empowerment)-1	0.147	0.191	0.771	0.447	-0.242	0.536
Communication-0	0.000	0.000				
Communication-1	0.628	0.203	3.096	0.004	0.214	1.041
Teamwork-0	0.000	0.000				
Teamwork-1	0.214	0.185	-1.158	0.256	-0.591	0.163
TQ and management-0	0.000	0.000				
TQ and management-1	0.069	0.206	0.334	0.741	-0.352	0.490
Supplier involvement-0	0.000	0.000				
Supplier involvement-1	-0.212	0.162	-1.308	0.200	-0.542	0.118



Predictions and residuals (TQM have positive attribute to service delivery in RSA Construction industry):

Observation	Weight	TQM have positive attribute to service delivery in RSA Construction industry	Pred(TQM have positive attribute to service delivery in RSA Construction industry)	Residual	Std. residual	Std. dev. on pred. (Mean)	Lower bound 95% (Mean)	Upper bound 95% (Mean)	Std. dev. on pred. (Observation)	Lower bound 95% (Observation)	Upper bound 95% (Observation)
Obs1	1	2.000	1.989	0.011	0.016	0.334	1.308	2.671	0.737	0.486	3.493
Obs2	1	2.000	1.607	0.393	0.598	0.224	1.150	2.064	0.694	0.191	3.023
Obs3	1	1.000	2.008	-1.008	-1.533	0.362	1.270	2.745	0.750	0.478	3.538
Obs4	1	1.000	1.415	-0.415	-0.631	0.400	0.599	2.231	0.769	-0.154	2.984
Obs5	1	1.000	1.241	-0.241	-0.366	0.350	0.527	1.954	0.745	-0.278	2.759
Obs6	1	2.000	1.534	0.466	0.708	0.355	0.810	2.259	0.747	0.011	3.058
Obs7	1	1.000	1.158	-0.158	-0.241	0.420	0.303	2.014	0.780	-0.432	2.749
Obs8	1	1.000	0.702	0.298	0.453	0.391	-0.095	1.499	0.765	-0.857	2.261
Obs9	1	2.000	1.772	0.228	0.347	0.313	1.133	2.411	0.728	0.287	3.257
Obs10	1	2.000	1.655	0.345	0.524	0.423	0.792	2.518	0.782	0.061	3.250
Obs11	1	1.000	1.126	-0.126	-0.191	0.340	0.433	1.818	0.740	-0.383	2.634
Obs12	1	1.000	1.049	-0.049	-0.075	0.357	0.322	1.777	0.748	-0.476	2.575
Obs13	1	1.000	1.406	-0.406	-0.618	0.315	0.763	2.050	0.729	-0.080	2.893
Obs14	1	1.000	1.803	-0.803	-1.222	0.301	1.190	2.417	0.723	0.329	3.277
Obs15	1	1.000	0.948	0.052	0.079	0.436	0.059	1.837	0.789	-0.660	2.556
Obs16	1	2.000	1.433	0.567	0.862	0.387	0.643	2.223	0.763	-0.123	2.989
Obs17	1	2.000	2.546	-0.546	-0.831	0.377	1.778	3.315	0.758	1.001	4.091
Obs18	1	1.000	0.992	0.008	0.012	0.360	0.258	1.726	0.749	-0.536	2.520
Obs19	1	1.000	2.060	-1.060	-1.613	0.330	1.388	2.732	0.735	0.561	3.560

Obs20	1	1.000	1.607	-0.607	-0.924	0.224	1.150	2.064	0.694	0.191	3.023
Obs21	1	1.000	0.966	0.034	0.052	0.373	0.206	1.726	0.755	-0.575	2.507
Obs22	1	2.000	2.168	-0.168	-0.255	0.408	1.335	3.001	0.774	0.590	3.746
Obs23	1	2.000	1.950	0.050	0.077	0.268	1.404	2.495	0.710	0.502	3.397
Obs24	1	1.000	0.806	0.194	0.295	0.384	0.023	1.589	0.761	-0.746	2.358
Obs25	1	1.000	1.553	-0.553	-0.841	0.306	0.928	2.178	0.725	0.074	3.032
Obs26	1	2.000	1.568	0.432	0.658	0.292	0.972	2.163	0.719	0.101	3.034
Obs27	1	1.000	1.753	-0.753	-1.145	0.304	1.133	2.373	0.724	0.276	3.230
Obs28	1	2.000	2.154	-0.154	-0.234	0.272	1.600	2.708	0.711	0.703	3.604
Obs29	1	2.000	1.385	0.615	0.936	0.350	0.670	2.099	0.745	-0.134	2.903
Obs30	1	2.000	1.607	0.393	0.598	0.224	1.150	2.064	0.694	0.191	3.023
Obs31	1	1.000	1.099	-0.099	-0.151	0.325	0.437	1.761	0.733	-0.396	2.594
Obs32	1	1.000	1.260	-0.260	-0.396	0.289	0.670	1.850	0.718	-0.204	2.725
Obs33	1	3.000	2.154	0.846	1.287	0.272	1.600	2.708	0.711	0.703	3.604
Obs34	1	4.000	2.222	1.778	2.706	0.341	1.527	2.916	0.740	0.712	3.731
Obs35	1	1.000	1.203	-0.203	-0.309	0.412	0.363	2.043	0.776	-0.379	2.785
Obs37	1	3.000	1.642	1.358	2.066	0.305	1.020	2.264	0.724	0.165	3.120
Obs38	1	2.000	2.111	-0.111	-0.169	0.276	1.547	2.675	0.713	0.657	3.565
Obs39	1	1.000	1.607	-0.607	-0.924	0.224	1.150	2.064	0.694	0.191	3.023
Obs40	1	2.000	1.784	0.216	0.328	0.414	0.940	2.629	0.777	0.200	3.369
Obs41	1	2.000	1.607	0.393	0.598	0.224	1.150	2.064	0.694	0.191	3.023
Obs42	1	3.000	2.741	0.259	0.393	0.398	1.930	3.553	0.768	1.174	4.308
Obs43	1	1.000	1.607	-0.607	-0.924	0.224	1.150	2.064	0.694	0.191	3.023

Leadership and management commitment / Tukey (HSD) / Analysis of the differences between the categories with a confidence interval of 95% (TQM have positive attribute to service delivery in RSA Construction industry):

Contrast	Difference	Standardized difference	Critical value	Pr > Diff	Significant
0 vs 1	0.231	0.819	2.040	0.419	No

Tukey's d critical value: 2.884

Category	LS means	Standard error	Groups
0	1.811	0.263	A
1	1.580	0.174	A

Leadership and management commitment / Dunnett (two sided) / Analysis of the differences between the control category Leadership and management commitment-0 and the other categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Critical difference	Pr > Diff	Significant
0 vs 1	0.231	0.819	2.040	0.575	0.419	No

Continuous Improvement / Tukey (HSD) / Analysis of the differences between the categories with a confidence interval of 95% (TQM have positive attribute to service delivery in RSA Construction industry):

Contrast	Difference	Standardized difference	Critical value	Critical difference	Significant
1 vs 0	0.161	0.669	2.040	0.509	No

Tukey's d critical value: 2.884

Category	LS means	Standard error	Groups
1	1.776	0.206	A
0	1.615	0.215	A

Continous Improvement / Dunnett (two sided) / Analysis of the differences between the control category Continous Improvement-0 and the other categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Critical difference	Pr > Diff	Significant
0 vs 1	-0.161	-0.669	2.040	0.492	0.509	No

Process Improvement / Tukey (HSD) / Analysis of the differences between the categories with a confidence interval of 95% (TQM have positive attribute to service delivery in RSA Construction industry):

Contrast	Difference	Standardized difference	Critical value	Critical difference	Significant
0 vs 1	0.427	1.531	2.040	0.136	No

Tukey's d critical value: 2.884

Category	LS means	Standard error	Groups
0	1.909	0.246	A
1	1.482	0.195	A

Process Improvement / Dunnett (two sided) / Analysis of the differences between the control category Process Improvement-0 and the other categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Critical difference	Pr > Diff	Significant
0 vs 1	0.427	1.531	2.040	0.569	0.136	No

Customer satisfaction / Tukey (HSD) / Analysis of the differences between the categories with a confidence interval of 95 % (TQM have positive attribute to service delivery in RSA Construction industry):

Contrast	Difference	Standardized difference	Critical value	Critical difference	Significant
1 vs 0	0.223	0.779	2.040	0.442	No

Tukey's d critical value: 2.884

Category	LS means	Standard error	Groups
1	1.807	0.227	A
0	1.584	0.221	A

Customer satisfaction / Dunnett (two sided) / Analysis of the differences between the control category Customer satisfaction-0 and the other categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Critical difference	Pr > Diff	Significant
0 vs 1	-0.223	-0.779	2.040	0.583	0.442	No

Training / Tukey (HSD) / Analysis of the differences between the categories with a confidence interval of 95 % (TQM have positive attribute to service delivery in RSA Construction industry):

Contrast	Difference	Standardized difference	Critical value	Critical difference	Significant
0 vs 1	0.543	2.354	2.040	0.025	Yes

Tukey's d critical value: 2.884

Category	LS means	Standard error	Groups
0	1.967	0.206	A
1	1.424	0.210	B

Training / Dunnett (two sided) / Analysis of the differences between the control category Training-0 and the other categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Critical difference	Pr > Diff	Significant
0 vs 1	0.543	2.354	2.040	0.471	0.025	Yes

Focus on Employees (Empowerment) / Tukey (HSD) / Analysis of the differences between the categories with a confidence interval of 95 % (TQM have positive attribute to service delivery in RSA Construction industry):

Contrast	Difference	Standardized difference	Critical value	Critical difference	Significant
1 vs 0	0.236	0.771	2.040	0.447	No

Tukey's d critical value: 2.884

Category	LS means	Standard error	Groups
1	1.814	0.250	A
0	1.577	0.210	A

Focus on Employees (Empowerment) / Dunnett (two sided) / Analysis of the differences between the control category Focus on Employees (Empowerment)-0 and the other categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Critical difference	Pr > Diff	Significant
0 vs 1	-0.236	-0.771	2.040	0.625	0.447	No

Communication / Tukey (HSD) / Analysis of the differences between the categories with a confidence interval of 95 % (TQM have positive attribute to service delivery in RSA Construction industry):

Contrast	Difference	Standardized difference	Critical value	Critical difference	Significant
1 vs 0	0.966	3.096	2.040	0.004	Yes

Tukey's d critical value: 2.884

Category	LS means	Standard error	Groups
1	2.179	0.248	A
0	1.213	0.217	B

Communication / Dunnett (two sided) / Analysis of the differences between the control category Communication-0 and the other categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Critical difference	Pr > Diff	Significant
0 vs 1	-0.966	-3.096	2.040	0.636	0.004	Yes

Teamwork / Tukey (HSD) / Analysis of the differences between the categories with a confidence interval of 95 % (TQM have positive attribute to service delivery in RSA Construction industry):

Contrast	Difference	Standardized difference	Critical value	Critical difference	Significant
0 vs 1	0.365	1.158	2.040	0.256	No

Tukey's d critical value: 2.884

Category	LS means	Standard error	Groups
0	1.878	0.280	A
1	1.513	0.176	A

Teamwork / Dunnett (two sided) / Analysis of the differences between the control category Teamwork-0 and the other categories with a confidence interval of 95 %:

Contrast	Difference	Standardized difference	Critical value	Critical difference	Pr > Diff	Significant
0 vs 1	0.365	1.158	2.040	0.642	0.256	No

TQ and management / Tukey (HSD) / Analysis of the differences between the categories with a confidence interval of 95 % (TQM have positive attribute to service delivery in RSA Construction industry):

Contrast	Difference	Standardized difference	Critical value	Critical difference	Significant
1 vs 0	0.111	0.334	2.040	0.741	No

Tukey's d critical value: 2.884

Category	LS means	Standard error	Groups
1	1.751	0.288	A
0	1.640	0.177	A

TQ and management / Dunnett (two sided) / Analysis of the differences between the control category TQ and management-0 and the other categories with a confidence interval of 95%:

Contrast	Difference	Standardize d difference	Critical value	Critical difference	Pr > Diff	Significant
0 vs 1	-0.111	-0.334	2.040	0.677	0.741	No

Supplier involvement / Tukey (HSD) / Analysis of the differences between the categories with a confidence interval of 95% (TQM have positive attribute to service delivery in RSA Construction industry):

Contrast	Difference	Standardized difference	Critical value	Critical difference	Significant
0 vs 1	0.307	1.308	2.040	0.200	No

Tukey's d critical value: 2.884

Category	LS means	Standard error	Groups
0	1.849	0.224	A
1	1.542	0.192	A

Supplier involvement / Dunnett (two sided) / Analysis of the differences between the control category Supplier involvement-0 and the other categories with a confidence interval of 95%:

Contrast	Difference	Standardized difference	Critical value	Critical difference	Pr > Diff	Significant
0 vs 1	0.307	1.308	2.040	0.479	0.200	No

4.4 Summary of the Key Findings of Data Analysis

The study has revealed that some of the TQM concepts are used more than the others in the project delivery within the South African public sector. Of the ten (10) concepts, six

(6) were scored above 50% by respondents. Though the other four (4) were below 50%, it has been revealed that they are used in certain instances.

Traditional Project Management where time, cost and quality is the basis of running a successful project was tested against Total Quality Management in executing public infrastructure projects. The study has revealed that TQM will improve the time, cost and quality of the projects. Though about half of the respondents viewed the statement that TQM concepts positively improve capital expenditure spending in the public sector to be 'about right'.

The study has revealed that the personnel involved in infrastructure projects attend other forms of training rather than attend quality training. The data collected shows that majority of the respondents neither go for training or if they do, it takes place rarely.

Majority of the respondents have revealed that quality management is incorporated in the contractual documentation. Therefore there is an opportunity to standardise documents to include quality management programs. This is found to move the public sector to quality certifications. The certifications will streamline both the process and resources that are required to ensure quality is achieved.

TQM concepts such as Supplier Involvement, were found to be difficult to implement well in the execution of the projects in the public sector mainly because the suppliers do not deal directly with the projects team until a formal award letter is given to the contractor by the Supply Chain Unit. On the other hand for most of the works the bidders must go through competitive bidding process which make it difficult to build long term relationship with the bidders.

Literature have proven that for an organisation to successfully implement TQM, it is easy if such organisation have a certification in quality like ISO 9000.

There are many different ways that literature approaches the implementation of TQM, nonetheless they seem to link to each other.

The computed analysis reveals that there is association between TQM concepts improving project time in the public projects and service delivery in the South African construction industry.

The test of variance between and within the 10 TQM concepts and if TQM have positive attributes to service delivery in the South African construction industry. The statistics have revealed that there is significant deference on both Training, Communication against TQM having positive attributes to service delivery in the South African construction industry.

5 CONCLUSIONS AND RECOMENDATIONS

5.1 Introduction

The South African public sector uses a variety of Total Quality Management (TQM) concepts in infrastructure project delivery. The study have revealed that some of the concepts are used more than the others. Taking it from a holistic perspective, it can be concluded that the public sector have to streamline their quality process and start looking at implementing quality standards such as ISO9001. In that manner, it will be easier to introduce TQM into the systems.

If TQM can be introduced in the public sector which in the South African construction industry is the main employer of consultants, contractors and professionals in the construction fraternity, it can in the long run bring the culture of quality in the industry as a results the projects could be completed with the desirable quality, which have long term benefits.

5.2 Restatement of the Objectives

There are three main objectives of the research, the first one being; investigate the level of Total Quality Management (TQM) concepts adoption, while delivering the infrastructure projects, in the South African public sector. The study has revealed that, TQM concepts are available but sparsely utilised in the South African public sector. The factors that attributes to the underutilisation of the concerts can be linked to low turnover for staff training.

The second objective, was to investigate if the Project Management (PM) process have positive contribution towards the implementation of Total Quality Management (TQM) concepts. In general, the study has revealed that TQM will improve capital expenditure spending in the public sector. The study did not show if time and quality will inprove in the implementation of TQM.

The last objective, was to investigate if there are process or procedures that are in place within the public sector to ensure quality management is brought forward on the

infrastructure project delivery within the public sector. The study has revealed that the quality is highly incorporated in the contracts and works. The only major setback is quality training is still lacking.

5.3 Conclusions

The literature, data collected and the statistical analysis have revealed that TQM concepts are used in the implementation of the infrastructure projects within the South African public sector. The hypothesis that TQM concepts are used in the public sector infrastructure projects is accepted. The findings of the analysis shows that there is a strong correlation between the attributes of TQM in service delivery and the fact that TQM concepts positively improving the project time (Schedule) of the public projects.

It is also noted that there is poor service delivery that is experienced by the communities in South Africa. Therefore, the public sector should streamline their process to increase the quality standards in implementing the infrastructure projects. This can be achieved through quality management programs, such as ISO 9000 if implemented. This in the long term will assist immensely in implementing TQM. Some of the benefits that can be achieved through TQM is reducing waste, continuous improvement, cost effectiveness, reducing rework and improving customer focus.

The people running the public projects should be taken for regular quality management training. Training is one key aspect of TQM and it will boost the knowledge of the personnel entrusted with the public infrastructure projects which translate to public funds being safe guarded.

The study have revealed that TQM can improve project time (schedule) and CAPEX spending, therefore it can be stated that project management can be linked to TQM.

The study revealed that majority of the organisation incorporate quality management in the tender contractual documentation. On the other hand, the organisations they still lack on training which can bolster the culture of quality in the public infrastructure.

The aims and objectives of the study have been achieved. TQM concepts are being used in the South African construction industry but they are not aligned to have much impact.

5.4 Recommendations

It is highly recommended that the public sector should implement quality management programmes, such as ISO 9001. This will set a good platform to move towards TQM.

Of the ten (10) elements of TQM, the respondents of the research have revealed that training is not done adequately. For TQM or quality management programmes to be successful it is imperative that continuous training to be offered to all levels of the personnel.

5.5 Reflections on the Research Process

The following were found to be the constraints in the execution of the research;

- The limited time to complete the research
- The cost of delivering and collecting the questionnaires was high as the respondents were based in different parts of Gauteng and as set out elsewhere in the document, the quicker and cheaper option was to email but it had risk of breaching the confidentiality of the respondents.
- Fewer questionnaires were received and this could have effect on the results.
- Some research questions could not be answered in this research and it was found to be a constraint of the study. There was no knowledge that could be used to support the assumptions that gave rise to the questions. The list of the questions that were found to be limitation of the study can be found under Section 3.11, Table 3-1: Design of the instrument.

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ANNEXURE A: ETHICS CLEARANCE CERTIFICATE

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SCHOOL OF CONSTRUCTION ECONOMICS AND MANAGEMENT RESEARCH ETHICS COMMITTEE

CLEARANCE CERTIFICATE

PROTOCOL NUMBER CEM/15/12/05/MRR

PROJECT TITLE

ARE TQM CONCEPTS USED IN THE
INFRASTRUCTURE PROJECTS DELIVERY WITHIN THE
SOUTH AFRICAN PUBLIC SECTOR ?

INVESTIGATOR(S)

Emmanuel Marang Khomela
(ST NO. 786750)

SCHOOL/DEPARTMENT

SCHOOL OF CONSTRUCTION ECONOMICS AND
MANAGEMENT

DATE CONSIDERED

8th December 2015

DECISION OF THE COMMITTEE

Approved conditionally with respect to the declaration

EXPIRY DATE

11th December 2017

DATE

11th December 2015

CHAIRPERSON

(Dr. E Heron)

CC: Professor D. Root

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary Mrs. M. Sithole at the SCEM reception desk.

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to completion of a yearly progress report.**


Signature

Date

11 / 12 / 2015

ANNEXURE B: INFORMATION SHEET AND CONSENT FORM



INFORMATION SHEET AND CONSENT FORM

Are Total Quality Management (TQM) Concepts Used in the Infrastructure Projects Delivery within the South African Public Sector?

Who am I?

Hello, I am Emmanuel Marang Khomela. I am studying toward a Master's Degree in Project Management in Construction at the University of the Witwatersrand, Johannesburg, South Africa.

What we are doing

I am conducting research on quality concepts within the South African public sector. I am conducting a study to find out if total quality management (TQM) concepts are been used in the infrastructure projects delivery within the South African Public Sector?

Your participation

I am asking if you will allow me to bring through the questioners for you to complete that would be about the topic above, the interview will be conducted on your knowledge and opinion of the topic in the subject. If you agree you will complete the questioner for approximately 10 minutes.

Please understand that **your participation is voluntary** and you are not being forced to take part in this study. The choice of whether to participate or not, is yours alone. If you choose not to take part, you will not be affected in any way whatsoever. If you agree to participate, you may stop participating in the research at any time and tell me that you don't want to continue. If you do this, there will be no penalties and you will not be prejudiced in any way.

Confidentiality

All identifying information will be kept in a locked cabinet at my residence or a hard drive that require my password to unlock, and will not be available to others and will be kept confidential to the extent possible by law. The records from your participation may be reviewed by people responsible for making sure that research is done properly, including members of the ethics committee at the University of the Witwatersrand, Johannesburg. (All of these people are required to keep your identity confidential). You are not required to affix your identity records in the documents that you are to complete but if it happened you did so records that identify you will be available only to people working on the study.

Your answers will be stored electronically (Scanned documents) and in hard copy file in a secure environment and used for research or academic purposes only. If it happens that the stored data is used in the future it will be subject to further Witwatersrand Ethics Committee review and approval.

I will not record your name anywhere and no one will be able to connect you to the answers you give.

Risks/discomforts

At the present time, we do not see any risk of harm from your participation. The risks associated with participation in this study are no greater than those encountered in daily life.

Benefits

There are no immediate benefits to you from participating in this study. However, this study will be extremely helpful to us in that we hope will promote understanding of this topic.

If you would like to receive feedback on our study, we will record your phone number on a separate sheet of paper and can send you the results of the study when it is completed sometime after March 2016.

Who to contact if you have been harmed or have any concerns

This research has been approved by the Witwatersrand Research Ethics Committee. If you have any complaints about ethical aspects of the research or feel that you have been harmed in any way

by participating in this study, please call the Office of the Deputy Vice-Chancellor (Research) on Tel 011 717 1152 or e-mail Zeblon.Vilakazi@wits.ac.za

If you have concerns or questions about the research you may call me on Tel 011 929 7086 or email me at emmanuel@erwat.co.za or 786750@students.wits.ac.za

CONSENT

I hereby agree to participate in research on “**Are Total Quality Management (TQM) Concepts Used in the Infrastructure Projects Delivery within the South African Public Sector?**”. I understand that I am participating freely and without being forced in any way to do so. I also understand that I can stop participating at any point should I not want to continue and that this decision will not in any way affect me negatively. I understand that this is a research project whose purpose is not necessarily to benefit me personally in the immediate or short term. I understand that my participation will remain confidential.

.....

Signature of participant

Date:.....

I understand that the information that I provide will be stored electronically and hardcopy file and will be used for research purposes now or at a later stage.

.....

Signature of participant

Date:.....

ANNEXURE C: QUESTIONNAIRE

UNIVERSITY OF THE WITWATERSRAND,
JOHANNESBURG

Faculty of Engineering & the built Environment
School of Construction Economic and Management



Email: emmanuel@erwat.co.za
Email: 786750@students.wits.ac.za
Cell: 082 524 7548
Tel: 011 929 7086

Topic: Are Total Quality Management (TQM) Concepts Used in the Infrastructure Projects Delivery within the South African Public Sector?

Dear Participant

This questionnaire is part of a research project to understand if the Total Quality Management (TQM) concepts are been used in the infrastructure projects delivery within the South African public sector. Your response is of great importance in enabling me better understand this topic. However, your decision to take part in this survey is entirely voluntary.

If you decide to take part in the survey, the questionnaire should take you about eight to ten minutes to complete. Please answer the questions in the spaces provided. The information you provide will be treated in the strictest confidence. You are not required to include your name or address anywhere in the questionnaire.

The answers from your questionnaire will be used as part of the main data set for my research in my studies towards a Master's Degree in Project Management in Construction at the University of the Witwatersrand, Johannesburg, South Africa.

I hope you will find participating in the survey and completing the questionnaire enjoyable. You are humbly requested to complete and submit the questionnaire on or before the 27th of January 2016. Once you have completed the questionnaire, please send me an email and I will come collect the completed questioner.

If you have any questions or would like further information, please do not hesitate to contact me, Emmanuel Khomela, on 082 524 7548 or 011 929 7086 or email me at emmanuel@erwat.co.za or 786750@students.wits.ac.za

Thank you in anticipation.

Emmanuel Marang Khomela

Section A: General

This section requires some general information on your experience, your primary role on projects, discipline & working environment.

Please mark with **(X)** in the appropriate circle.

Description	Response (please select one response per question)	Please Mark with (X)
How many years' experience do you have related to procurement in the construction industry?	0 to less than 5 years	☐
	5 to less than 10 years	☐
	10 to less than 20 years	☐
	20 years or over	☐
Specify your stakeholder position in the project	Client	☐
	Engineer (Consultant)	☐
	Contractor	☐
	Sub-Contractor	☐
What is your role(s) in the project?	End User	☐
	Project Manager	☐
	Principal agent	☐
	Project Engineer	☐
	Project Technician	☐
	Other (Specify)	☐
What type of projects are you usually involved in?	Civil engineering	☐
	Mechanical engineering	☐
	Electrical engineering	☐

	Other (Specify)	☐
--	--------------------------	--------------------------

Section B: Short Structured Questions

This section requires information from you on your experience with Total Quality Management concepts within your current working environment:

Question B1

Please choose one infrastructure project in the public sector that you were involved, in the past five years. This include the current projects that are running. Please mark with (X)

A. Ongoing project

☐

B. Completed in the past five years

☐

Question B2

Select all the TQM concepts that you applied in the chosen project

TQM Concept	Select all TQM concept(s) applied on the project
Leadership and management commitment	☐
Continuous improvement;	☐
Process improvement	☐
Customer satisfaction;	☐
Training	☐
Focus on employees (Empowerment)	☐
Communication	☐
Teamwork	☐
TQ and measurement	☐
Supplier involvement	☐

Question B3

Total Quality Management (TQM) have positive attribute to the service delivery in South Africa construction industry.

Strongly agree	Agree	Not sure	Disagree	Strongly disagree
☐	☐	☐	☐	☐

Question B4

Total Quality Management (TQM) concepts positively improves the project time (Schedule) of the public projects.

Strongly agree	Agree	Not sure	Disagree	Strongly disagree
☐	☐	☐	☐	☐

Question B5

Total Quality Management (TQM) concepts positively improves the spending of capital budget of the public projects.

Far too much	Too much	About right	Too little	Far too little
☐	☐	☐	☐	☐

Question B6

How often does employees involved with the infrastructure projects in your organisation taken for Training?

All the time	Frequently	Sometimes	Rarely	Never
☐	☐	☐	☐	☐

Question B7

How often do you attend Quality management Training?

All the time

Frequently

Sometimes

Rarely

Never

☐☐☐☐☐

Question B8

Quality management is incorporate in the tender contractual documentation?

Strongly agree

Agree

Not sure

Disagree

Strongly
disagree

☐☐☐☐☐