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Quality in South African Construction: A construction manager's perspective

BY

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I, the undersigned declare that this dissertation is original, has not been published before and is not currently being considered for publication elsewhere. This dissertation is for Masters study purposes, collected and utilised specifically to accomplish the commitments and objectives of this study, and has not to my knowledge been previously given in to any other university. I also declare that the publications cited in this work have been personally and specifically acknowledged.

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ABSTRACT

Construction projects are an extremely complex process, involving diversified construction activities and a heterogeneous mix of materials and components. There are many factors affecting the quality of construction, such as design, materials, machinery, topography, geology, hydrology, meteorology, construction technology, methods of operation, technical measures and management systems. Because of the fixed project location, large volume and different location of different projects, the poor control of these factors may produce quality problems. Clients will not be satisfied if the project fails to meet their price, quality, time frame, functionality and delivery performance standard. In view of this, the construction manager must be employed, having the skills and knowledge or make the effort to design and manage processes of project construction. Therefore, the contractors and suppliers may deliver good products and resources to accomplish a quality construction project. The construction manager applies flexible skills to attain the quality requirements of a project by working hand-in-hand with all different stakeholders to ensure they produce spectacular results.

A mixed concurrent triangulation design which consists of both quantitative and qualitative approach was adopted for this study. For quantitative data, survey questionnaires were designed via Google forms and 119 responses were from construction managers around South Africa. A stratified sampling was used and the data collected was analysed using the Statistical Package for the Social Sciences (SPSS-v27). For qualitative data, a purposive sampling was used, and the semi-structured interviews were conducted with 15 construction managers and the data obtained was analysed using NVivo analysis (v12). Ethical issues were taken into consideration.

The findings of the study showed that the participants understood quality in general and when used in construction. The participants agreed that for construction projects, the goal and desire of all project stakeholders, construction managers in particular, is to ensure that projects are delivered according to acceptable and agreed standards. The construction managers focus on the skills and knowledge employed to the construction of the project. Namely, they look at the material, labour, equipment, tools and methods to producing the end-product of quality. Construction managers use their skills which are inclusive of effective communication, leadership and negotiation to construction projects which will be fit for its purpose, meet or exceed client's expectations and conform to both project specifications and regulations. It is essential to mention that if all the other stakeholders play their roles on the project, it makes it easier for the construction managers to perform their responsibilities which indeed lead a project to success. Construction managers use quality management systems to ensure the projects are of quality and eliminating any factors affecting quality. They begin with quality planning, quality assurance and quality control. Construction managers ensure quality by working with the project team to define a practical approach to managing quality, including applicable standards and quality processes. These are driven by standards and quality processes contained in the

project blueprint. They also perform quality assurance by executing quality management plans using the standards and processes defined in the project blueprint. Perform a quality audit to evaluate how well the team is following the plan and meeting customer's expectations. Lastly, construction managers control the quality by ensuring the deliverables are correct and free of defects and focus on quality from the beginning to the end of the project.

In conclusion, it is essential for construction managers to be open to learning on a daily basis to improve knowledge and have a variety of solutions to any quality-related issues. To avoid issues, it is essential to deal with any of the factors affecting quality as soon as it arises. It is very important also take into consideration ISO 9000, ISO 14000, SANS, NHBRC, CIDB and NEMA which are quality regulations. Regular site inspections are advised where a construction manager visits a site to check if materials and construction methods used conform with the quality standards.

This information is useful for having a general understanding of quality and explore factors affecting quality of construction projects. It also assists construction managers on what skills to focus/improve in order to be competent and deliver quality projects. Lastly, it reminds construction managers to quickly attend to any factor that might jeopardise the project quality.

Keywords: Construction Manager, Clients, Quality, Conformance, Quality Management Systems, Factors affecting quality.

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LIST OF ACRONYMS

CM– Construction Management

CCM – Candidate Construction Management

GDP – Gross Domestic Product

PrCM – Professional Construction Management

FEL – Front-End Loading

ISO – International Organisation for Standardisation

PDCA – Plan-Do-Check-Act

PMP – Project Management Plan

PPE – Personal Protective Equipment

PPP – Pre-Project Planning

QA – Quality Assurance

QC – Quality Control

QMP – Quality Management Plan

QMS – Quality Management System

SACPCMP – South African Council for Project and Construction Management Professions

SANS – South African National Standards

QMS – Quality Management Systems

CHAPTER 1: INTRODUCTION

1.1 Introduction

This chapter evaluates the importance of quality in the construction industry as a whole and how different stakeholders perceive quality depending on their roles. Construction projects in South Africa are likely to be unsuccessful because of poor quality during or after the construction phase. The factors affecting quality include incompetent management team, unskilled workforce, use of low-quality materials and lack of auditing systems, etc. Therefore, this study also addresses the factors affecting quality which cause conflicts within different stakeholders of the project. It is essential to highlight that this study emphasises the role of construction managers in attaining quality projects within budget and timescale in order to make the client satisfied. This study focuses on construction managers around South Africa who are academics, consultants and contractors but may be helpful and useful to other disciplines who wish to pursue the field of project management. The impact of this study will have the capacity to add to the improvement of quality management systems from the planning phase of the project to the handing over since different views and opinions from different sources will be discussed.

This chapter additionally talks about the research methodology used for the study, limitations and ethical considerations. Lastly, the structures of this study as well as its significance are discussed.

1.2 Background of the study

The construction industry of South Africa is faced with issues that include the shortages of skills, non-conformance to standards, payment delays, price increase competitiveness along with lack of quality in projects (Loxton, 2004). Projects become unsuccessful and sometimes do not reach the completion stage due to poor quality caused by the various factors that affect quality (*ibid*). Lombard (2006) described quality as the most essential element in the accomplishment of construction projects. Quality management is essential in the construction industry from conception to completion of projects. Nevertheless, the outcome of a quality project significantly depends on the design and construction phase. Mallawaarachchi and Senaratne (2015:84) added that “*quality of construction projects is observed as the attainment of requirements of all the project stakeholders and ensuring the satisfaction of everyone, especially the client*”. If the quality outcomes are not according to the required standards of a project, that project is regarded as a defective construction project and sometimes becomes unsuccessful and be forced to stop until corrective measures are taken. The other threats to quality are the variations that occur during the construction process which can cause a project to fail (CIDB, 2011). Construction managers are known as professionals equipped with skills and techniques of managing a project from its inception to completion (Shadan and Fleming, 2012).

Quality is a very crucial aspect with massive impact in project failures (Shadan and Fleming, 2012 & Agbenyega, 2014). “*The clients believe the project quality is achieved when the project was constructed as designed*” (CIDB, 2011) whereas the construction managers look at it according to the processes utilised while constructing it, if were per the ‘*clients requirements, designs and related standards*’ (Preethi and Monisha, 2017).

1.2.1 Construction quality overview

It tends to be said that the economic benefit cannot be attained if there is no quality control (Lombard, 2006). Preethi and Monisha (2017) stated that quality symbolises the civilisation of human beings and with the advancement of human civilisation, quality control assumes an exceptional part in the business. This is because clients only pay when they are satisfied with the product or service provided nothing more or less (*ibid*). Many academics well-defined quality as delivering a client’s service or product with no defect and this may only be made possible by the use of right techniques of construction project management (Loxton, 2004; Lombard, 2006; Elshaer, 2012; Agbenyega, 2014 & Mallawaarachchi and Senaratne, 2015). As such, it is vitally important that a qualified and knowledgeable construction manager is made in charge of the management process or else the project becomes unsuccessful (Preethi and Monisha, 2017). Quality in construction is all about conforming to project specifications (CIDB, 2011).

To attain quality in construction, one must focus on:

- Conforming to the specifications of a project;
- Fulfilling the client’s conditions; and
- Guaranteeing the project accomplishes its purpose (CIDB, 2011).

As the population increases and the advancement in technology, everything becomes more intricate, evaluating and guaranteeing quality becomes ever more complex (FIDIC, 2001). Quality management systems are developed to address these needs. Quality management in a construction project takes place within three different phases, namely:

- Quality planning;
- Quality assurance; and
- Quality control (PMBOK, 2000).

i. Quality planning

This is the first phase of quality management which takes place as soon as the project documents are made available to the project management team. The team usually looks at any possible ways and tasks to complete the project that will comply with all the requirements related to the project (Senaratne and Jayarathna, 2012).

ii. *Quality assurance (QA)*

The second phase is quality assurance, known as a method utilised by a construction company to preserve quality standards and consistence (Mallawaarachchi and Senaratne, 2015). Basically, it is how the company manages quality in a construction project (Senaratne and Jayarathna, 2012). Companies perform quality assurance by stipulating numerous inspections at different levels of a project while continuously improving its qualities (*ibid*). Quality assurance programs usually comprise of the arrangement of employee workshops, an effective safety programme as well as the best possible procurement system to obtain quality material and supplies at all times (Visschedijk, Hendriks and Katrien Nuyts, 2005).

iii. *Quality Control (QC)*

Quality control is the intermittent investigation to guarantee that the project requirements (Mallawaarachchi and Senaratne, 2015). In most cases, quality control is performed by the management team, namely, construction manager, engineers and foremen (*ibid*). It is performed by setting up specific construction standards, identifying the variations from the standards, correcting or minimising the variations and improving the standards for future purposes. As a matter of fact, it essential to always to attend to all the factors that affect quality of construction projects before and during the timescale of a project.

1.2.2 Factors affecting the project quality

Construction projects are a tremendously multifaceted process, comprised of diversified construction activities and a heterogeneous mix of materials and components. (Sunke, 2009 & Agbenyega, 2014). Since construction projects are located at a fixed location, poor control of large material volumes and different location of different projects results to quality problems (Ashokkumar, 2014). Mallawaarachchi and Senaratne (2015:85) highlighted that “*numerous factors affecting the quality of construction include the materials, topography, designs, geology, equipment, construction technology, hydrology, construction technology, management systems and operational techniques etc.*” It is mandatory for all the construction companies to control the whole construction process to be according to the required quality standards, specifications of a client with regards to quality, cost and time. By doing so, companies stand better chances of surviving in the business (*ibid*). Construction companies are obliged to comply with the quality requirements as well as maintaining these requirements with the fundamental control and prevention, in order to deliver products and services of high quality, harmless, suitable and affordable (CIDB, 2011). To comply to quality requirements the construction manager must identify all the factors that might affect the quality of a project and apply flexible skills to attain the quality requirements of a project by working hand-in-hand with all different stakeholders to ensure they produce spectacular results (Preethi and Monisha, 2017).

1.2.3 The perspective of a construction manager towards construction quality

The construction managers are stakeholders found in the construction management systems of a project in which the client appoints construction management firm to perform the management and coordination of the project design and construction (Laedre, *et al*, 2006). Gharehbaghi and McManus (2003) added that in a project, the construction managers usually lead the design-building process, working together with the engineers, architects, contractors, the large number of governments and technical specialists. The construction managers are the driving force behind the scenes and control the modus operandi of the construction project (Harvey, 2007). Construction managers have a responsibility of arranging, sorting out, coordinating, controlling and assessing the construction processes of a construction company following the directions of project managers and clients (Steyn, 2013). They are equipped with education, knowledge, skill set, technology and an attitude of analytical thinking which helps them to take a holistic approach towards the construction project (Oke, 2017).

Construction managers perceive quality of the project to the following:

- Fitness for purpose;
- Conformance to specifications;
- Meeting or exceeding the requirements of a client;
- Value for money; and
- Consistency (Harvey, 2007 & Mira, 2019).

1.3 Problem statement

Clients are only satisfied if the end product or service meets its delivery performance standards, price, functionality, quality and timeframe. Therefore, the construction manager must have adequate education, skills and knowledge, and come up with management processes of a construction project, which is not always the case.

1.4 Research questions

1.4.1 How do construction managers perceive quality in construction?

1.4.2 What are the responsibilities of a construction manager towards quality of a project?

1.4.3 What are the factors influencing the management of quality in construction projects and role of the construction managers?

1.4.4 How do construction managers ensure the delivery of quality construction project?

1.5 Objectives

1.5.1 To critically assess construction managers' understanding of quality in the construction industry.

1.5.2 To identify the responsibilities of a construction manager when it comes to the quality of a project.

1.5.3 To evaluate factors influencing the management of quality construction projects and role of the construction managers.

1.5.4 To explore ways in which a construction manager ensures the project is of quality.

1.6 Research methodology

Research is not simply a procedure of accumulating and assembling data, it is about discovering solutions to unresolved anomalies or inventing something (Goddard and Melville, 2004). The methods to use when collecting data are quantitative, qualitative and mixed methods.

The nature of this study allowed the researcher to use the mixed methods, known as the concurrent triangulation design for the collection of data. This improves the research by guaranteeing that the boundaries of one type of data are balanced by the strengths of another (Bergman, 2008). This ensures that understanding is enhanced by assimilating diverse knowledge (*ibid*). Mixed methods incorporate both quantitative and qualitative research.

1.6.1 Quantitative Research

This method is utilised to evaluate the problem via making mathematical information or data that can be converted into usable insights (Kothari, 2004). It is utilised to evaluate sentiments, practices and other distinct variables and simplify results from a greater sample (Korrapati, 2016). It additionally utilises quantifiable information to plan realities and reveal patterns in research (*ibid*).

The quantitative part for this research was in the form of questionnaires. The participants were 119 construction managers randomly chosen and found on SACPCMP website from around South Africa working for either a contractor, consultant or an academic. For capturing and analysing the data obtained from questionnaire, the Statistical Package for Social Sciences (SPSS-v27) was utilised. SPSS is able to capture abundance of data and is able to achieve every analysis covered in the text and much more (Green and Salkind, 2016). Probability sampling method known as stratified sampling was used for quantitative data.

1.6.2 Qualitative Research

Qualitative research is utilised to find insights of fundamental explanations, sentiments, as well as motivations (Patton & Cochran, 2004). It makes available the perceptions into the problem or assists with the development of ideas or hypotheses for prospective quantitative research (*ibid*). “*Qualitative*

is a critical technique because it involves the researcher, as he will understand a research problem more comprehensively and will be most participative on this approach” (Nxumalo, 2017:8). The methods for collecting a qualitative data include participation/observations, focus groups and individual interviews (Harrel and Bradley, 2009). The sample size is usually small (*ibid*).

The qualitative part for this research study was semi-structured interviews. Fifteen construction managers were selected to participate on interviews. The collected data was analysed using NVivo analysis (v12) which Braun and Clarke (2006:14) defined as “*a method for identifying, analysing, organising, describing, and reporting themes found within a data set*”. Purposive sampling method was utilised as participants were selected because they are likely to produce/generate useful information/data (Patton and Cochran, 2002).

1.7 Limitations

This study is limited to construction managers who were:

- Registered with the South African Council for Project and Construction Management Professionals.
- Participating on the interviews without the researcher in their midst due to Covid-19 restrictions.

1.8 Ethical Considerations

For ethical considerations, the researcher ensured that the participants of the study were unsusceptible to distress, undue intrusion, physical discomfort, personal embarrassment, indignity or any other harm (Stevens, 2013). The researcher also endeavoured to guarantee the following:

- The identities of the participants were unidentified;
- The partaking was done on a free will, together with not giving awards or requesting donations from participants;
- The results found from the study was presented in an honest and truthful custom;
- The researcher obtained gatekeeper letters from the participants and applied for ethical clearance before the beginning of data collection; and
- Ethical clearance was obtained from the UKZN ethical clearance office (As attached in appendix A).

1.9 Significance of the Study

This study assesses the role of construction managers in ensuring quality on construction projects in South Africa. This is significant in view of the criticism against the quality of constructed projects in the construction industry given the factors that affect quality. This study also equips construction

managers with knowledge of understanding quality in construction, identifies the factors affecting quality and how the construction managers may construct projects of quality. It illustrates how construction managers perceive quality. It also teaches other construction stakeholders the benefits of having a construction manager in a project and their responsibilities in a project.

1.10 Structure of the Study

1.10.1 Chapter 1: Introduction

This chapter provides a brief understanding of a research topic. It contained the background of construction quality based on the literature review. It further contains a problem statement, research questions and objectives. Furthermore, it discusses the research methodology. It also included limitations, ethical considerations, and the significance of this study.

1.10.2 Chapter 2: Literature Review

This chapter comprises of comprehensive research that has been done on construction quality. This section also contains current knowledge and theoretical and methodological contributions to construction quality.

1.10.3 Chapter 3: Research Model

This chapter discusses the findings and compare them to the findings of the literature review and strategic framework. Any relevant information found in the literature review and during the analysis of data will be discussed.

1.10.4 Chapter 4: Research Methodology

This chapter explains the types of techniques used to collect data and the target group from which the information was sourced. The research tools used are also elucidated in great details, as well as methods for data analysis. A concurrent triangulation method was utilised in obtaining data using questionnaires and semi-structured interviews. The data was later analysed and compared to draw conclusions.

1.10.5 Chapter 5: Data Analysis and Research Findings

This chapter evaluates the collected data utilising investigative as well as rational reasoning to scrutinise every element of the data collected. Data obtained from questionnaires was analysed with SPSS (v27) and the data obtained from semi-structured interviews was analysed with NVivo analysis (v12) and then conclusions were drawn. The results obtained are summarised into tables and graphs, as well as direct quotes using thematic analysis.

1.10.6 Chapter 6: Conclusion/Recommendations

This chapter provides the final discussions based on the problem statement, research questions and objectives of the study. It summarises the analysis of research results from the previous chapter. Thereafter, recommendations are made.

1.11 Summary

The previous sections of the study introduced and provided a brief understanding about quality in construction as well as the role of construction managers. The background of the topic from secondary sources are contained which played a crucial role in finding a problem statement, research questions and objectives. The main limitations are discussed, as well as the summery of the research methodology.

CHAPTER 2 – LITERATURE REVIEW

2.1 Introduction

This chapter comprises of comprehensive research on quality in the South African construction industry and the factors affecting it. An exhaustive review is undertaken on the concept of quality management processes employed by the construction managers to meet customer expectations as related to time, quality and costs. The responsibilities of construction managers in a delivering a quality project were also discussed.

2.2 Background of the construction industry

In every country, the construction industry is considered as an economically significant industry. It contributes to the economy by providing basic needs such as housing, by providing the infrastructure and physical structures of a country through generating job opportunities, and contributing to a country's Gross Domestic Product (GDP) (Haupt and Harinarain, 2016 & Wibowo, 2009). According to Cumberlege (2008), the construction industry indeed contributes miraculously to the economy of Southern Africa. Construction projects are the basis of economic growth where it signifies the index of a country's development (Tsong-Chieh, Furusaka and Han, 2010). The level of its quality relays to national image and further closely relates to public life, property and living quality (*ibid*). In South Africa, the construction industry is acknowledged as the strategic national asset and is believed to attain economic growth while enhancing the lives of the country's populace (CIDB, 2011).

It has become normal for construction companies to face challenges such as delays, issues related to workmanship and cost overrun in comparing their projects around the world (Juran and Godfrey, 2000). Lack of auditing, poor-quality materials, design complexity and lack of proper supervision are among other common causes of construction imperfections (Ali and Rahmat, 2010). The technical quality defects in construction include leaking roofs, basement cracks, faulty electrical systems, and many others (*ibid*). The management of quality is crucial for meeting customer expectations which paves the way to clients' loyalty (Boljevi, 2007). Quality is the most important aspect of construction projects' success. Nonetheless, numerous reports have criticised the construction industry, particularly based on productivity, quality and quality system (Neyestani, 2016). The majority of construction managers focus on the cost and time instead of quality for construction projects, but the scholars emphasise more attention should be towards quality (Mane and Patil, 2015). At the present time, quality has not just impacted on products and services in the organisations, but relates to the systems, processes and supervision as well. Researchers have revealed that the expense of low quality is significant, and regularly a lot bigger than appeared in bookkeeping reports (Haupt and Harinarain, 2016). For most organisations, the quality-related costs go from 25 to 40% of the operational costs

(Jura and Godfrey, 2000). In any case, scarcely any managers know about the degree of the effect of failure.

It is vital to manage project quality as it improves the accomplishments of the company. Quality allows the company to carry out services that conform to expectations of clients and regulation requirements, securing its status concurrently cutting the expenses and enhancing perfection (Mane and Patil, 2015). Lastly, it assists company to guarantee it is functioning in the most bearable means (Neyestani, 2016).

It is essential to have a look at South African construction industry to find methods and systems utilised to construct successful quality projects.

2.2.1 South African construction industry

The nation's economic growth is majorly influenced by the construction industry as it occupies an essential place in the development plans of the nation (Lakshmi, 2015). Government endures to put emphasis on social infrastructure expenditure through the development of social housing, hostels, schools and hospitals, etc. (PwC, 2016). South Africa is affected by lack of quality attention in the construction industry (CIDB, 2011). This is caused by the group of factors that include lack of standardisation, shortages of skills, increased fee competition, delays in payment and inconstant quality results (Lombard, 2010). The continual developments in construction have attracted market for both local and foreign contractors and developers to invest in the country of South Africa (Lakshmi, 2015). The South African construction industry has of late went under expanding pressure of globalisation and the opening up of nearby business sectors is basically meaning that the local participants competes with international participants in tenders. The local construction industry is now using international standards which make it internationally competitive, this is according the vision that government pronounced for the construction industry (Government Gazette, 2000). One example of this is a development of a Durban Point Promenade which was developed by the Asian developers but constructed by the local companies (Nyide, 2018). The quality of the mentioned project is measured based on international standards.

It is essential to manage the quality of a project. Quality is a significant part of the construction projects making it vital for a project team to remain attentive through the project lifecycle (Mane and Patil, 2015). It is the obligation of the project team to maintain the nature of quality of the project (Nyide, 2018). The team should eliminate the construction of low standard projects by arranging the quality policies efficiently (*ibid*). Or else, this may result in loss of the project as a whole and consequently, loss of job opportunities and reputation of the company within the business (Rumane, 2011).

No one can justify poor quality work (Waje and Patil, 2016). Certainly; it is any stakeholder's duty to perform duties which may lead to delivering good quality projects, depending on their specific roles. The project owners spend fortunes so that constructors will produce products and services that comply to their requirements, their scope of works and their specifications (Neyestani, 2016). They would like to be proud of their new facility and have many years of use from it without the inconvenience of repairing defective workmanship (Nyide, 2018).

Poor quality construction may result in:

- Additional costs and delays to the builder when work is redone or mended;
- Injury and death if the structure fails during or after construction;
- Additional costs to clients when defects have to be repaired later, for increased maintenance costs or for disruptions to their operations while defects are repaired; and
- A bad reputation for the construction company (Abramsson, Edmark, Ewers, Falk, Ullmar and Josephson, 2006).

2.3 Quality overview

Different people understand quality differently, depending on where they are applying it to (Chandrupatla, 2009). It is widely known as a degree of excellence (Mallawaarachchi and Senaratne, 2015). In a product, the client as a user recognises the quality of fit, finish, appearance, function, and performance (Garvin, 1984). Whereas the service may be valued according to the degree of satisfaction by the client getting the service (*ibid*). As soon as the quality requirements are established, approaches to quantify and screen the qualities should be put in place (Chandrupatla, 2009). This assists with basis of nonstop enhancement in the product or service. The main objective for quality is to guarantee that the client does not complain when the product or service is being delivered (Alberto, 2011). If the client is happy, the service provider or the producer receives the payment, and the trust is forever gained from the client (*ibid*). Therefore, the relationship between the two parties is a lifelong one.

The increased quality importance has been emphasised throughout the past few years (Lakshmi, 2015). Quality is being demanded by the world market and it has gotten the matter of endurance to the companies to achieve it. It is the key of the drawn-out progress and development of any organisation (Preethi and Monisha, 2017). Perfection and excellence have become quality principles but not exceptions (*ibid*). Therefore, companies all over the world must have and utilise different types of quality management systems in order to attain quality requirements.

The best way to describe 'quality' also known as the 'degree of excellence' is to start with a basis put introduced by Garvin (1984) and supported by other academics. These bases describe five tactics to defining quality: transcendent, product-based, user-based, production-based and value-based. Quality

needs to be managed and quality management pursues to guarantee the reliability of products and services (Chandrupatla, 2009). Attaining such reliability necessitates that one determines exactly what one understands by quality. To determine what is exactly meant by quality, one must thoroughly look at quality framework as well as quality dimensions (Garvin, 1984).

2.3.1 Quality framework

i. *Transcendent (Excellence)*

This approach sees the quality of a product or service as an innate characteristic that is both absolute and universally recognisable (Garvin, 1984). Fields, Hague, Koby, Lommel, and Melby (2014:403) added that under this approach, “*a product or service holds excellence as related to its subjective relationship to some standard*”. The capacity to confirm that emotional relationship must be created through experience (Fields, *et al*, 2014). As for construction, a project should comply with ISO 9001 and be appealing in terms of beauty and performance (ISO 9001, 2015).

ii. *Product-Based (Number of desirable attributes)*

The product-based approach favours measurable attributes over an individual's personal preferences. To evaluate the product quality, one must look for dimensions like performance, features, reliability, conformance, durability, serviceability, aesthetics, and perceived quality (Garvin, 1984). However, an unambiguous ranking is possible only if the attributes in question are considered preferable by virtually all buyers (Fields, *et al*, 2014). According to Oke (2017), a construction project's quality may be measured by evaluating its materials, construction methods and if it conforms to specifications, etc. He added that there are two obvious effects to this approach. First, higher quality can only be obtained at higher cost. Because quality imitates the quantity of features that a product contains, and because features are considered to be costly to produce, higher-quality goods will be more expensive. Second, quality is regarded as an essential characteristic of goods, rather than as something ascribed to them. Quality reflects the presence or absence of measurable product attributes, therefore, it can be assessed objectively, and is based on more than preferences alone (Garvin, 1984).

iii. *User-Based (Fitness for use)*

This approach is based on the premise that quality is “*in the eye of the beholder*” where the beholder is the user (Fields, *et al*, 2014:406). This is based on distinct and personal view of quality, and one that is highly subjective (Garvin, 1984). According to this approach, quality is the degree to which a product or service satisfies the user's needs, wants, or preferences (*ibid*). Looking at the construction project, it is of quality if it well meets the requirements of the user (Oke, 2017). Garvin (1984) emphasised that quality differences are captured by shifts in a product's demand curve and to the concept of fitness for use. Each of these concepts, however, faces two problems. The first is practical — how to aggregate widely varying individual preferences so that they lead to meaningful definitions

of quality at the market level. The second is more fundamental — how to distinguish those products attributes that connote quality from those that simply maximise customer satisfaction.

iv. *Production-based (Conformance to specifications)*

It relates to the production and engineering requirements (Fields, *et al*, 2014). When one thinks about quality from a production point of view, one wants to set up the requirements, specifications, and technology inside the company. The concept applies to services as well as products. Improvement there is for example to reduce scratch. Quality, in this case, cares about how manufacturing process looks like (Garvin, 1984). The customer does not see this inside work. And he or she wants to reduce production costs by reducing quality from manufacturing perspective. It is quite a dangerous situation. In this approach, excellence in quality is not necessarily in the eye of the beholder but rather in the standards set by the organisation (Mwelwa, 2019).

v. *The Value-based (Satisfaction relative to price)*

Value-based definitions take this idea one step further. They actually define quality in terms of costs and prices (Garvin, 1984). In view of this, a quality product is one that makes available performance at a satisfactory price or conformance at an acceptable cost (*ibid*). The difficulty in employing this approach lies in its blending of two related but distinct concepts. Quality, which is a measure of excellence, is being equated with value, which is a measure of worth. The result is a hybrid “affordable excellence” that lacks well-defined limits and is difficult to apply in practice.

2.3.2 Dimensions of quality

To achieve quality gains, one needs to think differently, a conceptual bridge to the customer’s vantage point (Garvin, 1984). Clearly, market studies obtain a new importance in this context, as does a careful review of competitors’ products. One thing is certain, high quality means pleasing consumers. Product designers, in turn, should shift their attention from prices at the time of purchase to life cycle costs that include expenditures on service and maintenance (Fields, *et al*, 2014). Quality of a product or service is easily understood by breaking it down to eight dimensions or categories of quality (*ibid*).

Eight dimensions can be identified as a framework for thinking about the basic elements of product quality:

1. Conformance;
2. Features;
3. Reliability;
4. Durability;
5. Serviceability;
6. Aesthetic;

7. Perceived quality; and
8. Performance (Fields, *et al*, 2014 & Garvin 1984).

Performance denotes a product's primary operating characteristics (Mwelwa, 2019). Features is those secondary characteristics that supplement the product's basic operational capabilities (Fields, *et al*, 2014). Reliability replicates the likelihood of a product's failing during a specified period of time (Mwelwa, 2019). A related dimension of quality is conformance, or the degree to which a product's design and operating characteristics match pre-established standards. Both internal and external elements are involved (*ibid*). Durability, a measure of product life, has both economic and technical dimensions (Mwelwa, 2019). Technically, durability can be defined as the amount of use one gets from a product before it physically deteriorates (*ibid*). Serviceability deals with the elapsed time before service is restored, the timeliness with which service appointments are kept, the nature of their dealings with service personnel, and the frequency with which service calls or repairs fail to resolve outstanding problems (Fields, *et al*, 2014). The final two dimensions of quality are the most subjective (Alberto, 2011). Both aesthetics and perceived quality are closely related to the user-based approach (*ibid*). Aesthetics is how a product looks, feels, sounds, tastes, or smells are clearly matters of personal judgment, and reflections of individual preferences (Mwelwa, 2019). Perceptions of quality can be as subjective as assessments of aesthetics (*ibid*). Together, the eight major dimensions of quality cover a broad range of concepts (Garvin 1984). Several of the dimensions involve measurable product attributes; others reflect individual preferences. Some are objective and timeless, while others shift with changing fashions. Some are inherent characteristics of goods, while others are ascribed characteristics (*ibid*). A product or service can rank high on one dimension of quality and low on another (Mwelwa, 2019). Indeed, an improvement in one may be achieved only at the expense of another. It is precisely this interplay that makes strategic quality management possible; the challenge to managers is to compete on selected dimensions (Garvin 1984).

Just like a quality of a product, quality of a construction project is a general philosophy by which process are carried in a total quality infrastructure (Alberto, 2011).

2.4 Quality in construction

It is essential to highlight that the construction process happens through projects which are “*temporary endeavours undertaken to create a unique product, service, or result*” (PMBOK, 2013:1). The temporary nature of projects indicates that a project has a definite beginning and end. The end is reached when the project's objectives have been achieved or when the project is terminated because its objectives will not or cannot be met, or when the need for the project no longer exists (PMBOK, 2013).

The level of success of construction projects greatly depends on the quality performance (Shobana and Ambika, 2016). Quality in construction cannot exist without a project and a construction project cannot exist without quality (*ibid*). Construction projects are a balance between cost, time and quality. It is possible to have high quality and low cost, but at the expense of time, and conversely to have high quality and a fast project, but at a cost (Oke, 2017). If both time and money are restricted, then quality is likely to suffer (*ibid*). High quality is not always the primary objective for the client; time or cost may be more important. It is only realistic to specify a very high standard of quality if the budget and time is available to achieve that standard (Alberto, 2011).

Quality of projects is one of the traditional and global measures of project performance. For construction projects, the goal and desire of all project stakeholders, a construction manager in particular, is to ensure that projects are delivered according to acceptable and agreed standards (Oke, 2017). Further, “*quality of construction projects can be regarded as the fulfilment of expectations of the project participants by optimising their satisfaction*” (Mallawaarachchi and Senaratne, 2015:84). Quality should be managed as from the design stage till the completion and operating stage (PMBOK, 2013).

Quality can also be described as meeting specifications and approved standards agreed by stakeholders (Oke, 2017). Clients cannot get satisfied if the end product fails to meet their price, quality, time frame, functionality and delivery performance standard. Quality is one of the critical factors in the success of construction projects. The main attraction of the term lies in the fact that it is basically a positive concept (Boljevi, 2007). “*No one is against quality and everyone wants to have it*” (Boljevi, 2007:218). Quality of construction projects, as well as project success, can therefore, be regarded as the fulfilment of expectations (i.e. the satisfaction) of the project participants which are the clients, users, designers, constructors, etc. (Preethi and Monisha, 2017). Failure to meet the quality requirements can have serious, negative consequences for any or all of the project’s stakeholders (Mallawaarachchi and Senaratne, 2015).

There are shortcuts to acquire quality to construction projects but they surely affect the project negatively, either during its construction or once the project functions. For example:

- Meeting customer requirements by overworking the project team may result in decreased profits and increased project risks, employee attrition, errors, or rework.
- Meeting project schedule objectives by rushing planned quality inspections may result in undetected errors, decreased profits, and increased post-implementation risks (Fields, *et al*, 2014 & Mallawaarachchi and Senaratne, 2015).

When defining objectives for construction project quality, it essential to consider the following:

- Available budget and time.

- Existing corporate policies (such as environmental policies).
- Key requirements of the business.
- Key requirements of other stakeholders.
- The views of external organisations such as the local planning authority.
- Local and national legislation (Fields, *et al*, 2014).

Juran (1999) defined construction quality as delivering customer service or product without a defect being present. As such, it is vitally important that briefing documents set out clearly the product specifications that are required. Specific standards of quality can generally be defined, prioritised and measured quite precisely, and criteria weighting can help in the appraisal of design options, in particular where conflicting views exist amongst stakeholders (Mane and Patel, 2015). The standard of quality that the design team try to achieve should reflect the requirements set out by the client in the briefing documentation (Neyestani, 2016). The contractor's obligation is to carry out and complete the works in a proper and workmanlike manner as described by the contract documents. This means the contractor must carry out the works with reasonable skill and care, to the reasonable satisfaction of the contract administrator (*ibid*).

The quality of materials and standard of workmanship might be controlled by the contractor on site by implementing a quality plan (Woudhysen and Abley, 2004). According to Hammar (2018) the plan establishes the resources required and associated documents (lists, purchasing documentation, machinery, equipment, etc.) and the control activities (verification of compliance with specifications, validation of specific processes, monitoring of activities, inspections and tests). These activities can be defined through inspection, testing plans, action plans and where applicable specific tests (for example, load tests for structures) (*ibid*).

Quality in construction relates to and/or aims to achieve the following:

- Satisfaction of contract specification;
- Completion of project within time and budget;
- Enhancing customer/owner satisfaction;
- Motivation and empowerment of employees;
- Meeting the construction company's standards;
- Meeting the code and specification requirements of the state or country;
- Avoiding disputes and claims; and
- Performance based on purpose (Neyestani, 2016).

For quality to be classified as poor or good quality, there are assessments undertaken by the contractor, client and external auditors. These assessments include the cost of poor quality,

organisation's standing in the marketplace and the operation of quality management system (Rumane, 2011 and Saif, 2018).

2.5 Assessment of quality

In today's global competitive environment, with the increase in customer demand for higher-performing products, organisations are facing many challenges (Rumane, 2011). They are finding that their survival in the competitive market is increasingly in doubt (*ibid*). To achieve a competitive advantage, effective quality improvement is critical for an organisation's growth (Saif, 2018). This can be achieved through development of long-range strategies for quality (Saif, 2018). Assessment of existing quality systems is helping the development of long-term organisational strategies for quality (Mane and Patil, 2015).

The following are the strategies used to assess quality:

a) Cost of poor quality

In order to know customer satisfaction, an independent product survey can be carried out to determine the reasons and improvement measures to be adapted (Rumane, 2011). Such assessment can be done through a questionnaire related to quality of work (workmanship) and functioning, and getting the customer's opinion/ reaction (*ibid*). Rumane (2011) alluded that management can use the same for quality improvement. Necessary improvement if required for proper functioning of the installed system should be carried out to maintain customer satisfaction. Normally, the contractor is required to maintain the completed project for a certain period under the maintenance contract, and therefore necessary modifications can be carried out during this period (Waje and Patil, 2016). Such defects/modifications have to be recorded by the organisation as feedback information and necessary measures can be taken to avoid occurrence of similar things in other projects (*ibid*). The cost involved to carry out such repairs/modifications is borne by the contractor, which helps improve customer satisfaction. Poor quality results in higher maintenance and warranty charges (Rumane, 2011). Preventive measures are required for overcoming this problem. Necessary data can be collected to analyse the reasons for rejections (*ibid*).

b) Organisation's standing in the marketplace

A company's standing in the marketplace fetches business opportunities for the organisation (Abramsson, *et al*, 2006). The organisation needs to know where it stands on quality in the marketplace and this can be done through market study (Rumane, 2011). Numerous questions related to the product should be considered for such studies, which can be carried out by the marketing department of the company (Abramsson, *et al*, 2006 and Rumane, 2011). The input from the study should be considered for quality improvement. Various quality tools can be used to analyse the

situation and the system can be improved taking into consideration the analysis results (Mane and Patil, 2015).

c) Operation of quality management system

This element of assessment is related to the evaluation of present quality management system activities (Mane and Patil, 2015). Assessment of present quality activities can be evaluated from two perspectives:

- Assessment that focuses on customer satisfaction results but includes an evaluation of the present quality system.
- Assessment that focuses on evaluation of the present quality system with little emphasis on customer satisfaction results (ISO 9001, 2015).

In either case, the assessment can be performed by the organisation itself or by an external body (Hammar, 2018). The assessment performed by the organisation is known as self-assessment, whereas an assessment performed by an external body is referred as a quality audit (Rumane, 2011). *“A quality audit is formal or methodical, examining, reviewing, and investigating the existing system to determine whether agreed-upon requirements are being met”* (Rumane, 2011: 361).

Audits are mainly classified as:

- First Party—Audits their own organisation (Internal Audit)
- Second Party—Customer audits the supplier
- Third Party—Audits performed by independent audit organisation (Rumane, 2011).

Third-party audits may result in independent certification of a product, process, or system, such as ISO 9000 quality management system certification (Rumane, 2011). Third-party certification enhances an organisation’s image in the business circle (ISO 9001, 2015). The assessment provides feedback to management on the adequacy of implementation and effectiveness of the quality system (Hammar, 2018).

2.6 Quality management system

A quality management system (QMS) is a management technique used to communicate to employees what is required to produce the desired quality of products and services and to influence employee actions to complete tasks according to the quality specifications (ISO 9001, 2015). The Quality Management assists the construction manager determine if deliverables are being produced to an acceptable quality level and if the project processes used to manage and create the deliverables are effective and properly applied (Hammar, 2018 & PMBOK, 2013). Quality management is vital to the success of an organisation (*ibid*). It enables it to deliver products and services that meet both customers’ requirements and regulations, protecting its reputation while reducing costs and driving

improvement (Aized, 2012). It also helps an organisation ensure it is operating in the most sustainable way (Boljevi, 2007). The purpose of quality management system can be namely such as reducing possible errors all phases of projects by proper control, finding faults/errors soon, measuring to avoid repeated mistakes, and determining and initiating corrective action/preventive measures (Aized, 2012).

Quality management takes a preventative approach, and an effective quality management system (QMS) will identify the risks to an organisation and provide ways to mitigate them (Ali and Rahmat, 2010). In identifying and managing these risks, a QMS provides the superior customer satisfaction and loyalty; identification and elimination of waste; better performance from suppliers and employees committed to quality and improvement (*ibid*). Quality management ensures superior quality projects (Boljevi, 2007). Quality of a project can be measured in terms of performance, reliability and durability (*ibid*). Quality is a crucial parameter which differentiates an organisation from its competitors. Quality measures and techniques are specific to the type of deliverables being produced by the project and this why the organisation should employ adequate quality management systems (Ying, 2012).

Quality management is increasingly being seen as an answer to two problems prevalent in the construction industry: waste and safety breaches (Aized, 2012). These equate to costs that any construction manager would be keen to avoid (*ibid*). To understand how pervasive and effective quality management requires one to look at operational problems as being failures in process (Ying, 2012). For instance, an incident on site may be as much down to supply side quality failure as individual error (*ibid*). “*Quality management is about mitigating these mistakes*” (Hammar, 2018:35).

Quality management systems assist the construction manager achieve the following:

- Meeting the customer’s requirements, which helps to instill confidence in the organisation, in turn leading to more customers, more sales, and more repeat business; and
- Meeting the organisation's requirements, which ensures compliance with regulations and provision of products and services in the most cost- and resource-efficient manner, creating room for expansion, growth, and profit (Aized, 2012 & Oke, 2017).

2.6.1 Quality management systems used in construction

- Quality Planning
- Quality Assurance
- Quality Control (PMBOK, 2013).

2.6.1.1 Quality planning

Quality planning is a disciplined process to ensure that a structured sequence of activities is completed (Senaratne and Jayarathna, 2012). These activities will ensure that an organisation can provide a

quality product on time, at the lowest cost and to the customer's specific specifications (*ibid*). This is the first phase of quality management which takes place as soon as the project documents are made available to the project management team (PMBOK, 2013). The team usually looks at ways and tasks to complete the project that will comply with all the requirements related to the project (Senaratne and Jayarathna, 2012). According to Juran's quality planning road map, the key elements of implementing company-wide strategic quality planning are identifying the customers and their needs, establishing optimal quality goals, creating measurements of quality, planning processes capable of meeting quality goals under operating conditions and producing continuing results in an improved market share (Juran, 1998). Leonard and McAdam (2002) further emphasise that organisations need to integrate quality planning and strategic planning to avoid conflict between the two plans because the quality plan will likely to lose out and could result in several disruptive effects, such as a further emphasis on quality measurements, tension between financial and quality goals and non-involvement of employees and customers in strategic planning. Aized (2012) added that quality planning ensures that quality requirements are addressed throughout the product and service lifecycle.

The aim of quality planning is simply to produce a project quality plan (PQP). A project quality plan, sometimes referred to as a quality management plan, is a project-specific quality plan that describes the activities, standards, tools and processes necessary to achieve quality in the delivery of a project (Aized, 2012 & PMBOK, 2013). It is sometimes considered to be interchangeable with the project execution plan (PEP) which sets out the overall strategy for managing the project, describing who does what and how, and defining the policies, procedures and priorities that will be adopted (Aized, 2012).

The project quality plan should:

- Provide explanatory text describing the nature of the project and the quality expectations.
- Set out the organisations quality policies (for example, if they are ISO 9001 certified) and how these policies will apply to the project.
- Identify other quality criteria or policies that may need to be followed, such as the requirements of clients or funders.
- Describe how quality requirements will cascade down through the supply chain.
- Describe the activities necessary to deliver the project and the order in which they will be carried out.
- Describe the resources required.
- Set out quality roles and responsibilities.
- Identify the standards that will apply.

- Describe monitoring and reporting procedures and the process for delivering continuous improvement.
- Describe procedures for dealing with defects.
- Describe document control procedures.
- Describe change control procedures.
- Set out any training requirements.
- Schedule tools that will be used.
- List reference material (Aized, 2012, Hammar, 2018 & PMBOK, 2013).

2.6.1.2 Quality assurance (QA)

In general terms quality assurance includes measures to meet the required quality. Caswell (2000) defined quality assurance as all those planned and systematic actions necessary to provide confidence that a product or service will satisfy given requirements for quality. Generally, a company maintains a quality assurance chart by specifying various checks at different levels as well as constantly improving its attributes (Senaratne and Jayarathna, 2012). Usually the government or outside third party is responsible for performing quality assurance (*ibid*). QA is spot checking of contract compliance, test results, and ultimately making sure that the quality control process is working (Hammar, 2018). The primary function of quality assurance is to obtain completed construction that meets all contract requirements (Tempa, 2015). It addresses both the quality of a finished product or service (the effectiveness of the operation) and the efficiency (costs and resources) of producing it (*ibid*). This gives confidence that standards and requirements are being met. The quality assurance process implements a set of planned and systematic acts and processes (PMBOK, 2013).

Quality Assurance (QA) in the construction process is therefore responsible for the following:

- It involves regular but random testing of materials and workmanship (time-based or work-based intervals)
- It prevents, identify, and correct quality-related problems and
- During the construction process, QA instructors mostly provide guidance and leadership to the construction people (Tempa, 2015).

2.6.1.3 Quality control (QC)

Quality control is a process employed to ensure a certain level of quality in a product or service. Mallawaarachchi and Senaratne (2015:21) defined quality control as “*the periodic inspection to ensure that the constructed facilities meet the standard specified in the contract*”. It is usually carried out by the management team, namely, construction manager, engineers and foremen (Mallawaarachchi and Senaratne, 2015). It may include whatever actions a business deems necessary to provide for the control and verification of certain characteristics of a product or service (Ying,

2010). Emiedafe (2017) added that quality control consists of making sure things are done according to the plans, specifications, and permit requirements during construction project. In fact, quality control makes it imperative for clients to get the most out of their projects (*ibid*). The basic goal of quality control is to ensure that the products, services, or processes provided meet specific requirements and are dependable, satisfactory, and fiscally sound (Mallawaarachchi and Senaratne, 2015).

Unfortunately, quality control is often forgotten in the rush to complete construction projects, or sometimes just turns into a paper exercise, and is a task the project manager leaves to the construction manager, or on bigger projects quality engineers or quality managers (Lydia, 2010). However, it is the project manager's responsibility to ensure that quality control is treated seriously, is not only about paperwork, and that people are delegated with specific responsibilities to deliver the correct quality, understanding what to look for and what the required quality standards are (Leonard and McAdam, 2002). This helps considerably when people have the required skills and take pride in the quality of their work (*ibid*). All the quality paperwork in the world, with all their signatures, will not turn a poor-quality product into a good quality product (Rumane, 2011). However, the paperwork trail is important in ensuring that proper quality procedures have been implemented and followed (*ibid*).

Essentially, quality control involves the examination of a product, service, or process for certain minimum levels of quality (Oke, 2017). The goal of a quality control team is to identify products or services that do not meet a company's specified standards of quality (Wibowo, 2009).

2.6.2 Project management triangle as related to quality

Without doubt, quality management systems provide the consistency and satisfaction in terms of methods, materials, equipment, which causes firms to meet the requirements of their customers, and achieve organisational targets in the projects (Aized, 2012&Neyestani, 2016), as illustrated in figure 2.1. There are three main interdependent constraints for every project; time, cost and scope (Aized, 2012). This is also known as '*project management triangle*'. The project management triangle is used by managers to analyse or understand the difficulties that may arise due to implementing and executing a project (Leonard and McAdam, 2002). All projects irrespective of their size will have many constraints (*ibid*).

Quality is not a part of the project management triangle, but it is the ultimate objective of every delivery (Stojcetovic, 2013). Hence, the project management triangle represents quality (*ibid*). The construction manager needs to strike a balance between the three constraints so that quality of the project will not be compromised (Leonard and McAdam, 2002). Many construction managers are under the notion that 'high quality comes with high cost', which to some extent is true (Oke, 2017). By using low quality resources to accomplish project deadlines does not ensure success of the overall

project (Lydia, 2010). Like with the scope, quality will also be an important deliverable for the project (*ibid*).

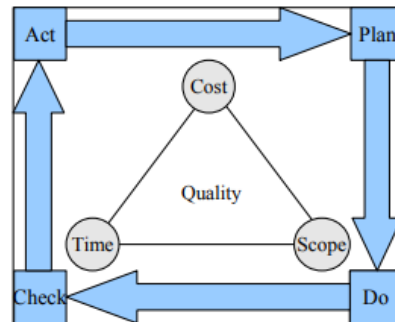


Figure 2.3: Schematic QMS on organisational targets of projects (project management triangle) (Neyestani, 2016).

Figure 2.1 illustrates the project management triangle. The project management triangle is the boundaries in which the project objectives are met (Wibowo, 2009:354). Just as restrictions enhance creativity, the project management triangle provides a framework that everyone in the project can agree on (Mwelwa, 2019). These metrics drive the project forward while allowing for adjustments as needed when issues arise (Oke, 2017).

The following are the project management triangle components:

i. Scope

Scope looks at the outcome of the project undertaken (Tempa, 2015). This consists of a list of deliverables, which need to be addressed by the project team. Project scope deals with the specific requirements or tasks necessary to complete the project (Mane and Patil, 2015). Scope is essential to manage on any project because if it cannot be controlled, the project is not likely to be delivered on time or under budget (Preethi and Monisha, 2017).

A successful construction manager will know how to manage both the scope of the project and any change in scope which impacts time and cost (Leonard and McAdam, 2002).

ii. Cost

The financial commitment of the project is dependent on several variables (Preethi and Monisha, 2017). There are the resources involved, from materials to people, which include labour costs (Tempa, 2015 & Preethi and Monisha, 2017). There are other outside forces that can impact a project, which must be considered in the cost of the work (Tempa, 2015).

It's imperative for both the construction manager and the organisation to have an estimated cost when undertaking a project (Rumane, 2011). Budgets will ensure that project is developed or implemented below a certain cost (Lydia, 2010). Sometimes, construction managers have to allocate additional

resources in order to meet the deadlines with a penalty of additional project costs (Leonard and McAdam, 2002).

iii. Time

At its basic, the schedule is the estimated amount of time allotted to complete the project, or producing the deliverable (Senaratne and Jayathna, 2012). Usually, this is figured out by first noting all the tasks necessary to move from the start to the finish of the project (Tempa, 2015). A project's activities can either take shorter or longer amount of time to complete (*ibid*). Completion of tasks depends on a number of factors such as the number of people working on the project, experience, skills, etc. (PMBOK, 2013). Time is a crucial factor which is uncontrollable (Senaratne and Jayathna, 2012). On the other hand, failure to meet the deadlines in a project can create adverse effects (Preethi and Monisha, 2017). Most often, the main reason for organisations to fail in terms of time is due to lack of resources (Senaratne and Jayathna, 2012).

Construction managers look to get support from their team in this area, through collaborative time management tools and processes so the project is collectively able to stay on track (Leonard and McAdam, 2002). Programmes like Gantt charts are used (Lydia, 2010).

In figure 2.1, the project management triangle is surrounded by the PDCA (plan-do-check-act) model/Deming cycle (Aized, 2012). The model is implemented to improve the quality and effectiveness of processes within project lifecycle management (Mwelwa, 2019). The model includes solutions testing, analysing results and improving the process (Aized, 2012).

Every company that seeks to establish a quality management system has to define its own quality policy (Senaratne and Jayarathna, 2012). According to ISO 9001 (2015) a quality policy is a component of business policy of certain organisation as well as a defining framework of quality goals. Quality policy indicates the general quality intentions and goals of an organisation (PMBOK, 2013).

There are factors affecting the quality of construction and severe attention should be put on them to achieve good quality (Oke, 2017).

2.7 Factors affecting construction quality

The construction industry like any other production industry is faced with challenges that affect the performance and output of the endeavour (Lukumon, Babatunde, Kabir, Samuel, Iyabo and Rafiu, 2015). Identifying potential critical factors that affect the quality of a project before the commencement will ensure client satisfaction at the completion of project (Oke, 2017). Quality performance has been considered a function of procedures adopted during the construction process (Lukumon, *et al*, 2015). This includes adequate project planning and site organisation, proper

installation of equipment and materials, and proper construction of components (*ibid*). Figure 2.2 shows the factors affecting quality.

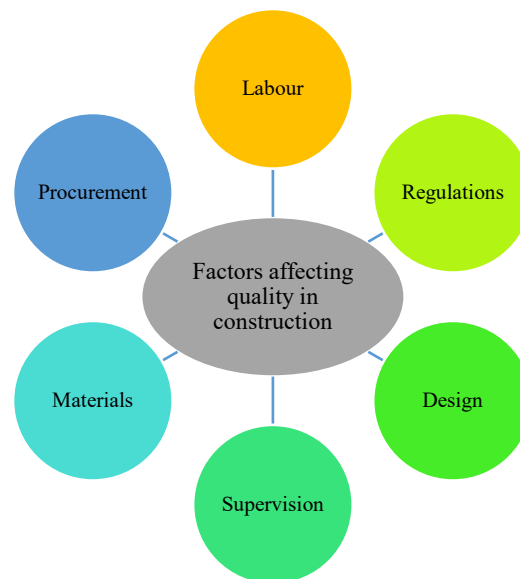


Figure 2.4: Factors affecting quality in construction

2.7.1 Labour

Quality management ensures increased revenues and higher productivity for the organisation (Lukumon, *et al*, 2015). Both skilled and non-skilled workers are vital and indispensable for the smooth-running of a free-market and/or capitalist society (Makhene and Twala, 2009). Generally, however, individual skilled workers are more valued to a given company than individual non-skilled workers, as skilled workers tend to be more difficult to replace (Oke, 2017). As a result, skilled workers tend to demand more in the way of financial compensation because of their efforts (*ibid*). If an organisation is earning, employees are also earning (Abramsson, *et al*, 2006). Therefore, money is a strong motivating factor. Organisations should spend on the employment of skilled labour or develop its workers by training them to obtain the sufficient special skills and knowledge in their work (Aized, 2012). The quality of a construction project depends on how skilled the labours are (Lukumon, *et al*, 2015). Lukumon, *et al*, (2015) added that usually skilled labour are those labour with an idea of quality outcomes, specifications and can read and appraise the design drawings. An educated and trained (skilled) labourer is more efficient than an untrained and uneducated (unskilled) labourer because the former understands the intricacies of his job in a better way than the latter (Woudhysenand Abley, 2004). In general, efficient/skilled workers are a great asset to the construction industry. They require less supervision. They work hard, are honest and responsible. They make proper utilisation of resources and do not waste raw materials. They produce quality products in larger quantities. As a result, costs of production fall and profits increase (Kwat, 2018).

2.7.2 Regulations

South Africa has a well-developed set of technical standards that can be used to describe the standards of materials and workmanship for construction works (Nyide, 2018). These include a range of South African National Standards (SANS) and International Organisation for Standardisation (ISO) standards (*ibid*). The SANS and ISO standards representatives ensure that construction projects are of quality by reviewing quality management plan and inspecting the actual work whether or not it conforms with the quality standards (CIDB, 2011).

The quality regulations mostly adhered to in South African construction industry include:

- ISO 9001:2015

ISO 9000 or “quality management principles” are a set of fundamental beliefs, norms, rules and values that are accepted as true and can be used as a basis for quality management (ISO, 2015a). The ISO 9001 standards series can form and have formed the foundation for a competent and beneficial quality management system in the construction industry (ISO, 2015b). Checking that the system works is a vital part of ISO 9001:2015 (*ibid*). The basic principles behind ISO 9001 are formally defining customer requirements (quality), making plans to meet them, checking if they have been met or not, and taking action if abnormalities are determined (Schenkel, 2004). It is recommended that an organisation performs internal audits to check how its quality management system is working (Rumane, 2011). An organisation may decide to invite an independent certification body to verify that it is in conformity to the standard or it might invite its clients to audit the quality system for themselves (*ibid*).

- SANS 10155 code of practice for accuracy in buildings (CIDB, 2011).

It provides consistency in the quality of a construction project. It drives an organisation to meet and exceed customer expectations, leading to an increase in market and shareholder value. It also provides both mandatory and optional performance requirements for a range of project attributes in conformance to quality. It provides the following in respect of each of these attributes:

- User needs;
- Performance description;
- Performance requirement; and
- Ways in which it can be demonstrated or predicted that solutions satisfy requirements (SANS 10155, 2009).

2.7.3 Design

Jaiyeoba and Folagbade (2015) noted that the quality of drawings and specifications received from designers affect the quality of the design and construction phases and consequently the quality of the

constructed facility. Defective designs have an adverse impact on project performance and participants and are responsible for many construction failures (Stamatiadis, Sturgill, Goodrum, Shocklee and Wang, 2013). To avoid this, the construction managers perform the constructability reviews to all the project design drawings to identify the errors to the drawing before the planning phase commences (Stamatiadis, Sturgill and Amiridis, 2017). There is industry impetus encouraging early construction involvement in development (Jaiyeoba and Folagbade, 2015). This helps detect errors in the quality of project designs, solve them and come up with the best construction methods possible before the actual construction begins (*ibid*).

2.7.4 Supervision

Jaiyeoba and Folagbade (2015) saw supervision as a combination of procedure, process and situations that are smartly designed to improve effectiveness of individuals and groups. Good supervision must involve mutual agreement, respect and personal trust between supervisors and supervisee (Zulu and Chileshe, 2008). This will lead to an enhanced service delivery (*ibid*). Supervision has been a major concern that could limit quality performance of construction projects (Mahajan, 2016).

Somba (2015) described that supervision tools include: project details; supervision manuals; bills of quantities; and project drawings. It was noted that in accordance with the approved project plan or work program, resources, designs, specifications and schedule of works are properly implemented (*ibid*).

2.7.5 Materials

Quality is often seen as a subjective viewpoint of how well a given outcome will be. However, quality also plays into what types of materials are used for a project and how the budget transforms over the course of a project. Project managers must consider how the potential impact from low-quality materials will affect the outcome of the project. If a project manager opts for a less expensive item, the overall budget could be reduced but the quality might be poor as well. However, the lower cost may be an indicator of lower quality, which would undermine the original goals of the project. Budget quality is the counterpart to quality materials.

2.7.6 Procurement

Although procurement procedures need to be tailored to enhance the fulfilment of different project objectives (Eriksson and Vennstrom, 2012), clients tend to choose those procurement procedures they have a habit of using, regardless of any differences between projects (Laedre, Austeng, Haugen, and Klakegg, 2006). In order to enhance change, an increased understanding of how different procurement procedures affect different aspects of project performance in different types of projects is therefore vital (Gharehbaghi and McManus, 2003).

The higher the level of collaboration between client and contractors in joint specification equates to the better the economic performance, the better the time performance, the better the quality and the better the collaboration (Eriksson and Vennstrom, 2012). Also, the better the collaboration among project actors, the better the economic performance, the better the time performance and the better the quality (Laedre, *et al*, 2006). Construction Management (CM) is one such approach, in which the clients appoint an external organisation to manage and co-ordinate the design and construction phases of a project (Gharehbaghi and McManus, 2003). CM has been described as being able to accelerate project duration, improve overall buildability, improve project quality, encompass flexibility and facilitate price competition (Steyn, 2013). This approach indicates clearly that different project stakeholders perceive construction quality differently which brings the focus on construction managers attributes and perception on quality.

2.8 The attributes of a construction manager

Construction managers are often tasked with balancing a variety of duties at once (Eriksson and Vennstrom, 2012). They are often responsible for overseeing the entire jobsite, but most importantly, must be able to manage and supervise a unique combination of individuals. The projects, whether big or small, rely on construction managers to provide leadership, coordinate tasks and oversee the completion of the entire project (Gharehbaghi and McManus, 2003). For a construction manager to be successful, these five qualities below will ensure that each task on the jobsite runs effectively and efficiently.

2.8.1 Excellent communication

An effective construction manager should possess excellent communication skills (Eriksson and Vennstrom, 2012). They must be able to communicate clearly and confidently, to create stronger relationships between workers and managers (*ibid*). This will enable skilled workers, employees and construction personnel to perform their tasks to the best of their abilities (Jaiyeoba and Folagbade, 2015). Also, construction managers must communicate with team members frequently and on a consistent basis to ensure everyone is on the same page and working towards a common goal (Harvey, 2007). This may help in preventing unnecessary delays in the project so that each task is completed on time (*ibid*).

2.8.2 Ability to delegate Tasks

An effective construction manager should be able to assign tasks to different workers based on their specific capabilities and specialised skills (Jaiyeoba and Folagbade, 2015). This will ensure that everyone on the jobsite is given work that best aligns with their particular skill set, not only benefiting the worker, but the entire project as well (Eriksson and Vennstrom, 2012). A good construction manager is also capable of delegating leadership and supervisory roles to others, which helps them

oversee specific areas on the jobsite (Stamatiadis, *et al*, 2013). Great managers acknowledge that they cannot do the entire job on their own and entrusting other capable leaders will help facilitate the project (*ibid*). In addition to delegating tasks to skilled workers, managers must provide the appropriate timeframe for a given project, which allows employees to maximise their productivity (Eriksson and Vennstrom, 2012).

2.8.3 Ability to prioritise activities

Construction projects are multi-faceted and complex processes that involve several different activities and specialised workers (Oke, Aigbavboa and Dlamini, 2017). Understanding the importance of these activities is essential for the success of any given project (*ibid*). An effective construction manager must lay out the most optimal work schedule and execute the plan to the best of their abilities (Stamatiadis, *et al*, 2013). In many instances however, unforeseen circumstances, like unpredictable weather or logistical issues may arise (Oke, Aigbavboa and Dlamini, 2017). In these cases, project managers must assess their new situation and be able to re-prioritise their activities to ensure the project stays on track. Failure to adjust to these circumstances may derail the progress already made (*ibid*).

2.8.4 Value teamwork

In most large-scale projects, an entire team is necessary for its completion, and construction is no different (Oke, Aigbavboa and Dlamini, 2017). A good project manager acknowledges this and regards teamwork as an integral part of the construction process (Stamatiadis, *et al*, 2013). Not only does this include managing the specific tasks, but also ensures that the entire jobsite operates with values of collaboration and cooperation in mind (Eriksson and Vennstrom, 2012). By doing this, a more positive atmosphere will be achieved, which boosts team morale and increases productivity among all workers (*ibid*).

2.8.5 Possess problem solving skills

In the course of any construction project, problems and obstacles are bound to occur (Jaiyeoba and Folagbade, 2015). An effective construction manager should be equipped with excellent problem-solving skills to properly address any issue that may arise (Stamatiadis, *et al*, 2013). More importantly, project managers will be able to predict and forecast what problems a project may encounter and have multiple options and solutions ready (Misra, 2019). These problems include everything from weather issues, delivery delays and even personal issues amongst team members (*ibid*). A good construction manager is able to devise strategies that are specific to a particular project and tailored to a unique group of individuals (Stamatiadis, *et al*, 2013).

The work of a construction manager is extremely complex and multi-dimensional. Not only are the above mentioned five skills good to keep in mind, they are essential for the success of any project.

Apart from the technical capabilities and skills associated with construction, a construction manager must be welcoming and approachable to create an atmosphere that workers enjoy being a part of (Jaiyeoba and Folagbade, 2015). Dedication to both work-related and personal development is an integral part of what makes a good construction manager (*ibid*). These five qualities will provide a superior work experience and positive environment for not only managers but for all working on the jobsite as well.

2.9 Construction management qualifications

Since construction management is a profession, it is a standard to obtain related qualifications (Jaiyeoba and Folagbade, 2015). The qualifications include a BTech, BSc, honours, masters and PHD (UKZN, 2017 and UCT, 2016). The purpose of these qualifications is to build the necessary knowledge, understanding and skills required for students to become competent and professional registered practicing construction managers (UKZN, 2017). This empowers students to demonstrate their ability to apply the knowledge, understanding, skills, attitudes, and values they have acquired through the courses and make true impact on the built environment industry (*ibid*). The courses focus on the planning, execution, and management of construction projects (UCT, 2016). These courses basically equip the graduates with the following:

- Pre-tender planning and programming of projects to determine the optimal use of resources;
- Post-tender refining and monitoring of construction programmes to ensure the smooth running and the completion of contracts on time;
- Quality control of labour and material used in construction projects;
- Controlling and managing sub-contractors and suppliers, etc.; and
- Co-ordinating the handing over of the completed quality projects (UKZN, 2017 & UCT, 2016).

It is essential for every construction management graduate to register with SACPCMP (NOSA, 2017). The SACPCMP was established to regulate construction management and construction project management professionals, as a means of protecting the public (*ibid*).

2.10 South African Council for the Project and Construction Management Professions (SACPCMP)

The South African Council for the Project and Construction Management Professions is a juristic entity established by Section two of the Project and Construction Management Act (Act No 48 of 2000). The SACPCMP was established to provide for statutory professional certification, registration and regulation of the project and construction management professions in order to protect public interest and advance construction and project management education (SACPCMP, 2019). Every construction management graduate must be registered under this council as a

candidate construction manager (CCM). After obtaining the relevant practical experience and criterion of the council in the candidacy period, one becomes a professional construction manager (PrCM) (*ibid*).

2.11 The perspective of a construction manager towards construction quality vs clients

The construction managers are stakeholders found in the construction management systems which are the arrangements in which the client appoints an external organisation (construction management firm) to manage and coordinate the design and construction phases of a project (Laedre, *et al*, 2006). A minimum of three year of experience is required to be able to manage a site (*ibid*). The construction managers work for the project and act as the leaders of the design-building process, designers, builders, technical agencies, large number of governments and subcontractors (Gharehbaghi and McManus, 2003). The construction managers are the driving force behind the scenes and control the modus operandi of the construction project (Harvey, 2007). Construction managers are charged with the responsibility of planning, organising, directing, controlling and evaluating the activities of a construction department or construction company following the directions of the general manager, senior manager or project owner if in case it is not a company project (Steyn, 2013). The general function of construction managers is to work as an agent appointed by the project owner to ensure that the project is completed within the specifications and plans provided (Laedre, *et al*, 2006). The construction manager has the duty to inspect the contractors' works against defects and deficiencies but no liability falls on the construction manager if any contractor fails to perform the work in accordance with the contract documents (Misra, 2019).

Clients are satisfied if the end product meets their expectations in terms of price, time frame, functionality and delivery performance standard (Oke, 2017). Whereas the construction managers look at this far beyond (*ibid*). The construction managers focus on the skills and knowledge employed to the construction of the project. They pay attention at the materials, labour, equipment, tools and methods to producing the end-product of quality (Preethi and Monisha, 2017). The clients are moving forward with the advancing technology. Clients demand improved service quality, faster building and innovations in technology (Stamatiadis, *et al*, 2017). An appropriate level of quality could be determined during all phases of the construction project (Preethi and Monisha, 2017). Specially, construction phase is where the project could impact by its operability, availability, reliability, and maintainability of a facility (*ibid*). The construction managers can reject non-conforming work, subject to review by the Architect (Misra, 2019).

Construction managers relate quality of the project to the following:

- Fitness for purpose;
- Conformance to specifications;

- Meeting or exceeding customer expectations;
- Value for money; and
- Consistency (Harvey, 2007 & Misra, 2019).

The definitions of quality also vary in their usefulness to different stakeholders (Harvey, 2007). Quality defined as excellence can provide powerful motivation to a workforce and quality defined as value or conformance to specifications can lead an institution to focus on efficiency, whereas quality defined as meeting and/or exceeding expectations compels management to keep abreast of changes in consumer demands (Harvey, 2007 & Misra, 2019).

2.11.1 Fitness for purpose

Fitness for purpose equates quality with the fulfilment of a specification or stated outcomes (Harvey, 2007). Quality is thus judged by the extent to which the product or service fits a stated purpose (*ibid*). This fitness-for-purpose notion is distinct from the idea of quality as something special, elitist, or difficult to attain (Misra, 2019). It is a functional definition of quality rather than an exceptional one. If something does the job it is designed for then it is deemed to be a quality product or service (Misra, 2019). Fitness for purpose has emerged as the fashionable way to harness the drive for perfection (*ibid*).

Quality as fitness for purpose is a concept that stresses the need to meet or conform to generally accepted standards such as those defined by an accreditation or quality assurance body, the focus being on the efficiency of the processes at work in the institution or programme in fulfilling the stated, given objectives and mission. (Vlăsceanu, Grünberg and Pârlea, 2004).

2.11.2 Conformance to specifications

Conformance is how well realities match specifications, rules, principles and plans (Vlăsceanu, *et al*, 2004). Conformance is achieved with processes of quality control and quality assurance (*ibid*). Conformance to specifications may cause managers to focus on internal efficiency while neglecting external effectiveness (Preethi and Monisha, 2017). Preethi and Monisha (2017) added that the focus is on delivering work that matches what was requested in requirements and work that matches a design. If the project deviates greatly from the intended design, that project is said to have poor conformance quality (*ibid*). Since it is difficult to match target values exactly, project stakeholders allow for tolerances (Misra, 2019). These tolerances express how much a project can deviate from the target while still having what is considered to be an acceptable conformance quality (*ibid*).

2.11.3 Meeting or exceeding customer expectations

Clients demand improved service quality, faster building and innovations in technology (Preethi and Monisha, 2017). It is the duty of the construction managers to deliver what the client wants and

continuous knowledge accumulation is absolutely required. The end-product is the major objective to be constructed within the given budget, timeframe and available resources. According to Sureshchandar, Rajendran, & Kamalanabhan (2001:112), '*the aim of any organisation is to have a customer and to retain such customer*'. To achieve this while at the same time providing exceptional service rendering to the customer: (1) total commitment to customer service is required from each employee, while (2) he/she is also required to realise the quality philosophy each minute of the day (Sureshchandar, *et al*, 2001).

2.11.4 Value for money

Value for money is a definition of quality that judges the quality of provision, processes or outcomes against the monetary cost (both overt and hidden) of making the provision, undertaking the process or achieving the outcomes (Vlăsceanu, *et al*, 2004). In essence, quality as value for money sees quality as return on investment. One view sees value for money as being achieved if a specified outcome (product or service) is obtained at lowest cost (Harvey, 2007). An alternative view sees value for money as getting a specified product for a predetermined cost that suits the customer.

As Erlendsson (2002:86) states: '*value for money is a term used to assess whether or not an organisation has obtained the maximum benefit from the goods and services it both acquires and provides, within the resources available to it*'. Erlendsson (2002) also points out that the value of some elements may be difficult to measure, because they are unclear or intangible. Subjective judgement is therefore required when assessing value for money (Misra, 2019).

2.11.5 Consistency

Quality is also construed as perfection or consistency (Field, *et al*, 2014). This involves a shift from outcome standards measurement to process standards (*ibid*). A quality project in this sense is one that is consistent or without flaws (Erlendsson, 2002). This notion of quality emphasises reliability and is encapsulated in two interrelated ideas: zero defects and quality culture (*ibid*). The zero defects approach to quality replaces the emphasis on exclusivity with one that makes quality accessible for all (Misra, 2019).

Quality as perfection/consistency turns quality into a relative concept (Erlendsson, 2002). There are no absolutes against which the output can be assessed, no universal benchmarks (*ibid*). Consistency of organisational standards is quality assured through mechanisms such as ISO 9000 or similar certification, which focuses on the codification of processes to ensure that errors are not made (Rumane, 2011).

Based on the perspective of construction managers or above-mentioned analysis of quality definitions by different authors, the following definition of quality was developed for this research:

‘Quality is the degree to added value to products and/or service delivery as perceived by all the stakeholders through conformance to specifications and the degree to added excellence to products and/or service delivery through a motivated workforce, to meeting customer satisfaction’ (Erlendsson, 2002; Fields, et al, 2014; Mallawaarachchi and Senaratne, 2015&Misra, 2019)

2.12 The role of a construction manager towards quality of a project

Construction managers have recognised the potential of quality management to deal with some of the problems most commonly associated with construction projects (Lydia, 2010). Construction managers are charged with the responsibility of planning, organising, directing, controlling and evaluating the activities of a construction department or construction company following the directions of the general manager, senior manager or project owner if in case it is not a company project (Saif, 2018). They are equipped with education, knowledge, skill set, technology and an attitude of analytical thinking which helps them to take a holistic approach towards the construction project (Oke, 2017).

According to Tang and Cam (1999), the conceptual framework as proposed in figure 2.3 illustrates predictors in the form of construction managers’ quality practices, top management commitment, quality management and quality projects. Quality management of construction project leads to construction of quality projects that meet both clients’ needs and legal requirements. However, for quality management to be realised, the construction managers need to implement quality management practice (Saif, 2018). To successfully implement quality practices, there must be support from the top management of the company (Tang and Cam, 1999 & Saif, 2018).



Figure 2.5: Conceptual framework of quality management (Tang and Cam, 1999).

Quality policy is defined and issued by the construction manager (Boljevi, 2007:222). Boljevi added that the construction manager is also responsible for its implementation and realisation. Quality policy indicates the general quality intentions and goals of an organisation (PMBOK, 2013). When construction managers create the quality policy for the project, they consider the following principles:

1. The client, user or investor are always in the first place;
2. Observing the rules, standards and assumed responsibilities;
3. Quality is a management priority;
4. Excellence is a standard;
5. Demonstration of leadership in business;
6. Harmonised sustainable development with both the society and environment as well;
7. Planning and improvement are the working mode of an organisation;
8. Learning, motivation and engagement of employees;
9. Advancing quality and partnership with the suppliers; and
10. Quality advancement is a dynamic procedure with expandable goals (Boljevi, 2007; Oke, 2017 and Stamatiadis, *et al*, 2017).

The construction manager also defines the quality objectives harmonised with the quality policy which are integral parts of the project general strategic goals (Oke, 2017). Quality objectives must be challenging, feasible, measurable and controllable. Smallwood and Rwelamila (2011) mentioned that quality objectives are defined through four mutually harmonised standpoints of contractors, consultants, suppliers and customers' interests, risks, costs and benefits (Mane and Patil, 2015). The interest of service providers is the maximum amount of products, minimal manufacturing costs and high quality products, with effective utilisation of resources (*ibid*). Just like any service provider, construction managers strive for regular and loyal customers, satisfied with the quality of their projects (Neyestani, 2016). Moreover, the goal of construction managers is to get new customers and expand their market (Oke, 2017). The customer's interest is to obtain confidence in high project quality of the service provider as a stable and reliable supplier (Boljevi, 2007). This is why the construction managers manage the quality of their project from inception to completion (*ibid*).

The construction manager develops the quality management plan (QMP) after consulting with the project manager and the stakeholders (Neyestani, 2016). Note that the former has to approve the final QMP (*ibid*). Implementation of the quality management standards has a significant impact on organisations as it promotes both staff and client satisfaction (Landin, 2000). Quality management systems save organisations unnecessary costs due to improved productivity and efficiency (Mane and Patil, 2015). This is why the construction manager usually adjusts/modifies the initial quality management plan as the project advances (Neyestani, 2016). Medium to major changes must be approved by the Project Manager (Mane and Patil, 2015&Neyestani, 2016).

The construction manager carefully ensures throughout the project that the product/service to be delivered will meet the requirements in the quality management plan (Oke, 2017). This often means that construction manager has to do/manage technical tasks such as testing code (Neyestani, 2016&Oke, 2017). Additionally, the construction manager makes sure that the policies and processes

(pertaining to quality) described in the QMP are respected (*ibid*). The construction manager prepares technical reports that are used by team members to enhance the project, as well as non-technical reports that are elevated to management describing the current status of the project from a quality perspective (Mane and Patil, 2015).

2.13 Chapter summary

Within this chapter, a detailed review of the relevant literature on quality within the construction industry in South Africa was discussed as well how construction managers perceive quality in construction. Quality is defined in many different ways depending on which stakeholder point of view. The construction managers perceive quality of a project as related to its fitness for purpose; conformance to specifications; meeting or exceeding customer expectations; value for money; and consistency and their goal ever quality is achieving these attributes. To obtain the mentioned attributes, the construction managers need to employ/implement the best beneficial and relative Quality Management System. Implementing a quality management system will result in a number of long-term commercial gains. To achieve a quality project, quality materials, labour, tools and equipment are essential.

CHAPTER 3: Research model

3.1. Introduction

This chapter discusses the model of this study. It discusses the factors affecting quality and construction managers' role on attaining quality while managing the factors affecting quality. Lastly, it discusses the goal of this study, which is assisting the construction managers with the construction of quality projects.

3.2 Background of the model

Quality of projects is among the traditional measures of project (Oke, Aigbavboa and Dlamini, 2017). The goal of all the construction stakeholders is to guarantee that the projects are delivered according to acceptable standards (Ali and Rahmat, 2010 & Oke, *at al.*, 2017). Ofori (2006) describes quality as *“the features and characteristics of production process that bear on its ability and capacity to satisfy the stated need or fitness”*. Clients are satisfied if the end product meets their expectations in terms of price, time frame, functionality and delivery performance standard (Oke, 2017). Whereas the construction managers look at this far beyond (*ibid*). The construction managers focus on the skills and knowledge employed to the construction of the project. They pay attention at the materials, labour, equipment, tools and methods to producing the end-product of quality (Preethi and Monisha, 2017). Specially, construction phase is where the project could impact by its operability, availability, reliability, and maintainability of a facility (*ibid*). The construction managers with the review of the architect, is able to reject work that is not conforming to regulations and specifications (Misra, 2019). This is why it is essential for any project to have the construction manager involved from the pre-construction phase to hand over.

Atkinson, Waterhouse and Wells (1997) disclose that project owners are only satisfies when the end product meets their price, quality and its functionality. In view of this, the construction managers must possess the skills and knowledge, or make the effort to design and manage construction processes, unless the client meets their required employment conditions (Takim and Akintoye, 2002). More so, the contractors and suppliers may then proceed with delivering quality products and resources to a project or to any organisation giving them an opportunity to earn a reasonable return on the investment of their time and capital (*ibid*). Accordingly, clients will be impressed if the final product meets their prerequisites regarding usefulness and nature of administration. Generally, successful stakeholders' performance has to be estimated and overseen to guarantee their persistent interest and co-activity in a construction project (Ali and Rahmat, 2010&Preethi and Monisha, 2017).

Production industries are challenged by factors affecting the performance and output of the endeavours known as quality defects and the construction industry is no exception (Lukumon, Babatunde, Kabir, Samuel, Iyabo and Rafiu, 2015).A project with *‘poor quality’* is also known as

having ‘*quality defects*’ Atkinson *et al.*, (1997). To guarantee client satisfaction of an overall project, it is essential to pin down all the potential factors that may have the possibility of affecting the quality of a project before it even commences (Oke, 2017). According to Preethi and Monisha (2017), these factors include lack of supervision, use of unskilled labour and subcontractors, inexperienced management and low-quality materials. Lack of skilled labour, failure of conforming with regulations and variation orders are no exception (Oke, *at al.*, 2017).

Figure 3.1 illustrates the conceptual model of the study. The factors affecting quality are regarded as the inputs since the aim is to identify them and eliminate in any possible way (Takim and Akintoye, 2002). The competent construction managers’ expertises are used to manage the quality of a project by eliminating all the threats to it. The main goal is the attainment of have a quality project at all times, which is regarded as the output of the model.

3.3 Development of the conceptual model



Figure 3.1: Conceptual model of the study

3.3.1 Factors affecting construction project quality

The potential factors that affect construction quality include:

i. Labour

Labour, either skilled or unskilled, is very essential in any activity of a project and it is a requirement in any project that such parties exist and are sufficient in a project (Makhene and Twala, 2009). Nevertheless, the skilled labourers are more valuable to the construction industry than the unskilled labourers. This is because skilled labourers possess a certain artisan skill and it is difficult to replace (Oke, *at al.*, 2017). Usually, the skilled workers are always brought by the company to any site they are working and the unskilled are usually hired in the local areas (*ibid*).

The skilled labourers require less supervision and they properly use company resources without wasting any raw materials (Lukumon, *at al.*, 2015). They have a higher production rate which results to company's decrease in production costs and increase in returns (Kwat, 2018). Therefore, the quality of a construction project depends on how skilled the labours are (Lukumon, *et al.*, 2015). Usually skilled labourers are those labourers with an idea of quality outcomes, specifications and can read and appraise the design drawings. To add, skilled labourers are well-organised when compared to unskilled labourers since they are trained for the job which makes them understand the job than the unskilled (Woudhysen and Abley, 2004). It is therefore a responsibility of a construction manager to ensure that these two parties are well utilised to deliver a project of high quality. This is achieved by having frequent meetings with the teams and coordinate the work in progress.

ii. Regulations

South Africa has a well-developed set of practical regulations which are utilised to define the standards of workmanship and materials for construction works (CIDB, 2011). The common ones are International Organisation for Standardisation (ISO) and South African National Standards (SANS) (*ibid*). The SANS and ISO standards representatives ensure that construction projects are of quality by reviewing quality management plan and inspecting the actual work whether or not it conforms with the quality standards (CIDB, 2011). It is possible to find some project stakeholders that are not abiding to regulations because of negligent or lack of knowledge. Construction managers know all the industry-related rules and regulations and are believed to be able to transfer the knowledge to all the stakeholders on site. It is their responsibility that all construction sites follow the regulation of safety as well as of quality.

iii. Equipment

The activities associated with construction projects where the extent of the work for an enormous scope, early and convenient finishing of work with quality control is essential (Charhate and Phadatare, 2016). To accomplish this, mechanisation of work must be done, where the construction equipment and machinery plays a huge role.

Suitable usage of equipment plays a pivotal role to speed, quality, economy, safety and appropriate accomplishment of the project (Charhate and Phadatare, 2016). The equipment used in the construction processes play a measure role within the construction industry. It is not generally desirable or feasible for the contractor to possess every single kind of construction equipment needed for the project (Woudhysen and Abley, 2004). Bearing in mind the different aspects of the utility of equipment/machinery, the contractor must economically legitimise whether to own the equipment or hire it. The sum put into the acquisition of equipment must be recuperated during the useful period of that equipment. Challenges faced on sites because of equipment may include insufficient and faulty equipment/machinery which affect the quality of a project. It is therefore a construction manager's responsibility to ensure that adequate equipment for every task is available on time.

iv. Design

The quality of drawings and specifications provided by the architects and engineers has a huge effect on the quality of the construction project (Lukumon, 2015). Improper or faulty plans negatively affect the quality performance of a project and the designers of such plans are liable for major construction failures (Stamatiadis, Sturgill, Goodrum, Shocklee and Wang, 2013). To avoid this, the construction managers perform the constructability reviews to all the project design drawings to identify the errors to the drawing before the planning phase commences (Stamatiadis, Sturgill and Amiridis, 2017). This helps detect errors in the quality of project designs, solve them and come up with the best construction methods possible before the actual construction begins (*ibid*). It is also a responsibility of a construction manager to ensure the availability of the latest revisions of all project drawings (Stamatiadis, et al., 2013).

v. Supervision

'Supervision is a combination of procedure, process and situations that are smartly designed to improve effectiveness of individuals and groups' (Adepoju, 1998). In any supervision there must be mutual agreement, admiration and personal trust between super intendants the individuals being supervised (Zulu and Chileshe, 2008). Therefore, there will always be heightened service delivery (*ibid*). The literature identifies supervision to be the measure concern in affecting quality of construction projects (Mahajan, 2016).

The tools used for supervision comprises of but not limited to details of a project, bills of quantities, project drawings and supervision manuals(Somba (2015). Reports are necessary to ensure the correct commutation channels within the project. Construction managers produce such reports and are also responsible for supervising the construction team ensuring a safe work environment from the beginning of a project to an end (Stamatiadis, et al., 2013). This ensures good working relationships between all the stakeholders on site which guarantees the quality of work produced.

vi. *Materials*

Quality is often seen as a subjective viewpoint of how well a given outcome will be. However, quality also plays into what types of materials are used for a project and how the budget transforms over the course of a project (Jaiyeoba and Folagbade, 2015). Construction managers should be aware of all the possible effects from poor quality materials (Nyide, 2018). If the construction manager settles for cheaper material, the overall budget may be reduced but the quality of a project may be jeopardised and be poor too (Charhate and Phadatare, 2016). Nonetheless, the lower cost might indicate lower quality, which would subvert the first objective of the project (*ibid*). It is vital to always utilise the materials specified on project specifications. It is therefore essential for a construction manager to perform stock control or tracking to ensure the availability of the right quality and quantities of material (Zulu and Chileshe, 2008). Defective material also affects the overall quality of a project. It is therefore essential that construction managers have correct effective ways of checking the standard of material to be used (Jaiyeoba and Folagbade, 2015).

vii. *Procurement method*

Despite the fact that procurement techniques should be custom fitted to upgrade the satisfaction of various task targets (Dubrovnik, 2009), clients will in general pick those obtainment systems they have a propensity for utilising, paying little mind to any contrasts between projects (Eriksson and Vennstrom, 2012). To upgrade change, an expanded comprehension of how extraordinary obtainment techniques influence various parts of activity execution in various sorts of projects is subsequently essential (Laedre, *et al*, 2006).

The higher the degree of coordinated effort between the client and contractors in joint specification equates to the better cooperation (Eriksson and Vennstrom, 2012). Also, the better the relationship among project team, the improved the better the time performance, economic performance, and improved quality performance (Laedre, et al, 2006). This is why the construction management approach is utilised, where the clients appoint an external organisation to oversee and perform co-ordination of design and construction phases (Gharehbaghi and McManus, 2003). A construction manager possesses responsibilities of accelerating the duration of a project, enhancing the entire construction, improve quality, incorporating adaptability and encouraging value competition (Steyn, 2013). This approach indicates clearly that different project stakeholders perceive construction quality

differently which brings the focus on construction managers perception. Quality control and assurances are therefore essential.

viii. Variations

Variations comprise of all adjustments of the original extent of a project as in the contract (Memon, Rahman and Hasan, 2014). These frequently originate clashes as well as frustrations the construction project team. Consequently, it is vital to control variation orders. Variations arise for many reasons of which some reasons are predictable. Variation orders are mostly caused for the reason that equipment is not available, design complexity and poor workmanship. Variations affect the quality of work adversely (Memon, Rahman and Hasan, 2014).Jaiyeoba and Folagbade (2015) stated that the quality of work is commonly influenced by regular varieties since contractors must make up for the losses by compromising. Construction managers and other projects stakeholders should try by all means to avoid any variations since it does not only affect the quality of a project but delays and reworks which escalate the project costs (Memon, Rahman and Hasan, 2014).

3.3.2 Construction managers' role on factors affecting quality.

A construction manager is a professional service that utilises specialised, management systems to manage all the phases of construction from the commencement to the completion (Lydia, 2010). The goal of this professional is to control a project's time, cost and quality, sometimes referred to as a project management triangle or triple constraints (*ibid*). In today's world, it has become much more common for construction managers to have a college degree, usually bachelor, honours and/or master's degree (Oke, 2017). These degrees range widely in the technical and scientific fields, including: construction management, building studies and engineering, surveying and civil engineering. According to the American Council for Construction Education (2009),“*the academic field of construction management incorporates an extensive variety of subjects. These vary from basic managing skills, skills related to construction to technical understanding of construction practices*”.

A competent construction manager must have an effective use of quality management systems in order to construct a quality project. He must create a quality management plan with all the policies before the project commencement. During the construction phase, he must perform quality inspections for quality assurance purposes and do quality control within the project timescale (Jaiyeoba and Folagbade, 2015).

3.3.3 Quality project

Construction managers plan, organise, direct, control and evaluate the tasks of a contractor following the directions of the project manager (Saif, 2018). They are equipped with education, knowledge, skill set, technology and an attitude of analytical thinking which helps them to take a holistic approach towards the construction project (Oke,*et al.*, 2017). Proper utilisation of construction managers'

expertise produces a project of high quality within an expected timescale and given budget. Construction managers supervise application of a quality management plan for a project. The main idea, again, is to deliver a project to the specifications of the customer or stakeholder. When meeting client expectations is set as the basis of the project, it makes ready to surpass these expectations and cause clients to become impressed promoters of the organisation and its administration (Jaiyeoba and Folagbade, 2015). It is essential to understand the clients' requirements from the word go as this assists construction managers to work hand in hand with clients in order to build up requirements at a best possible level (*ibid*).

Having identified the factors affecting project quality and discussed the expertise of a competent construction manager to overcome such, the aim is to construct quality projects at all times. The output will be a quality project which will be fit for its purpose, conform to all related regulations during and after the construction phase and specifications, meet or exceed client satisfaction and surely the workforce will have gained more experience once the project is completed (Nyide, 2018).

3.4 Chapter summary

This chapter discussed the model of the study. It discussed the factors affecting quality, construction managers' role on the factors affecting quality of construction projects and the goal of this study, which is assisting the construction managers with the construction of quality projects.

CHAPTER 4 – RESEARCH METHODOLOGY

4.1 Introduction

This chapter discusses the theoretical background of research methodology and analyses the relevant research approaches used in the study. The explanation of selected methodological approach is provided in detail as well as the techniques adopted for data collection and data analysis. The validity and reliability of the study are described as well as the ethical issues considered during the research. The mixed method design utilised is also explained. A purposive sampling was utilised for qualitative research and a stratified sampling was utilised for quantitative research.

4.2 Research Paradigms

A paradigm is a shared world view representing the principles and standards in a discipline and ways of solving the problems are suggested (Schwandt, 2001). Patton (2002:26) described a paradigm as “*a way of describing the views of the world that are knowledgeable by logical assumptions concerning value systems, nature of social reality, ethics and ways of knowing*”. A paradigm may also be described as a notion that conducts the way activities are being done and defines approaches to practices (Kivunja and Kuyini, 2017). A paradigm arrangement comprises of an epistemology, philosophy, ontology with a methodology (Aliyu, Singhry, Adamu and Abubakar, 2015). An epistemology is considered to be an analysis of the nature of a body of knowledge together with its explanation of knowledge (Carter, 2007). Epistemology has influence on research purely on a theoretical way and is associated with the various theories of knowledge (*ibid*). Ontology is a theory discipline that denotes the nature of what is present and real (Aliyu, *et al*, 2015:6). The benefits of using ontologies are: augmented communication, the ability of using knowledge several times, the knowledge conservation, the ability to change and adjust, and enhanced accessibility to information (Aliyu, *et al*, 2015). There are various paradigms, such as positivism, post-positivism, critical theory, constructivism etc. (Mittwede, 2012). For mixed methods research, a pragmatic paradigm is used. The pragmatic paradigm is convenient for guiding research design, particularly when different methods are philosophically inconsistent.

For this study, the researcher used pragmatic paradigm because he wanted to recognise the reality of the subject matter at hand, therefore the researcher desired to be also subjective with the study he undertook. Further, the pragmatic paradigm was chosen for this study for the following reasons:

- The pragmatic paradigm ensures that the theory can be generalised to a larger degree;
- Future predictions can be made;
- Qualitative and quantitative data paves a way for further scientific research;

- Reliability is ensured as it preserves reliability, dependence as well as replicability in the data collection;
- The accuracy of the parsimony is useful when studying a large number of people and therefore saves time;
- It is free from personal prejudices.

4.2.1 Pragmatic paradigm

The pragmatic paradigm indicates a perspective that centres around “what works” as opposed to what may be considered totally and dispassionately ‘valid’ or ‘genuine’ (Creswell, 2013). Early pragmatists dismissed the possibility that social inquiry utilising a solitary scientific method could access to certainties with respect to present reality (Creswell and Clark 2011). These pragmatists believed that certainty could be judged by its consequences (*ibid*). The term paradigm was introduced by Kuhn in 1970, it was utilised to examine the shared speculations, beliefs and values of a community experts with respect to the nature of reality and knowledge. Lastly, pragmatism is understood as the paradigm that intends to overcome any issues among the scientific process and structuralist direction of more established methods and the realistic approaches and freewheeling orientation of newer approaches (Creswell, 2013 & Creswell and Clark, 2011).

4.3 Research approaches

Research is an intensive and methodical investigation, which is more advanced than existing knowledge to obtain specific and exhaustive information, giving a foundation for enquiry and descriptive statement on the topic in question (Thwala, 2015). The procedure of research includes methodical process of data collection, data analysis, and interpretation of data as a result of enquiring better understanding of the problem in question (Thomas, 2010).

There are three key kinds of research methods, namely: qualitative, quantitative and mixed methods (Creswell, 2013) and the difference between these methods is the way that data is collected and analysed.

4.3.1 Qualitative research

Qualitative research pursues the given research problem or topic from the viewpoint of the research participants (Yilmaz, 2013). According to Tracy (2013:20), “*qualitative research is tied in with drenching oneself in a scene and attempting to figure it out, whether during a company meeting, network celebration, or during an interview and it includes deliberately analysing and noting of little signals to conclude how to carry on, just as to sort out the unique circumstance and construct bigger information claims about the way of*”.

Qualitative research is utilised to find insights of fundamental motives, sentiments, and inspirations (Patton & Cochran, 2004). It offers perceptions related to the problem or supports in developing ideas for prospective quantitative data (*ibid*).

The main advantages of qualitative methods include:

- Meaningful and socially notable to the participant;
- Unexpected by the researcher;
- Holistic and descriptive in nature;
- Allows the researcher the adaptability to test initial responses of the participant, that is inquire as to ‘why’ or ‘how’; and
- Concentrates on lived insight, set in its specific context(Mack, Woodsong, MacQueen, Guest and Namey, 2005; Tracy, 2013).

4.3.2 Quantitative Research

Quantitative research is utilised to assess the problem by generating numerical data or information that is transformed into applied statistics(Kothari, 2004). Korrapati (2016)added that it is utilised to enumerate views, behaviour, and other diverse factors and streamline outcomes from a prominent sample. Quantitative research is tested with methods of statistics to decide whether the projecting simplifications of the philosophy grasp accuracy (Creswell, 2013). A key stability of the quantitative approach is found in its common recognition through others as being coherent, consistent, strategic and methodical (Pierce, 2008). Fox and Bayat (2007) argued that the best generally used quantitative research methods are investigational technique, observation methods and survey study. The benefit of quantitative research is that the key stability of this study is connected to its toughness and rigorous systematic nature (Pierce, 2008).

4.3.3 Mixed Methods Research

The mixed method approach is described as a method of data collection, data analysis and collaboration of both qualitative and quantitative information within one distinct research study to know a research problem comprehensively (Korrapati, 2016). Using this method, a researcher is able to collect both numeric and text information to give solutions to the research study problem (Creswell, 2008). The combination use of quantitative and qualitative research gives a comprehensive solution to a research problem than using either one research approach(*ibid*). Nevertheless, the drawbacks are that, it requires a lot of energy to collect and analyse two comprehensive and sometimes unconnected collections of information at one time. A core benefit of mixed methods research is that it allows the researchers to create and confirm theory in one study at the same time. Furthermore, mixed methods research gives resilient conclusions (Creswell and Clark, 2007). The researcher used a mixed method known as concurrent triangulation design to collect data by distributing the questionnaires while

conducting interviews concurrently. In a concurrent triangulation design the qualitative and quantitative data are gathered simultaneously in one stage (Creswell and Clark, 2007). The data is analysed independently afterward compared and/or combined. This strategy is utilised to affirm, cross-validate or substantiate findings. It is frequently used to overcome a shortcoming in one strategy with the qualities of another. It can also be valuable in expanding quantitative information through assortment of open-ended qualitative data (Bergman, 2008).

4.4 Research method adopted

The concurrent triangulation design mixed method approach was used as shown in figure 4.1.

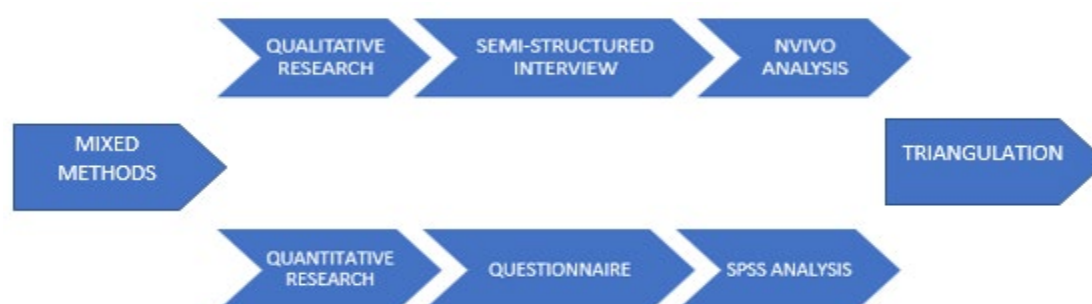


Figure 4.1: Concurrent triangulation design mixed approach (Creswell, 2013).

The purpose of concurrent triangulation design mixed method was to gather several but corresponding information relevant to the same subject to best understand the research problem (Creswell, 2008). The intent in utilising this strategy was to unite the different strengths of the quantitative methods (large sample size, trends and generalisation) with those of qualitative methods (*ibid*). Both qualitative and quantitative data were collected concurrently and analysed unconnectedly but the results were combined to derive the conclusions of the study. The researcher used semi-structured interviews to gather qualitative data and questionnaires for quantitative data collection.

4.5. Data collection method

4.5.1 Semi-Structured Interviews (Qualitative data collection)

A semi-structured interview utilises a guide with all the questions and topics that are to be covered during the discussion between the interviewer and the participant (Harrell and Bradley, 2009). The interviewer has some watchfulness concerning the request wherein questions are asked, yet the questions are standardised and tests are given to guarantee that the researcher covers the correct material (*ibid*).

“Researchers can use interviews for a variety of purposes” (Harrell and Bradley, 2009: 24). Interviews resemble everyday conversations or discussions even though they are focused on the researchers need for data. Interviews should aim to be reproducible, systematic, credible and transparent (Patton and Cochran, 2004). Ruben and Ruben (2005:7) express that “qualitative

interviews resemble night goggles, allowing researchers to see what is not usually visible and inspect what is taken a gander at yet seldom seen". Moreover, such interviews have a possibility to produce the highest response rate (Creswell, 2013).

Semi-structured interviews were held with fifteen construction managers to find their perspective on construction quality and quality management systems utilised. The participants were knowledgeable about the nature and the purpose of the study. The information collected from the participants using semi-structured interviews was transcribed and later analysed.

4.5.2 Questionnaires (Quantitative data collection)

The other process of data collection was questionnaires as it enabled the researchers to investigate a large number of participants (Walliman, 2011). The questionnaire was formulated based on the literature review and objectives of the study (*ibid*). The benefits of using incorporate that they are moderately simple to dissect and participants have the opportunity to consider their answers; they are not normally needed to reply (Singh, 2006). Even though questionnaires are mostly common, it is inappropriate for researchers to investigate long and complex matters since it is just a series of closed questions (Walliman, 2011).

Questionnaires were sent to 272 construction managers around South Africa. The questionnaires were filled during the participants' free time which took no more than fifteen minutes to complete via Google Forms and the researcher received email notifications whenever there was a response completed. By using questionnaires, the researcher aimed to get several insights of construction managers and their understanding regarding construction quality and how it is managed (Singh, 2006).

Likert scale

According to Joshi, Kale, Chandel and Pal (2015), a Likert scale was conceived to quantify attitude in a deductively acknowledged and approved way. An attitude can be characterised as particular methods of behaving/reacting in a particular situation rooted in relatively enduring organisation of belief and thoughts (around an item, subject or an idea) obtained through social interactions (*ibid*). Participants were requested to display the level of agreement (from strongly disagree to strongly agree) with the given assertion (items) on a metric scale. Here all the statements in combination reveal the specific dimension of the attitudes towards the issue, henceforth necessarily linked with one another (Sing, 2006). There are two diversities that the Likert scale depends on, namely, asymmetric and symmetric scale. An asymmetric scale is where there are more choices on one side of neutrality than the other and a symmetric scale is where there are equal choices on either side of neutrality (Tsang, 2012). The 5-point scale is more engaging to the minds of the participants (Joshi, *et al*, 2015).

The researcher used an asymmetric 5-point Likert scale. The first scale of the questionnaire varies from ‘*strongly disagree*’ to ‘*strongly agree*’. Most choices agree with the statements more than disagree. For example, the responses were ‘*strongly disagree, disagree, neutral, agree, strongly agree*’. The second scale ranges from never to always. The responses were ‘*never satisfied, satisfied, moderate, satisfied, and always satisfied*’.

4.6 Population and Sampling

Tryfos (1996:19) describes sampling as the “*demonstration, process, or procedure of choosing a delegate part of a population to determine the boundaries and qualities of the entire population*”. Though quantitative researches progress towards random sampling, qualitative studies regularly utilise purposive or measure-base sampling, which is sample that has the qualities applicable to the research questions (Nastasi, 2004).

Population is the object study made up of individuals, associations, groups, human items and occasions or the issues to which they are exposed (Welman, Kruger and Mitchelle, 2009). At that point, a sample is a small percentage of the population, or a sub-part of a large part. Sampling, however differentiates among probability and non-probability sampling. Probability samples have the capacity to choose a component probability contained within the sample or not included. Despite what might be expected, non-probability samples cannot decide on a component probability to be involved in a sample (Etikan, Musa and Alkassim, 2016).

4.6.1 Sampling frame

“*Sampling frame is defined as a population from which a statistical sample is taken*” (Encarta Dictionaries, 2007). In this study, the chosen respondents came to be the construction managers in South Africa.

Construction managers were targeted for the study because they are engaged in different construction project phases varying from planning, design, and construction (Misra, 2017). These professionals are regularly responsible for creating safety and quality policies, as well as programmes on site and work closely with the main contractor and subsequently, their roles in quality management are clearly expressed (*ibid*).

Construction managers represent the project owners and contractors to manage the construction team to ensure the construction of quality projects (Lydia, 2010). They are known as the closets party to any construction stakeholder (*ibid*). Their major responsibility is to guarantee a safe working site and quality project using arrangements of right equipment and machinery, execution of suitable construction systems and measures, and management of proper plant and equipment operation (Misra, 2017). In addition, better well-being results occur if construction managers promote positive safety

behaviour on site including the provision of appropriate personal protective equipment (PPE) and regular safety signals to workers (Lydia, 2010).

4.6.2 Probability Sampling

Probability sampling is a sampling process that uses some type of random selection (Teddle and Yu, 2007). In probability sampling, any unit has a possibility of chosen to be in a sample. These samples are normally chosen with the support of random numbers (Blair, 2009). There are several types of probability sampling such as stratified random samples, cluster samples, simple random samples, and systematic samples (Teddle and Yu, 2007 & Welman *et al.*, 2009).

4.6.2.1 Probability sampling used

The researcher used a stratified sampling. Stratified sampling is a kind of sampling strategy wherein the total populace is divided into lesser clusters or strata to carry out a sampling process (Creswell, 2008). The strata were framed dependent on some regular attributes in the population data which include different number of construction managers from each province around South Africa (Nastasi, 2004). Subsequent to partitioning the population into strata, the researcher randomly selected the sample relatively (*ibid*). The researcher then used random sampling equation from the total of 850 construction managers from SACPCMP (Le Roux, 2012).

Equation 4.1: Random sampling formula (Frerichs, 2008)

$$n = \frac{N}{1 + N(e)^2}$$

$$n = \frac{850}{1 + 850(0.05)^2}$$

$$n = 272$$

Where: n = sample size, N = population size and e = level of precision.

For the quantitative data, from the estimated population of 2020 construction managers from the South African Council for the Project and Construction Management Professions (SACPCMP), with a $\pm 5\%$ Precision Level ($e = \pm 5\%$), the Confidence Level is 95%, the calculated sample size for this study is approximately **272**.

4.6.3 Non-probability sampling

Le Roux (2012:14) defined non-probability sampling as “a process where likelihoods are unable to be allotted to the units accurately, and henceforth it turns out to be difficult to come up with the dependability of the sample according to probability”. Non-probability cannot claim that a sample is representative (King, 2011). Non-probability sampling is suitable for exploratory research envisioned

to create new ideas that will be thoroughly tested later (Welman,*et al.*, 2009). Amongst other things, non-probability sample includes purposive sampling and convenience sampling.

4.6.3.1 Purposive sampling

In purposive sampling, the researcher chooses what ought to be known and get ready to discover participants that willing to be part of the study and provide the data by quality of experience and knowledge of the relevant study(Bernard 2002). Significant information providers are attentive and reflective members of the community of interest who better understand the issue in question and are both able and willing to share their knowledge (*ibid*). Preparation is needed in that one must the backgrounds before one samples the population in order to discover knowledgeable and reliable participants most proficiently (Snedecor 1939). This is the sampling method utilised for the qualitative research of this study.

4.6.4 Sampling method and sample size selected

4.6.4.1 Qualitative data

The sampling techniques that was used for qualitative data is purposive sampling. Researchers choose this technique because it allows them to select the individuals who possess good knowledge on the subject to be discussed (Tongco, 2007). Construction managers have different number of years of experience especially being that some of them have been in the field for more years as compared to others. The selection of these participants was random. Construction managers were selected from every firm, either working for consultant, contractor or an academic, making the total sample size to be **20**. Due to Covid-19 restrictions, there were 15 participants, indicating a 75% response rate for interviews. During sampling, no consideration was given demographic or individual qualities. The chosen group was the fundamental focal point of the study since it was through them that legitimate data for research was acquired.

4.6.4.2 Quantitative data

For quantitative data, a total of 272 participants were chosen from SACPCMP, using a stratified sampling, as shown in table 4.1. The process of data collection took approximately two months starting in the beginning of August 2020 to October 2020. The questionnaire was uploaded on Google Forms and links were forwarded to the participants via emails for the members to answer. The respondents were to complete the questionnaires at their own time for them to respond to the questions appropriately.

An overall number of 119 responses which were all usable (44%), were gotten specifically from members of the SACPCMP. Central Limit theorem supported the response rate and will be further discussed in chapter 5. In a case where there is a low response rate, the responses may be accepted if a

few criterions are being met. A survey response rate of 40% or higher should be considered excellent in most circumstances (Keeter, Courtney, Michael, Jonathan, and Peyton, 2006). A high response rate is likely driven by high levels of motivation to complete the survey, availability of participants or a strong personal relationship(*ibid*). Saunders, Chang, Jiang, and Sivo (2006) alluded that response rates vary depending on methodology, but if emails are used to circulating the surveys, the expected rate must be at least 35%. In this case, the major reason for having a low response was because of Covid-19 restrictions. The researcher was not able to track the participants since they could not respond on their emails after receiving the link to fill-up the questionnaire forms.

Table 4.2: Issued questionnaires vs responses

Provinces	Each province (SACPCMP)	Sample size (n)	Responses
Eastern Cape	82	18	7
Free State	39	20	14
Gauteng	372	70	18
KwaZulu-Natal	121	54	47
Limpopo	25	20	4
Mpumalanga	25	20	5
Northern Cape	11	5	4
North West	11	5	3
Western Cape	164	60	17
Total	850	272	119

4.6.5 Accessible issues

Accessibility to research information is a significant factor in research. In the event that the researcher will not be able to access both primary and secondary data on the research topic, the research findings will be obscure (Gibbs, 2007). For this study, a large portion of the primary data was obtained from construction managers through interviews and questionnaire surveys. Then again, secondary data was collected from books, journals, periodicals and some other applicable electronic sources were utilised to accomplish the objectives of the study.

The researcher found it hard to reach out to the participants since direct meetings were not allowed due to the rules of Covid-19. This resulted to having less participants than the calculated sample size. The researcher ended up receiving 119 responses out of 272 that were sent. To adhere to the pandemic rules, the researcher sent the questionnaires via emails requesting the participants to fill in the forms through Google forms. The researcher was notified via the email whenever there was a response received.

4.7 Data Analysis

The data analysis process comprises of the understanding written data and illustration (Gibbs, 2007). It entails organising the information with an objective of analysing it and then examining the

information expansively (*ibid*). Interpreting the data gathered will assist the researcher to decipher its message (Irwin, 2008). The reason to analyse data is to acquire practical and useful information. The analysis, regardless of whether the data is qualitative or quantitative, may portray and sum up the information, recognise relationships between variables, compare variables, distinguish the difference between variables and forecast outcomes (Kelly, 2016). Data analysis is defined by Gibbs (2007:9) as ‘*a transformation of collected information from a qualitative arrangement into an understandable and clear set of facts and figures in a manner of an analytical method*’.

The data collected from the semi-structured interviews on construction managers was analysed and interpreted using Nvivo data analysis. The data obtained from the questionnaires from the construction managers was then captured and analysed using the SPSS (v27). The results were then analysed and interpreted by the researcher.

4.7.1 Nvivo data analysis (Qualitative data)

Qualitative data analysis is known as “*the range of processes and procedures whereby there is a shift from the qualitative information that was gathered, into some form of explanation, comprehension or interpretation of people and circumstances that are researched*” (Sunday, 2015:125). It begins with a complete data in the form of text (Kelly, 2016). Qualitative data analysis draws out patterns from ideas and perceptions (Sunday, 2015). The qualitative data was analysed using NVivo software (version 12). QSR International states that “*NVivo provides the researchers a place to organise, store and retrieve their data so they can work more efficiently, save time and rigorously back up findings with evidence. Import data from virtually any source including text, audio, video, emails, images, spreadsheets, online surveys, social and web content and more*”.

The principles of qualitative data analysis are:

- Individuals differ in their knowledge and understanding of reality;
- A social phenomenon cannot be known outside its framework;
- Qualitative research can be utilised to describe phenomenon or produce theory grounded on data; and
- Understanding human behaviour arises gradually and non-linearly(Sunday (2015).

The qualitative data was analysed using NVivo data analysis. NVivo is a qualitative data analysis (QDA) computer software package produced by QSR International (Hilal, 2013). It minimally arranges and defines the data set in a manner it should be, which is to group responses together using key words, common understanding (Wong, 2008 and Zamawe, 2015). Nvivo is mostly used as a method where comprehensive level meanings were fixed, thus establishing an in-depth account of a certain subject (Anderson, 2007).

NVivo forms an important part of qualitative data analysis as it boosts the accuracy and speed of the analysis process (Zamawe, 2015). “*The software indeed decreases a great number of manual tasks and gives the researcher more time to discover tendencies, recognise themes and derive conclusions*” (Hilal, 2013:182). It contains an advantage of managing data and ideas, querying data, modelling visually and reporting (Hilal, 2013).

The responses from the semi-structured interviews were collected and interpreted by the researcher. The Nvivo data analysis was approached in an inductive way where coding and theme development was directed by the content of the data. The themes were established from the content of the information attained from interviews and subsequently assembled into related themes.

4.7.2 SPSS (Quantitative data analysis)

Statistical Package for the Social Sciences (SPSS) is a software tool used to capture quantitative data (Green and Salkind, 2016). SPSS is capable of handling large amounts of data and can perform a range of analysis (*ibid*). It serves as a reasonable prologue to new users and furthermore permits those wishing to embrace further developed analysis to work their way methodically through each stage (Coakes and Steed, 2009). The SPSS software is mostly used for capturing statistical information, so that numeric data can be analysed and interpreted to be correctly concluded (Nxumalo, 2017).

This researcher sent out questionnaires to 272 participants to collect quantitative data, more specifically, the construction managers from around South Africa. The information was gathered through the questionnaires given to the participants. The responses were then recorded on the SPSS software (version 27) and the data was analysed. Using the various data, the researcher then analysed the information by commenting on what was presented by the results. The understanding of this information was accompanied by the review of literature in chapter five. The results of the analysed data were represented with the utilisation of factor analysis, the correlation matrix, the Bartlett’s test of sphericity and the Kaiser-Meyer-Olkin (KMO), Cronbach’s alpha (α), and descriptive statistics. New variables were computed after dimension reduction in factor analysis.

However, to make predictions about the population utilising the research data the researcher had to go an extra mile and utilise inferential statistics. Inferential statistics scrutinise the changes and relationships between two or more population samples (Coakes and Steed, 2009). These are more complex analyses and allows for noteworthy changes between variables and the sample group of the population (*ibid*). With inferential statistics, the research is able to generalise the results to the population as a whole. The following is a list of commonly used descriptive statistics:

- Correlation – seeks to describe the nature of a relationship between two variables, such as for example, strong, weak, negative, positive or statistically significant. The correlation indicates a relationship or pattern however it does not imply or indicate causation.

- Analysis of variance – tries to determine if two means of two sampled groups is statistically significant or not due to random chance however it does not speculate why (Muhamad, 2017).

Data for this study was collected from the questionnaires and were analysed using Statistical Package for Social Sciences (SPSS) software version 27.0.

4.8 Ethical considerations

Ethical considerations in research are critical. “*Ethics are the norms or standards for conduct that distinguish between right and wrong*” (Resnik, 2015:12). They assist in the determination of the difference between acceptable and unacceptable behaviours (Gildenhuis, 2004). Ethical standards prevent researchers of being in contradiction of producing false data and therefore, encourage the pursuit of knowledge and truth which is the main goal of research (*ibid*). Ethical behaviour is also critical for collaborative work since it inspires an atmosphere of trust, accountability, and mutual respect among researchers (Quadri, 2013). Examples of ethical consideration is inclusive of voluntary participation and informed consent (UKZN, 2014). These ethics are followed to ensure that participants are deciding to partake willingly and that they were informed with respect to the procedures of the research study and potential dangers (Stevens, 2013). Stevens (2013) added that ethical standards additionally ensure the confidentiality and anonymity of the participants are protected. The researcher applied for ethical approval from the University of KwaZulu-Natal research office. For this study, (Stevens, 2013). The researcher also endeavoured to ensure that:

- The researcher obtained an ethical clearance from the University of KwaZulu-Natal research office – Ethical clearance no. HSS/0485/019M;
- The gatekeeper letters were obtained before commencing data collection and the informed consent letter were designed and signed by the participants before their participation in the study;
- The researcher guaranteed that research participants’ rights were protected from unnecessary interruption, distress, indignity, or psychological or other harm
- The researcher ensured the confidentiality and anonymity of the participants when they participated;
- The researcher did not impose any undue influence to the participants, so that the participants will feel comfortable in their participation.;
- Participants were given a chance to reconsider their participation if they felt uncomfortable. The participants were kept up to date regarding their participation in the study about the intentions and contents of the interviews as well as the questionnaires through consent forms; and

- The participation was voluntarily and there was no award given to the participants for their participation (Resnik, 2015 & UKZN, 2014).

4.9 Validity and Reliability

“For the assessments to be comprehensive, it must not be bias and distorting. Reliability and validity are two significant concepts when defining and measuring bias and distortions” (Vegada, Karelia, and Pillai, 2014:6). Careful attention needs to be placed on these two aspects as they can make the difference between good and poor research and can also help to assure that fellow researcher accepts findings as sound and dependable (Brink, 1993).

4.9.1 Reliability

Reliability denotes the uniformity of valuations, whereas validity refers to how well valuation measures what it ought to (Duckworth, 2013). Consequently, concerning the understanding of human beings, reliability must be able to reason and manage information and opinions to motivate interpretation of the reader (Walliman, 2011). Walliman (2011:20) explained reliability as *“when the researcher is able to rely on his/her senses and reasoning to produce facts that reliably interpret reality”*. Reliability is the point to which a certain piece of obtained data will be found on several cases over time (Winter, 2000). Kirk and Miller (1986) identified three types of reliability discussed in quantitative research, which relate to:

1. The stability of a measurement over time;
2. The similarity of measurements within a given time period; and
3. The degree to which a measurement, given repeatedly, remains the same.

Kimberlin and Winetrstein (2008) clarified that it is the researcher who must work out if their data interpretations are reliable. Therefore, the researcher ensured the reliability of the quantitative data collected by evaluating or checking the Cronbach’s Alpha on SPSS software if it is at least 0.7 (Tavakol and Dennick, 2011) and checked consistency on the information gathered through the interviews.

4.9.2 Validity

Henrichsen, Smith and Baker (1997) defined validity as *“an indication of how sound the research is. It determines whether the research truly measures its objectives”*. This determines whether the means of measurement are accurate and whether they are actually measuring what they are intended to measure (Golafshani, 2003). Therefore, to enhance validity for this study, the researcher employed a strategy known as triangulation through the convergence of data collected from interviews and questionnaires. The researcher also ensured the validity of the study by selecting the registered construction managers and asking a series of questions based on the study objectives in both questionnaires and semi-structured interviews (Leung, 2015).

4.10 Chapter Summary

This chapter elucidated on the research methods utilised to conduct this research study. The chosen methodology was mixed methods, which is a combination of qualitative and quantitative research. Semi-structured interviews were used for qualitative data and questionnaires were used for quantitative data. NVivo (v12) data analysis programme was used to analyse and interpret the qualitative data and the SPSS version 27 software was used for the analysis and interpretation of the quantitative data. The sample and methods of data collection were considered and adopted methods were classified. The familiar qualitative and quantitative research approaches were discussed. The collected data will be analysed in chapter 5.

CHAPTER 5: DATA ANALYSIS

5.1 Introduction

This chapter represents the captured data from the qualitative and quantitative research. The data is then analysed, described and interpreted in a systematic manner as the next step of the research process. The documentation and analysis process aimed to present data in an intelligible form in order to identify trends and relations in accordance with the research objectives. In addition, this chapter analyses and graphically represents the outcomes obtained from the construction managers' questionnaire survey after all the numeric data was analysed using SPSS (v27). The research results are firstly presented as an analysis of the quantitative data obtained from the survey questionnaire. The analysis of the qualitative data was recorded using individual semi-structured interviews and analysed using NVivo analysis (v12). The chapter concludes by triangulating the results.

5.2 Quantitative data

5.2.1 Questionnaire Response Rate

The participants were the construction managers registered under the SACPCMP, either as Professional Construction Manager (Pr.CM) or Candidate Construction Manager (CCM). They were from all the nine provinces of South Africa. Since the country was still under Covid-19 restrictions which made it impossible for the researcher to travel around, the researcher used SACPCMP website to find the details of participants and Linked-in website to obtain email addresses of the participants and circulated the questionnaire links to 272 construction managers and received 119 responses which equates to 44% response rate. The questionnaires were filled electronically which took less than fifteen minutes to complete. With the use of questionnaires, the researcher attained some perceptions of construction managers regarding quality and the quality-related responsibilities of CMs within the project.

The questionnaire was categorised into 8 sections: Section A: demographics of participants, section B: general understanding of quality, section C: construction managers (CM)' perspective of quality, section D: quality management systems (QMS), section E: factors affecting quality, section F: attributes of a construction manager, section G: benefits of employing a CM in a project, and section H: rating of a past project in terms of quality with 2 sub-parts, i.e. during (a) construction phase and (b) handover phase.

5.2.2 Background information of the participants

The total of 119 participants consisted of 80 males (67%) and 39 females (33%), as shown in table 5.1. A cumulative quantity of females joining the construction industry, this traditionally male-dominated environment, which is not surprising, even though the numbers are still minimal when compared with men (Agherdien and Smallwood, 2008). Forty two percent (42%) of the participants were Africans, followed by Indians with 24%, Coloureds with 18% and Whites with 16%. The age range of the participants was from 25 years to 65 years. The official retirement age in South Africa is sixty (60) years but one of the participants was above. The Labour Relations Act states that *“employees who wish to retire at 65 years would be able to do so, regardless of their age at the time of making the election”*. Section 187 (2)(b) of the Labour Relations Act states that an employee can proceed working after the age of sixty only if an agreement was reached with the employer, which is known as normal retirement age.

Table 5.1: Demographics of the participants

		Frequency	Percent
Gender	Male	80	67%
	Female	39	33%
	Total	119	100%
Race	African	50	42%
	Coloured	21	18%
	Indian	28	24%
	White	20	16%
	Total	119	100%
Age	25 - 29	59	50%
	30 - 34	26	22%
	35 - 39	14	11%
	40 - 44	12	10%
	45 - 49	5	4%
	50 - 65	3	3%
	Total	119	100%
Province	Eastern Cape	7	6%
	Free State	14	12%
	Gauteng	16	13%
	KwaZulu-Natal	47	40%
	Limpopo	4	3%
	Mpumalanga	4	3%
	Northern Cape	4	3%
	North West	6	5%
	Western Cape	17	15%
	Total	119	100%

Most (40%) of the participants were from KwaZulu-Natal (KZN), followed by Western Cape with 15%, Gauteng with 13%, Free State with 12%, Eastern Cape (6%), North West (5%) and minority from Limpopo (3%), Mpumalanga (3%) and Northern Cape (3%).

Table 5.2 illustrates the qualification one must have obtained to be considered as a construction manager. The majority (38%) of the participants had a qualification of an Honours degree, followed by a diploma with 25%, Masters degree with 14% and lastly, PHD with 7%.

Table 5.2: Educational information of participants

		Frequency	Percent
Qualifications	Diploma	30	25%
	BSc	19	16%
	Honours	45	38%
	Masters	17	14%
	PHD	8	7%
	Total	119	100%

Table 5.3 shows the percentages of where the participants are employed. Most (43%) participants work for contractors, it decreases consecutively thereafter, which is 34% for consulting firms and 23% who are academics. It goes on to show the years of experience of the participants within the construction industry. Majority (60%) of participants have experience between 1 and 5 years, it decreases rapidly thereafter, i.e. 20% for between 6 and 10 years., 11% for between 11 and 15 years, 5% for between 16 and 20 years, and 4% for between 21 and 26 years.

Table 5.3: Employment background of participants

		Frequency	Percent
Employer	Contractor	51	43%
	Consultant	40	34%
	Academic	28	23%
	Total	119	100%
Experience (years)	1 - 5	71	60%
	6 - 10	24	20%
	11 - 15	13	11%
	16 - 20	6	5%
	21 - 26	5	4%
	Total	119	100%

5.2.3 Data analysis of questionnaire sections

a) Reliability and Consistency

Reliability between items is tested using Cronbach's alpha (α) (Tavakol and Dennick, 2011). Technically speaking, Cronbach's alpha is a coefficient of reliability not basically a statistical test. The acceptable standard for reliability when using Cronbach's Alpha should be at least 0.700. Basically, a score of more than 0.7 is usually acceptable. Nevertheless, some authors suggest higher values of 0.90 to 0.95 (Salkind, 2015). There is higher Cronbach's alpha if the data is normally distributed than if it is either positively or negatively skewed.

Cronbach's alpha can be represented as a function of the number of test items and the average intercorrelation among items (Tavakol and Dennick). For conceptual purposes, the formula for Cronbach's alpha is shown in equation 5.1.

Equation 5.1: Cronbach's alpha (Tavakol and Dennick, 2011).

$$\alpha = \frac{N \cdot \bar{c}}{\bar{v} + (N - 1) \cdot \bar{c}}$$

In the formula N is equal to the number of items, $\bar{c}$ is the average inter-item covariance among the items and $\bar{v}$ equals the average variance.

One can see from this formula that if the number of items increase, Cronbach's alpha increase. Additionally, if the average inter-item correlation is low, alpha will be low (Tavakol and Dennick, 2011). As the average inter-item correlation increases, Cronbach's alpha increases as well (holding the number of items constant).

A high level for alpha may imply that the items in the test are exceptionally related (Field, 2013). Nonetheless, alpha is likewise sensitive to the quantity of items in a test. A bigger number of items can result in a larger α and the smaller number of items may result to smaller α . If alpha is high, this may be caused by having questions asking the same thing. On the other hand, having a smaller alpha may be caused by not having enough questions on the test. Adding more relevant items to the test can expand alpha. Poor interrelatedness between the test questions can also cause low alpha scores (Field, 2006). This can bring about erroneously tests or wrongly labelled as untrustworthy (*ibid*). Takavol and Dennick (2006) proposed that improving your insight about internal consistency and unidimensional will lead to the correct utilisation of Cronbach's alpha.

b) Corrected item total correlation

The item-total correlation test ascends from the psychometrics in the contexts where a quantity of tests or questions are given to an individual and where the problem is to construct a useful single quantity for each individual that can be utilised in comparing that individual with others in a certain population (Field, 2013). In a reliable scale, all items should correlate with the total. If the values are less than the cut-off value 0.3 (BrckaLorenz, Chiang and Nelson Laird, 2013 & Field, 2013), it means that a particular element does not correlate very well with the average scale, and it may have to be dropped. If it is 0.3 and more, there is a very good correlation between items (Field, 2013). The mean inter-item correlation for a set of items is said to be preferably between 0.20 and 0.40, signifying that while the items are rationally standardised, they do comprehend unique variance so as to not be similar in form and relations with each other (Piedmont, 2014). Items with low correlation will have to be dropped because that means those items do not correlate very well with the overall scale (Field, 2006). However, in bigger samples, items with lower correlation may be accepted (Field, 2013).

4.2.3.1 Section B: General understanding of quality (GU)

4.2.3.1.1 Questions and results

Table 5.4 shows the findings on how the participants generally understand quality, supported by figure 5.1. All (100%) the participants agreed that construction projects are indeed a balance between cost, time and quality. Therefore, when defining objectives for construction project quality, it is essential to consider the available budget and time. All participants agreed that the main aim of quality is customer satisfaction, meaning delivering a project without any defect being present. Since projects have different requirements and/or specifications, the majority (82%) of participants strongly agreed that quality replicates attributes that a project comprises of.

Table 5.4: General understanding of quality

Section B: General understanding of quality (GU)	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Standard deviation
Construction projects are a balance between cost, time and quality (GU1).				8%	92%	4.92	0.747
				10	109		
Quality is delivering customer service or product without a defect being present (GU2).				10%	90%	4.90	0.577
				12	107		
Quality reflects the quantity of attributes that a project contains (GU3).			2%	16%	82%	4.81	0.437
			2	19	98		
Quality is one of the critical factors in the success of construction projects (GU4).				3%	97%	4.96	0.302
				4	115		
The main aim of quality is to ensure customer satisfaction (GU5).				8%	92%	4.92	0.266
				10	109		
When defining objectives for construction project quality, it is essential to consider the available budget and time (GU6).				8%	92%	4.90	0.439
				10	109		
The clients and construction managers perceive the quality of a project the same (GU7).	11%	13%	38%	27%	11%	3.26	1.153
	13	15	46	32	13		
Clients are satisfied if the end product meets their expectations in terms of price, time frame, functionality and delivery performance standard (GU8).				17%	83%	4.92	0.368
				20	99		
For construction projects, the goal and desire of all project stakeholders, construction managers in particular, is to ensure that projects are delivered according to acceptable and agreed standards (GU9).				9%	91%	4.92	0.279
				11	108		
The managers look at the skills and knowledge employed to the construction of the project. i.e., they look at the material, labour, equipment, tools and methods to producing the end-product of quality (GU10)				13%	87%	4.87	0.333
				15	104		

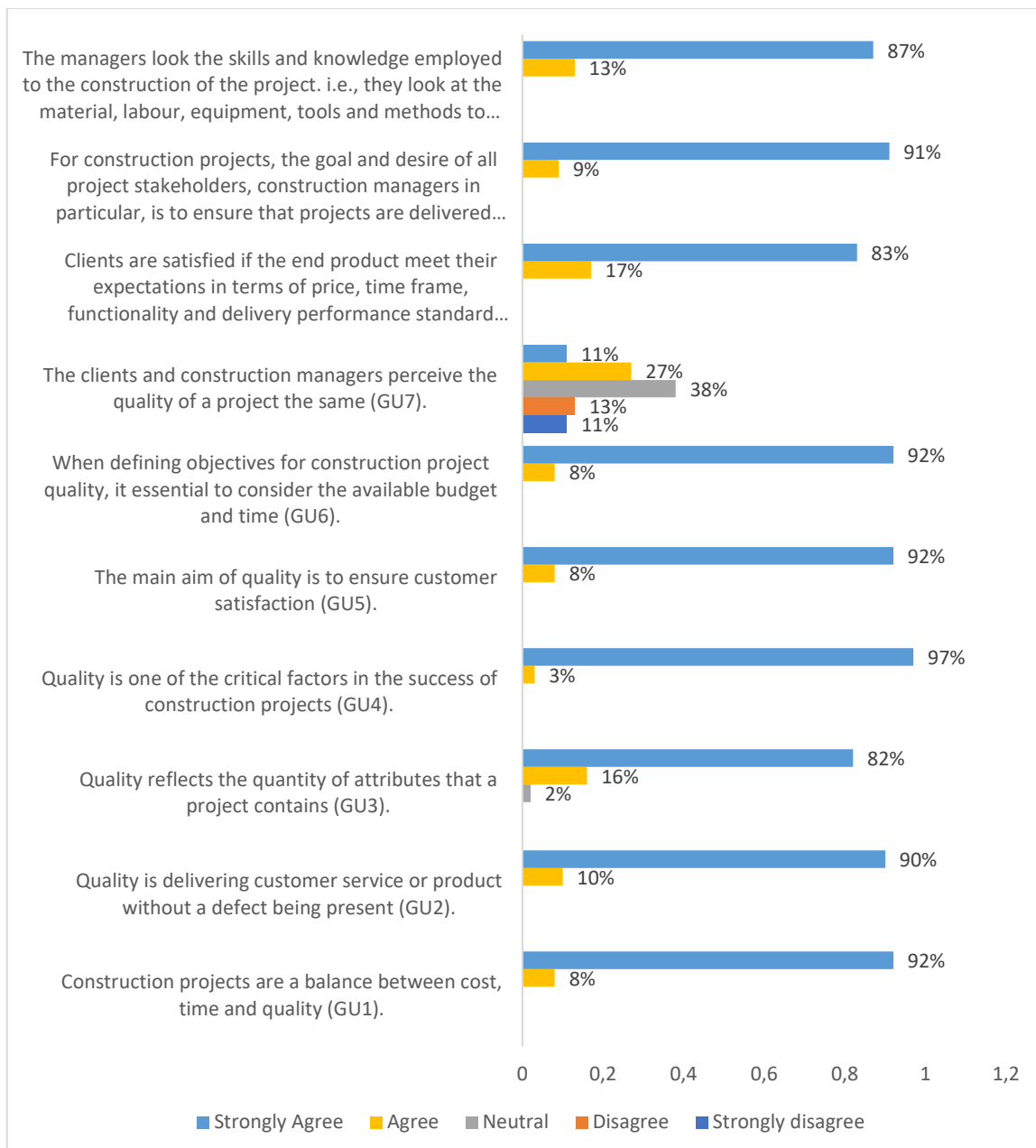


Figure 5.1: General understanding of quality (GU)

Each and every one (100%) of the participants agreed that in construction projects, the objective and goal of all project stakeholders, construction managers in particular, is to guarantee that projects are delivered according to the acceptable and agreed standards. With that being mentioned, the majority (38%) of the participants were unsure whether clients always perceive quality the same as construction managers. Given the difference, all participants agreed that clients are satisfied if the end product meet their expectations in terms of price, time frame, functionality and delivery performance standard and on the other hand, the managers look the skills and knowledge employed to the construction of the project. i.e., they look at the material, labour, equipment, tools and methods to producing the end-product of quality.

5.2.3.1.2 Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) and Bartlett's test

The Kaiser-Meyer-Olkin measure of sampling adequacy is a statistic that indicates the proportion of variance in the variables that might be caused by underlying factors (Somaini, Engelhardt, Fumagalli and Ingelmo, 2016). High values (close to 1.0) generally indicate that a factor analysis may be useful with ones data. If the value is less than 0.50, the results of the factor analysis probably will not be very useful (Hoque, Siddiqui, Awang, Baharu, 2018).

Table 5.5 indicates that the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO-test) value was 0.742 thereby greater than the suggested value of 0.50 (Hoque, *et al.*, 2018) and the Bartlett's test of sphericity (Somaini, *et. al.*, 2016) reached statistical significance at $p = 0.000$ ($p < 0.05$) thereby favouring the factorability of the correlation matrix (Pallant, 2013). This shows that a factor analysis was useful for the data.

Table 5.5: KMO and Bartlett's test

KMO and Bartlett's Test		
The Kaiser-Meyer-Olkin measure of sampling adequacy.		0.742
Bartlett's test of sphericity	Approx. Chi-Square	421.268
	df	45
	Sig.	.000

5.2.3.1.3 Factor analysis of the general understanding quality

Table 5.6 indicates the factor matrix of the general understanding of quality for construction managers. For factor analysis, principle components extraction was used with Kaiser normalisation and Promax rotation with a kappa 4 (Pett, Lackey, and Sullivan, 2003). Small coefficients were suppressed with an absolute value below 0.5. The factors retained were based on the number of interpretable factors. The Eigen-value-greater than-one criteria yielded one factor. Consequently, a three-factor solution which comprised of nine out of ten questions was favoured yielding Eigen values greater than one. The results revealed the loading of each of the items which were extracted through principal axis factoring. Out of ten items, nine of the items loaded strongly on the component and so they were considered as factors influencing the co-valuation among multiple observations. (>0.5) (Pallant, 2013). Item 7 was suppressed.

Table 5.6: Factor Matrix

Component Matrix^a		Component		
		1	2	3
GUQ1	Construction projects are a balance between cost, time and quality.	0.665	-0.137	0.171
GUQ2	Quality is delivering customer service or product without a defect being present.	0.668	0.472	0.045
GUQ3	Quality reflects the quantity of attributes that a project contains.	0.747	0.105	-0.161
GUQ4	Quality is one of the critical factors in the success of construction projects.	0.648	0.312	0.064
GUQ5	The main aim of quality is to ensure customer satisfaction.	0.677	0.121	-0.331
GUQ6	When defining objectives for construction project quality, it essential to consider the available budget and time.	0.710	0.398	-0.244

GUQ7	The clients and construction managers perceive the quality of a project the same.	0.224	0.301	0.163
GUQ8	Clients are satisfied if the end product meet their expectations in terms of price, time frame, functionality and delivery performance standard.	0.545	-0.542	0.138
GUQ9	For construction projects, the goal and desire of all project stakeholders, construction managers in particular, is to ensure that projects are delivered according to acceptable and agreed standards.	0.554	-0.463	-0.088
GUQ10	The managers look the skills and knowledge employed to the construction of the project. i.e., they look at the material, labour, equipment, tools and methods to producing the end-product of quality.	0.696	-0.553	0.162

Table 5.7 displays how much variance is explained by these factors. PCA technique using principal axis factoring exhibited 3.97, 1.43, and 1.03, representing 39.66%, 14.27%, and 10.29% of the variance respectively and 64.22% of the total variance.

Table 5.7: Total Variance Explained for general understanding of quality

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
GUQ1	3.966	39.663	39.663	3.966	39.663	39.663
GUQ2	1.427	14.269	53.932	1.427	14.269	53.932
GUQ3	1.029	10.289	64.221	1.029	10.289	64.221
GUQ4	0.874	8.739	72.960			
GUQ5	0.648	6.481	79.441			
GUQ6	0.623	6.231	85.672			
GUQ7	0.573	5.729	91.402			
GUQ8	0.400	3.998	95.399			
GUQ9	0.251	2.508	97.907			
GUQ10	0.209	2.093	100.000			

5.2.3.1.4 Reliability statistics

Section B (General understanding of quality) had a value of Cronbach's alpha equal to 0.661 which is 'questionable' but acceptable, as shown in table 5.8. According to Field (2006:3) "*if the deletion of an item increases Cronbach's alpha then this means that the deletion of that item improves reliability*". Therefore, question 7 (The clients and construction managers perceive the quality of a project the same) was deleted, the value of Cronbach's alpha increased to 0.831, which is 'good' reliability, suggesting that the items have higher internal consistency in responses (Tavakol and Dennick, 2011).

Table 5.8: Reliability statistics

question		Mean	Std. Deviation	Corrected Item-Total Correlation	Cronbach's Alpha
	General understanding of quality				0.661
GUQ1	Construction projects are a balance between cost, time and quality.	4.92	0.279	0.512	0.661
GUQ2	Quality is delivering customer service or product without a defect being present.	4.90	0.302	0.541	
GUQ3	Quality reflects the quantity of attributes that a project contains.	4.81	0.437	0.515	
GUQ4	Quality is one of the critical factors in the success of construction projects.	4.96	0.302	0.511	
GUQ5	The main aim of quality is to ensure customer satisfaction.	4.92	0.266	0.453	
GUQ6	When defining objectives for construction project quality, it essential to consider the available budget and time.	4.92	0.266	0.514	
GUQ7	The clients and construction managers perceive the quality of a project the same.	3.26	1.153	0.161	

GUQ8	Clients are satisfied if the end product meet their expectations in terms of price, time frame, functionality and delivery performance standard.	4.84	0.368	0.358	
GUQ9	For construction projects, the goal and desire of all project stakeholders, construction managers in particular, is to ensure that projects are delivered according to acceptable and agreed standards.	4.92	0.279	0.339	
GUQ10	The managers look the skills and knowledge employed to the construction of the project. i.e., they look at the material, labour, equipment, tools and methods to producing the end-product of quality.	4.87	0.333	0.551	

The corrected item-total correlation for most of the items in the table above was above 0.3 (Tavakol and Dennick, 2011). Because the sample was higher, 119 participants, all items with the value above 0.2 may be accepted (Field, 2013). Question GUQ7 had correlation value below 0.2 which increased the chances of being dropped as it was not correlating with the overall scale from its respective section, this question had the value of 0.161.

Table 5.9 shows the Cronbach's alpha for section A when item 7 is deleted. The new value is 0.831 indicating a good reliability between items which suggests that there is a higher internal consistency between the items (Tavakol and Dennick, 2011).

Table 5.9: Cronbach's alpha when item 7 is deleted

Reliability Statistics		
Cronbach's Alpha	Cronbach's alpha based on standardised items	No. of Items
0.831	0.837	9

5.2.3.2 Section C: Construction managers' perspective of quality

5.2.3.2.1 Questions and results

Table 5.10: Construction managers' perspective of quality

SectionC: Construction managers' perspective of quality	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Standard deviation
Construction managers create quality policy of a project(CMP1).			3%	43%	54%	4.50	0.623
CMs define the quality objectives and ensure they are achieved (CMP2).			4	51	64	4.71	0.472
CMs develop the Quality Management Plan after consulting with the project manager and the stakeholders (CMP3).			1%	27%	73%	4.67	0.539
Project is of quality if it is in conformance to specifications (CMP4).			1	32	86	4.92	0.279
A project must be Fit for purpose for it to be of quality (CMP5)			4%	26%	70%	4.92	0.279
Quality is known as meeting or exceeding customer expectations (CMP6).			5	31	83	4.88	0.454
Quality is construed as perfection or consistency (CMP7).				9%	91%	4.88	0.324
CMs are responsible for project success and/or failure (CMP8).				10%	90%	4.08	0.984
				10	109		
				12%	88%		
				14	105		
	4%	4%	14%	40%	38%		
	5	5	17	47	45		

Table 5.10 shows how the construction managers perceive quality in construction projects, supported by figure 5.2. The majority (54%) of participants strongly agreed that they create quality policies of their projects, especially those with longer experience within the industry. Most (99%) of the participants agreed that they do define the quality objectives and ensure they are achieved. The minority (4%) were uncertain whether CMs develop the quality management plan after consulting with the project manager (PM) and other project stakeholders, whereas on the other hand, the majority (96%) agreed with the statement. All (100%) the participants agreed that a project is of quality if is a) in conformance to specifications; b) fit for its purpose after construction; and c) meets or exceeds customer expectations in terms of time, quality. Every participant agreed that quality is construed as perfection or consistency. Majority (78%) of participants agreed that construction managers are indeed responsible for project success and/or failure, this is because they oversee and allocate resources for various construction projects (Ayegun and Olawumi, 2018). They are skilled in both the technical skills required for the job and in leading and directing their team (*ibid*). In addition, their responsibilities are what guide a project to success varying from residential, commercial, and industrial buildings to bridges and skyscrapers. It is essential to mention that if all the other stakeholders play their roles on the project very well, it makes it easier for the construction managers to perform their responsibilities which indeed lead a project to success.

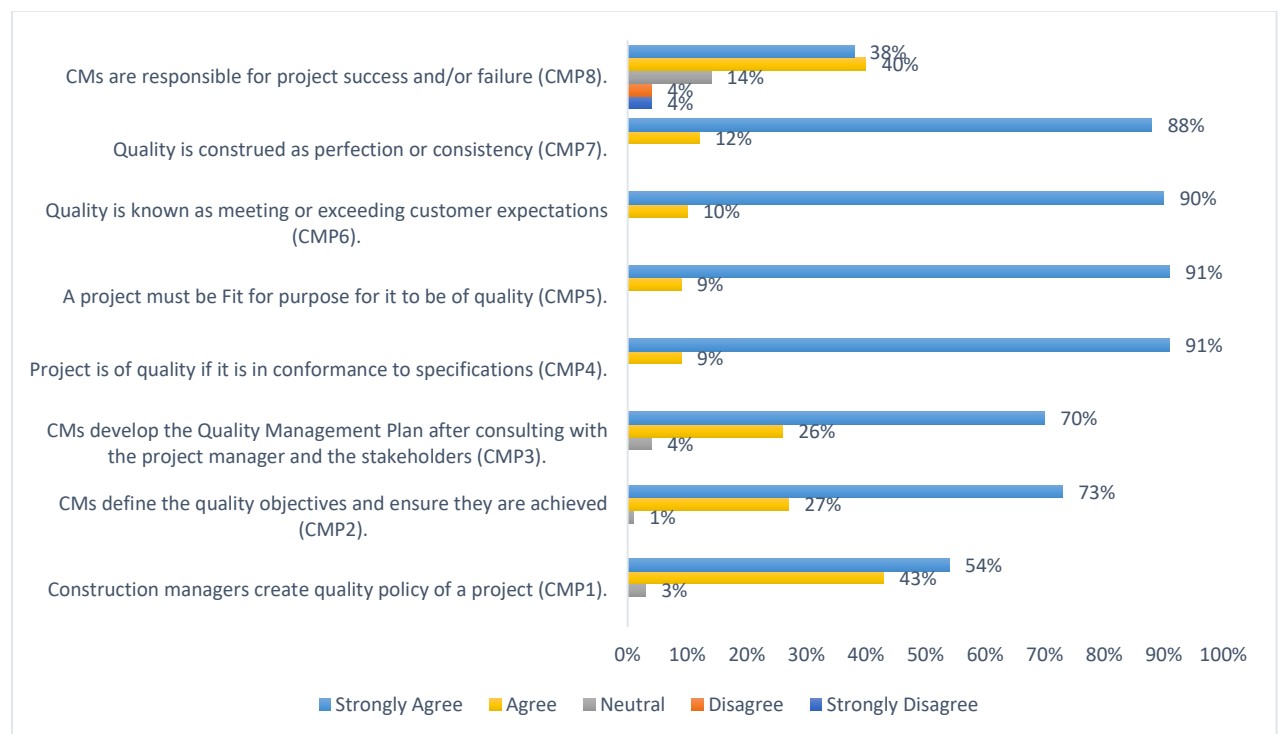


Figure 5.2: Construction managers' perspective of quality

5.2.3.2.2 KMO and Bartlett's test

Table 5.11 shows that the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO-test) value was 0.716 thereby greater than the suggested value of 0.50 (Hoque, *et al.*, 2018) and the Bartlett's test of sphericity (Somaini, *et al.*, 2016) reached statistical significance at $p = 0.000$ ($p < 0.05$) thereby supporting the factorability of the correlation matrix (Pallant, 2013). This indicates that a factor analysis was useful for the data.

Table 5.11: KMO and Bartlett's Test of construction managers' perspective of quality

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.716
Bartlett's Test of Sphericity	Approx. Chi-Square	338.071
	df	28
	Sig.	.000

5.2.3.2.3 Factor analysis of the construction managers' perspective of quality

Table 5.12 indicates the factor matrix of the construction managers' perspective of quality. A two-factor solution comprising of seven out of the eight questions was favoured yielding Eigen values greater than one (Pett, Lackey, and Sullivan, 2003). The results revealed the loadings of each of the items which were extracted through principal axis factoring. Out of the eight items, seven of the items loaded strongly on the component and so they were considered as factors influencing the co-variation among multiple observations. (>0.5) (Pallant, 2013). Item 8 was suppressed.

Table 5.12: Factor matrix of the construction managers' perspective of quality

Component Matrix ^a		Component	
		1	2
CMP1	Construction managers create quality policy of a project	0.579	0.589
CMP2	CMs define the quality objectives and ensure they are achieved	0.582	0.623
CMP3	CMs develop the Quality Management Plan after consulting with the project manager and the stakeholders	0.647	0.391
CMP4	Project is of quality if it is in conformance to specifications	0.824	-0.247
CMP5	A project must be Fit for purpose for it to be of quality	0.806	-0.423
CMP6	Quality is known as meeting or exceeding customer expectations	0.533	-0.388
CMP7	Quality is construed as perfection or consistency	0.711	-0.338
CMP8	CMs are responsible for project success and/or failure	0.083	0.430

Table 5.13 illustrates how much variance is explained by these factors. PCA technique using principal axis factoring exhibited 3.22 and 1.58, explaining 40.22% and 19.70% of the variance respectively and 59.91% of the total variance.

Table 5.13: Total Variance Explained for construction managers' perspective of quality

Total Variance Explained						
Component	Total	Initial Eigenvalues		Extraction Sums of Squared Loadings		
		% of Variance	Cumulative %	Total	% of Variance	Cumulative %
CMP1	3.217	40.216	40.216	3.217	40.216	40.216
CMP2	1.576	19.699	59.914	1.576	19.699	59.914

CMP3	0.929	11.614	71.529			
CMP4	0.728	9.105	80.634			
CMP5	0.573	7.161	87.795			
CMP6	0.450	5.627	93.421			
CMP7	0.364	4.555	97.976			
CMP8	0.162	2.024	100.000			

Extraction Method: Principal Component Analysis.

5.2.3.2.4 Reliability statistics

Section C (Construction managers' perspective of quality) had a value of Cronbach's alpha equal to 0.631 which is 'poor' but acceptable, as shown in table 5.14. Therefore, question 8 (CMs are responsible for project success and/or failure) was deleted, the value of Cronbach's alpha increased to 0.757, which is 'acceptable' reliability, suggesting that the items have higher internal consistency in responses (Tavakol and Dennick, 2011).

Table 5.14: Reliability statistics

question		Mean	Std. Deviation	Corrected Item-Total Correlation	Cronbach's Alpha
CMP1	Construction managers create quality policy of a project.	4.50	0.623	0.495	0.631
CMP2	CMs define the quality objectives and ensure they are achieved.	4.71	0.472	0.536	
CMP3	CMs develop the Quality Management Plan after consulting with the project manager and the stakeholders.	4.67	0.539	0.472	
CMP4	Project is of quality if it is in conformance to specifications.	4.92	0.279	0.536	
CMP5	A project must be Fit for purpose for it to be of quality.	4.92	0.279	0.460	
CMP6	Quality is known as meeting or exceeding customer expectations.	4.88	0.454	0.240	
CMP7	Quality is construed as perfection or consistency.	4.88	0.324	0.411	
CMP8	CMs are responsible for project success and/or failure.	4.08	0.984	0.090	

The corrected item-total correlation for most of the items in the table above was above 0.3 (Tavakol and Dennick, 2011). Because the sample was higher, 119 participants, all items with the value above 0.2 may be accepted. Question CMP8 had correlation value below 0.2 which increased the chances of being dropped as it was not correlating with the overall scale from its respective section, this question had the values of 0.090.

Table 5.15 shows the Cronbach's alpha for section A when item 8 is deleted. The new value is 0.757 indicating an acceptable reliability between items which suggests that items there is a higher internal consistency between the items (Tavakol and Dennick, 2011).

Table 5.15: Cronbach's alpha when item 8 is deleted

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardised Items	No of Items
0.757	0.797	7

5.2.3.3 Section D: Quality management systems (QMS)

5.2.3.3.1 Questions and results

Table 5.16 shows the responses on quality management systems, supported by figure 5.3. The majority (97%) of participants agreed that quality management systems provide the superior customer satisfaction and loyalty. All participants agree that QMSs assist in meeting the organisation requirements and assist in reducing costs of rework and wastage. This is because the purpose of a quality management system is to guarantee every time a process is performed, the same information, methods, skills and controls are used and applied in a consistent manner (Husain, 2016). Minority (10%) of participants were indecisive if a quality management plan is created by a construction manager, whereas the remaining (90%) participants agreed. All (100%) participants agreed that quality assurance are procedures to guarantee a high level of quality in production during the development of products or services. The participants also agreed that quality control is indeed a process through which a business seeks to ensure that product quality is maintained or improved. Majority (68%) of participants agreed that if ever a project or a certain section of a project has a quality defect, it must be redone. This is basically because the defected section may cause failure of a component part of a building or structure and cause damage to person or property, resulting in financial threat to the client (Ayegun and Olawumi, 2018).

Table 5.16: Quality management systems

SectionD: Quality management systems (QMS)	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Standard deviation
QMS provides the superior customer satisfaction and loyalty (QMS1).			3%	16%	81%	4.82	0.404
			4	51	64		
QMSs assist in meeting the organisation requirements (QMS2).			1%	27%	73%	4.80	0.403
			1	32	86		
QMSs assist reduce costs of rework and waste (QMS3).			4%	26%	70%	4.84	0.368
			5	31	83		
A quality management plan is created by a construction manager (QMS4).			10%	24%	66%	4.55	0.673
			12	29	78		
Quality planning is the task of determining what factors are important to a project and figuring out how to meet those factors (QMS5).				9%	91%	4.87	0.333
				11	108		
Quality assurance are processes to ensure a high level of quality in production during the development of products or services (QMS6).				13%	87%	4.87	0.333
				15	104		
Quality control is a process through which a business seeks to ensure that product quality is maintained or improved (QMS7).				13%	87%	4.89	0.313
				15	104		
Quality control tools include checklists, check sheets and statistical analysis, etc (QMS8).				11%	89%	4.89	0.313
				13	106		
If ever a project or a certain section of a project has a quality defect, it must be redone (QMS9).	2%	11%	21%	51%	17%	3.72	0.911
	2	13	25	59	20		

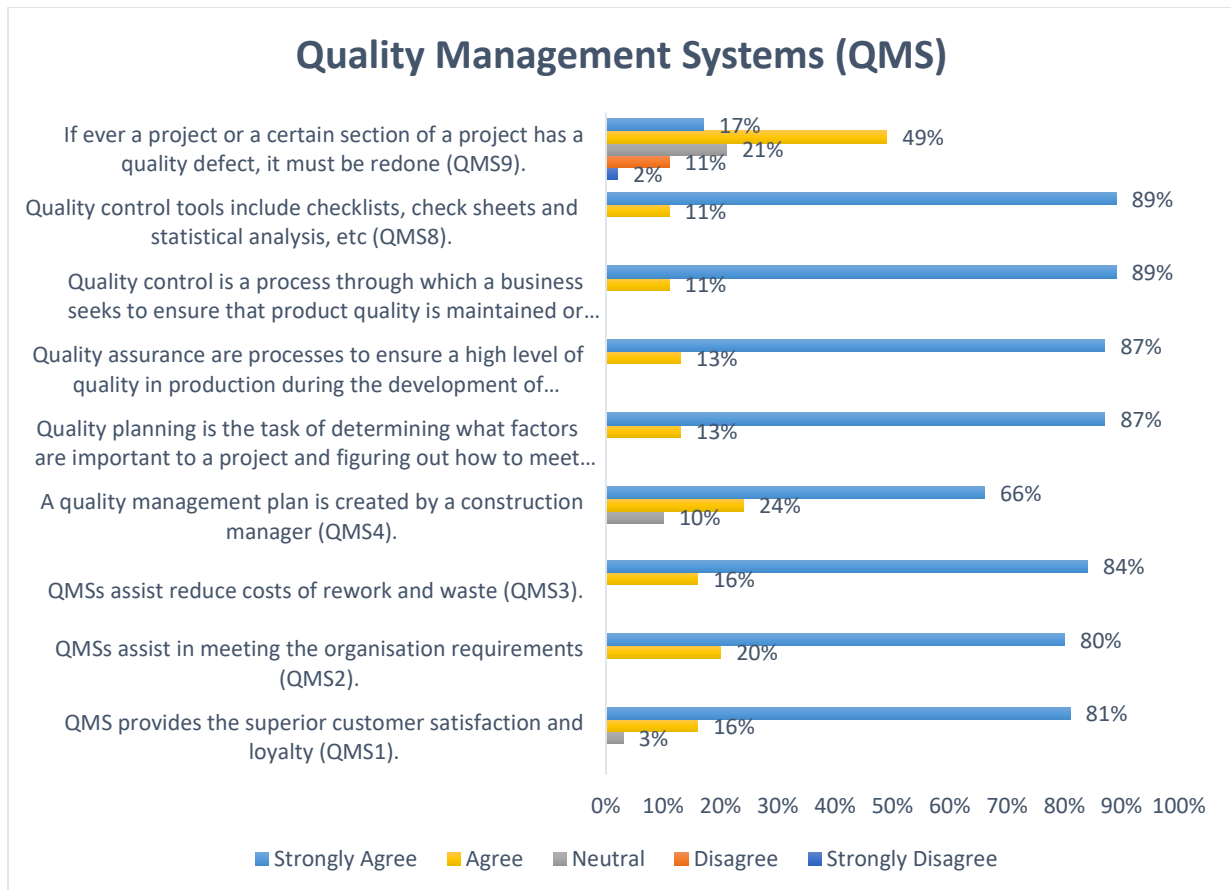


Figure 5.3: Quality Management Systems (QMS)

4.2.3.3.2 KMO and Bartlett's test

table5.17 shows that the KMO value was 0.807 thereby greater than the suggested value of 0.50 (Hoque, *et al.*, 2018) and the Barlett's test of sphericity (Somaini, *et. al.*, 2016) reached statistical significance at $p= 0.000$ ($p<0.05$) thereby supporting the factorability of the correlation matrix (Pallant, 2013). This indicates that a factor analysis was useful for the data.

Table 5.17: KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.807
Bartlett's Test of Sphericity	Approx. Chi-Square	530.099
	df	36
	Sig.	.000

4.2.3.3.3 Factor analysis of the quality management systems

Table 5.18 indicates the factor matrix of the quality management systems. A two-factor solution which comprised of eight out of the nine questions was favoured yielding Eigen values greater than one. The results revealed the loadings of each of the items which were extracted through principal axis factoring(Pett, *et al.*, 2003). Out of the nine items, eight of the items loaded strongly on the

component and so they were considered as factors influencing the co-variation among multiple observations. (>0.5) (Pallant, 2013). Item 9 was suppressed.

Table 5.18: Factor matrix of the quality management systems

Component Matrix ^a		Component	
		1	2
QMS1	QMS provides the superior customer satisfaction and loyalty.	0.714	-0.546
QMS2	QMSs assist in meeting the organisation requirements.	0.804	-0.423
QMS3	QMSs assist reduce costs of rework and waste.	0.819	-0.313
QMS4	A quality management plan is created by a construction manager.	0.606	-0.087
QMS5	Quality planning is the task of determining what factors are important to a project and figuring out how to meet those factors.	0.648	0.177
QMS6	Quality assurance are processes to ensure a high level of quality in production during the development of products or services.	0.755	0.465
QMS7	Quality control is a process through which a business seeks to ensure that product quality is maintained or improved.	0.745	0.485
QMS8	Quality control tools include checklists, check sheets and statistical analysis, etc.	0.690	0.154
QMS9	If ever a project or a certain section of a project has a quality defect, it must be redone.	0.205	0.425

Table 5.19 shows how much variance is explained by these factors. PCA technique using principal axis factoring exhibited 4.26 and 1.36, explaining 47.28% and 15.12% of the variance respectively and 62.40% of the total variance.

Table 5.19: Total Variance Explained for quality management systems

Total Variance Explained							
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	
QMS1	4.255	47.280	47.280	4.255	47.280	47.280	
QMS2	1.361	15.118	62.399	1.361	15.118	62.399	
QMS3	0.923	10.256	72.655				
QMS4	0.745	8.282	80.936				
QMS5	0.648	7.204	88.141				
QMS6	0.404	4.491	92.631				
QMS7	0.302	3.350	95.982				
QMS8	0.227	2.520	98.502				
QMS9	0.135	1.498	100.000				

4.2.3.3.4 Reliability statistics

Section D (Quality management systems) had a value of Cronbach's alpha equal to 0.752 which regarded as 'acceptable', as shown in table 5.20. According to Field (2006), if the value of Cronbach's alpha is between 0.7 and 0.8, it is acceptable. If question 9 was deleted, the value of Cronbach's alpha increased to 0.846, which is regarded as 'good' reliability (Tavakol and Dennick, 2011).

Table 5.20: Reliability statistics

question		Mean	Std. Deviation	Corrected Item-Total Correlation	Cronbach's Alpha
	Quality Management Systems (QMS)				0.752
QMS1	QMS provides the superior customer satisfaction and loyalty.	4.82	0.404	0.558	
QMS2	QMSs assist in meeting the organisation requirements.	4.80	0.403	0.661	
QMS3	QMSs assist reduce costs of rework and waste.	4.84	0.368	0.653	
QMS4	A quality management plan is created by a construction manager.	4.55	0.673	0.430	
QMS5	Quality planning is the task of determining what factors are important to a project and figuring out how to meet those factors.	4.87	0.333	0.504	
QMS6	Quality assurance are processes to ensure a high level of quality in production during the development of products or services.	4.87	0.333	0.644	
QMS7	Quality control is a process through which a business seeks to ensure that product quality is maintained or improved.	4.89	0.313	0.659	
QMS8	Quality control tools include checklists, check sheets and statistical analysis, etc.	4.89	0.313	0.523	
QMS9	If ever a project or a certain section of a project has a quality defect, it must be redone.	3.72	0.911	0.136	

The corrected item-total correlation for most of the items in the table above was above 0.3 (Tavakol and Dennick, 2011). Because the sample was higher, 119 participants, all items with the value above 0.2 may be accepted. Question QMS9 had correlation value below 0.2 which increased the chances of being dropped as it was not correlating with the overall scale from its respective section, this question had the values of 0.136.

Table 5.21 shows the Cronbach's alpha for section A when item 9 is deleted. The new value is 0.846 indicating a good reliability between items which suggests that items there is a higher internal consistency between the items (Tavakol and Dennick, 2011).

Table 5.21: Cronbach's alpha when item 9 is deleted

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardised Items	No of Items
0.846	0.870	8

5.2.3.4 Section E: Factors affecting quality (FAQ)

5.2.3.4.1 Questions and results

Table 5.22 illustrates all the responses on the factors affecting quality in construction projects, supported by figure 5.4. Ninety nine percent (99%) of the participants surely agree that non-conformance with regulation negatively affects the quality of a project. Even though the minority did not agree with the use of unskilled labour but the majority (96%) agreed. In a case where the work description is not critical or does not require any skills and if there is also good supervision, unskilled labour is not a threat. All (100%) the participants agreed that non-conformance with specification, poor on-site supervision, lack of induction and training, poor planning and scheduling, lack of communication and ignorance and lack of knowledge. The majority (99%) of the participants also

agreed that quality is negatively affected by the low productivity and efficiency of equipment used, average delays in decision making as well as the use of unskilled subcontractors. The majority (73%) of participants agreed that the number of projects at hand affect quality of one of the projects. This is because effective management of multiple projects is a difficult task even for a qualified construction manager who knows about project management and it is impossible for someone who is not properly trained (Ayegun and Olawumi, 2018). Seventy four percent (74%) of the participants agreed that the involvement of the end-user client affects quality of the project during construction.

Table 5.22: Factors affecting quality

Factors affecting quality (FAQ)	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Standard deviation
Non-conformance with regulations (FAQ1).			1%	12%	87%	4.87	0.366
			1	14	104		
Use of unskilled labour (FAQ2).		1%	3%	19%	77%	4.71	0.570
		1	4	23	91		
Non-conformance with specifications (FAQ3).				13%	87%	4.87	0.343
				15	104		
Poor on-site supervision (FAQ4).				16%	84%	4.84	0.368
				19	100		
Lack of induction and training (FAQ5).				35%	65%	4.65	0.480
				42	77		
Poor planning and scheduling (FAQ6).				22%	78%	4.78	0.415
				26	93		
Lack of communication (FAQ7).				14%	86%	4.87	0.343
				17	102		
Ignorance and lack of knowledge (FAQ8).				16%	84%	4.84	0.368
				19	100		
Low productivity and efficiency of equipment (FAQ9).			1%	31%	68%	4.67	0.489
			1	37	81		
Poor material and plant management (FAQ10).				20%	80%	4.80	0.403
				24	95		
Poor procurement planning and management (FAQ11).				19%	81%	4.81	0.397
				23	96		
Average delays in decision making (FAQ12).			1%	16%	83%	4.82	0.404
			1	19	99		
Number of projects at hand (FAQ13).	3%	14%	20%	39%	24%	3.64	1.087
	4	17	24	45	29		
Uncontrolled variation orders (FAQ14).				16%	84%	4.84	0.368
				19	100		
Involvement of End-User client (FAQ15).	1%	4%	21%	33%	41%	4.09	0.930
	1	5	25	39	49		
Inclement weather conditions (FAQ16).			14%	38%	48%	4.34	0.716
			17	45	57		
Use of unskilled trade subcontractors (FAQ17).			1%	8%	91%	4.90	0.329
			1	10	108		

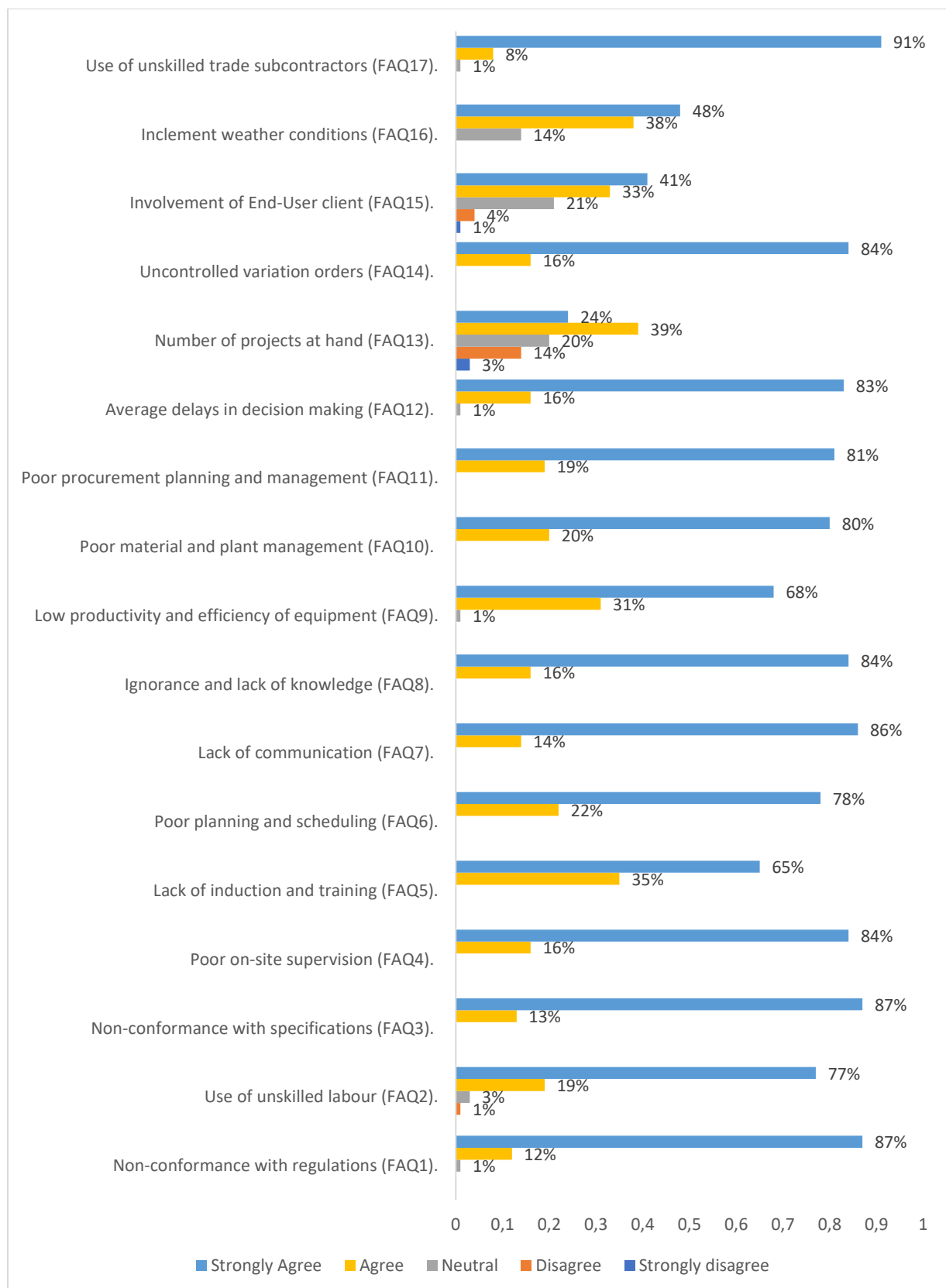


Figure 5.4: Factors affecting quality

5.2.3.4.2 KMO and Bartlett's test

Table 5.23 shows that KMO value was 0.812 thereby greater than the suggested value of 0.50 (Hoque, *et al.*, 2018) and the Bartlett's test of sphericity (Somaini, *et al.*, 2016) reached statistical significance at $p = 0.000$ ($p < 0.05$) thereby supporting the factorability of the correlation matrix (Pallant, 2013). This indicates that a factor analysis was useful for the data.

Table 5.23: KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.812
Bartlett's Test of Sphericity	Approx. Chi-Square	1522.279
	df	136
	Sig.	.000

5.2.3.4.3 Factor analysis of the factors affecting quality

Table 5.24 indicates the factor matrix of the factors affecting quality. A four-factor solution which comprised of seventeen out of the seventeen questions was favoured yielding Eigen values greater than one. The results revealed the loadings of each of the items which were extracted through principal axis factoring (Pett, Lackey, and Sullivan, 2003). All seventeen of the items loaded strongly on the component and so they were considered as factors influencing the co-variation among multiple observations. (>0.5) (Pallant, 2013). No item was suppressed.

Table 5.24: Factor matrix of the factors affecting quality

Component Matrix ^a		Component			
		1	2	3	4
FAQ1	Non-conformance with regulations.	0.756	0.281	-0.217	0.142
FAQ2	Use of unskilled labour.	0.639	0.175	-0.327	0.374
FAQ3	Non-conformance with specifications.	0.797	0.241	-0.187	0.076
FAQ4	Poor on-site supervision.	0.834	0.123	-0.220	-0.043
FAQ5	Lack of induction and training.	0.558	-0.305	0.326	0.373
FAQ6	Poor planning and scheduling.	0.749	-0.337	0.231	-0.139
FAQ7	Lack of communication.	0.771	-0.341	0.168	-0.372
FAQ8	Ignorance and lack of knowledge.	0.745	-0.377	0.183	-0.340
FAQ9	Low productivity and efficiency of equipment.	0.585	-0.417	0.291	0.408
FAQ10	Poor material and plant management.	0.787	-0.307	0.103	0.063
FAQ11	Poor procurement planning and management.	0.802	-0.221	-0.023	0.001
FAQ12	Average delays in decision making.	0.720	0.163	-0.316	-0.176
FAQ13	Number of projects at hand.	0.362	0.529	0.495	0.406
FAQ14	Uncontrolled variation orders.	0.735	0.015	-0.261	-0.132
FAQ15	Involvement of End-User client.	0.380	0.740	0.362	-0.148
FAQ16	Inclement weather conditions.	0.385	0.604	0.420	-0.350
FAQ17	Use of unskilled trade subcontractors.	0.644	0.273	-0.319	0.071

Table 5.25 illustrates how much variance is explained by these factors. PCA technique using principal axis factoring exhibited 7.83, 2.26, 1.38 and 1.11 explaining 46.09%, 13.28%, 8.10% and 6.56% of the variance respectively and 74.01% of the total variance.

Table 5.25: Total Variance Explained for factors affecting quality

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
FAQ1	7.834	46.085	46.085	7.834	46.085	46.085
FAQ2	2.257	13.275	59.360	2.257	13.275	59.360
FAQ3	1.377	8.103	67.462	1.377	8.103	67.462
FAQ4	1.113	6.550	74.012	1.113	6.550	74.012
FAQ5	0.725	4.264	78.276			
FAQ6	0.629	3.700	81.976			
FAQ7	0.592	3.482	85.458			
FAQ8	0.486	2.859	88.317			
FAQ9	0.395	2.323	90.640			
FAQ10	0.346	2.035	92.675			
FAQ11	0.276	1.624	94.299			
FAQ12	0.230	1.351	95.650			
FAQ13	0.221	1.301	96.951			
FAQ14	0.201	1.183	98.134			
FAQ15	0.147	0.864	98.997			
FAQ16	0.123	0.722	99.720			
FAQ17	0.048	0.280	100.000			

5.2.3.4.4 Reliability statistics

Section E (factors affecting quality) had a value of Cronbach's alpha equal to 0.878 which means there is a 'good' reliability between items, as shown in table 5.26 (Tavakol and Dennick, 2011).

Table 5.26: Reliability statistics

question	Factors affecting quality				Cronbach's Alpha
		Mean	Std. Deviation	Corrected Item-Total Correlation	
FAQ1	Non-conformance with regulations.	4.87	0.366	0.707	0.878
FAQ2	Use of unskilled labour.	4.71	0.570	0.556	
FAQ3	Non-conformance with specifications.	4.87	0.343	0.736	
FAQ4	Poor on-site supervision.	4.84	0.368	0.743	
FAQ5	Lack of induction and training.	4.65	0.480	0.465	
FAQ6	Poor planning and scheduling.	4.78	0.415	0.629	
FAQ7	Lack of communication.	4.87	0.343	0.624	
FAQ8	Ignorance and lack of knowledge.	4.84	0.368	0.595	
FAQ9	Low productivity and efficiency of equipment.	4.67	0.489	0.474	
FAQ10	Poor material and plant management.	4.80	0.403	0.654	
FAQ11	Poor procurement planning and management.	4.81	0.397	0.666	
FAQ12	Average delays in decision making.	4.82	0.404	0.621	
FAQ13	Number of projects at hand.	3.64	1.087	0.434	
FAQ14	Uncontrolled variation orders.	4.84	0.368	0.614	
FAQ15	Involvement of End-User client.	4.09	0.930	0.458	
FAQ16	Inclement weather conditions.	4.34	0.716	0.460	
FAQ17	Use of unskilled trade subcontractors.	4.90	0.329	0.579	

The corrected item-total correlation for all of the items in the table above was above 0.3 (Tavakol and Dennick, 2011). Because the sample was higher, 119 participants, all items with the value above 0.2 may be accepted. All the items correlated well with each other.

5.2.3.4.5 Descriptive statistics for factors affecting quality

Table 5.27: Descriptive statistics for factors affecting quality

question	Factors affecting quality	Mean	Std. Deviation	Relative Importance Index	Rank
FAQ1	Non-conformance with regulations.	4.87	0.366	0.720	2
FAQ2	Use of unskilled labour.	4.71	0.570	0.685	6
FAQ3	Non-conformance with specifications.	4.87	0.343	0.712	3
FAQ4	Poor on-site supervision.	4.84	0.368	0.201	15
FAQ5	Lack of induction and training.	4.65	0.480	0.457	11
FAQ6	Poor planning and scheduling.	4.78	0.415	0.277	12
FAQ7	Lack of communication.	4.87	0.343	0.781	1
FAQ8	Ignorance and lack of knowledge.	4.84	0.368	0.521	10
FAQ9	Low productivity and efficiency of equipment.	4.67	0.489	0.168	16
FAQ10	Poor material and plant management.	4.80	0.403	0.621	9
FAQ11	Poor procurement planning and management.	4.81	0.397	0.249	14
FAQ12	Average delays in decision making.	4.82	0.404	0.625	8
FAQ13	Number of projects at hand.	3.64	1.087	0.254	13
FAQ14	Uncontrolled variation orders.	4.84	0.368	0.711	4
FAQ15	Involvement of End-User client.	4.09	0.930	0.521	10
FAQ16	Inclement weather conditions.	4.34	0.716	0.651	7
FAQ17	Use of unskilled trade subcontractors.	4.90	0.329	0.691	5

Relative index analysis was used to rank the criteria according to their relative importance. Relative importance index analysis permits detecting most of the important measures based on participants' responses and it is also a suitable tool to prioritise indicators rated on Likert-type scales (Johnson and LeBreton, 2004). Table 5.27 shows the seventeen factors affecting quality. Lack of communication was ranked first with an RII value of 0.781, whereas non-conformance with regulation ranked second with an RII of 0.720, non-conformance with specifications ranked third with an RII of 0.712, uncontrolled variation orders ranked fourth with RII of 0.711, use of unskilled trade subcontractors ranked fifth with an RII of 0.691 and use of unskilled labour ranked sixth with RII value of 0.685. Followed by inclement weather conditions (7) and average delays in decision making (8), poor material and plant management (9), with RII values of 0.651, 0.625, 0.621 respectively. Ignorance and lack of knowledge as well as involvement of end-user client were ranked tenth with RII values of 0.521. Lack of induction and training was ranked eleventh with RII value of 0.457, poor planning and scheduling ranked twelfth with RII value of 0.277, number of projects at hand ranked at thirteen with RII value of 0.254, followed by poor procurement planning and management (14), poor on-site supervision (15) and Low productivity and efficiency of equipment with RII values of 0.249, 0.201 and 0.168 respectively.

5.2.3.5 Section F: Attributes of a construction manager (CMA)

5.2.3.5.1 Questions and results

Table 5.28 illustrates the responses on the attribute of an effective construction manager. During a construction project, complications and obstacles are certain to occur. All (100%) the participants strongly agreed that an effective construction manager must be equipped with excellent problem-

solving skills to properly address any issue that may arise. A good construction manager acknowledges this, and regards teamwork as an integral part of the construction process (Eriksson and Vennstrom, 2012). They must be able to communicate clearly and confidently, to create stronger relationships between workers and managers. The participants also strongly agreed that an effective and competent construction manager must have strong leadership skills, technical expertise, good negotiation skills, and be a good decision maker. Each and every participant strongly agreed that construction with what they know and consistently attempt to widen their reservoir of knowledge. They have a solid possession of handling most effective strategies expected to plan and initiate their objectives (Ayegun and Olawumi, 2018).

Table 5.28: Attributes of a construction manager

Section F:Attributes of a CM (CMA)		
Effective communication skills (CMA1)	√	100%
Strong leadership skills (CMA2)	√	100%
Good decision maker (CMA3)	√	100%
Technical expertise (CMA4)	√	100%
Team player (CMA5)	√	100%
Team-building skills (CMA6)	√	100%
Good negotiation skills (CMA7)	√	100%
Empathetic (CMA8)	√	100%
Competence (CMA9)	√	100%
Lifetime learner (CMA10)	√	100%
Problem solving skills (CMA11)	√	100%

5.2.3.6 Section G: Benefits of a construction manager in a project

5.2.3.6.1 Questions and results

Table 5.29 shows the responses on the benefits of a construction manager in a project, supported by figure 5.5. All (100%) the participants agree that if the construction manager is employed in a project it is likely the project will conform with specifications, suitable construction methods will be used, conform with construction drawings, there will be clear information and communication channel and proper coordination between the construction team. The majority (51%) of participants agreed that there would be the appointment of experienced contractors making the attainability of quality more possible. Most (55%) of the participants agreed that having a construction manager available will decrease number of variation orders. This is because the construction manager does constructability studies to identify the challenges as soon as possible so that the construction phase runs smoother.

Table 5.29: Factors affecting quality (FAQ)

Benefits of a Construction Manager in a project (CMB)	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Standard deviation
Conforming with specifications (CMB1).				21% 25	79% 94	4.79	0.409
Use proper and modern construction equipment (CMB2).			5% 6	29% 35	66% 78	4.61	0.584
Use suitable construction methods to suit specific project (CMB3).				17% 20	83% 99	4.83	0.376
Conformance with construction drawings and specification (CMB4).				13% 15	87% 104	4.87	0.333
Clear information and communication channel (CMB5).				9% 11	91% 108	4.91	0.291
Proper coordination between the construction team (CMB6).				8% 10	92% 109	4.92	0.279
Appointment of experienced contractors (CMB7).	5% 6	13% 15	31% 37	19% 23	32% 39	3.61	1.202
Adequate planning and organising (CMB8).				8% 10	92% 109	4.92	0.279
Have complete and suitable design at the right time (CMB9).			3% 4	22% 26	75% 89	4.71	0.523
Proper and up-to-date project planning and scheduling (CMB10).				12% 14	88% 105	4.88	0.324
Effective strategic planning (CMB11).				7% 8	93% 111	4.93	0.251
Use of appropriate construction methods (CMB12).			2% 2	20% 24	78% 93	4.76	0.464
Ensure proper material procurement (CMB13).				26% 31	74% 88	4.74	0.441
Having frequent progress meeting (CMB14).				16% 19	84% 100	4.84	0.368
Efficient and timely supply of materials (CMB15).				29% 35	71% 84	4.71	0.458
Allowance of material price escalation in original tender document (CMB16).		4% 5	8% 10	47% 55	41% 49	4.25	0.773
Ensure up to date technology utilisation (CMB17).			3% 4	42% 50	55% 65	4.53	0.550
Decrease number of variation order (CMB18).	2% 2	13% 15	29% 35	19% 23	36% 44	4.02	2.991
Proper project feasibility study (constructability reviews) (CMB19).				4% 5	96% 114	4.96	0.201

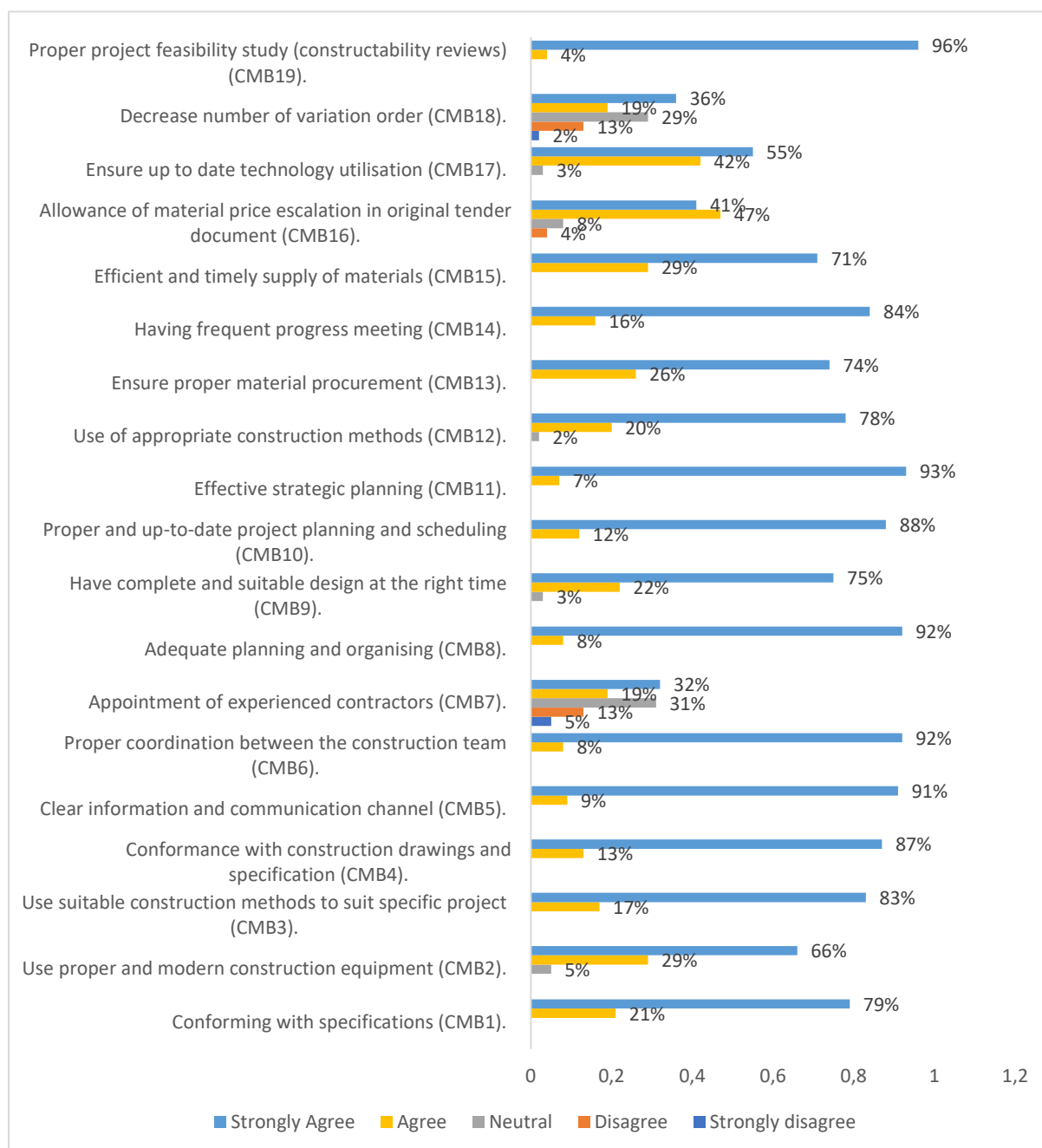


Figure 5.5: Benefits of a construction manager in a project

5.2.3.6.2 KMO and Bartlett's test

Table 5.30 shows that the KMO value was 0.83 thereby greater than the suggested value of 0.50 (Hoque, *et al*, 2018) and the Bartlett's test of sphericity (Somai, *et. al.*, 2016) reached statistical significance at $p = 0.000$ ($p < 0.05$) thereby supporting the factorability of the correlation matrix (Pallant, 2013). This specifies that a factor analysis was useful for the data.

Table 5.30: KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.830
Bartlett's Test of Sphericity	Approx. Chi-Square	1263.453
	df	171
	Sig.	.000

5.2.3.6.3 Factor analysis of the benefits of a construction manager in a project

Table 5.31 indicates the factor matrix of the factors affecting quality. A five-factor solution which comprised of eighteen out of the nineteen questions was favoured yielding Eigen values greater than one. The results revealed the loadings of each of the items which were extracted through principal axis factoring. Eighteen of the nineteen items loaded strongly on the component and so they were considered as factors influencing the co-variation among multiple observations. (>0.5) (Pallant, 2013). Item 18 (decrease number of variation order) was suppressed.

Table 5.31: Factor matrix benefits of a construction manager in a project

Component Matrix ^a		Component				
		1	2	3	4	5
CMB1	Conforming with specifications.	0.650	0.229	-0.460	0.449	0.225
CMB2	Use proper and modern construction equipment.	0.715	0.189	0.211	-0.084	-0.288
CMB3	Use suitable construction methods to suit specific project.	0.732	0.026	-0.120	0.020	-0.104
CMB4	Conformance with construction drawings and specification.	0.771	-0.094	-0.096	0.176	-0.110
CMB5	Clear information and communication channel.	0.757	-0.419	0.148	0.196	0.136
CMB6	Proper coordination between the construction team.	0.775	-0.399	0.137	0.097	0.189
CMB7	Appointment of experienced contractors.	0.105	0.508	0.605	-0.007	0.230
CMB8	Adequate planning and organising.	0.607	-0.323	-0.031	0.289	0.323
CMB9	Have complete and suitable design at the right time.	0.643	0.259	-0.231	0.041	-0.350
CMB10	Proper and up-to-date project planning and scheduling.	0.706	-0.393	0.305	-0.063	0.056
CMB11	Effective strategic planning.	0.706	-0.294	0.043	-0.160	0.057
CMB12	Use of appropriate construction methods.	0.701	0.223	-0.110	-0.161	-0.142
CMB13	Ensure proper material procurement.	0.552	0.557	-0.214	-0.142	-0.136
CMB14	Having frequent progress meeting.	0.642	-0.035	-0.220	-0.362	0.123
CMB15	Efficient and timely supply of materials.	0.573	0.438	-0.138	0.149	0.309
CMB16	Allowance of material price escalation in original tender document.	0.320	0.512	0.492	-0.182	0.236
CMB17	Ensure up to date technology utilisation.	0.498	0.539	-0.094	-0.044	0.157
CMB18	Decrease number of variation order.	0.098	0.214	0.392	0.423	-0.440
CMB19	Proper project feasibility study (constructability reviews).	0.675	-0.324	0.116	-0.238	-0.338

Table 5.32 illustrates how much variance is explained by these factors. PCA technique using principal axis factoring exhibited 7.08, 2.36, 1.38, 1.12 and 1.03, explaining 37.27%, 12.42%, 7.26%, 5.89% and 5.44% of the variance respectively and 68.28% of the total variance.

Table 5.32: Total Variance Explained for the benefits of a construction manager in a project

Total Variance Explained						
Component	Total	Initial Eigen values		Extraction Sums of Squared Loadings		
		% of Variance	Cumulative %	Total	% of Variance	Cumulative %
CMB1	7.081	37.266	37.266	7.081	37.266	37.266
CMB2	2.360	12.422	49.688	2.360	12.422	49.688
CMB3	1.379	7.257	56.945	1.379	7.257	56.945

CMB4	1.119	5.890	62.836	1.119	5.890	62.836
CMB5	1.034	5.441	68.277	1.034	5.441	68.277
CMB6	0.966	5.084	73.361			
CMB7	0.820	4.314	77.675			
CMB8	0.703	3.698	81.373			
CMB9	0.586	3.082	84.455			
CMB10	0.566	2.977	87.432			
CMB11	0.506	2.661	90.093			
CMB12	0.429	2.256	92.349			
CMB13	0.290	1.528	93.877			
CMB14	0.276	1.453	95.330			
CMB15	0.256	1.347	96.677			
CMB16	0.221	1.165	97.842			
CMB17	0.169	0.887	98.729			
CMB18	0.150	0.788	99.516			
CMB19	0.092	0.484	100.000			

5.2.3.6.4 Reliability statistics

Section G (benefits of having a construction manager in a project) had a value of Cronbach's alpha equal to 0.645 which is regarded as 'questionable' but acceptable reliability between items, as shown in table 5.33. If question 18 was deleted, the value of Cronbach's alpha increased to 0.836, which is regarded as 'good' reliability (Tavakol and Dennick, 2011).

Table 5.33: Reliability statistics

question	Benefits of having a construction manager in a project	Mean	Std. Deviation	Corrected Item-Total Correlation	Cronbach's Alpha
CMB1	Conforming with specifications.	4.79	0.409	0.266	0.645
CMB2	Use proper and modern construction equipment.	4.61	0.584	0.619	
CMB3	Use suitable construction methods to suit specific project.	4.83	0.376	0.516	
CMB4	Conformance with construction drawings and specification.	4.87	0.333	0.524	
CMB5	Clear information and communication channel.	4.91	0.291	0.454	
CMB6	Proper coordination between the construction team.	4.92	0.279	0.458	
CMB7	Appointment of experienced contractors.	3.61	1.202	0.236	
CMB8	Adequate planning and organising.	4.92	0.279	0.345	
CMB9	Have complete and suitable design at the right time.	4.71	0.523	0.489	
CMB10	Proper and up-to-date project planning and scheduling.	4.88	0.324	0.441	
CMB11	Effective strategic planning.	4.93	0.251	0.395	
CMB12	Use of appropriate construction methods.	4.76	0.464	0.534	
CMB13	Ensure proper material procurement.	4.74	0.441	0.505	
CMB14	Having frequent progress meeting.	4.84	0.368	0.304	
CMB15	Efficient and timely supply of materials.	4.71	0.458	0.498	
CMB16	Allowance of material price escalation in original tender document.	4.25	0.773	0.389	
CMB17	Ensure up to date technology utilisation.	4.53	0.550	0.440	
CMB18	Decrease number of variation order.	4.02	2.991	0.143	
CMB19	Proper project feasibility study (constructability reviews).	4.96	0.201	0.377	

The corrected item-total correlation for most of the items in the table above was above 0.3 (Tavakol and Dennick, 2011). Because the sample was higher, 119 participants, all items with the value above 0.2 may be accepted. Question CMB18 had correlation value below 0.2 which increased the chances

of being dropped as it was not correlating with the overall scale from its respective section, this question had the values of 0.143.

Table 5.34 shows the Cronbach's alpha for section A when item 18 is deleted. The new value is 0.846 indicating a good reliability between items which suggests that items there is a higher internal consistency between the items (Tavakol and Dennick, 2011).

Table 5.34: Cronbach's alpha when item 9 is deleted

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardised Items	No of Items
0.836	0.899	18

5.2.3.6.5 Descriptive statistics for the benefits of having a construction manager in a project

Table 5.35: Descriptive statistics for the descriptive statistics for benefits of having a construction manager in a project

question	Benefits of having a construction manager in a project	Mean	Std. Deviation	Relative Importance Index	Rank
CMB1	Conforming with specifications.	4.79	0.409	0.609	9
CMB2	Use proper and modern construction equipment.	4.61	0.584	0.536	14
CMB3	Use suitable construction methods to suit specific project.	4.83	0.376	0.613	8
CMB4	Conformance with construction drawings and specification.	4.87	0.333	0.651	6
CMB5	Clear information and communication channel.	4.91	0.291	0.727	4
CMB6	Proper coordination between the construction team.	4.92	0.279	0.798	3
CMB7	Appointment of experienced contractors.	3.61	1.202	0.515	18
CMB8	Adequate planning and organising.	4.92	0.279	0.798	3
CMB9	Have complete and suitable design at the right time.	4.71	0.523	0.584	11
CMB10	Proper and up-to-date project planning and scheduling.	4.88	0.324	0.672	5
CMB11	Effective strategic planning.	4.93	0.251	0.813	2
CMB12	Use of appropriate construction methods.	4.76	0.464	0.588	10
CMB13	Ensure proper material procurement.	4.74	0.441	0.567	12
CMB14	Having frequent progress meeting.	4.84	0.368	0.630	7
CMB15	Efficient and timely supply of materials.	4.71	0.458	0.550	13
CMB16	Allowance of material price escalation in original tender document.	4.25	0.773	0.521	16
CMB17	Ensure up to date technology utilisation.	4.53	0.550	0.525	15
CMB18	Decrease number of variation order.	4.02	2.991	0.520	17
CMB19	Proper project feasibility study (constructability reviews).	4.96	0.201	0.845	1

Table 5.35 shows the nineteen benefits of having a construction manager in a project. Proper project feasibility study (constructability reviews) was ranked first with an RII value of 0.845, whereas effective strategic planning was ranked second with an RII of 0.813. Proper coordination between the construction team and adequate planning and organising were ranked third with an RII of 0.798. Clear information and communication channel were ranked fourth with RII of 0.727. Proper and up-to-date project planning and scheduling ranked fifth with an RII of 0.672 and conformance with construction drawings and specification ranked sixth with RII value of 0.651. Followed having frequent progress meeting (7), use suitable construction methods to suit specific project (8), conforming with specifications (9) and use of appropriate construction methods (10) with RII values of 0.630, 0.613, 0.609 and 0.588 respectively. Having complete and suitable design at the right time was ranked

eleventh with an RII of 0.584. Ensuring proper material procurement ranked twelfth with RII value of 0.567, efficient and timely supply of materials ranked at thirteenth with RII value of 0.550, followed by Use proper and modern construction equipment (14), ensure up to date technology utilisation (15) and allowance of material price escalation in original tender document (16) with RII values of 0.536, 0.525 and 0.521 respectively. Lastly, decrease number of variation order was ranked seventeenth with RII of 0.520 and appointment of experienced contractors was ranked eighteenth with RII of 0.515 (Johnson and LeBreton, 2004).

5.2.3.7 Section H: Rating of a past project in terms of quality during construction phase

5.2.3.7.1 Questions and results

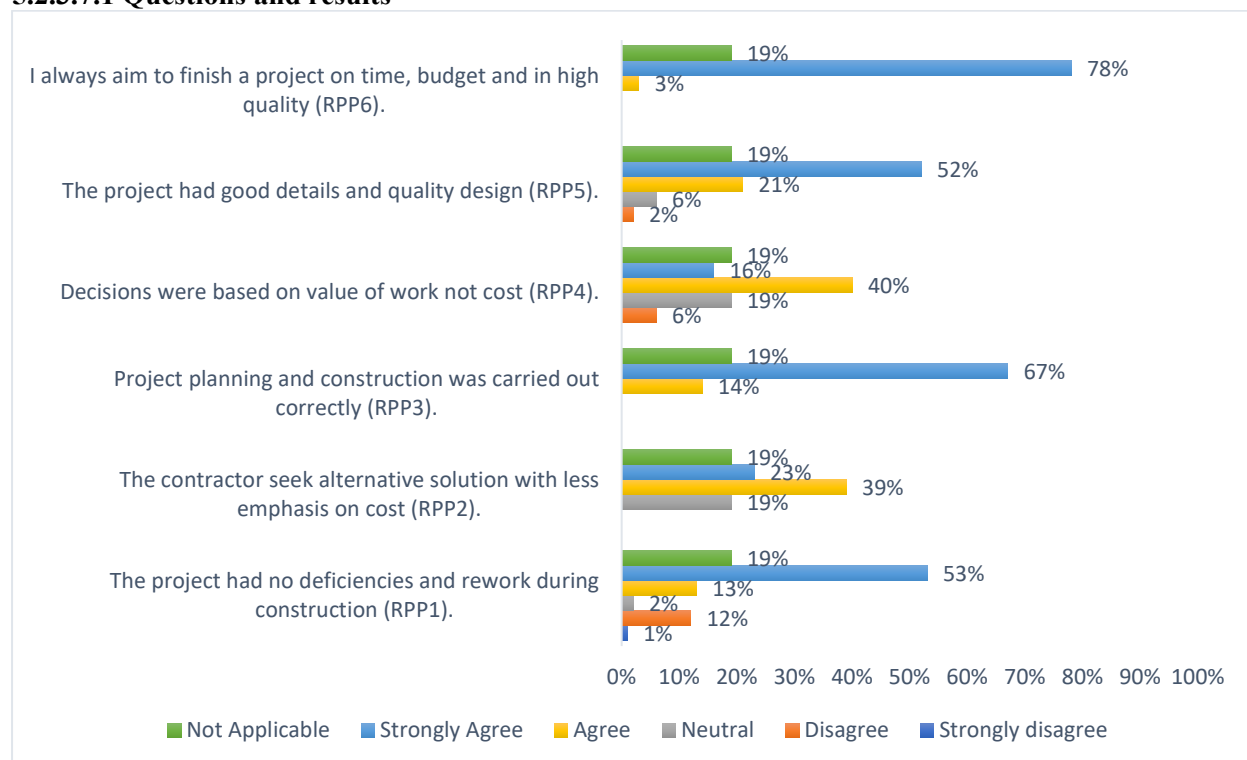


Figure 5.6: Rating of a past project in terms of quality during construction phase

Figure 5.6 shows the responses of section 7, subpart A. The participants rated their past projects in terms of quality during construction phase. Majority (66%) of participants agreed that their projects had no deficiencies and rework during construction. This is usually caused by the proper planning and management of a project. However, 19% of them had never worked on any project before because they are academics and/or working on their first projects. The minority (19%) of participants were unsure if the contractor sought alternative solutions with less emphasis on cost. Apart from the 19% of participants who never worked on any project before, the majority (81%) agreed that the project planning and construction were carried out correctly. The minority (6%) disagreed that the decisions were based on value of work not cost. The majority (74%) of participants agreed that the project had good details and quality design. All the participants who have worked on other projects previously, they agreed that they always aim to finish a project on time, budget and in high quality.

5.2.3.7.2 KMO and Bartlett's test

Table 5.36 illustrates that KMO value was 0.79 thereby exceeding the recommended value of 0.50 (Hoque, *et al.*, 2018) and the Bartlett's test of sphericity (Somaini, *et. al.*, 2016) reached statistical significance at $p = 0.000$ ($p < 0.05$) thereby supporting the factorability of the correlation matrix (Pallant, 2013). This indicates that a factor analysis was useful for the data.

Table 5.36: KMO and Bartlett's Test for rating of a past project in terms of quality during construction phase

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.793
Bartlett's Test of Sphericity	Approx. Chi-Square	515.274
	df	15
	Sig.	.000

5.2.3.7.3 Factor analysis of the rating of a past project in terms of quality during construction phase

Table 5.37 indicates the factor matrix of the factors affecting quality. A one-factor solution which comprised of six out of the six questions was favoured yielding Eigen values greater than one. The results revealed the loadings of each of the items which were extracted through principal axis factoring. All six of the items loaded strongly on the component and so they were considered as factors influencing the co-variation among multiple observations. (>0.5) (Pallant, 2013). No item was suppressed.

Table 5.37: Factor analysis for the rating of a past project in terms of quality during construction phase

Component Matrix ^a		Component
		1
RPP1	The project had no deficiencies and rework during construction.	0.762
RPP2	The contractor sought alternative solution with less emphasis on cost.	0.816
RPP3	Project planning and construction was carried out correctly.	0.893
RPP4	Decisions were based on value of work not cost.	0.847
RPP5	The project had good details and quality design.	0.823
RPP6	I always aim to finish a project on time, budget and in high quality.	0.870

Table 5.38 indicates how much variance is explained by these factors. PCA technique using principal axis factoring exhibited 4.20, explaining 69.91% of the variance respectively and 69.91% of the total variance.

Table 5.38: Total Variance Explained for the rating of a past project in terms of quality during construction phase

Total Variance Explained						
Component	Total	Initial Eigen values		Extraction Sums of Squared Loadings		
		% of Variance	Cumulative %	Total	% of Variance	Cumulative %
RPP1	4.195	69.913	69.913	4.195	69.913	69.913
RPP2	0.680	11.333	81.246			
RPP3	0.421	7.015	88.261			
RPP4	0.369	6.154	94.415			
RPP5	0.216	3.602	98.017			

RPP6	0.119	1.983	100.000			
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4.2.3.7.4 Reliability statistics

Section G (1) (rating of a past project in terms of quality during construction phase) had a Cronbach's alpha value equal to 0.879, regarded as 'good' reliability, as shown in table 5.39 (Tavakol and Dennick, 2011).

Table 5.39: Reliability statistics

question	Rating of a past project in terms of quality during construction phase	Mean	Std. Deviation	Corrected Item-Total Correlation	Cronbach's Alpha
RPP1	The project had no deficiencies and rework during construction.	4.62	1.214	0.650	0.879
RPP2	The contractor sought alternative solution with less emphasis on cost.	4.44	1.005	0.727	
RPP3	Project planning and construction was carried out correctly.	5.05	0.580	0.818	
RPP4	Decisions were based on value of work not cost.	4.24	1.142	0.760	
RPP5	The project had good details and quality design.	4.82	0.873	0.745	
RPP6	I always aim to finish a project on time, budget and in high quality.	5.16	0.431	0.778	

The corrected item-total correlation for all the items in the table above was above 0.3 (Tavakol and Dennick, 2011). All the items correlated well with each other.

4.2.3.7 Section H (2): Rating of a past project in terms of quality during handover phase

4.2.3.6.1 Questions and results

Figure 5.7 shows the responses on subpart b of rating the past project. *"Handover is a process not a date. Planning for it should be from the start of the project and it should be viewed as an incremental transfer of knowledge and operation from project team to business-as-usual (ibid). The benefits and deliverables must be measurable and communicable from the start"*(PMBOK, 2017:15). On this section, twenty percent (20%) of the research participants did not take part since they were not previously being involved in any project. The majority (72%) of the participants were satisfied with the quality of the subcontracted work in the handover stage. The majority (54%) of participants were very satisfied with the project management and implementation of agreed quality assurance procedures. All the participants were satisfied with the workability of handover material and maintenance manuals. The majority (78%) of participants were satisfied with the quality assignment material and maintenance manual. Eighty percent (80%) of participants were satisfied with the degree of completion at handover inspection. Above 70% of the participants were satisfied with the repair of defects and deficiencies noticed during handover inspection (77%) and also satisfied with adherence to schedule as per mutual agreement (80%).

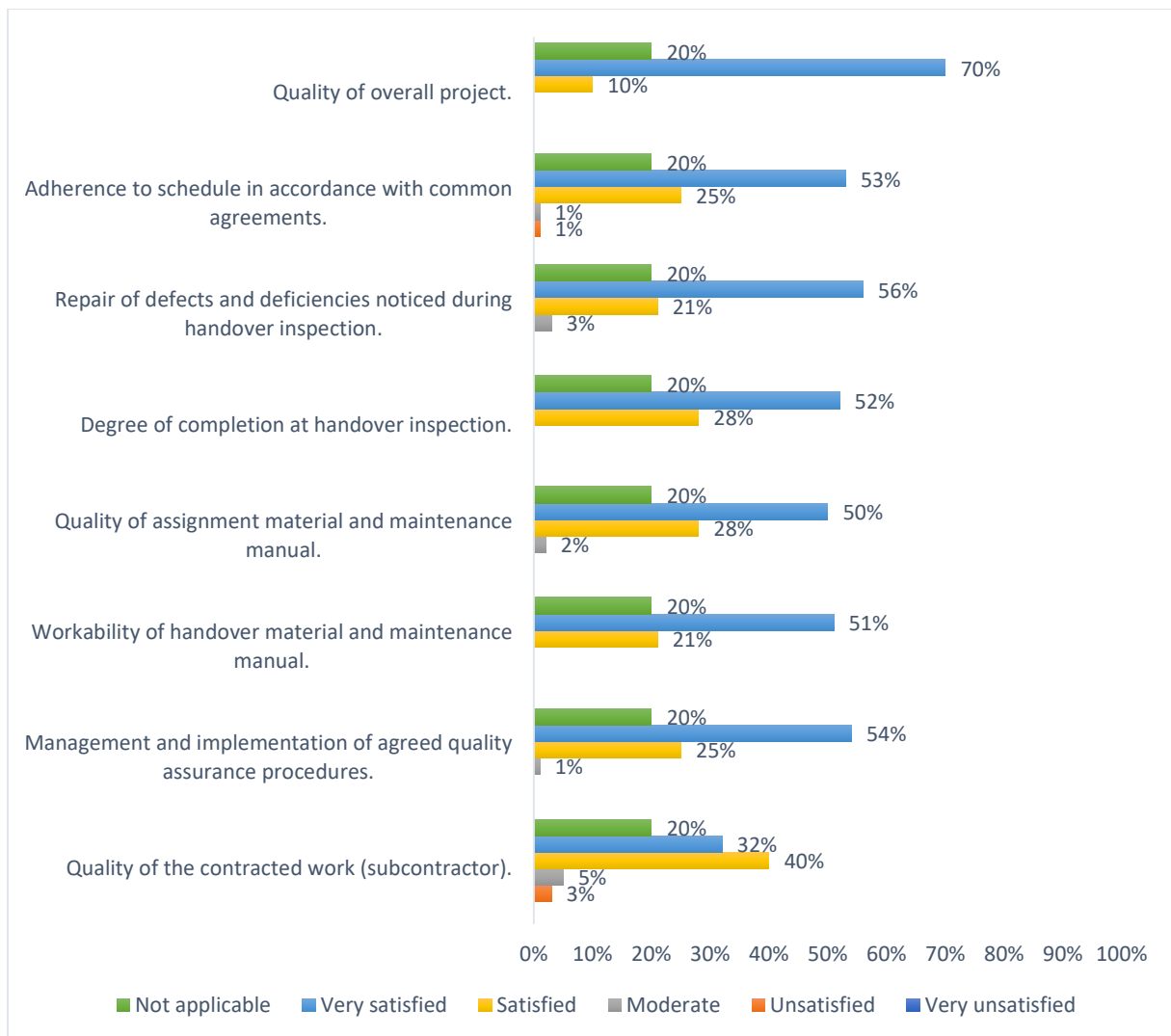


Figure 5.7: Quality assurance and handover

5.2.3.7.2 KMO and Bartlett's test

Table 5.40 illustrates that KMO value was 0.91 thereby greater than the suggested value of 0.50 (Hoque, *et al*, 2018) and the Bartlett's test of sphericity (Somaini, *et. al.*, 2016) reached statistical significance at $p = 0.000$ ($p < 0.05$) thus supporting the factorability of the correlation matrix (Pallant, 2013). This specifies that a factor analysis was useful for the data.

Table 5.40: KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.914
Bartlett's Test of Sphericity	Approx. Chi-Square	1444.272
	df	28
	Sig.	.000

5.2.3.7.3 Factor analysis of the rating of a past project in terms of quality during handover phase

Table 5.41 indicates the factor matrix of the factors affecting quality. A one-factor solution which comprised of eight out of the eight questions was favoured yielding Eigen values greater than one (Pett, *et al.*, 2003). The results revealed the loadings of each items which were extracted through principal axis factoring. All eight of the items loaded strongly on the component and so they were considered as factors influencing the co-variation among multiple observations. (>0.5) (Pallant, 2013). No item was suppressed.

Table 5.41: Factor matrix for the rating of a past project in terms of quality during handover phase

	Component Matrix^a	Component
		1
1	Quality of the contracted work (subcontractor).	0.792
2	Management and implementation of agreed quality assurance procedures.	0.954
3	Workability of handover material and maintenance manual.	0.961
4	Quality of assignment material and maintenance manual.	0.950
5	Degree of completion at handover inspection.	0.961
6	Repair of defects and deficiencies noticed during handover inspection.	0.938
7	Adherence to schedule in accordance with common agreements.	0.948
8	Quality of overall project.	0.856

Table 5.42 illustrates how much variance explained by these factors. PCA technique using principal axis factoring exhibited 6.80, explaining 85.00% of the variance respectively and 85.00% of the total variance.

Table 5.42: Total Variance Explained for the rating of a past project in terms of quality during handover phase

Total Variance Explained						
Component	Total	Initial Eigen values		Extraction Sums of Squared Loadings		
		% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.800	84.998	84.998	6.800	84.998	84.998
2	.430	5.372	90.370			
3	.302	3.776	94.146			
4	.143	1.784	95.930			
5	.111	1.388	97.318			
6	.107	1.338	98.656			
7	.080	.995	99.651			
8	.028	.349	100.000			

5.2.3.7.4 Reliability statistics

Section G (2) (rating of a past project in terms of quality during construction phase) had a Cronbach's alpha value equals to 0.97 which is regarded as 'good' reliability, as shown in table 5.43 (Tavakol and Dennick, 2011).

Table 5.43: Reliability statistics

question	Quality assurance and handover	Mean	Std. Deviation	Corrected Item-Total Correlation	Cronbach's Alpha
QAH1	Quality of the contracted work (subcontractor).	4.64	0.963	0.742	0.969
QAH2	Management and implementation of agreed quality assurance procedures.	4.92	0.691	0.938	
QAH3	Workability of handover material and maintenance manual.	4.91	0.701	0.945	
QAH4	Quality of assignment material and maintenance manual.	4.89	0.734	0.931	
QAH5	Degree of completion at handover inspection.	4.92	0.691	0.944	
QAH6	Repair of defects and deficiencies noticed during handover inspection.	4.94	0.717	0.909	
QAH7	Adherence to schedule in accordance with common agreements.	4.90	0.741	0.927	
QAH8	Quality of overall project.	5.08	0.530	0.813	

The corrected item-total correlation for all the items in the table above was above 0.3 (Tavakol and Dennick, 2011). All the items correlated well with each other.

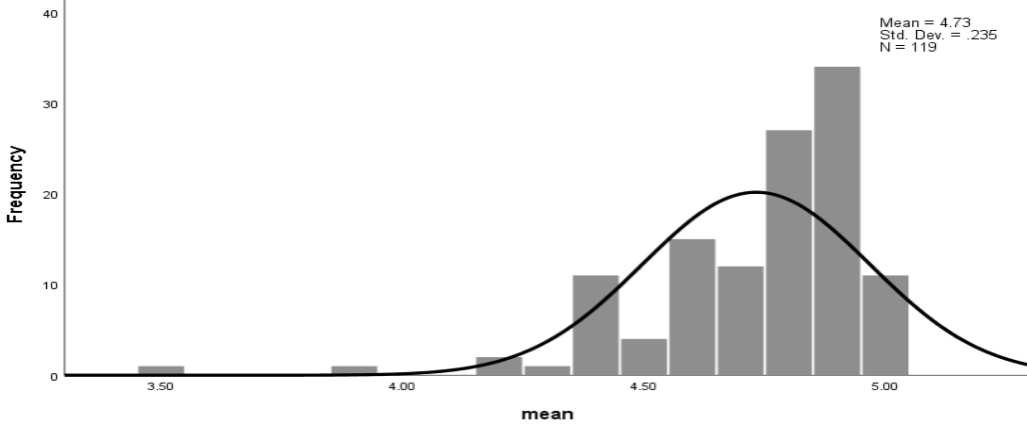
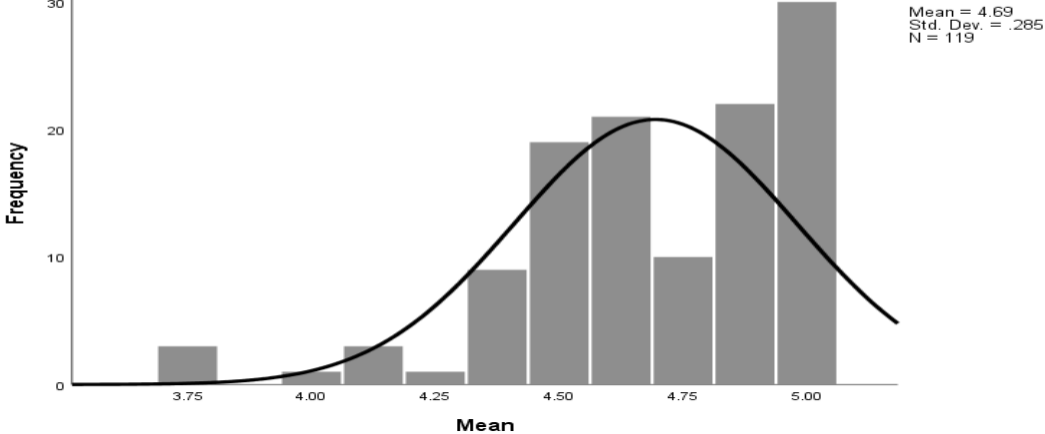
5.2.4 Computed variable analysis

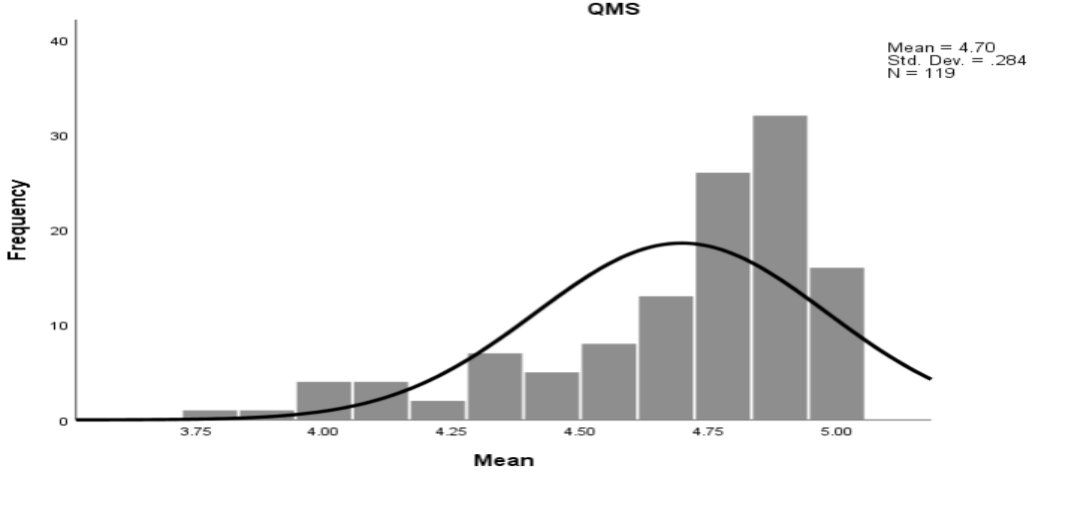
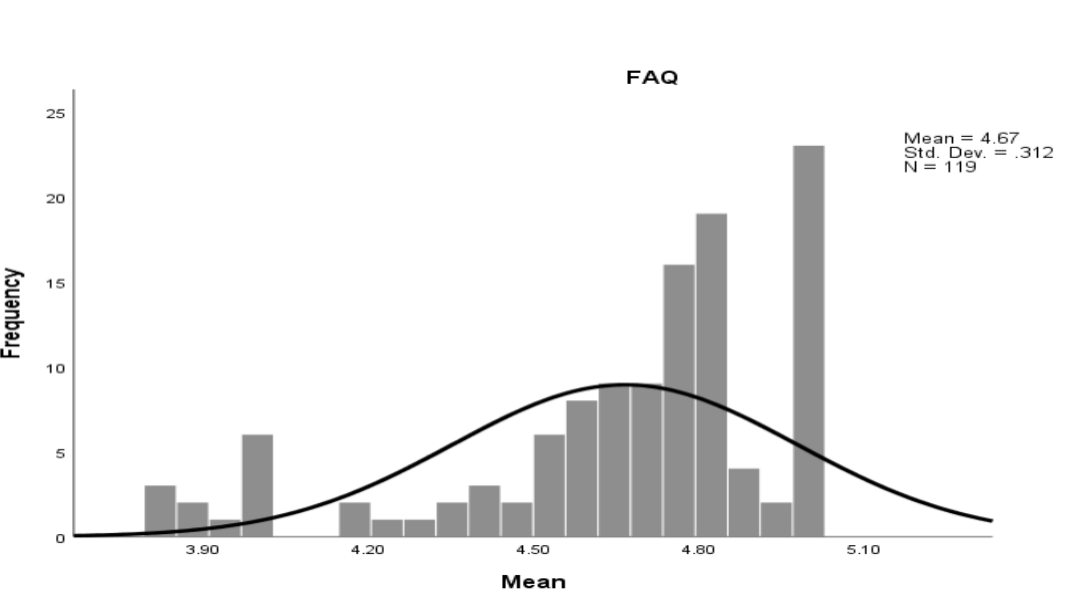
Table 5.44 shows the computed variables of each section to work out the overall skewness and means. Skewness alludes to distortion or deviation in a symmetrical bell curve, or normal distribution, in a set of data. If the curve is shifted to the left or to the right, it is said to be skewed (Tavakol and Dennick, 2011). Skewness can be evaluated as a representation of the extent to which a given distribution varies from a normal distribution (*ibid*). the skewness for a normal distribution is zero, and any symmetric data should have a skewness near zero. Negative values for skewness indicate data that are skewed to the left and positive values for the skewness indicate data that are skewed to the right.

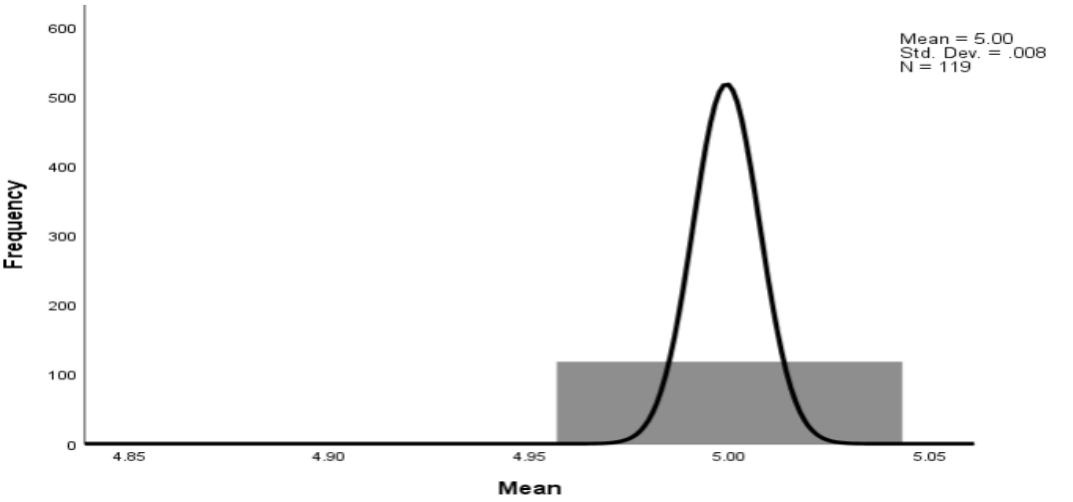
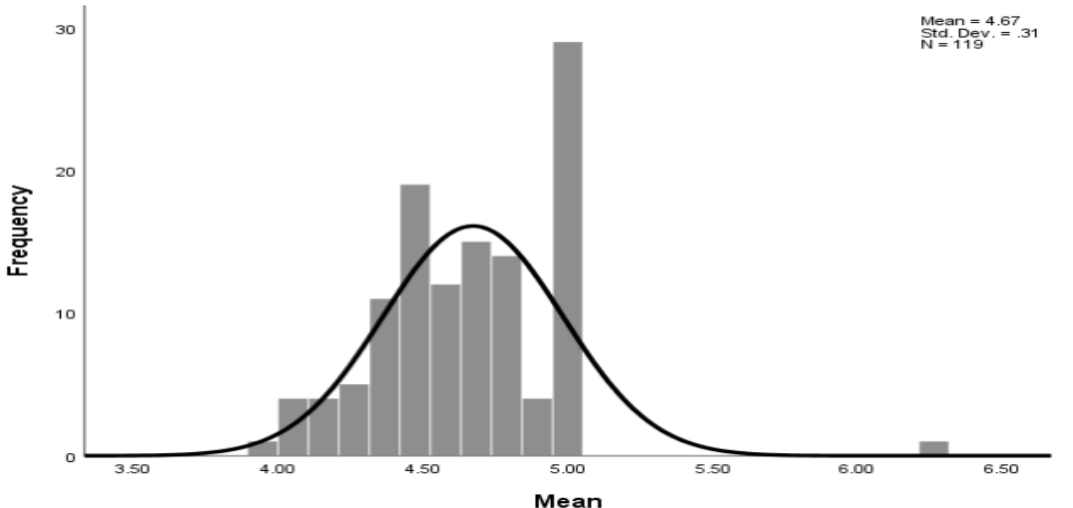
Table 5.44: Computed Variables statistics

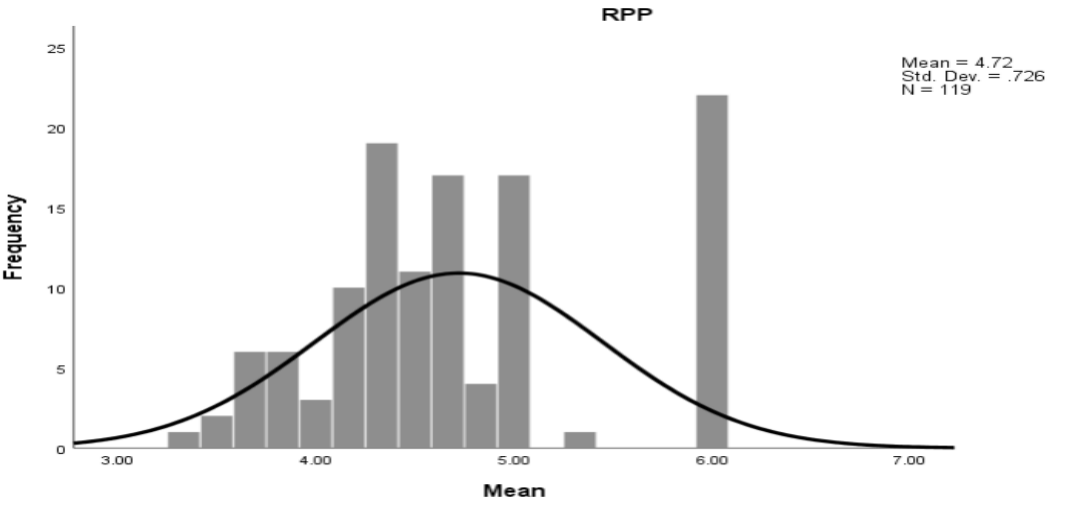
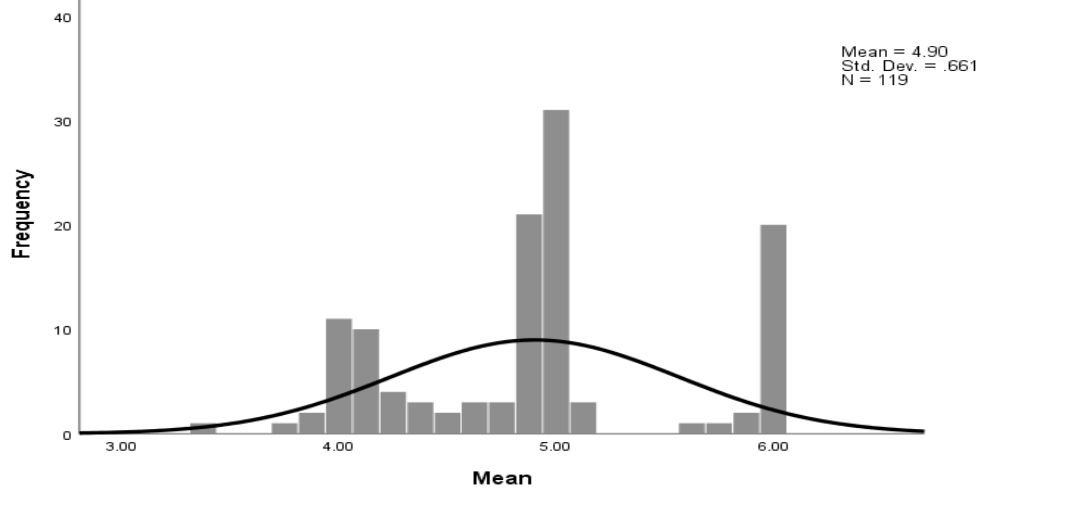
	Mean	Standard deviation	Skewness
General understanding of quality	4.7319	0.235	-1.938
Construction Managers' perspective of quality	4.6943	0.286	-1.094
Quality Management Systems (QMS)	4.6965	0.284	-1.291
Factors affecting quality	4.6663	0.313	-1.243
Attributes of a construction manager	4.9992	0.008	-10.909
Benefits of having a construction manager in a project	4.6732	0.310	0.699
Rating of a past project in terms of quality during construction phase	4.7213	0.726	0.564
Quality assurance and handover	4.9013	0.661	0.230
Participants	119		

Table 5.45: computed variables

COMPUTED ITEM	GRAPH	ANALYSIS
General understanding of quality	GUQ  Mean = 4.73 Std. Dev. = .235 N = 119	The mean was 4.73 showing that the participants understood what quality was. The graph is negatively skewed showing that most of the responses were between level 4 (agree) and level 5 (strongly agree). The graph is skewed to the left or negatively skewed by 1.938.
Construction Managers' perspective of quality	QMP  Mean = 4.69 Std. Dev. = .285 N = 119	The mean was 4.69 showing that the participants understood role of a construction manager in ensuring quality projects and how they perceive quality is different than other stakeholders. The graph is negatively skewed showing that most of the responses were between level 4 (agree) and level 5 (strongly agree). The graph is skewed to the left or negatively skewed by 1.094.

Quality Management Systems (QMS)	QMS  Mean = 4.70 Std. Dev. = .284 N = 119	The mean was 4.70 showing that the participants understood what quality management systems to be used to ensure quality and the roles of a construction manager. The graph is negatively skewed showing that most of the responses were between level 4 (agree) and level 5 (strongly agree). The graph is skewed to the left or negatively skewed by 1.291.
Factors affecting quality	FAQ  Mean = 4.67 Std. Dev. = .312 N = 119	The mean was 4.67 showing that the participants understood the factors affecting quality within construction projects. The graph is negatively skewed showing that most of the responses were between level 4 (agree) and level 5 (strongly agree). The graph is skewed to the left or negatively skewed by 1.243.

Attributes of a construction manager	CMA  Mean = 5.00 Std. Dev. = .008 N = 119	The mean was 5.00 showing that the participants strongly agreed that there are really certain attributes one must have to become a competent CM. The graph is negatively skewed showing that most of the responses were between level 4 (agree) and level 5 (strongly agree). The graph is skewed to the left or negatively skewed by 10.909.
Benefits of having a construction manager in a project	CMB  Mean = 4.67 Std. Dev. = .31 N = 119	The mean was 4.67 showing that the participants really believed that a construction manager has a major role within the industry. The graph is negatively skewed showing that most of the responses were between level 4 (agree) and level 5 (strongly agree). The graph is skewed to the right or positively skewed by 0.699.

Rating of a past project in terms of quality during construction phase	RPP  Mean = 4.72 Std. Dev. = .726 N = 119	The mean was 4.72 showing that the participants were not happy with how the details of project were made available to them but made sure the construction phase was carried out perfectly. The graph is negatively skewed showing that most of the responses were between level 4 (agree) and level 5 (strongly agree). The graph is skewed to the right or positively skewed by 0.564.
Quality assurance and handover	QAH  Mean = 4.90 Std. Dev. = .661 N = 119	The mean was 4.90 showing that the participants were impressed by the quality of their past projects. The graph is negatively skewed showing that most of the responses were between level 4 (satisfied) and level 5 (very satisfied). The graph is slightly skewed to the right or positively skewed by 0.230.

5.2.5 Relationship of significance

“Spearman’s correlation is a nonparametric measure of the strength and direction of association that exists between two variables measured on at least an ordinal scale” (Hauke and Kossowski, 2011:16).

Spearman’s correlation coefficient uses ranks to calculate the correlation. Values for the coefficient correlation ranges from -1.00 to +1.00 (Rebekić, Lončarić, Petrović, and Marić, 2015). A positive correlation implicates that an increase in the first variable would correspond with an increase in the second variable and a negative coefficient suggests an inverse relationship (*ibid*). The correlation coefficient, r , explains the strength and direction of the linear relationship between x and y . However, the reliability of the linear model also depends on how many observed data points are in the sample. Therefore, the focus must be in both the values of the correlation coefficient r and the sample size n , together. (Hauke and Kossowski, 2011).

Level of significance

The value of the correlation coefficient was set at 5% (Kimberlin and Winetrstein, 2008). The following scale is in relation to the Spearman’s coefficient correlation which indicates the relationship between two variables.

- - 0.10 – no correlation;
- 0.10 – 0.25 –very weak correlation;
- 0.25 – 0.40 – weak;
- 0.40 – 0.50 – modest;
- 0.50 – 0.75 – strong;
- 0.75 – 0.90 – very strong;
- 0.90 – 1.0 – full correlation; and
- 0.90-1.0, full correlation
- 2 stars show 99% confidence, 1 star, 95%
- $p>0.05$ “no relationship of significance”

$p<0.05$ “there is a relationship of significance” (Hauke and Kossowski, 2011 & Pantić, *et al*, 2010).

Table 5.46: Spearman's correlation between computed variables

Correlations			General understanding of quality	Construction Managers' perspective of quality	Quality Management Systems	Factors affecting quality	Attributes of a construction manager	Benefits of having a construction manager in a project	Rating of a past project in terms of quality during construction phase	Quality assurance and handover
Spearman's rho	General understanding of quality	Correlation Coefficient	1.000	0.364**	0.128	0.208*	0.155	-0.038	0.119	0.172
		Sig. (2-tailed)	.	0.000	0.165	0.023	0.093	0.678	0.198	0.061
	Construction Managers' perspective of quality	Correlation Coefficient	0.364**	1.000	0.146	0.078	0.153	-0.035	0.190*	0.203*
		Sig. (2-tailed)	0.000	.	0.114	0.400	0.098	0.705	0.039	0.027
	Quality Management Systems	Correlation Coefficient	0.128	0.146	1.000	0.403**	0.004	0.564**	0.278**	0.094
		Sig. (2-tailed)	0.165	0.114	.	0.000	0.965	0.000	0.002	0.308
	Factors affecting quality	Correlation Coefficient	0.208*	0.078	0.403**	1.000	0.136	0.481**	0.259**	0.206*
		Sig. (2-tailed)	0.023	0.400	0.000	.	0.139	0.000	0.004	0.024
	Attributes of a construction manager	Correlation Coefficient	0.155	0.153	0.004	0.136	1.000	0.143	0.128	0.136
		Sig. (2-tailed)	0.093	0.098	0.965	0.139	.	0.122	0.164	0.140
	Benefits of having a construction manager in a project	Correlation Coefficient	-0.038	-0.035	0.564**	0.481**	0.143	1.000	0.324**	0.139
		Sig. (2-tailed)	0.678	0.705	0.000	0.000	0.122	.	0.000	0.132
	Rating of a past project in terms of quality during construction phase	Correlation Coefficient	0.119	0.190*	0.278**	0.259**	0.128	0.324**	1.000	0.699**
		Sig. (2-tailed)	0.198	0.039	0.002	0.004	0.164	0.000	.	0.000
	Quality assurance and handover	Correlation Coefficient	0.172	0.203*	0.094	0.206*	0.136	0.139	0.699**	1.000
		Sig. (2-tailed)	0.061	0.027	0.308	0.024	0.140	0.132	0.000	.

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Table 5.46 shows a 99% confidence that there is a weak positive relationship of significance (0.36) between 'general understanding of quality' and 'construction managers' perspective of quality'. This means when there is a change in one of them, the other is also affected in the same direction but slower. There is a 95% confidence that there is a very weak positive relationship of significance (0.21) between 'general understanding of quality' and 'factors affecting quality'. There is no relationship of significance between 'general understanding of quality' and quality management system (0.13), attributes of a construction manager (0.16), rating of a past project in terms of quality during construction phase (0.12) and quality assurance and handover (0.17) that is because the correlation co-efficient is too small, it is less than 0.2 which is very weak (Govender, 2006). There is

no relationship of significance between 'general understanding of quality' and 'benefits of having a construction manager in a project' (0.04), the correlation co-efficient is too small.

There is 95% confidence that there is a very weak positive relationship of significance (0.19) between 'construction managers' perspective of quality' and 'rating of a past project in terms of quality during construction phase'. There is also a 95% confidence that there is a positive weak relationship of significance (0.20) between 'construction managers' perspective of quality' and 'quality assurance and handover'. There is no relationship of significance between 'construction managers' perspective of quality' and 'quality management systems' (0.15), 'factors affecting quality' (0.08) and 'attributes of a construction manager' (0.15).

There is 99% confidence that there is a modest positive relationship of significance (0.40) between 'quality management systems' and 'factors affecting quality' because the correlation co-efficient ranges from 0.4 to 0.59 (Govender, 2006). There is 99% confidence that there is a strong positive relationship of significance (0.56) between 'quality management systems' and 'benefits of having a construction manager in a project'. There is 99% confidence that there is a weak positive relationship of significance (0.28) between 'quality management systems' and rating of a past project in terms of quality during construction phase'.

5.3 Questionnaire summary

The participants of the survey questionnaires were 119 construction managers from around South Africa. They were registered with SACPCMP either as Candidate Construction Manager (CCM) or Professional Construction Manager (PrCM). The participants were chosen because the research focused on their discipline. The aim was to find their perspective on quality in construction industry and the methods they utilise to ensure quality during construction phase and after. All the participants had a background understanding about quality as a whole as well as quality management systems and the factors affecting quality like non-conformance with regulations and specifications, use of unskilled labour and contractors, etc. The study showed that indeed for one to become a competent construction manager must have effective communication skills, strong leadership skills, technical expertise and be a good decision maker and a lifetime learner. There were those variables that correlated very well and are inclusive of rating of a past project in terms of quality during construction phase' and 'quality assurance and handover'.

5.4 Construction Managers' interview

Twenty construction managers were chosen as participants for probing about quality in construction for research purposes. Only 15 participants availed themselves and the other 5 were not available due to busy schedules. The purpose of the interviews was to explore their perception of quality, to find what quality management systems they use and also find the factors affecting quality. The interview was composed of 30 questions and a table with the rating of construction management attributes.

5.4.1 Interviews response rate

The construction managers from around South Africa were needed for the interviews as the research was focused on that specific discipline. The researcher tried by all means to get participants from all the groups, i.e., females, males, Africans, Coloureds, Indians and whites. The participants worked for the contractors, consulting firms or were academics. In total, 15 construction managers participated, indicating an 75% response rate. The interviews took an average of 30 minutes. All the questions were answers without any undue influence, and they had enough time to respond to questions. All the interviews took place after office hours. The questions were clear and straightforward.

5.4.2 Demographics

Table 5.47: Interview demographics

		Frequency	Percent
Gender	Male	10	67%
	Female	5	33%
	Total	15	100%
Race	African	8	54%
	Coloured	2	13%
	Indian	3	20%
	White	2	13%
	Total	15	100%
Age	25 - 30	5	33%
	31 - 40	5	33%
	41 - 50	4	27%
	51 - 60	1	7%
	Total	15	100%
Qualifications	Diploma	6	40%
	BSc	4	26%
	Honours	3	20%
	Masters	1	7%
	PHD	1	7%
	Total	15	100%
Experience (years)	1 - 10	8	53%
	11 - 20	3	20%
	21 - 30	3	20%
	31 - 40	1	7%
	Total	15	100%
SACPCMP registered	Candidate	7	47%
	Professional	8	53%
	Total	15	100%

As shown in table 5.47, majority (ten out of fifteen) of the participants were male and only five were females. Eight participants were Africans, two were coloured, three were Indians and two were Whites. The participants had been in the industry for a period ranging from one year up to forty years. Their ages ranged from 25 to 59 years. The majority of participants had Honours degrees (6), followed by Diplomas (4), Masters (3), PHDs (1) and Bachelor's degrees (1). The years of experience ranged from 1 – 34 years. All the participants were registered with SACPCMP, with 8 participants registered as professionals and 7 registered as candidates.

5.4.3 NVivo analysis

Qualitative data collected was analysed utilising NVivo analysis (v12), as it provides a vastly flexible approach that can be modified for the needs of many studies, providing a rich and detailed, yet complex data (Fereday and Muir-Cochrane, 2006). The NVivo analysis used and approached in an inductive way where coding and theme development focused on the content of the information(*ibid*). Based on the content of the data, as shown in figure 5.8, the following themes emerged:

- A. Quality in construction;
- B. Attributes of a quality project;
- C. Factors affecting quality;
- D. Quality Management Systems;
- E. Attributes of a Construction Manager.



Figure 5.8: Research themes

A. Quality in construction

All participants understood quality as conformance to requirements, may be a product or service. Participant 1 added that *“quality in its simplest structure can be characterised as meeting the clients’ needs or compliance with the specifications”*. Participant 5 stated that *‘the easiest approach to understand the field of quality project is to portray it as a sum of four pillars, namely: ‘customer satisfaction, measure improvement, fact-based management and the empowered performance’*. All the participants agreed that construction projects are a balance between cost, time and quality. Participant 2 added that *“‘Time’ is the available time carry out a project, ‘cost’ signifies the available money and ‘quality’ signifies the fit-to-purpose that the project must achieve to be a success”*. Therefore, it is essential to consider the other factors whenever talking with one of them. Nine out of fifteen participants mentioned that poor quality in construction is manifested in poor or non-sustainable workmanship, and unsafe structures; and in delays, cost overruns and disputes in construction contracts. Participant 2 and 3 highlighted that for a project to be considered to be of quality, it must be fit for purpose and or reach practical completion, it must have no defects at final completion, it must conform to client’s requirements and regulatory requirements. When asked if there is any difference between quality and excellence, ten out of fifteen participants agreed, generally stating that quality is just doing everything according to specifications but excellence on the other hand, is going way beyond the given specifications and including extras on a project while ensuring it still conforms to quality regulations.

B. Attributes of a quality project

Participant 4 before giving attributes of a project, described the features of a project. Saying *“a project is typically for a customer. The project is temporary in nature. It typically has a defined start and a defined end-point’. The project will have a unique set of necessities that need to be delivered within the boundaries of this project. A project is typically for a customer/client”*. He then added that a project must meet client’s expectations and conform to the specifications as given by the client and designer. Other participants elucidated that for a project to be of quality, it must meet or exceed customer expectations, conform with quality regulations, be fit for its purpose after construction. Participant 5 and 6 added that consistency is essential as it helps in ensuring finishing the project within its objectives, and also builds a strong relationship between contracting parties.

The participants generally ensure quality of a project by defining the quality measures and project requirements, and focus on them. Balance continual project improvements with gold-plate requirements. Project Management Institute (2017) defined *‘gold plating’* as the act of making changes to a project that are not part of the original scope, also known as variations. Participant 7 said she ensures the construction of a quality project by (1) ensuring that the relevant stakeholders sign the project brief she developed, that also includes business case, project charter etc; (2), she makes sure that Basic Assessment is done to prepare for the design. At stage 3, she oversees the design done by

either architect or engineers, this one is most critical stage because if issues are not resolved here that will lead to a disastrous construction. *‘You cannot construct something that does not conform to requirements. I ensure that the design itself meets the employer’s needs and specifications and also NHBRC regulations for a building project’*. Other participants added that once the construction phase has commenced, one must oversee quality by working hand in hand with the project team to characterise a viable approach to managing quality, including pertinent standards and quality processes. These are driven by all accounts and processes contained in the project outline. Additionally, perform quality assurance by executing quality management plan utilising the standards and processes defined in the project blueprint. They perform a quality auditing to evaluate how well the team is complying to the quality plan and meeting the project requirements. Lastly, they control the quality by guaranteeing the expectations are correct and free of defects and focus on quality from the conception of a project to completion

Participant 9 said she performs inspections to detect imperfections. *“I Start as early as possible; identifying and correcting defects close to the point of origin as it saves time and money”*. She holds site and technical meetings to address issues faced on site. She reports to project internal stakeholders on a monthly basis. She tracks the project progress using earned value management systems (EVM) and also do milestone checklist on site. Respond to some issues according to their response urgency because sometimes decision-making process takes time. Finally, she visits site and do materials verification.

C. Factors affecting quality;

The participants suggested that the right time to identify potential factors affecting quality of a project is at the beginning of the project in Front-end Loading (FEL) Stages, also referred to as pre-project planning (PPP), prior to the construction itself because if those challenges are not resolved, they are carried to the construction phase which frustrate the management of construction. One participant added that *‘to avoid issues, it is essential to deal with any of the factors as soon as it arises’*.

According to all the participants, one of the major areas of concern was poor workmanship. Participant 11 defined workmanship by stating that *‘In simple terms, workmanship is the skill and quality put into making a product or completing a project. If workers or subcontractors are careless or do not follow proper protocol you can end up with a finished product that lacks the quality you have anticipated’*. He added that *‘the other factor is non-conformance with regulations, known as any failure to meet a requirement’*. A requirement can be that of a client, statutory or regulatory body or the organisations. Participant 12 alluded that *‘when a non-conformity occurs, one must react to it by either controlling and correcting it or dealing with the consequences which may be paying big fines or imprisonment’*. Majority of participants (twelve out of fifteen) mentioned the use of ‘incorrect materials’ that it also affects quality of a project. Due to unavailability of material prescribed by the

designers, contractors tend to buy cheaper materials which end up sabotaging the overall project quality. The participants suggest that a construction manager must always double check materials on site and/or ask for samples before material is delivered on site. The participants said quality regulations to be taken into considerations are ISO 9000, ISO 14000, SANS, NHBRC, CIDB and NEMA.

All the participants raised variations as another major factor affecting quality. Changes/variations happen all the time in projects. These changes may or may not be desirable, but changes due to scope creep and gold plating fall under the “undesirable” category. Changes due to these practices are known as uncontrolled change and you must keep them from happening. Managing scope creep and gold plating is a key part of scope management. The participants added that unclear specifications, incomplete designs, lack of communication and inclement weather conditions also affect project quality.

Other factors affecting performance quality of construction projects included lack of construction managers competence, poor monitoring and feedback, lack of on-site project manager, inadequate project team capability, poor planning and control techniques, poor/insufficient information and communication channels, lack of early and continual client/consultant consultation by contractor and insufficient construction managers experience. Participant 5 added that *‘lack of technical and professional expertise and resources to perform task, lack of employee commitment and understanding and lack of education and training to drive the improvement process really negatively affects the project quality’*.

D. Quality Management Systems;

The participants mentioned that project quality comprises of the procedures and activities that determine quality policies, objectives and responsibilities so that the project will gratify the requirements for which it was undertaken. the processes and activities that determine quality policies, objectives and responsibilities so that the project will satisfy the needs for which it was undertaken. Then added that quality management systems (QMS) are defined as a formalised system that document processes, procedures, and responsibilities for achieving quality policies and objectives. When defining the QMS, the participants referred to it as quality planning, quality assurance and quality control. When asked to elaborate, participant 13 alluded that *‘quality assurance specifies standards, quality control verifies compliance to standards. A successful quality assurance program aims to ensure that the quality procedures implemented during the design phase of a construction project effectively meet the company-established standards for quality service, performance and production’*. At a high level, quality assurance covers activities from design, development, production and installation and is designed to ensure your customers *‘know’* your work will be quality; while quality control is more focused on monitoring the actual quality of finished products through

objective measurements and numbers. ISO 9001:2015, the international standard specifying requirements for quality management systems, is the most prominent approach to quality management systems. While some use the term "QMS" to describe the ISO 9001 standard or the group of documents detailing the QMS, it actually refers to the entirety of the system. The QMSs that the participants had used before include ISO 9000, TQM, Six sigma, and PDCA. Participant 14 defined *'Six Sigma' as a quality management methodology used to help businesses improve current processes, products or services by discovering and eliminating defects*. Adding that *'almost all the QMSs works that same, it just depends on what the company uses'*.

E. Attributes of a Construction Manager.

All the participants said for one to be considered as a construction manager who is ready to run his own site must have a tertiary level qualification, be registered under SACPCMP and have more than 2 years of experience. Participant 1 stated that *'the responsibilities of a construction manager are what guide a project to success'*. All the participants mentioned that construction managers oversee and assign resources for various construction projects. Four participants added that, a great construction manager is skilled in both the technical skills required for the job and in leading and directing their team. Projects can vary from residential, commercial, and industrial buildings to bridges and skyscrapers. Participant 15 said *'construction managers oversee all aspects of the construction process, working closely with engineers and architects to develop plans, establish timetables, and determine labour and material costs'*. All the participants mentioned that CMs are responsible for ensuring the project is completed on budget, within scope and of quality. They also hire and manage subcontractors and employees, gather permits, and ensure all aspects of the project are up to code. Participant 15 added that *'the main construction manager responsibilities are overall project planning, distributing resources, time management, risk management, creating benchmarks, managing the budget, managing staff, and managing relationships with key stakeholders'*. Figure 5.9 shows the attributes of a competent construction manager as rated by the participants. Having one as the highest rated to be the essential attribute.

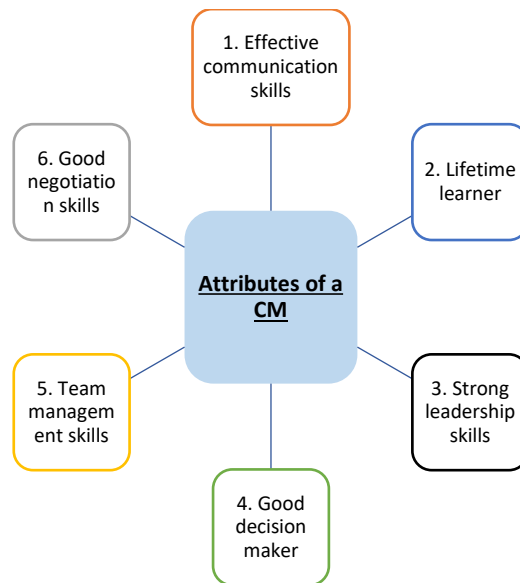


Figure 5.9: Attributes of a CM

1. Effective communication skills

The participants rated this attribute as number one (1). The participants stated that this is because communication skills allow anyone to understand and be understood by others. These can include but are not limited to sharing ideas with others, actively listening in conversations, giving and receiving feedback and public speaking. Participant 14 added that *‘since the construction industry has many different stakeholders, a construction manager is obliged to be able to clearly liaise with all the parties, from labourers to engineers and clients’*. Participant 8 said *‘the ability to communicate effectively with superiors, colleagues, and staff is essential, no matter what industry you work in’*. participant 2 said that *‘being able to give and receive feedback appropriately is an important communication skill’*.

2. Lifetime learner

The participants rated ‘lifetime learner’ as the second (2) essential attribute. Elaborating that the construction industry is an ever-changing environment that requires all the disciplines to adapt with the ever-advancing construction methods, regulations and technologies. Participant 4 described lifetime learning as *‘being voluntary with the purpose of achieving personal fulfilment. The means to achieve this could result in informal or formal education’*. Participant 6 stated that *‘a competent construction manager must be willing to learn something new on a daily basis’*. Participant 3 alluded that *‘lifetime learning can enhance ones understanding of the world around, provide one with more and better opportunities and improve our quality of life’*.

3. Strong leadership skills

The participants rated ‘leadership skills’ as the third (3) essential attribute. One participant mentioned that *‘a leader is one who knows the way, goes the way, and shows the way’*. Adding to that, he stated that *‘irrespective of how one defines a leader, he or she can prove to be a difference maker between*

success and failure'. The participants highlighted that a good leader has a futuristic vision and knows how to turn his ideas into real-world success stories. Being a good leader also requires high-level soft skills, these skills are different from technical skills, that are easier to measure and define. These leadership skills include 'soft skills'. Participant 4 defined 'soft skills' by stating that *'they are more about an employee's character traits and qualities, for example, attitude, work ethic, problem solving abilities, empathy, communication and collaboration'*.

4. Good decision maker

The participants rated 'good decision making' as the fourth (4) essential attribute because a lot of what happens in the construction process is decision making. If one can imagine how many decisions are made each day by the construction manager and people in the office. Participant 1 mentioned that *'the decisions made at any particular stage should reflect the activities that are being undertaken at that stage'*. Adding to that, he stated that *'those decisions should not backtrack, as this will involve abortive costs and the repetition of tasks that have already been undertaken, and they should not leap ahead as this will prejudice activities that have not been undertaken and may produce to inappropriate outcomes'*.

5. Team management skills

The participants rated 'team management skills' as the fifth (5) essential attribute. When asked to elaborate, the participants stated that *'team management is one of the most difficult and necessary skills to master'*. This is because people are all different, and they have strengths and weaknesses that make them who they are. The skill of team management takes those strengths and weaknesses and makes them work together in a smooth-running method. Participant 3 stated that *'this skill is one of the most important, and you cannot be a good construction manager without it. Otherwise, the team would fall apart'*.

6. Good negotiation skills

The participants understood negotiation as a method by which people settle differences. It is a process by which compromise or agreement is reached while avoiding argument and dispute. In the construction industry, negotiation is required at almost every stage of a project, from acquiring land and obtaining planning permission, to making appointments, awarding contracts, negotiating change orders and extensions of time, resolving disputes, and so on. Participant 15 said that *'the ability to influence others is an important skill for negotiation. It can help you define why your proposed solution is beneficial to all parties and encourage others to support your point-of-view'*.

5.4.4 Interview summary

The construction managers were the main focus of the study as it focused on how they perceive quality in the construction projects. The researcher also aimed to find the responsibilities of a construction manager towards quality. The researcher then focused on the attributes of a construction

manager in order to be able perform all the duties which is basically to drive the project to being a success. The participants made it clear that for one to become a construction manager, he must have a tertiary level qualification and more than 2 years of experience. He must be registered under SACPCMP as either a CCM or PrCM. The construction managers agreed that for a project to be considered to be of quality, it must have attributes that include meeting or exceeding customer expectation, be fit for its purpose, conform to specifications as well as regulations (Iso 9000, Iso 14000, SANS, NHBRC, CIDB and NEMA). The QMSs that the participants had used before include ISO 9000, TQM, Six sigma, and PDCA. Lastly, for a construction manager to be able to carry out a quality project, he must show abilities of good communication, lifetime learner, leadership skills, team management and good negotiation skills.

5.5 Triangulation

Triangulation in research is the usage of multiple approaches to investigating a question (Heale and Forbes, 2013). The objective is to increase confidence in the findings through the confirmation of a proposition using two or more independent measures (*ibid*). The combination of findings from two or more rigorous approaches provides a more comprehensive picture of the results than either approach could do alone (Creswell 2013). Triangulation is typically associated with research methods and designs (Creswell and Clark, 2007). However, there are several other variations on the term (*ibid*). Triangulation may be the use of multiple theories, data sources, methods or investigators within the study of a single phenomenon. In this study, triangulation combined all the data received from both questionnaires and interviews which drew conclusions and provided more comprehensive picture of the results (Heale and Forbes, 2013).

5.5.1 Triangulation of the study

Table 5.48: Triangulation of the study

	Qualitative	Quantitative
CM's understanding of quality	• Meeting the customer expectations; • Compliance with customer specification; • Conformance to regulations; • Be fit for its purpose after construction; • Quality reflects the quantity of attributes that a project contains.	• Project is of quality if it is in conformance to specifications; • A project must be fit for purpose for it to be of quality; • Quality is known as meeting or exceeding customer expectations; • Quality is construed as perfection or consistency.

Attributes of a CM	• Effective communication skills; • Strong leadership skills; • Good decision maker; • Team management skills; • Good negotiation skills; • Lifetime learner.	• Effective communication skills; • Strong leadership skills; • Good decision maker; • Technical expertise; • Team player; • Team-building skills; • Good negotiation skills; • Empathetic; • Competence; • Lifetime learner; • Problem solving skills.
Factors affecting quality	• Non-conformance to specifications; • Poor workmanship; • Non-conformance to quality regulations; • Poor/faulty materials; • Poor planning and control techniques; • Poor/insufficient information; • Lack of early and continual client/consultant consultation by contractor; and • Insufficient construction managers experience.	• Non-conformance with regulations; • Use of unskilled labour; • Non-conformance with specifications; • Poor on-site supervision; • Lack of induction and training; • Poor planning and scheduling; • Lack of communication; • Ignorance and lack of knowledge; • Low productivity and efficiency of equipment; • Poor material and plant management; • Poor procurement planning and management; • Average delays in decision making; • Number of projects at hand; • Uncontrolled variation orders; • Involvement of End-User client; • Inclement weather conditions; • Use of unskilled trade subcontractors.
Ensuring the construction of a quality project	• Defining the quality criteria and project requirements; • Perform quality planning; • Review designs before construction; • Perform quality assurance; • Conform to quality standards; • Perform quality control; • Identify defects and attend to them as soon as possible; • Perform material verification;	• Create quality plan; • Create quality policy; • Perform feasibility studies; • Perform quality assurance; • Perform quality control; • Define the quality objectives and ensure they are achieved; • Always aim to finish a project on time, budget and in high quality.

Table 5.48 shows the triangulation of the study between qualitative and quantitative data analysis. Participants who participated on interviews defined quality as meeting or exceeding customer satisfaction, compliance with the specifications and regulations. They added that quality is different to excellence because ‘excellence’ is the quality of being excellent; state of possessing good qualities in an eminent degree while ‘quality’ on the other hand, is level of excellence. The participants who participated on questionnaires also agreed with the statements. Adding that quality is construed as perfection or consistency.

On interviews, the researcher asked the participants on interviews to rank the attributes of a construction manager and they ranked ‘effective communication skills’ as number 1. On

questionnaires, the researcher asked the participants if they agreed that effective communication skills, strong leadership skills, and good decision maker, etc, were essential for being a competent construction manager and all the participants strongly agreed. The researcher also asked the participants on interviews to name the factors affecting quality in construction projects the participants mentioned non-conformance to specifications, ranking it to be the most critical one followed by poor workmanship either for labour or subcontractors. On questionnaires, using the RII values of the responses, the researcher found that lack of communication was ranked first, followed by the non-conformance to quality regulations.

To ensure a quality project is delivered, the interviewed participants mentioned that they first define quality criteria and project requirements, perform quality planning, identify defects and attend to them as soon as possible, perform quality assurance and quality control. The participants of the questionnaire survey said they create a quality plan and policy, perform feasibility studies, define quality objectives and ensure they are archived, perform quality assurance and control. They strongly agreed that is essential to always aim to finish a project on time, budget and in high quality.

5.5.2 Model

Figure 5.9 shows the model of the study after the data analysis was performed. The factors affecting quality include poor workmanship which is either by unskilled labour or contractor and/or inexperienced construction manager. The other factors are non-conformance to project specifications and regulations. Poor communication skills caused by insufficient information, delays in decision making and uncontrolled variations. Other factors affecting quality include poor on-site supervision, lack of induction and training, ignorance and lack of knowledge, usage of poor materials and lack of equipment management, not forgetting the inclement weather conditions.

For one to be a construction manager must obtain a tertiary level qualification of either a diploma, bachelor's degree, honours, masters or PHD. To be able to hold construction management role on a site, a minimum of 1-year labour management experience is required. The attributes of a construction manager include having effective communication skills, strong leadership, good negotiation skills, lifetime learner and be a good decision maker. Responsibilities of a construction manager include defining quality criteria and project requirements, performing quality planning, assurance and control, perform material verification and always conforming to quality standards.

A competent construction manager to be able attend to factors affection quality must be able to perform quality planning, quality assurance and quality control measures. This will assist in delivering a quality project where the expectations of client are met or exceeded, conformance to quality regulations, and the project will be fit for its purpose after completion.

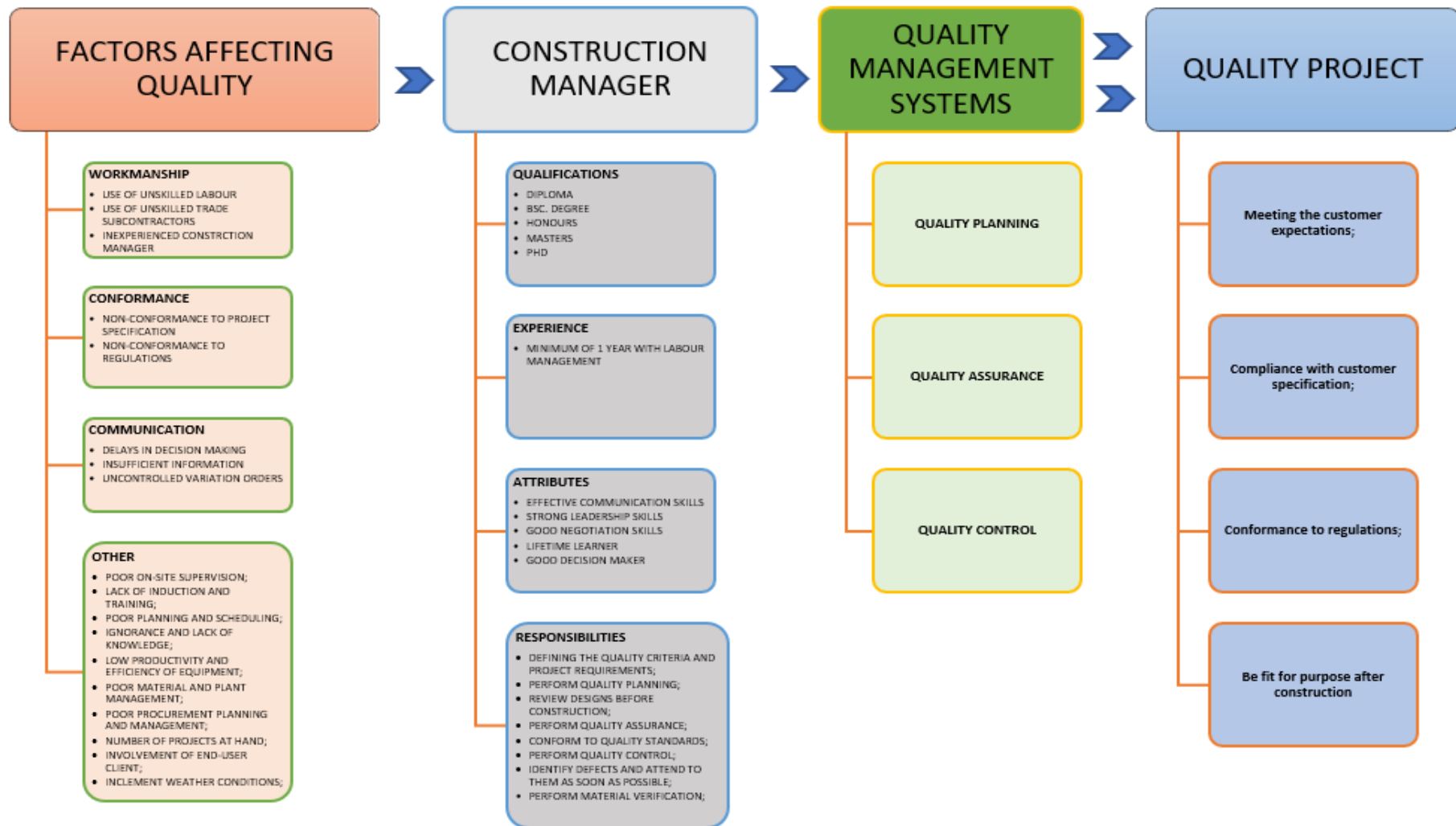


Figure 5.10: New research model

5.6 Chapter summary

This chapter contained the data analysis of data collected from questionnaires and interviews. For quantitative data, the researcher was able to analyse the responses of the participants, KMO and Bartlett's test, factor analysis, descriptive analysis and finding the RII and ranking of factors affecting quality, as well as the benefits of having a construction manager on a project using SPSS. For qualitative data, the researcher used NVivo analysis to generate themes from the responses. The researcher later did a triangulation, comparing the results from the mixed methods and worked out a revised model.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter sums up the findings in relative to the research questions and objectives. This chapter will also review the methods of research and analysis utilised in this study. Evaluation of the objectives of the study will at that point be conducted. The point of this section is to introduce the conclusions drawn from the results of the analysis of the questionnaires and interviews and then make recommendations for further studies.

6.2 Literature review summary

An exhaustive literature review was undertaken on quality. Quality is viewed differently by different individuals. Yet, everyone knows what is meant by “*quality*” (Chandrupatla, 2009:1). It is widely known as a degree of excellence (Mallawaarachchi and Senaratne, 2015). Once the specifications are established, strategies to measure and monitor the characteristics need to be found (Chandrupatla, 2009). This provides the basis for continuous improvement in the product or service. The ultimate aim for quality is to ensure that the customer will be satisfied to pay for the product or service (Alberto, 2011). This should result in a reasonable profit for the producer or the service provider (*ibid*). The relationship with a customer is a lasting one. The reliability of a product plays an important role in developing this relationship (Chandrupatla, 2009).

The construction industry like any other production industry is faced with challenges that affect the quality and output of the endeavour (Lukumon, Babatunde, Kabir, Samuel, Iyabo and Rafiu, 2015). The major factors influencing quality performance of projects are related to the use of unskilled sub-contractors, poor site supervision, construction labour skills, poor planning and scheduling, lack of communication, and the scarcity of resources. In view of this, Leonard (2008) observed that reduced subcontractor responsibility assists in improving quality among construction projects. Issue of poor on-site monitoring and feedback as well as poor planning and scheduling are major factors in project quality performance. Rizwan (2008) concluded that most projects suffer because of lack of communication and wrong channels to communicate, plan and monitor, while a study by Mane and Patil (2015) revealed that low quality and scarcity/ poor availability of resources majorly affect quality performance to a very large extent.

Construction managers have recognised the potential of quality management to deal with some of the problems most commonly associated with construction projects (Lydia, 2010). Construction managers are charged with the responsibility of planning, organising, directing, controlling and evaluating the activities of a construction department or construction company following the directions of the general manager, senior manager or project owner if in case it is not a company project (Saif, 2018).

They are equipped with education, knowledge, skill set, technology and an attitude of analytical thinking which helps them to take a holistic approach towards the construction project (Oke, 2017).

6.3 Research methodology adopted

This study used the concurrent triangulation mixed method approach through survey questionnaires and semi-structured interviews to collect information. The information was analysed and thereafter interpreted using SPSS (v27) and NVivo (v12) analysis. The quantitative data was collected using survey questionnaires from 119 construction managers from around South Africa. The qualitative semi-structured interviews were utilised to collect data from 15 construction managers. The aim of this was to understand the feelings, values, and perceptions of the participants towards quality in construction.

6.4 Research problem

Clients are only satisfied if the end product or service meets their price, quality, timeframe, functionality and delivery performance standards. Therefore, the construction manager must have adequate education, skills and knowledge, and come up with management processes of a construction project. In view of this, the contractors and suppliers may deliver good quality products, services and resources to accomplish a quality project.

The main aim of this study was to critically assess construction managers' understanding of quality in the construction industry. While doing so, to identify the responsibilities of a construction manager when it comes to the quality of a project and evaluating factors influencing quality in construction projects and role of the construction managers. Lastly, to explore ways in which a construction manager ensures the project is of quality.

6.5 Findings

Table 6.1: Research question and objective 1

How do construction managers perceive quality in construction?	To critically assess construction managers' understanding of quality in the construction industry.
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According to the literature, interviews and questionnaires, it was found that *construction managers* understood quality as conformance to requirements, may be a product or service. Quality in its simplest form is understood by meeting the customer expectations or compliance with customer specifications. The literature and interviews found that projects are a balance between cost, time and quality (Preethi and Monisha, 2017). And interviews elaborated that Having '*time*' as the available time to carry out a project, '*cost*' as the amount of amount available and '*quality*' as project being fit-purpose that it must achieve. Construction managers believe it is essential to consider the other factors whenever dealing with one of them. As per the review, interviews and questionnaires, it was found

that for a project to be of quality, it must meet or exceed customer expectations, conform with quality regulations and be fit for its purpose after construction.

Table 6.2: Research question and objective 2

What are the exact responsibilities of a construction manager towards quality of a project?	To identify the responsibilities of a construction manager when it comes to the quality of a project.
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According to the interview findings, the responsibilities of a construction manager are what guide a project to success. Construction managers oversee all parts of the construction process, working closely with engineers and architects to develop plans, establish timetables, and determine labour and material costs. The main construction manager responsibilities are overall project planning, distributing resources, time management, risk management, creating benchmarks, managing the budget, managing staff, and managing relationships with key stakeholders. As per the review and interviews, construction managers oversee and allocate resources for various construction projects. A great construction manager is skilled in both the technical skills required for the job and in leading and directing their team (Oke, Aigbavboa and Dlamini, 2017). Projects can vary from residential, commercial, and industrial buildings to bridges and skyscrapers (*ibid*). They are responsible for ensuring the project is completed on budget, within scope and of quality (Jaiyeoba and Folagbade, 2015). They also hire and manage subcontractors and employees, gather permits, and ensure all aspects of the project are up to code (Laedre, *et al*, 2006). According to the questionnaires, the construction manager is therefore responsible for project success or failure, given that all other project stakeholders perform their responsibilities.

Table 6.3: Research question and objective 3

What are the factors affecting quality management in construction projects and role of the construction managers?	To evaluate factors affecting quality management in construction projects and role of the construction managers.
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According to the interviews, the right time to identify potential factors affecting quality of a project is at the beginning of the project in Front-end Loading (FEL) Stages, also referred to as pre-project planning (PPP), prior to the construction itself because if those challenges are not resolved, they are carried to the construction phase which frustrate the management of construction. In short, to avoid issues, it is essential to deal with any of the factors as soon as it arises. One of the major areas of concern was poor workmanship. In simple terms, workmanship is the skill and quality put into making a product or completing a project. If workers or subcontractors are careless or do not follow proper protocol, a finished product can end up lacking the anticipated quality. The other factor is non-conformance with regulations, known as any failure to meet a requirement. A requirement can be that of a client, statutory or regulatory body or the organisations (Makhene and Twala, 2009). When a

non-conformity occurs, one must react to it by either controlling and correcting it or dealing with the consequences which may be paying big fines or imprisonment (Woudhysen and Abley, 2004). The use of ‘incorrect materials’ also affects quality of a project. Due to unavailability of material prescribed by the designers, contractors tend to buy cheaper materials which end up sabotaging the overall project quality.

According to questionnaires, changes/variations happen all the time in projects. These changes may or may not be desirable, but changes due to scope creep and gold plating fall under the “undesirable” category. Changes due to these practices are known as uncontrolled change and must be kept from happening. Managing scope creep and gold plating is a key part of scope management (Lukumon, *et al*, 2015). Further to this, unclear specifications, incomplete designs, lack of communication and inclement weather conditions also affect project quality (Kwat, 2018).

Other factors affecting performance quality of construction projects include lack of construction managers competence, poor monitoring and feedback, lack of on-site construction manager, inadequate project team capability, poor planning and control techniques, poor/insufficient information and communication channels, lack of early and continual client/consultant consultation by contractor and insufficient construction managers experience. Lack of technical and professional expertise and resources to perform task, lack of employee commitment and understanding and lack of education and training to drive the improvement process really negatively affects the project quality (Woudhysen and Abley, 2004).

Table 6.4: Research question and objective 4

How do construction managers ensure the delivery of quality construction project?	To explore ways in which a construction manager ensures the project is of quality.
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Generally, construction managers ensure quality of a project by defining the quality criteria and project requirements, and stick to them. According to Nyide (2018:29) ‘*gold plating is the phenomenon of working on a project or task past the point of diminishing returns*’. For example, after having met the requirements, the construction manager works on further enhancing the project, thinking the client will be delighted to see additional or more polished features, rather than what was asked for or expected. The client might be disappointed in the results, and the extra effort by the construction manager might be futile. Therefore, there must be a balance continual project improvement with gold-plate/variation requirements. Most construction managers ensure the construction of a quality project by ensuring that the relevant stakeholders sign the project brief developed, that also includes business case, project charter etc. They make sure that Basic Assessment (BA) is done to prepare for the design. Also oversee the design done by either architect or engineers, this one is most critical stage because if issues are not resolved here that will lead to a disastrous construction. ‘*You cannot construct something that does not conform to requirements*’ quoted from

one participant's response. It is necessary to ensure that the design itself meets the employer's needs and specifications and also NHBRC regulations for a building project. In addition, once the construction phase has commenced, one must manage quality by working with the project team to define a practical approach to managing quality, including applicable standards and quality processes. These are driven by the standards and quality processes contained in the project blueprint. Also perform quality assurance by executing quality management plan using the standards and processes defined in the project blueprint. Perform a quality audit to evaluate how well the team is following the plan and meeting customer's expectations. Lastly, control the quality by ensuring the deliverables are correct and free of defects and focus on quality from the beginning to the end of the project.

6.6 Recommendations for future research

Further research should be performed on:

- Factors that might affect construction quality to make it easier for construction managers to identify on future projects;
- The responsibilities of a construction manager in order to attain a high-quality project;
- Quality regulations to be adhere to on a construction project; and
- How the construction managers must balance cost, time and quality of a project, to make each a priority.

The construction managers must use the information provided in this study:

- To be able to deliver projects of high quality and be willing to learn something new on a daily basis. This is because the construction industry is an ever-changing environment that requires all the disciplines to adapt with the ever-advancing construction methods, regulations and technologies.
- Improve their roles in construction of quality projects and assist other stakeholders during the process.

6.7 Chapter summary

This chapter explored the findings of the study and concluded the research study. The research questions and objectives were illustrated and addressed by using results from the literature and data analysis. The study fulfilled its objectives and a conclusion was derived from this. It showed that quality in construction cannot exist without a project and a construction project cannot exist without quality. Construction managers have a major role in an attainment of construction quality from the planning and during construction phase.

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Appendices

Appendix A – Ethical clearance



UNIVERSITY OF
KWAZULU-NATAL

INYUVESI
YAKWAZULU-NATALI

14 October 2019

Mr Siyabonga Simon Zondo (215057410)
School of Engineering
Howard College Campus

Dear Mr Zondo,

Protocol reference number: HSS/0485/019M
Project title: Quality In South African Construction & construction manager's perspective

Approval Notification – Expedited Application

In response to your application received 11 June 2019, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. **PLEASE NOTE:** Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 1 Year from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....
Dr Rosemary Sibanda (Chair)

/ms

Cc Supervisor: Dr Meshani Harinarain
cc Academic Leader Research: Professor Akshay Saha
cc School Administrator: Ms N Uramini

Humanities & Social Sciences Research Ethics Committee
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