Cost Management of Public Sector Construction Projects in KwaZulu-Natal

Prepared by:

Fezile Mkhize

Submitted in fulfilment of the academic requirements for the

Masters of Science in Construction Management (MScCM)

Construction Studies discipline

School of Engineering

Supervisor

Prof T Haupt

December 2017

PREFACE

The research contained in this dissertation was completed by the candidate while based in the Discipline of Property Development, School of Engineering of Agriculture, Engineering and Science, University of KwaZulu-Natal, Howard Campus, South Africa.

The content of this work has not been submitted in any form to another university and, except where the work of others is acknowledged in the text, the results reported are due to investigations by the candidate. As the candidate's Supervisor I agree to the submission of this dissertation.

Signed: Prof Theo C. Haupt

Date: 30 November 2017

DECLARATION: PLAGIARISM

I, Fezile Mkhize, declare that:

(i) the research reported in this dissertation, except where otherwise indicated or acknowledged, is my original work;

(ii) this dissertation has not been submitted in full or in part for any degree or examination to any other university;

(iii) this dissertation does not contain other persons' data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons;

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(a) their words have been re-written but the general information attributed to them has been referenced;

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(v) where I have used material for which publications followed, I have indicated in detail my role in the work;

(vi) this dissertation is primarily a collection of material, prepared by myself, published as journal articles or presented as a poster and oral presentations at conferences. In some cases, additional material has been included;

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Date: 29 November 2017

ABSTRACT

It is common that public sector construction projects do not finish on time, within budget or to the desired quality. These failures are caused by, for example, change of scope, change of schedule, change of design, unavailability of material, lack of appropriate construction experience, poor project co-ordination, and inefficient management of the project schedule which frequently lead to variation orders and cost overruns.

Government who is an Employer in the public sector construction project is interested in projects to be completed on time, within budget and a quality end product. The objective of the study was to investigate the effectiveness of cost management in the public sector construction projects determined by estimates done at various stages of the procurement process, with arguably increasing level of accuracy, the reasons for frequent cost overruns during the construction phase of projects need to be investigated. Therefore the aim of this research was to investigate the effectiveness of cost management techniques in the construction projects in public sector in KwaZulu Natal. The study also assessed the accuracy of the cost estimates that are developed by the quantity surveyors at different stages of the construction projects and the effectiveness of procurement methods used to implement projects.

The qualitative method was adopted for the data collection using systematic random sampling which resulted in 20 case studies selected and analysed. The open ended questions were used during the interviews to get the in depth understanding. Generally it was found that there was no clear evidence of cost management technique used by the public sector, the focus was on the outputs to be delivered and budget spending. The scrutiny of the case studies revealed that quantity surveyors were found to be out of touch of the market trend as 75 % of the tender amount were below the cost estimates. Inter alia the client was found to be the most predominant origin agent of cost overruns caused by the time it takes between the planning and the actual implementation of the project. The study recommends that the public sector should take an active role in cost management from the planning stage, the selection of a cost effective procurement method, the construction phase until the project closeout.

Key words: Cost management, causes of overruns, variation, cost overruns, cost estimates.

ACKOWLEDGMENTS

May the glory be to God Almighty who has sustained me during the course of my research project, I thank God for His unmerited favour over my life.

I acknowledge the invaluable guidance and encouragement of my supervisor, Prof Theo Haupt, who provided the support to make my dream to materialise, I could not ask for a better supervisor.

To my late parents, Nomazulu and Sandi Ndawonde, thank you for your unconditional love guidance and support you gave me. All the sacrifices you made for me are appreciated. I know you would very proud of me.

I owe thanks to the love of my life, Mandla, my two boys; Bonga and Thabo; and my daughter, Phelo. I am deeply thankful for your understanding, unwavering support, much needed encouragement and time you afforded me to focus on my studies.

Many thanks are extended to my family; siblings and in-laws for your underlying and never ending support during my studies.

Sincere thanks to my colleagues for their support during my master's year.

Finally, thank you to the Institution, the University of KwaZulu Natal for affording me an opportunity and believing in me.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter One: Introduction and Background

1.1 Introduction and main problem

It is a widely recognized fact that infrastructure is one of the primary drivers for economic growth and development. Government buildings are an integral part of infrastructure provision. Buildings such as schools, libraries, clinics, hospitals and other government facilities are used to deliver the primary services that are expected to be provided by government. The services such as education, health care, and other social services are critical in providing for the socio-economic needs of citizens. It is therefore, important for the public sector of KwaZulu Natal (KZN) to invest in the construction and maintenance of these buildings. To this end, the KZN government is investing a substantial amount of funds as per the 2016/17 KwaZulu Natal Provincial Treasury Estimates of Provincial Revenue and Expenditure.

South Africa like most countries has limited resources to accommodate the high demands and reduce the budget deficit and debt levels. It is therefore important to optimise returns on investment in the construction projects. The KZN government expects its construction projects to be completed on time, within budget and produce a high quality product (Burke, 2011, Thomas and Chow, 2004). Unfortunately, these expectations of the KZN public sector are usually not met as most projects do not finish on time and within budget.

The project budget is the maximum amount of money the owner is willing to spend on the design and construction of a facility including costs for uncertainties like contingencies, claims or cost overruns to economically justify the project (International Project Management Association, 2010). The project budget is an authorised amount of funds for the execution of a specific project. This allocation therefore implies that the project budgets are established to form the basis of management of project costs and for the construction projects to be delivered within cost limits. This is a common practise for both private and public sectors (Ashworth, 2015).

Cost management is one of several major tools used to control and improve cost performance of the project (Memon et al., 2012). It helps in keeping the project within budget. Cost control is significant throughout a construction project. It is therefore important to control and manage

costs from the beginning of the project until the end of a project. Project Cost Management involves processes in planning, estimating, coordinating, controlling and reporting all cost related activities from project initiation up to final disposal of an asset (Ashworth, 2015). The cost management plan outlines how to balance expenditure with the funds available (Burke, 2011). It is a strategic process that emphasises the optimisation of efficiencies and focuses on the customer and profitability (Memon et al., 2012).

The completion of project within an estimated cost is one of the most fundamental criteria for the success of a project. Cost management systems must assume a proactive character and flexible approach in order to be able to absorb any changes that may occur. If cost management is a proactive process it then implies that it happens during cost planning. Ashworth (2015) states that the advantages of cost planning include:

(i)   The tender amount is likely to equate with the budget approved;

(ii)   There is less potentials of additions or changes in bill of quantities being required;

(iii)   The value for money and cost effective design are possible to be realised;

(iv)   A sensible dissemination of spending is likely to yield a more sensible design;

(v)   The pre-tender analysis by both the quantity surveyor and architect should assist in decision making earlier, ensuing in a smooth implementation of a project during construction; and

(vi)   Cost planning affords a project with a reasonable basis for comparison with other projects.

In essence these advantages indicate that proper cost planning may improve project performance. If the cost estimate is incorrect as a result of poor planning, it leads to variations, cost overruns, and cost control becomes more difficult. As part of cost management, cost planning is critical in the initial stages of a project.

Estimates form the foundation of the procurement process. An early estimate is defined as an estimate that has been prepared before completion of detailed engineering designs (Oberleder, 2000) while the level of accuracy improves with the level of project definition. On completion of the detailed design the estimate may be prepared for tender and the level of accuracy should be improve as compared to a stage before completion of designs. For a building project a

detailed estimate is prepared by the contractor and submitted to the owner for approval. The contractor's estimate and the professional fees becomes a control budget to the Employer or sponsor. It is of vital importance for the estimate to be correct as all cost activities like cost control and management are directly dependent on it. Therefore if the cost estimate is incorrect, all the progress measurements during the execution of the project would be potentially measured against an incorrect budget (Oberleder, 2000).This also indicates the importance of accuracy in the designs which inform the estimate and lead to the project budget.

The manner in which budgets are arrived at and the level of accuracy is determined by where in the construction process the estimate is made. The project budget estimate is prepared by the quantity surveyor on behalf of the Employer according to Ashworth (2015). The South African construction industry is legislated and governed by the Construction Industry Development Board Act. As prescribed by the South African National Standards (2015) the KZN public sector normally uses the traditional procurement method where the public sector as an Employer hires a Professional Service Provider for designs and a contractor for construction. The estimates are prepared by the Professional Service Provider and approved by the owner. The process is then followed by an invitation for prospective qualifying contractors to submit bids. These bids will go through a procurement process and subsequently appointment of a contractor. The contractor's cost estimate will form an initial budget which will be used to procure a contractor. The budget estimate is adjusted based on the tender amount including the professional fees.

It is important to note that the two key functions of design and construction are performed by two different organisations who both work towards a similar goal in terms of the end product expected in the design-build type of projects. These contractual arrangements are complex as the designs and construction of construction projects are separate functions performed by different organisations working independently. This compartmentalisation of construction into separate functions leads to design without concern for constructability. This leads to the perpetuation of costly mistakes and makes projects prone to changes during the construction phase (Ssegawa, 2002). Variation orders are one of the causes of project cost overruns which are endemic problems internationally in construction (Oladapo, 2007).

Construction is complex and uncertain in nature that it is almost impossible not to have variations in a construction project (Ibid). If cost planning is done with accurate estimates as part of cost management, it can minimise overruns and lead to effective management of cost in a project. Ndihokubwayo and Haupt (2009) affirm that variation orders may increase the cost of construction without adding value to the project. It is critical to minimise them.

As part of planning it is also important to note that a project must be economically feasible. The feasibility study is done in the initial stages of a project. For a private project the economic feasibility can be determined by the economic analysis of the monetary return on investment to build the project. Unlike the private sector, the public sector is different in that the economic feasibility is determined by the benefit/cost ratio (Oberleder, 2000). Since economic feasibility is done on the initial stages of the project, where costs keep on escalating they are likely to end up exceeding the benefit therefore the project may end up not being feasible at a later stage and therefore not viable.

South Africa is a country faced with many socio-economic challenges emanating from the previous apartheid regime. The policies adopted by that regime did not consider the demographics of the country but was skewed in favour of the minority population. The current government developed a series of legislative framework in trying to address the disparities of the past system of government. This has impacted the construction industry negatively because its objectives are not only to complete projects on time, within budget and acceptable quality but to also empower communities which have Historically Disadvantaged Individuals (HDI). This intention of empowering communities also provides a platform for the transfer of skills transfer and the creation of employment. Oshungade & Kruger (2015:4) concluded that "an indicator of an effective construction industry is the completion of a construction project on time, on budget, and on specification, which are all considered to be major project objectives. However, in the South African context, over and above these indicators, empowerment and employment creation remain a crucial project objectives."

The objectives of employment creation and empowerment, the Public sector in South Africa is guided by the legislation and regulatory framework that governs public the construction projects. The legislative and regulatory framework include Preferential Procurement Policy

Framework Act 5 of 2000, Public Finance Management Act 1 of 1999, Construction Industry Development Board Act 38 0f 2000 and the Engineering Profession Act 46 of 2000.

The Public Finance Management Act was based on the constitution of South Africa. It forms the basis for how public funds must be spent and managed. The Preferential Procurement Policy Framework Act gives preference to the previously disadvantaged groups as a way to redress previous historical injustices of the country through a score card based system which prioritizes a particular demographic. The Construction Industry Development Board Act regulates the public sector construction industry and gives guidelines on the procurement of public sector construction projects. It recommends the utilisation of the best practices in the construction industry while being aligned with both the Preferential Procurement Policy Framework Act 5 of 2000, Public Finance Management Act 1 of 1999. The Engineering Profession Act focuses on professional registration in terms of how engineering councils are formed, their structure in terms of how they exercise their powers and authority.

It is therefore crucial to assess the effectiveness of cost management techniques that are implemented while also taking into consideration the cost planning and procurement system used in the construction projects of the public sector in KwaZulu Natal.

1.2 Problem Statement

This particular study takes into consideration the fact that the budget for public sector construction projects is determined by estimates done at various stages of the procurement process, with arguably increasing levels of accuracy. It is within this context that the reasons for the frequent cost overruns during the construction phase of a project are being investigated.

1.3 Hypothesis

    1.3.1. Estimates based on incomplete designs during pre-tender stage result in cost overruns.

1.3.2. There is a correlation between the traditional procurement method and the inefficiencies in cost control and management during the construction phase of public sector projects.

1.3.3. Estimates generated by public sector Professional Service Providers affect the overall cost management and performance of projects.

1.3.4. The cost management techniques implemented in the public sector are ineffective.

1.4 Research Objectives

The primary objective of the study is to investigate the effectiveness of cost management techniques that are implemented in construction projects within the public sector in KwaZulu Natal. This will be achieved through the following specific objectives:

1.4.1 To determine the level of accuracy of estimates based on incomplete designs

1.4.2 To establish the correlation between the traditional procurement method and the inefficiencies in cost control and management during the construction projects phase of public sector projects.

1.4.3 To assess the effect of estimates generated by the public sector Professional Service Provider on the overall cost management and performance of projects.

1.4.4 To investigate the effectiveness of the cost management techniques implemented in the public sector.

1.5 Research Methodology

In this research more than one method was used to collect data in order to assure the validity. This method is referred to as data triangulation according to (Welman et al., 2005). There are two types of research methods and these are separated into qualitative and quantitative research. A qualitative research approach was used in this study with the utilization of a case study as a strategy. Case studies as a phenomenology research strategy is pertinent when the research intends to address either a descriptive question; "what is happening or has happened?" or an explanatory question; "how or why did something happened?" (Yin, 2012:5).

A non-probability purposive sampling strategy was adopted. A purposive sampling method is used by hand picking of typical and interesting cases to obtain information from a large sample (Walliman & Baiche, 2005). For primary data, interviews were conducted with various stakeholders and secondary data was collected through the use of academic sources, namely textbooks, journals, acgrademic articles, reports, relevant pieces of legislations and archival records from both the Department of Public works (an Implementing Department), and from both client i.e. Department of Health and Education for triangulation.

According to Welman et al.(2005) construct validity ensures that a researcher is measuring what was intended in the study. The use of more than one measure also ensures validity. The interviews were used to collect qualitative data from selected samples during the research.

The review of literature was conducted and a through this a theoretical framework was developed. It is from this theoretical framework and the triangulation of data that the findings of the study were derived. Conclusions were drawn and recommendations formulated.

1.6 Limitations

The study focuses on the Provincial Departments that have infrastructure projects implemented by the Department of Public Works and is restricted to the KwaZulu Natal province. In order to achieve the purpose of the investigation it is realised that there are financial and time constraints hence no municipal or national construction projects survey can be done. There will be a focus on building projects as opposed to other types of projects in the construction

industry, such as civil engineering and infrastructural projects. The time period for the research is between February 2017 and December 2017.

1.7 Assumption

It was assumed that industry stakeholders would provide meaningful and accurate information in response to the research instrument and approach.

1.8 Significance of the research

In many developing countries including South Africa, financial resources are limited to accommodate the high demands of infrastructure while reducing the budget deficit and debt levels. It is therefore important to optimise returns on investment in the construction projects. The level of accuracy of estimates that is used to inform budgets is critical for cost management. The cost management on a construction project starts during the planning stage and budgeting is an important factor of a project. The study intends to contribute to increasing knowledge in the field of construction cost management by investigating. The findings of the study can assist in minimising the inefficiencies in cost control and management in the construction projects of the public sector.

1.9 Ethical Statement

To comply with internationally acceptable ethical standards of protecting the respondents by not using their names or the organisations they work in within the recordings used for the research. In this way no individual or organisation can be linked to a completed research instrument, thus assuring anonymity and confidentiality. No compensation will be paid to any respondents for participating in the study. Quality assurance will be done with respect to the following aspect:

- General conduct and competence of interviewers;
- Correctness of archival data:

- Quality of data capturing done by encoders and
- Variable will be checked if they contain only values in the accepted range and variable labels using frequency distribution

1.10 Structure of the study

The thesis is structured under the following headings and consist of six (6) chapters as follows:

- **Chapter 1**: Presents the introduction and general background of the research study. It highlights the problem and the objectives of the study. It briefly introduces the research methodology, the significance of the study and the lastly highlights the limitations in this section.

  Chapter 2: Provides review of the relevant existing literature in order for a theoretical framework to emerge against which the findings of the study can be compared. The overview of the construction industry is also discussed and the importance of the construction industry in South Africa highlighted. The redress of the past and its influence in the construction Industry are discussed. The chapter further discusses the cost estimates. It defines cost estimates, discusses its level of accuracy on different phases of construction project and the influence it has on the Budgets. In addition, the factors that impede effective cost management with regard to cost estimates including the factors that influence project success are also considered.

- **Chapter 3:** Discusses a detailed research methodology employed in the study. It explains the data collection procedure, the research design, the methods, the target population and the sample size used in the study. A detailed discussion on the methodology and the research instrument is also discussed.

- **Chapter 4**: Presents the data analysis and discussion. The results of descriptive analyses relate to the research, the existing findings in the literature and the knowledge gained from the literature review.

- **Chapter 5:** This chapter summarises the entire study and articulates the main findings, the hypothesis tested, the study conclusions, lastly the recommendations are formulated and suggestions for the areas for future studies made.

1.11 Definitions of key terms and concepts

The following concepts are specifically explained in the context in which they are used within the study:

- The Employer refers to; "a natural or juristic person, partnership, or organ of state entering into the contract with the contractor for the provision of supplies, services, or engineering and construction works" (CIDB, 2010:5).
- A Contractor refers to person or organisation that contracts to provide the goods, services or engineering and construction works covered by contract (ISO 10845-1-2010).
- A Professional Service Provider refers to; "a natural or juristic persons whose primary business is to provide independent technology-based intellectual services to employers and which, if a sole practitioner, has a professionally registered person as a principal or if a partnership, close corporation or company, has at least 50 percent of its principals registered in any of the categories of registration".

1.12 Conclusion

Chapter one introduced the subject of the research study, the research problem, research methodology and the significance of the study were described. This chapter also outline the layout of the entire research report.

The next which is chapter 2 discusses the overview of the relevant literature review to emerge a theoretical framework against which the findings of the study can be compared.

Chapter Two – Literature Review

2.1 Introduction

This chapter provides the theoretical framework to the study by reviewing the existing literature and elaborating on the necessity of this research. It gives an overview, the role and the importance of the Construction Industry in South Africa. The overview will describe South African construction industry's role in the economic development and its importance to redress the imbalances of the past. It further discusses the current economic constraints that impact the construction industry. The chapter concludes by discussing the importance of accurate budget estimates, cost planning and control for the benefit of the client and industry at large.

2.2 The economic importance of the Construction Industry in South African

Construction plays a vital role in the country's economic development and job creation according to Enhassi and Mohamed (2008). This statement is supported by Barry and Sebone (2009) in asserting that the developments such as the Gautrain and the construction of stadiums in preparation for the 2010 Soccer World Cup had a positive effect to the economy and stimulated growth for the South African economy. Moilwa (2013) also adds that infrastructure development is central to the efforts of government to stimulate economic growth. Furthermore, Myers (2013) suggest that for a country to have sustainable and meaningful development it requires an efficient construction industry to attain development. On the contrary, Banaitiene and Banaitis (2012) argue that the construction industries contribution towards development is meant for short term gains.

According to Renault (2017) the construction industry along with other major economic sectors is rated on both Gross Domestic Product (GDP) and Gross National Income (GNI), and the outputs are measured by gross outputs, capital formation and added value.

The importance of the construction industry is as follows (Olanrewaju and Abdul-Aziz, 2015):

- Strategic tool for achieving sustainable development;
- Construction output as growth-initiating and growth development;
- Contributes to Gross Fixed Capital Formation;
- Contributes significantly to the economy; GDP and GNI;
- Provides outputs to most industries and utilises the outputs of many industries;
- Contributes significantly to the informal sector;
- Income generation and re-distribution and;
- Employment generation.

Irrespective of how one view the contribution of the construction industry to economic development, it does not in any way invalidate the importance of construction industry with regards to economic development (Renault, 2017). The South African government also recognises the construction industry as the vehicle for economic growth (Moilwa, 2013, Renault, 2017).

2.3 Preferential Procurement Policy Framework Act (PPPFA)

Prior to 1994, the government procurement system in South Africa favoured large, established businesses and certain demographics namely white population. It was very difficult for newly established businesses to enter the procurement system. The Construction industry was not exempted to this policy framework (Mathonsi and Thwala, 2011). In 1994, government procurements were granted constitutional status, and were recognised as a means of addressing past discriminatory policies and practices (Bolton, 2006).

> *"An indicator of an effective construction industry is the completion of a construction project on time, on budget, and on specification, which are all considered to be major project objectives. However, in the South African context, over and above these criteria, empowerment and employment creation are also considered to be crucial project/client*

objectives. All of these project objectives may be impacted on by the procurement methods used "(Oshungade and Kruger, 2015: 5).

The recently published National Treasury's Preferential Procurement Regulations (2017) based on the PPPFA gives preferential points to the minority which in the South African context is referred to as Previously Disadvantaged Individuals (PDI). The 80/20 and 90/10 principles is applied whereby 80percent or 90% of the total points awarded to a tenderer depend on price and 20% or 10% of the points awarded may depend on tenderer's rating for Broad-Based Black Economic Empowerment (BBBEE). However, in terms of the new regulations, the 80/20 principle will now apply to tenders up to R50 million. The 90/10 principle will apply to tenders above R50 million (Ibid). Subcontracting of a minimum of 30 percent of the value of the contract of tender is encouraged as a specific condition for the tender.

There is a vulnerability of fraud on preferential programs through the formation of non-minority fronting companies (Marion, 2007, Blanchflower and Wainwright, 2005, Tunji-Olayeni, 2008). This unethical behaviour influences the scale of corruption which is found to be greater in the construction industry than in any other sector of the economy (Bowen et al., 2007). Blanchflower and Wainwright (2005) found evidence of collusion amongst bidders which resulted in prices rising above the competitive levels. The Transparency International (Bowen et al, 2012) has revealed how corruption can add up to 25% to the cost of public contracting. Bowen et al. (2012) further elaborated that South Africa is no exception to the corruption displayed through this unethical behaviour.

2.4 Community empowerment and skills transfer

Since the dawn of democracy in 1994 secondary objectives such as skills transfer, community upliftment and employment creation have become an important part of empowering the previously disadvantaged (Oshungade and Kruger, 2015). The effectiveness of a construction project is indicated by the primary objectives but the emergence of the secondary objectives which are client's critical success factors need to be considered (Jing et al., 2009). In some instances, the secondary objectives do not match the traditional expectations in terms of time, cost and quality however it fulfils an important objective of empowerment (Ibid). The study done by Yang et al (2010) selected 15 critical success factors in which it was concluded that

the factors regarding social responsibilities are the most important. Marion (2011) indicates that the engineer's estimates only incorporate project specific aspects considering previous tenders on projects that are similar.

The Construction Education and Training (2016) is involved in the development of skills for placement of apprentices within the building, civil and electrical contractors. It is however not clear how this training impacts the project performance and possible time spent on the project as well as the cost overruns.

2.5 Clients, contractors and consultants in cost management

2.5.1 The Client

The client, consultant and the contractor has a role to play in the overall cost managements and the risks involved in the procurement strategy taken (Chan et al., 2011). The Client is the initiator and is the most significant stakeholder in decision making on procurement methods to be undertaken which impact the performance and the overall cost effectiveness of the project (Pesämaa et al., 2009, Wardani et al., 2006). The Client is not just an individual or an organisation who pays for the construction but the bridge between the stakeholders, the users, owners, financers, the public and the people who design the construct (Courtney, 2008).

For the public sector client, the Infrastructure Delivery Management System (2012) only outlines the administration process qualitatively to determine the budget for construction projects. The level of estimate accuracy depends on the availability of information for instance, the scope, definition and specification by the client could have a significant effect on the level of estimate accuracy in the early stage than in the later stages (Liu and Kai, 2007).

Clients either can be from the private (individuals or organisations) or public sector (Boyd and Chinyio, 2006). The construction clients can be classified into; user, manager, or seller client.

Table 2- 1: The Public versus private sector

	The Public Sector	Private Sector
Focus on decision	Satisfying the regulations Courtney's (2008)	Focus on cost Courtney's (2008)

Procurement	Normally procure through traditional method, (Grobler and Pretorius, 2002b, Mbanjwa, 2003) Objectivity is made difficult by laws and regulation, previous experience (familiarity) also plays a role. (Pesämaa et al., 2009)	Projects normally use both design and build, and traditional. (Oshungade and Kruger, 2015) Objective in procurement method decision is easy and relationship negotiation can be applied. (Pesämaa et al., 2009)
Source of funding	Government budgets (Bosman, 2015)	Privately funded by owner/shareholders (Masterman, 2003)

Courtney's (2008) study investigated how clients deal with decision making and the influence of the owner, society, customer and construction sector at the early stage of the construction process. Customers were rated the most influential party in decision making followed by owner, society and construction industry respectively. For instance, in the private sector the cost estimation for the owner is based on customer demand and the rate of payback time. Should the cost estimate become too high which may results in high rent or selling price it gets re-estimated or rejected (Ibid).

The Traditional method is widely used in the private sector and according to Kwakye (1997) cited in (Oladapo, 2007), the compartmentalisation of construction into separate design and construction functions leads to designs without concern for buildability and the perpetuation of costly mistakes which lead to cost overruns. On the other hand the private sector uses other alternative methods on construction projects which seem to yield better result in term of cost management and minimisation of cost overruns (Oshungade and Kruger, 2015).

2.5.2 The Contractor

The main role of the contractor is the actual construction of the end product. According to Doloi (2013) there is a perception that the late completion of construction projects leading to cost overruns is the sole responsibility of the contractor but evidence shows that it is the a shared responsibility of both the client and the consultants. A cost overrun happens when the final cost of the project exceeds the original estimates (Memon et al., 2012, Azhar et al.,2008,

Doloi, 2013). Delays and cost overruns have effects on clients, contractors as well as the consultants (Ahmed et al., 2002, Doloi, 2013).

The final arbitrator of whether or not the budget and cost plan is correct should be the accepted contractor's tender which should equate to the budget. Project cost management assists in keeping the project within budget (Jaggar, 2002). Poor cost management often results in cost overrun (Memon et al., 2012).

Ahmed et al (2002) indicated that delays can be grouped in the following four broad categories according to how they operate contractually:

- Non-excusable delays – The contractor either causes or assumes the risk and is not compensated for it
- Excusable non-compensable delays – This goes beyond the Contractor's reasonable control and does not receive compensation for the cost of delay, but is entitled for an additional time to complete the project
- Excusable compensable delays – compensable delays are excusable delays, suspensions, or interruptions to all or part of the work
- Concurrent delays both Owner and the Contractor are responsible for the
  Delay. The contractor nor client can be held responsible for the delay

The manner a client selects the contractor within the construction industry in South Africa is legislated in the Construction Industry Development Board (CIDB) Act 38 of 2000. The CIDB contractor register is graded from grade 1 to 9 based on the financial capacity it can manage (CIDB, 2005). The contractor grade determines the tender value which the contractor is allowed to bid for (Renault, 2017). The registration reduces risks for both clients and contractors as the client is able to match the right project to the correct contractor thus reducing the failure rate of contractors in South Africa (Construction Development Board., 2015).

Table 2- 2: CIDB grading

(Adopted from Construction Development Board., 2010)

Grade	Tender value range (less than or equal to)

2	R 650 000
3	R 2 000 000
4	R 4 000 000
5	R 6 500 000
6	R 13 000 000
7	R 40 000 000
8	R 130 000 000
9	No limit

2.5.3 The Consultants

One of the roles of consultants is to design and advice the client on the cost implications of different design morphology and procurements, this process is called Cost planning (Ashworth et al., 2013). Hicks (1992) cited in Doloi (2013) states that regardless of contractor's financial strengths and competence levels, the accuracy of cost estimates at an early stage is critical to avoid cost overrun.

At the conceptual stage, an estimation is required in order to determine whether a project is feasible or not, a fairly accurate estimate is needed for tendering and budget controlling purposes (Memon et al., 2012, Ashworth, 2015). The complete design information leads to more accurate budget estimates (Jackson, 2002). The level of estimate accuracy depends on the availability of information for instance, scope definition and specification could have significant effects on the level of estimate accuracy in the earlier stages than in the later stages (Liu and Kai, 2007).The classification and understanding of characteristics of different clients in the construction industry is essential for construction service providers to determine the expected service in terms of innovation in the construction and fulfilling of the client's objectives (Tzortzopoulos et al., 2008).

Ashworth (2015) concludes that designs which require unnecessary complex construction methods and procedures, or fail to take account of mechanism of the work on site, fail in this respect. The lack of buildability results in an inefficient use of the construction industry's

resources (Ibid). Eighty percent of projects cost are determined during the initial stages of the design and therefore indicates the importance of accurate cost estimates which are part of the budget and cost plan (Ashworth, 2015, Ashworth et al., 2013, Jaggar, 2002).

The Council for the Built Environment (CBE), is an overarching body that coordinates six Professional Councils, (Architecture, Engineering, Landscape Architects, Project and Construction Management, Property Valuation, and Quantity Surveying). It also gives guideline   tariffs for the Professional service provider (Government gazette, 2015). The concept and fee values associated with the Cost of Works has been in existence for many years in most countries and has resulted in a reasonable quality of services for clients and appropriate remuneration for professionals (Ibid).

Adoption of performance based selection of consultants depending on previous consulting performance when the design team is appointed need to be emphasised (Ingram and Peltier, 2001). Even though consultant's duties start at inception through to the close-out of final account, during the post construction phase, the consultants performance tend to slow down as their fees at this stage are normally minimal.

 On average more than 50% of professional fees are paid before construction and less than forty percent for contract administration and inspection (Government gazette, 2015). The design changes during construction seem to be inevitable (Hanna and Swanson, 2007). *"The redesign costs are from 2.1% to 21.5% and on average 8.5% of the construction change cost, equivalent to the fee of a new design project"* (Chang et al., 2008). Redesign therefore leads to cost and time overruns. Ramus and Birchall (1998) as cited in (Oladapo, 2007) indicates that variations may arise in any of the following situations, among others when:

- The architect needs or wishes to vary the design or the specification;
- A discrepancy is discovered between any two or more of the contract documents;
- A discrepancy is discovered between any statutory requirement and any of the contract documents; and
- An error in or omission from the contract bills is discovered.

These variation's origin listed are mostly management factors which as asserted by (Azhar et al., 2008) are avoidable since they could be reasonably foreseen and prevented. Proper planning is important to minimise omissions, errors and abortive work due to poor designs as the consultant's decision during the pre-tender stages affects about 80 percent of the constructive

work (Ashworth, 2015). These decisions are normally taken based on the advice of the consultants and therefore the importance of the consultant's performance. There is minimal research that has been done on Consultant's performance evaluation. (Thomas and Chow, 2004) indicate that the consultants performance evaluation as one of techniques to manage project performance.

> *"The values of entrusting the design task to reliable and outstanding consultant has encouraged many public clients to advise best practices in collecting, evaluating and utilising consultant's performance for decision support"(Thomas and Chow, 2004: 280).*

(Ibid) conclude that the consultant's performance evaluation may impact the project performance.

Efficient and effective designs including the management of sites, forms the most critical factors, however, the client's responsibility of facilitating effective management within the project environment is crucial (Doloi, 2013). The performance should be evaluated at all stages namely; planning, designing, tendering, construction, post construction and final account. The criteria of evaluation related to the design stage is considered one of the most important factors (Thomas and Chow, 2004) and the accuracy of cost estimates as well as the financial management part of the evaluation. This will assist in ensuring value for money for the client is attained. Doiloi (2013) Indicated that in addressing the causes of cost overrun clients, consultants and contractor have the responsibility with regard to all the factors listed in Table 2- 3.

Table 2- 3: Roles of the client, consultant and contractor on planning and design

Factors	Client	Consultant	Contractor
Accurate project planning and monitoring	• Clearly defined scope • Clear specifications • Clear change request and feedback protocol to avoid change of scope and variations • Agreement on appropriate project budget and delivery timeframe	• Appropriate requirement analysis • Simplification of the design complexity • Consideration of buildability and requirements of specialized resources	• Clear understanding of the project scope • Understanding of the design • Details of resources required • Accurate work flow plan • Accurate schedule

		• Establishment of a clear change request and feedback protocols	• Clear process of project control • Monitoring and status reporting protocols
Design efficiency	• Early engagement of consultants for development of design • Accurate construction documentation	• Detailed and error-free design • Design simplification • Buildability analysis • Rigorous liaising with clients and design updates • Accurate project documentation	• Assessment of design, buildability, • and resource requirements • Accurate construction planning • Agreed communication and feedback • protocols

2.6 Procurement methods in South Africa

Procurement is defined as the process which creates, manages and fulfils construction contracts (Mathonsi and Thwala, 2011). Wardani et al. (2006) emphasises that procurement decisions have a major impact on the performance of a project performance, thus in order to manage costs effectively, procurement has to become a key part of the planning and coordination process (Pesämaa et al., 2009).

The traditional, design, build and management of construction are part of the procurement method which is used in the construction industry within South Africa (Grobler and Pretorius, 2002a, Mbanjwa, 2003).

(i) **Traditional method**

Traditional procurement is one of the widely used methods wherein the design and construction of a building are two separate functions performed by different organisations working independently (Grobler and Pretorius, 2002a, Oshungade and Kruger, 2015). The client is in contract with two entities; the design consultant and the contractor (Ibid). The client relies on the design consultant, an architect or consulting engineer to carry out the design work and supervise the construction (Ashworth et al., 2013, Jaggar, 2002, Mbanjwa, 2003). Construction is complex and uncertain in nature, and unlike manufacturing, the design and production functions in the construction process are conventionally separated concludes (Oladapo, 2007).

The high usage of the traditional procurement methods for construction projects in SA is that it best satisfies the secondary project objectives of empowerment and employment creation (Manqoba, 2014).

According to Kwakye (1997) cited in (Oladapo, 2007), the compartmentalisation of construction into separate design and construction functions leads to designs without concern for buildability and the perpetuation of costly mistakes. In the recent years there has been an increase in client dissatisfaction with drawbacks brought by the compartmentalised procurement system and they have opted for more integrated arrangements (Lam et al., 2008, Wardani et al., 2006). In the study by Turina et al., (2008) it was concluded that other alternative methods with a single point of responsibility are simplified, this then encourages for cooperation rather than competition and this minimise misunderstandings which result are the cause of disputes that can lead to cost overruns. It is important to make objective decisions when choosing a procurement method. However, the laws and regulations cause's difficulties in making complete objective decision (Pesämaa et al., 2009).

Figure 2- 1: Traditional procurement method
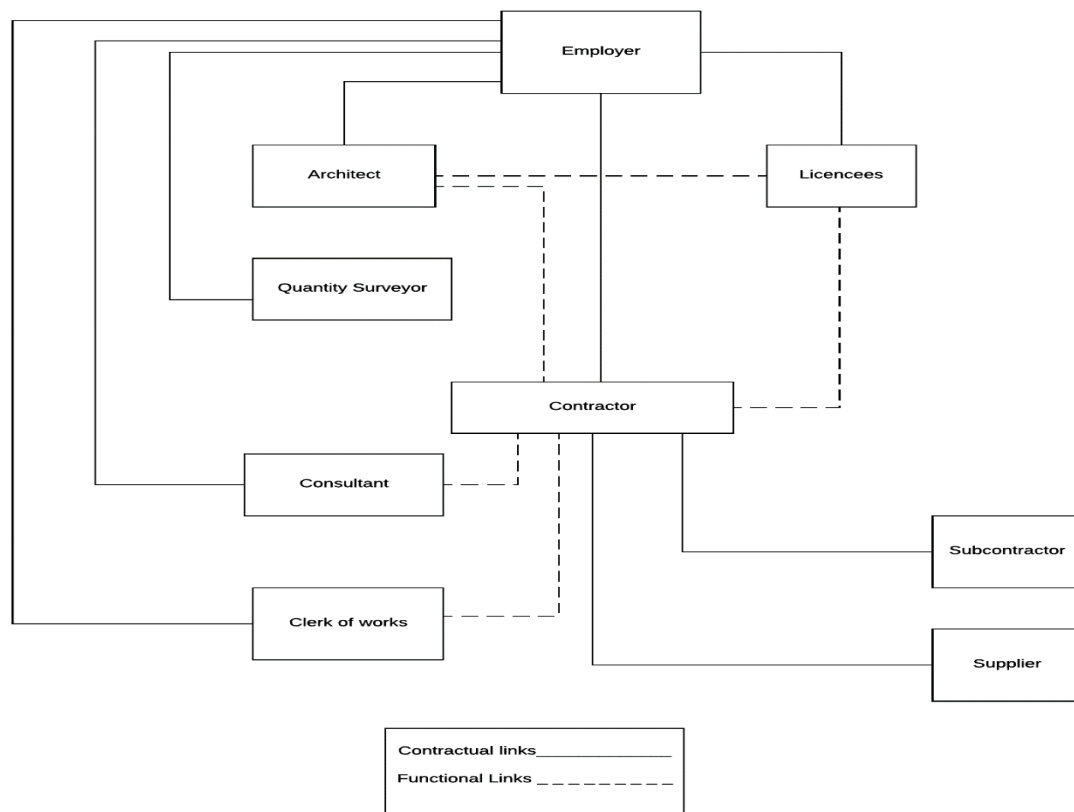
Adopted from Ashworth et al. (2013).

(ii)   **Design and build method**

The design and build method is not widely used in SA especially in the public sector (Oshungade and Kruger, 2015). In the design and build method the client appoints one entity to design and undertake construction (Mbanjwa, 2003, Schierholz, 2012). In this method there is more cooperation between the contractor and the designer at the early stages of the project and therefore effective cost management is achieved (Oshungade and Kruger, 2015). Cost management are effective in terms of their estimations as the contractor and the consultant can analyse buildability of the design, eliminates errors as well as omissions while accurate

construction planning and documentation are developed (Turina et al., 2008). Other activities can be undertaken concurrently and the overall project duration can be shortened (Mbanjwa, 2003, Schierholz, 2012). However, the degree of overlap called concurrency, in construction has a limit (Hanna et al., 1999). The activities that can be undertaken concurrently beyond this limit increase probability of rework, time and cost overrun significantly as concurrency can significantly increase complexity (Hanna et al., 1999, Love, 2002). It allows the client to budget as the total financial commitment at a reasonable degree of accuracy is determined before commencing work on site (Turina et al., 2008).

Figure 2- 2: Design and build method
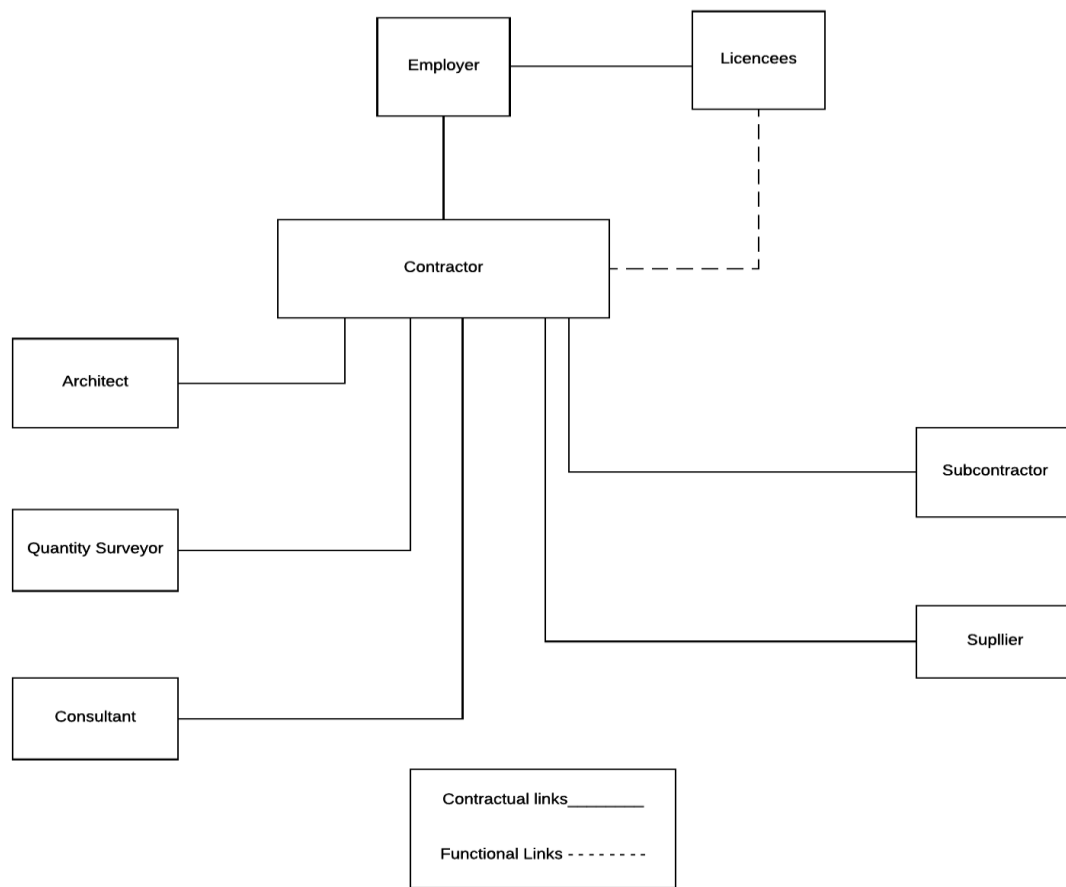
*(*Adopted from Ashworth et al.(2013).

(iii)   **Management based contract method**

With regards to the management based contract the client appoints a design team of professionals as well as management contractor to provide management expertise and act in a professional capacity to manage the project in return for a fee to cover overheads and profit but does not profit on construction works (Ashworth et al., 2013). The management contractor appoints a contractor during the appointment of the rest of the design team, therefore allowing the contractor to have an input into the design phase to undertake construction work on site (Mbanjwa, 2003, Ashworth et al., 2013). This form of contracting can be management contracting, construction management or design and manage (Ashworth et al., 2013). This is rated as the second best in when compared with other two methods used in SA (Oshungade and Kruger, 2015).

Figure 2- 3: Management based contract method
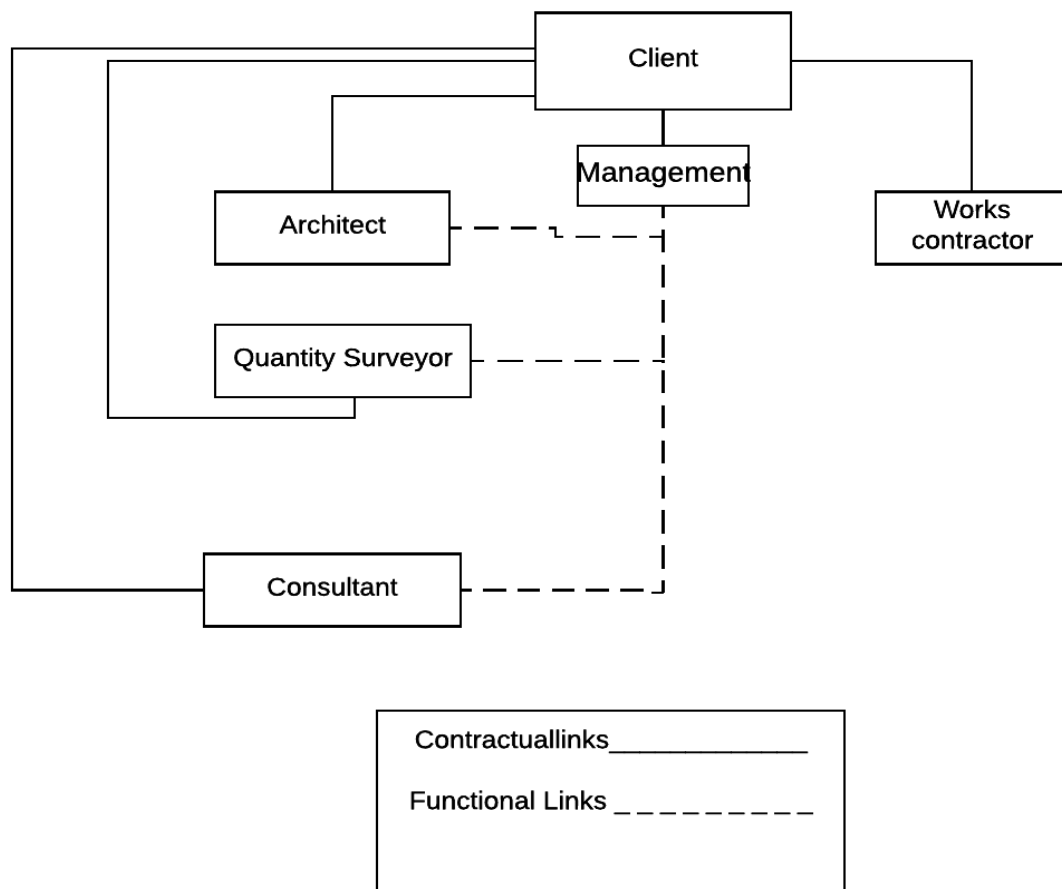
Adopted from Ashworth et al.(2002)

In the study by Oshungade and Kruger (2015) which was centralised around the different procurement methods used in South Africa it was established that the design and build method yields the best results in terms of time cost and quality.

Figure 2- 4: Comparison of procurement methods
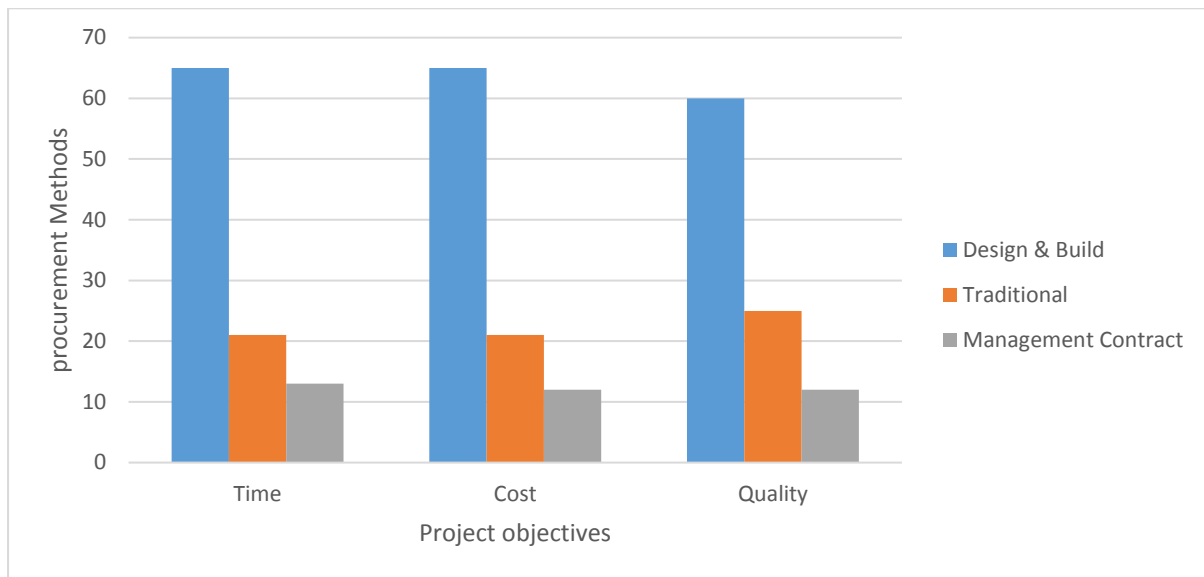
Adopted Oshungade and Kruger (2015)

Figure 2-6 presents a comparison of procurement methods used in South Africa in terms of the major project objectives of time, cost and quality. It reveals that design and build procurement method produces the best results as opposes to the traditional and Construction Management procurement (Ibid).

(iv)   **Incentive based compensation**

The Target cost contract is an alternative way for the interest of the clients and contractor to achieve a win-win situation (Chan et al., 2011). Other method that are used to manage and reduce cost is incentive based compensation (Pesämaa et al., 2009). It also improves cooperation and also the client, contractor and consultant share the risk of cost overruns.

2.7 The Cost Management process

The complexity of construction projects require a cost management system that is proactive and flexible enough to be able to absorb the changes that may occur at any stage of the process (Kern and Formoso, 2004). The integration of the whole project from inception to completion into cost planning is emphases by various studies (Ashworth et al., 2013, Jaggar, 2002, Kern and Formoso, 2004). Cost management functions should provide independent, objective,

accurate, reliable capital and operating costs Basak (2006) cited in (Memon et al., 2012). The cost management process is indicated in figure 2-7.

Figure 2- 5: The Cost management process
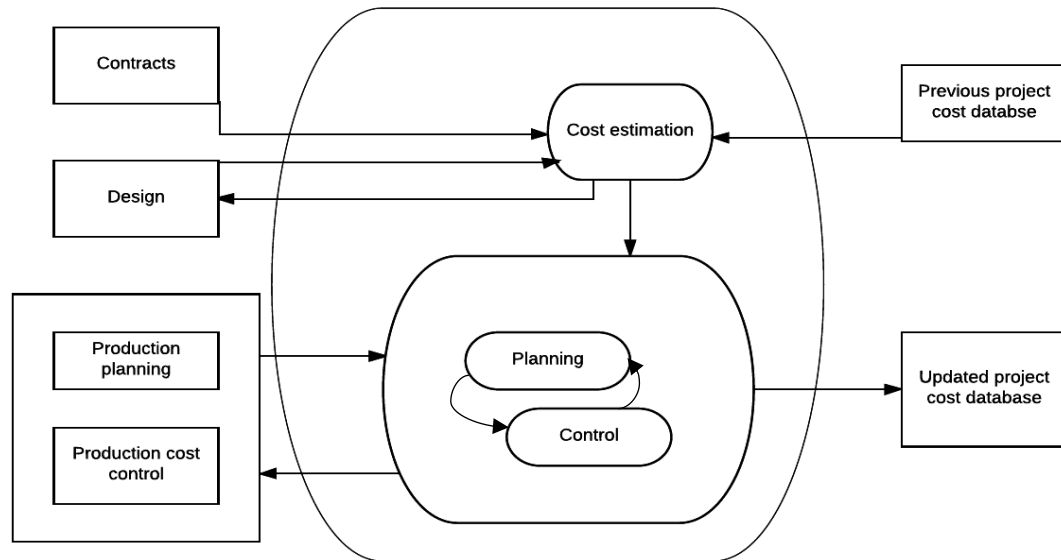
Adopted from Kern and Formoso *(2004)*

2.7.1 Cost planning

Cost planning is done within the budget provided by the client as well as by the design and construction considerations by the design team (Ashworth, 2015, Ashworth et al., 2013, Jaggar, 2002). Cost planning that is done during the pre-tender stage is a controlling mechanism to manage expenditure and to give the client value for money (Ashworth et al., 2013). It also keeps the designer fully informed of the cost implications of the design (Ashworth et al., 2013). Jaggar (2002) emphasis that the cost plan should commence by using historical information available by:

(a) Finding a cost analysis of similar project in terms of building type and function for instance if a school building is being built, it can be compared with another school,

(b) Identifying a type that closer match the building in terms of size, number of storeys, shape complexity, topography and geology

(c) Identify recently built

(d) Select an analysis with a location that is close as possible.

2.7.2 Cost estimates

Costs are regarded as one of the critical parameters of the project and a driving force of a project success (Ahmed et al., 2002, Swee Lean and Park, 2005). The client needs a preliminary cost estimate before the land acquisition and commitment to build in order to make a decision on the feasibility of the project (Ramabodu, 2014). During the tendering stage the level of estimation accuracy should be more accurate but the arbitrator is the accepted contractor price which should equate closely to the budget set (Jaggar, 2002). Oberlender and Trost (2001) concluded that that there the five most important factors affecting estimate accuracy during the early stages of capital projects, in their order of significance are:

(1) Basic process design;

(2) Team experience and cost information;

(3) Time allowed to prepare the estimate;

 (4) Site requirements; and

 (5) Bidding and labour climate

Lui and Kai (2007) further reiterated this by mentioning that these factors can either be control or idiosyncratic factors. Control factors can be regulated by estimators to improve the performance of estimation but idiosyncratic factors are factors that influence cost estimation but operate outside the control of the estimators including market or weather conditions amongst others (Ibid).

The accuracy of estimates during tender stage should be at least 10 percent as this includes estimations from detailed drawings, construction costs, management overheads and profit mark-up information Flagmen and Norman (1983) cited in (Liu and Kai, 2007). At pre-construction stage when the project scope is clearly defined the expected accuracy levels of the estimate should be around 5 percent and the focus should shift to cost control (Ferry and Brandon, 1991 cited in Lui and Kai, 2007).

After the appointment of the contractor the focus should be on cost control (Liu and Kai, 2007). Costs are regarded as one of the critical parameters of the project and a driving force of the success of a project (Ahmed et al., 2002).

2.7.3 Budgeting

A budget is the maximum amount of money the client is willing to spend for design and construction to economically justify the project (Oberleder, 2000). Budgeting normally happens at the initial stages of the project to decide if the project can proceed or not (Ibid). The budget referred to as the construction capital cost is one of the client's most critical component of the project (Ashworth et al., 2013). It is determined by philosophical predicting of how much the building is likely to cost at a very early stage by effective estimation (Ashworth et al., 2013). The accurate determination of the budget plays an important role in cost planning and design cost and controlling the whole project (Ashworth, 2015). The budget will include works to be carried out by the contractor, professional fees and any other taxes that may be due to government (Ashworth et al., 2013). The budget is determined by effective cost estimation based on historical data available (Jaggar, 2002).

2.7.4 Cost overruns and variation

The inability to complete projects within budget and on time has become a worldwide problem (Ahmed et al., 2002, Alinaitwe et al., 2013).The success of a project is usually measured by the time, quality, budget compliance, and the degree of customer satisfaction (Project Management Institute., 2010). Delays and cost overruns have a negative effect on clients, contractors and consultants as they result in disputes and cash flow problems (Ibid). When a project costs exceeds the planned targets, client dissatisfaction may rise and the cost may no longer match the budget limit (Alinaitwe et al., 2013).

Cost is affected by various factors as construction involves many parties such as the client, various professionals, contractors and suppliers, construction is therefore a multidisciplinary industry (Swee Lean and Park, 2005). The various parties working towards one project in terms

of the design, the technology and the implementation of the project can have an effect on the overall project (Ibid). Azhar et al.(2008) in their study grouped the ten top factors which lead to cost overruns, these include challenges in; macro-economic, business and regulatory environment as well as within the management factors and lastly political insecurity and instability also play a role Alinaitwe et al (2013).

Table 2- 4: Cost overrun factors

Macro-Economic factors	Business and Regulatory Environment	Management factors
fluctuation in prices of raw materials	lowest bidding procurement procedures	additional work
unstable cost of manufactured materials,	delays between design and procurement phases,	improper planning
high cost of machineries,	incorrect/ inappropriate methods of cost estimation	unsupportive government policies
		poor project (site) management/ poor cost control,

Adapted from Azhar et al. (2008)

2.8 Macro-economic factors

The construction cost is basically defined as the cost of material, cost of money, the cost of workforce and the cost of management. In the construction industry the prices change so quickly that the initial budget figures becomes completely unrealistic as most contractors quote prices based on their projected estimates and this has been viewed as one of the reason for cost overrun that is difficult to avoid. Ahmed et al (2002) concludes that these are unavoidable. Fluctuation in prices of materials and costs is severe when there are short supplies, in order to stabilize the cost of materials, an increase of supplied materials can be useful to break the monopoly of few suppliers controlling the supply chain of the market

2.8.1 Management factors

Sriprasert (2000) as cited in Azhar et al. (2008) indicates that ineffective construction management and poor cost control systems are causes of cost overruns. (Chen and Yang, 2015) adds that these matters are internal for instance the project manager is in charge of ensuring that the project is on track and is responsible for managing budget. Azhar et al. (2008) recommends that the desired cost control can be achieved through a project costs calculations, vigilant planning, monitoring of trends of inflation and depreciation factors and observing cost variations trends.

2.8.2 Business and Regulatory Environment

The government is in charge of developing and monitoring the adherence of practices in the construction industry to the regulations as per the legislative requirements. This indicates that any changes required to be introduced to improve the system is still government responsibility. Currently, the South African public sector predominantly utilises the traditional procurement method (Grobler and Pretorius, 2002b). The public sector should consider adopting other alternative procurement strategies such as the design-build contracts, direct negotiation contracts and other types of contracts (Grobler and Pretorius, 2002b, Azhar et al., 2008). In the design-build method other activities can be done concurrently and therefore lead to shorter project duration and cost savings when compared to other procurement methods.

2.8.3 Variation orders

In as much as various researchers emphasise the importance of cost planning and control but variation has become so prevalent in construction that it is almost impossible to complete a project without changes to the plans or the construction process itself (Ssegawa et al., 2002, Ndihokubwayo, 2008, Oladapo, 2007).

It is important to determine if these variations are critical and are indeed adding value to the project performance, this should assist in the development of proactive measures to reduce changes made within the project (Ndihokubwayo and Haupt, 2009). A beneficial variation order eliminates unnecessary costs and optimises the client's benefits by eliminating

unnecessary costs (Ibid). However, it should be noted that regardless of how beneficial a variation order might be non-value-adding costs are likely to accrue as a beneficial and detrimental variation orders (Arain and Pheng, 2005). Yang and Chen's (2015) study revealed that the changes by the client, quantities estimated inaccurately and unclear specifications and drawings are some of the main causes of budget changes.

2.9 Conclusion

It is evident that cooperation between various parties working towards a projects is crucial as every party involved has a role to play on the development of accurate cost estimate to minimise cost overruns. The compartmentalisation in the traditional procurement method and the lack of involvement of the contractor during inception and the design stages lead to designs without concern for buildability and result to costly mistakes. Furthermore, it was found that the macro economic factors that lead to cost overruns are not easy to manage as oppose to management and regulatory factors.

Chapter Three – Research Methodology

3.1 Introduction

This chapter gives an overview of the research methodology used in the study. It describes the specific procedures that were undertaken in achieving the research objectives indicated in the introductory chapter of the research. The research design, methods, sampling, data collection as well as the development of the data analysis are discussed. To confirm consistency and accuracy, the reliability and validity of the research are indicated. In addition the statistical methods of data analysis are discussed.

3.2 Research design

The research design describes the entire structure in which the research is conducted including how the data will be collected, analysed and interpreted to answer the research questions (Creswell, 2007, Kothari, 2004). Research design facilitates the various activities thereby resulting in an efficient and economical research (Kothari, 2004: 32). It is a practical conceptual plan within which research would be conducted and a suitable design will minimise bias while maximising the reliability of collected data including the analysis (Kothari, 2004).

Research design can be structured in two methods, namely quantitative and qualitative approach. According to Creswell (2013) quantitative research also known as positivism assess and identify the causes that influence the outcome by reducing the ideas into small, discrete set to test called variables. On the contrary the qualitative research known as constructivist approach seeks to understand the complexity of views rather than narrowing meanings into few ideas, it focuses on the specific context in which people and the research rely as much as possible to the situation being studied in a broader context (Ibid).

On the other hand Dainty (2007: 9) concludes that "a more expansive outlook towards mixing methodologies and research paradigms could yield deeper insight into, and understanding of, the way practitioners do management in construction sectors".

For the purpose of this study, qualitative methods was undertaken since it was important to get a holistic account of a complex issue under study to identify the many factors involved in the situation, it is not bound by cause-and-effect relationship among factors (Creswel, 2007).

3.3 Research methods

3.3.1 Quantitative and qualitative methods

Quantitative approach is positivism, it is limited to what can be measured objectively and exists autonomously of the feelings and individuals opinions (Wolman et al., 2005). The approach can be experimental, quasi-experimental or non-experimental research (Wolman et al., 2005) On the other hand, the qualitative method, is concerned with investigating the reasons for human behaviour and aims at discovering the underlying motives and desires (Kothari, 2004). Table 3 -1 shows the differences between quantitative and qualitative research.

Table 3 - 1: Differences between quantitative and qualitative research

	Quantitative	**Qualitative**
Purpose	Abstraction of reality	Investigate constraint of day to day events and peoples behaviours
Flexibility	Complex structured methods to confirm or disapprove (Adopted from Wolman et al., 2005) Hypothesis	Allows for greater flexibility, data can be changed progressively to allow deeper understanding of what is being invested.
Objectivity and subjectivity	Evaluate objective data consist of numbers	Deals with subjective data produces by participant
Data Collection	Control investigation and structured research to identify and isolate variables	Holististic approach as collection of wide range of data is crucial
Research approach	Experimental, quasi-experimental or non-experimental	Phenomenological or historical approach
Sample	Based on large numbers of cases and statistical significance	Based on small samples of people

Adapted from Wolman et al. (2005)

3.3.2 The characteristics of Qualitative research

According to Creswell (2013) the main characteristics of qualitative data are, namely:

- Natural setting- the research takes place on a natural setting where the research studies the participants experience on the issues under study
- Researcher as key instrument –a researcher collect data themselves through examining documents, observing behaviour or interviewing participants. The researcher does not need questionnaires or instruments developed by other researchers Multiple source of

data- Researcher collect data from multiple source of data rather than relying on a single data source

- Inductive and deductive data analysis - researcher builds patterns, categories and themes from bottom up working back and forth between the themes and database to determine if more evidence is required to support each theme.

- Participants' meaning- the researcher focus on learning the meaning from the participants' perspective of the problem not the researchers.

- Emergent design- the process of a qualitative cannot be tightly prescribed as it can be changed based on the findings on the field during data collection. The main purpose of qualitative data is to learn about the problem.

- Reflexivity – the researcher reflects about their role in the study and their personal background and how their role can shape interpretation.

- Holistic account- try to address a complex problem and this may involve multiple perspective reporting, identifying many factors involved in a situation.

3.4 Research Instrument and framework

It is necessary to describe the instrument and indicate what it measures, describe the subscales and what they measure, describe the response format and scoring method, and include some research on the reliability and validity of the instrument (Laher, 2016). It is impossible to draw conclusions based on the instruments without scrutinising the reliability, validity, and lack of bias in instruments (Ibid). Figure 3 -1 shows the research framework undertaken.

Figure 3 - 1: Research framework

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┌─────────────────────────────────────┐
│         Literature review           │
└─────────────────────────────────────┘
                 │
                 ▼
┌─────────────────────────────────────┐
│         Research design             │
└─────────────────────────────────────┘
                 │
                 ▼
┌─────────────────────────────────────┐
│         Purposive sampling          │
│  Projects completed between 2014 and│
│                2016                 │
└─────────────────────────────────────┘
                 │
                 ▼
┌─────────────────────────────────────┐
│             Qualitative             │
└─────────────────────────────────────┘
                 │
                 ▼
┌─────────────────────────────────────┐
│           Data analysis             │
└─────────────────────────────────────┘
                 │
                 ▼
┌─────────────────────────────────────┐
│            Conclusion               │
└─────────────────────────────────────┘
                 │
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┌─────────────────────────────────────┐
│       Research findings and         │
│        recommendations              │
└─────────────────────────────────────┘
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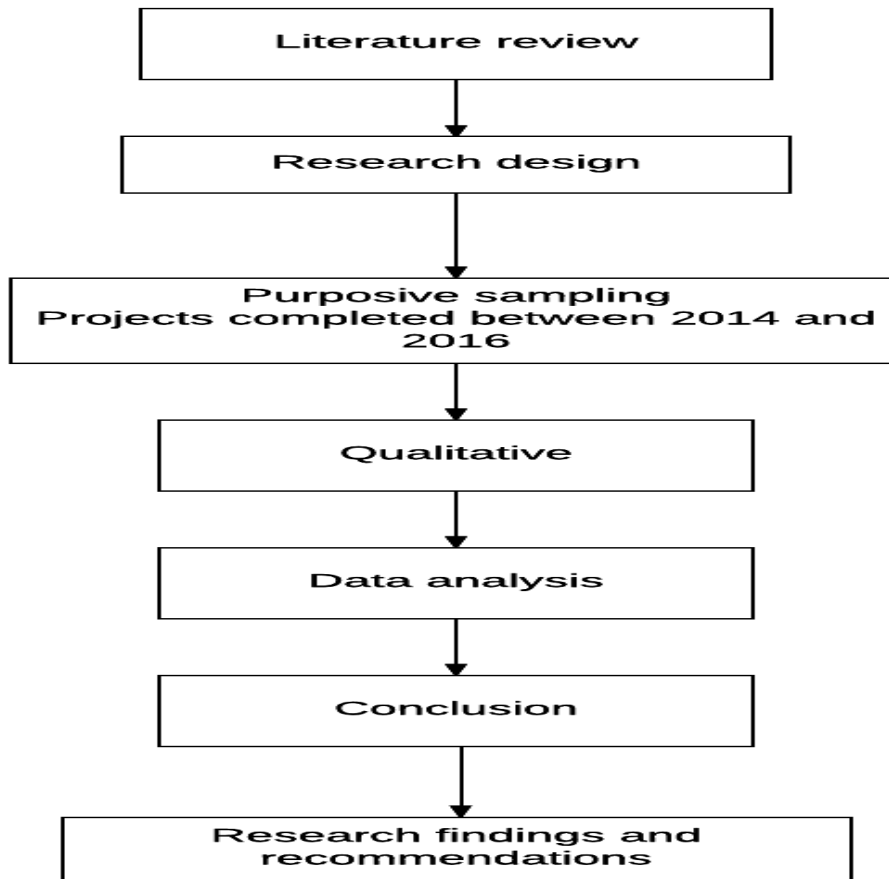
3.4.1 Research strategies

(i)   Literature review

A review of literature was conducted and a theoretical framework was developed on which findings of study can be compared. The literature review form base of the research as it is formulated by compiling a review of research findings from but not limited to books, journal, scholarly and government articles (Wolman et al., 2005). In the review process it was important to review literature related the study problem in order to:

- Determine the level of accuracy of estimates based on incomplete designs;
- Establish the correlation between the traditional procurement method and the inefficiencies in cost control and management during the construction projects phase of public sector projects;

- Assess the effect of estimates generated by the public sector Professional Service Provider on the overall cost management and performance of projects;
- And investigate the effectiveness of the cost management techniques implemented in the public sector.

The review gave the study an indication of where it fits, in relation with other studies on the same theme (Ibid).

(ii) A case study

The case study is when the limited number of units of analysis is intensively studied and the units can be typical or atypical (Wolman et al., 2005). It is done when the aim is to produce a valuable and deep understanding resulting in a new learning in the real world issues in terms of behaviour and meaning (Yin, 2012). It can be regarded as an in-depth analysis of a bounded system; by time, and or by place, of a single or multiple case over a period of time (Creswell, 2007). Case study can provide many sources of evidence and combining multiple techniques to generate data can strengthen and confirm results (Noor, 2008). The collection of data may include interviews, documents, observations or archival records that are rich in context and the researcher needs access to, and the confidence of participants (Schurink, 2009).

The collection of data using experiments, interviews and questionnaires is based on an interaction between the researched and the respondent (Auriacombe, 2007). The unobtrusive research method is not based on reactive research as the information is gathered without direct interaction between the respondent and the researched as the data can be collected through documents including archival records, publishes statistics, or educational data (Bless and Achola, 1990, Wolman et al., 2005). Unobtrusive methods has been found to be more useful to when combined with other methods, which become complimentary to it (Auriacombe, 2007).Yin (2012) claims that case studies that collect data from archival information may be biased and steps to encounter these should be considered by using different sources.

Yin, (2012) indicates that multiple cases can be difficult but it makes the researcher confident with the findings. For the study the data will be collected from archival records of the Department of Public work (an Implementing Department), as well as from both clients i.e. Department of Health and Education for triangulation.

(i)   Interviews

The interview method of collecting data involves verbal questions and responses which are aimed at ascertaining the underlying reasons people perceive the world in a particular way (Kothari, 2004). This can be done through telephonic or personal interviews. Interviews can be structured, unstructured or semi-structured. Creswell, 2007 Indicates that interviewing is a series of steps which include:

- Identification of interviewees base on purposive sampling;
- Determine the best and practical type of interview that will yield the most information to answer the research question namely personal, focus group or telephonic interview;
- Use of adequate recording
- Design and use an interview protocol with at least four or five open-ended questions.
- Pilot test the interview to refine them
- At the interview site obtain consent by asking the interviewee to sign the consent form to participate
- During the interview stay to the questions and listen rather than interrupting and also record the information on the interview protocol.

Structured interview comprise of predetermined questions in a particular order and high standard of recording (Kothari, 2004). Unstructured questions do not follow the predetermined question and there is relative flexibility which results in a lack of comparability of one interview to another and the analysis become difficult and time consuming (Ibid).
The interviews aimed at discovering in depth understanding of what was found on the statistical and the perceptions of respondents towards. The interviews also focused on procurement methods as the literature revealed that the traditional method is widely used in the public sector. The objective was to understand the participants' views on other methods.

In this study the qualitative data seek to obtain the perception of stakeholders relative to the development of cost estimates, cost overruns, procurement methods and general cost management techniques practised in the construction industry.

3.5 Research Data Collection

(i)   Primary data

The primary data is when the researcher gains data by direct, detached observation or measurement of phenomena in the real world and undisturbed by any intermediary interpreter (Walliman and Bousamaha, 2005). The primary data is original in character as the data is collected afresh from the participants (Cresswell, 2009).

(ii)   Secondary data

Secondary data refers to the data that is readily available collected by someone or an organisation, it can be either published or unpublished (Kothari, 2004). The literature review form the basis of the research as it is formulated by compiling a review of research findings from but not limited to books, journal, scholarly and government articles (Wolman et al., 2005).

A sample of construction projects undertaken and completed between the calendar year 2014 to 2016 will be the main source of data collection. A purposive sampling approach was adopted to identify the various projects to be included in the sample.

3.5.1 Qualitative data collection

Non-probability sampling is a commonly used qualitative research where the researcher's primary aim is to get an in-depth understanding, rather than quantity of understanding (Burger and Silima, 2006). Purposive sampling is non-probability sampling and is primarily used in qualitative studies where the researcher may select individuals, groups of individuals, institutions for a specific purpose in answering a research question (Teddlie and Yu, 2007). Creswell, 2014 concluded that the idea behind qualitative research is to purposefully select participants, site or documents that will help the researcher understand the problem and answer the research questions. According to Creswell (2007), a case study can be regarded as an examination or in-depth analysis of a single or multiple case, over a period of time. The researcher may collect data through public documents or private documents. The advantages of using documents is that it represent data to which participants have given attention and it save the researcher time and expense of transcribing (Creswell, 2013).

3.5.2 Quantitative data collection

Quantitative data can be collected using Survey Questionnaires. Questionnaires are dependable and reliable since they can be widely spread geographically, they also economical and provide a respondent with adequate time to give well thought out answers (Kothari, 2004). Wolman et al. (2005) argues that since there is no direct observations of the respondent's behaviour in questionnaires the consequence vary from poor cooperation to deliberate deception. A 5-point Likert scale was typically used as part of the questionnaire responses. In order to obtain the opinions of respondents the Likert scale can be used to produce hierarchies of preferences (Wolman et al., 2005). Numerical rating scales for situational test where participants are rated in their execution of tasks (Ibid).

Closed-end questions provide responses which are restricted in terms of how questions are answered as they require a selection of one of the possible alternative answer among the options given (Kothari, 2004). The closed-end questions are structured and easy to analyse (Ibid).

Structured interviews comprise of predetermined questions in a particular order and require high standard of recording (Kothari, 2004). Unstructured questions do not follow the predetermined format and there is relatively flexible which results in lack of comparability of one interview to another and this causes the analysis to become difficult and time consuming (Ibid).

In this study a qualitative research design has been chosen, the data is colleceted with the intention to obtain the perception of stakeholders relative to the development of cost estimates, cost overruns, procurement methods and general cost management techniques practised in the construction industry.

Mixed method sampling strategies utilizes both probability and purposive sampling to increase external validity and transferability (Teddlie and Yu, 2007). It is imperative to ascertain how and when the data mixing occurs (Creswell, 2013). The quantitative and qualitative data can be connected in a two-phase project where it begins with the analysis of quantitative data in order to identify participants for qualitative data collection in a follow-up phase (Creswell, 2013).

3.6 Population and sampling

The population is a group of potential participants whom the researcher uses to make generalisations based on the results of the study (Wolman et al., 2005). Sampling, rigorous categorisation and coding are critical and important to achieve a level of objectivity, reliability and generalizability in a study (Walliman and Bousamaha, 2005). Rigour generally is a processes of quality control mechanism to ensure the quality of the final research product (Laher, 2016). When sampling it is important to consider three broad aspects, namely, composition of sample, representativeness of the sample, and size of sample as they have implications on validity (Laher, 2016).

Sampling allows the researcher to save time and resources as it is not always possible to study the entire population (Burger and Silima, 2006). "A basic principle of probability sampling is that a sample will be representative of the population from which it is selected if all members of the population have equal chances of being selected in the sample" (Babbie and Mouton, 2001: 173). Probability samples aim to achieve accurate representativeness of the entire population and are primarily used on quantitative oriented studies selecting a large number of units (Teddlie and Yu, 2007).This can be achieved by random selection (Burger and Silima, 2006). Barbie and Mouton (2001) assert that the advantages of probability sampling is that it removes the possibility of being biased and the researcher understand the limits placed on generalizability. Unless the sample frame is kept in mind it is not easy to judge the representativeness of the entire population (Wolman et al., 2005).

Systematic sampling is used on a very large population of unknown characteristics. Systematic sampling procedures involves the selection of units in a series on a list according to a predetermined system (Walliman and Bousamaha, 2005). There are many possible systems. Perhaps the simplest is to choose every nth case on a list, for example, every tenth (Walliman and Bousamaha, 2005).The systematic sampling method at every 10th of the project of the sample was used for the study.

3.7 Data analysis:

3.7.1 Quantitative

"Data analysis by means of statistical techniques helps us to investigate variables as well as their effect, relationship and patterns of involvement within our world" (Wolman et al., 2005: 211). Lutabingwa and Auriacombe, 2007 emphasised the importance of knowing which tests, when and how to perform them as well as to interpret the results correctly. Each questionnaire should be checked to determine vague answers, inconsistences or multiple responses in a single item Singleton and Straits, 2004 cited in (Lutabingwa and Auricombe, 2007). Data coding is a process to analyse and make sense of data by assigning tags or assigning numbers to all questions in the questionnaire (Wolman et al., 2005).

Descriptive statistics measure the central tendency the dispersion will be adopted. Data will be captured, analysed through calculations and subsequently interpreted.

3.7.2 The data analysis: Qualitative

Creswell, 2007: 148 indicates that the there are three main analysis strategies for qualitative data namely:

- Preparation of data and organising it for analysis;
- Reduce data into themes through a process of coding and condensing codes and;
- Presentation of data into figures, tables for discussion.

In an exploratory research the data may be analysed continuously as it is collected. The analysis may lead to clues as to the most fruitful area of further data collection and subsequent analysis. In some phenomenon is it might not even be possible to begin the analysis until all the relevant data has been collected. (Walliman and Bousamaha, 2005).

3.8 Validity and reliability

Reliability is defined as the credibility of the research findings by generalising the scores regardless of the time of measurement, the test used or the person administering the test

(Wolman et al., 2005) for instance if a research can be repeated it needs to obtain the same findings as the original findings. Validity is the extent to which the research findings accurately represent what is happening in the research setting and how levels of biasness are assessed in this regard (Ibid). Prior to the conduction of the main study it is sensible to undertake a preliminary study to test the weaknesses of the research instrument and the study techniques so as to make improvements (Kothari, 2004).

Creswell (2013) concludes that, validity and reliability does not carry the same meaning and are described differently in qualitative research as compared to quantitative research. In qualitative validity means that the researcher checks the accuracy of the findings by undertaking different procedures, while qualitative reliability indicates that the researcher's approach is consistent across different site or projects (Ibid).

Validity is one of the strengths of the qualitative research as it is based on determining whether the findings are accurate from the opinion of researcher, the participant or the readers and trustworthiness, authenticity and credibility is maintained (Creswell & Miller, 2000 cited in Creswell, 2013). In order to ensure validity for this study the data was collected through the use of multiple sources of data analysis including observations. The researcher used the data from the Department of Public Work and the Department of Education. Creswell (2013) indicates that using data from different data sources can adds to validity of the study. The final report was given to both department for comments on the findings. A detailed description of setting about the theme was explored to ensure realistic and richer results to add to the validity of the findings.

For reliability the approach was consistent across 20 different projects that were studied and the data was collected from different sources.

3.9 Conclusion

This chapter outlined the research strategy, design as well as the methods utilized including the instruments used for the study. How the data was collected, analysed and presented was

discussed. The next chapter presents the findings of the case study, the questionnaire and interviews.

Chapter Four – Data analysis interpretation and discussions

4.1 Introduction

This chapter presents the analysis of data collected in the case study. Data analysis was done using Microsoft Excel 2013 in a tabular and graphical format. The explanatory narrative and summary tables are also included.

4.2 Case study analysis

Department of Public Works in KwaZulu-Natal was approached for permission to access Works Information Management System (WIMS). Permission was granted in writing to collect the data from their system. The Departments of Education and Health were also approached to access their information and permission was also granted. This information was collected through different sources, namely data from the electronic system, official reports and archival records. Both Departments were willing to share the information but there was a concern about confidentiality, Therefore, the project names and other critical data are not disclosed.

The case studies were selected using data from Public Works, the implementing Department of the KwaZulu-Natal Provincial government was selected. It was found that 435 projects had been completed. However, 205 were not considered as they did not have the necessary information such as details of consultants' fees and were excluded on this basis. Only 230 projects formed the final study population. The data was exported from the WIMS to the Excel spread sheet for reproduction. The projects for the case study were selected using a systematic random sampling method and every tenth project was selected resulted in 23 projects but three projects were found to have invalid information for a case study. Only 20 projects were therefore considered for the study. The sample was found to have 13 projects on storm damage, to ensure representation these were reduced to 7 and an additional set of projects of different nature were added. Analysis of other documents and minutes on the infrastructure programme were also accessed to obtain information about the relevant aspects of the projects.

The purpose of the case study is to analyse the consistencies and discrepancies between the budget estimates prepared during the pre-tender stage of each project by the quantity surveyor, the tender or contract amount quoted by the contractor and the final account.

4.3 Data analysis and interpretation

Quantity Surveyor's estimates and contractor's tender amount that exceeded the estimate, 75 % were lower than the estimated amount and 15 % were equal to the estimate. Project 1

exceeds the estimate by 352%, projects 8 and 15 were 20% lower than the estimate. Projects 3, 4 and 18 were equal to the estimate. The results suggest that 75% of the estimates by the quantity surveyors are higher than market-related rates. The findings suggest that quantity Surveyors are out of touch with market trends and costs. Table 4 - 1 shows that of the 20 projects, only 10% of the projects awarded were more than the estimate.

Table 4 - 2: Tender amount versus quantity surveyor estimate

Project number	Project Description	Percentage of tender amount versus estimate	Tender amount greater than estimate	Tender amount less than estimate	Tender amount equal to the estimate
1	Alterations and renovations	352%	>		
2	Alterations and renovations	-18%		<	
3	Repairs to roof	0%			=
4	Alterations and renovations	0%			=
5	Complete renovation	-16%		<	
6	Repairs and renovations	-12%		<	
7	Repairs and renovations	-16%		<	
8	Upgrade and additions	-20%		<	
9	Storm damage repairs	-17%		<	
10	Storm damage repairs	-18%		<	
11	Storm damage repairs	-18%		<	
12	Storm damage repairs	-18%		<	
Project number	Project Description	Percentage of tender amount versus estimate	Tender amount greater than estimate	Tender amount less than estimate	Tender amount equal to the estimate
13	Storm damage repairs	-20%		<	

Project number	Project Description	Percentage	Final amount greater	Final amount less than	Final amount equal to
14	Storm damage repairs	-19%		<	
15	Storm damage repairs	-20%		<	
16	The Construction of ECD	-13%		<	
17	The Construction of ECD	-19%		<	
18	Upgrade staff Residence	0%			=
19	Repairs and renovations	5%	>	<	
20	Construction of Staff Residence	-23%		<	
	Percentage in total		**10%**	**75%**	**15%**

4.3.1 Final account and tender amount

Table 4 - 2 shows the analysis of the accepted construction tender amount and the agreed final account of each project. It is evident that the final accounts of 45% of projects exceeded the initial tender amounts, 40% of projects had final costs less than the initial tender amounts and the remaining 15% had final accounts that equalled the tender amounts.

Table 4 - 3: Final account versus tender amount

Project number	Project Description	Percentaget of final amount	Final amount greater	Final amount less than	Final amount equal to

		versus tender amount	than tender amount	tender amount	the tender amount
1	Alterations and renovations	187%	>		
2	Alterations and renovations	-8%		<	
3	Repairs to roof	10%	>		
4	Alterations and renovations	5%	>		
5	Complete renovation	30%	>		
6	Repairs and renovations	-4%		<	
7	Repairs and renovations	10%	>		
8	Upgrade and additions	4%	>		
9	Storm damage repairs	-1%		<	
10	Storm damage repairs	-18%		<	
11	Storm damage repairs	-4%		<	
12	Storm damage repairs	0%			=
13	Storm damage repairs	0%			=
14	Storm damage repairs	-4%		<	
15	Storm damage repairs	0%			=
16	The Construction of ECD	-7%		<	
17	The Construction of ECD	-2%			
18	Upgrade staff Residence	26%	>		
19	Repairs and renovations	134%	>		
20	**Construction of** Staff Residence	**18%**	>	<	
Percentage **in total**			45%	40%	15%

48

4.3.2 Variation orders

Table 4 - 3 shows the results in respect to variation orders and the cost impact of variations in term of increasing or decreasing the total project cost. It is evident that 30% of projects had variations that increased the project costs, 20% projects decreased the project cost and the remaining projects had no variations at all

Table 4- 4: Variation orders

Project number	Project Description	Variation orders	Variations increased cost more than tender amount	Variations decreased cost less than tender amount	No variation
1	Alterations and renovations	161%	>		
2	Alterations and renovations	-11%		<	
3	Repairs to roof	0%			-
4	Alterations and renovations	0%			-
5	Complete renovation	2%	>		
6	Repairs and renovations	0%			-
7	Repairs and renovations	5%	>		
8	Upgrade and additions	-3%		<	
9	**Storm damage** repairs	**0%**			**-**
10	Storm damage repairs	0%			-
11	Storm damage repairs	0%			-
12	Storm damage repairs	0%			-
13	Storm damage repairs	0%			-
14	Storm damage repairs	0%			-

			Time overrun		
15	Storm damage repairs	0%			-
16	The Construction of ECD	-5%		<	
17	The Construction of ECD	-2%		<	
18	Upgrade staff Residence	20%	>		
19	Repairs and renovations	134%	>		
20	Construction of Staff Residence	9%	>		
Percentage in total			30%	20%	50%

4.3.3 Schedule

Table 4 - 4 shows the results in respect to time overruns. It is evident that 90% of the sample projects had time overruns, no projects have revealed to be completed early and only 10% were finished on schedule.

Table 4 - 5: Time overruns

Project number	Project Description	Time delays	Time overruns	Early completion	No time overruns
1	Alterations and renovations	400%	>		
2	Alterations and renovations	256%	>		
3	Repairs to roof	25%	>		
4	Alterations and renovations	125%	>		
5	Complete renovation	108%	>		

6	Repairs and renovations	233%	>		
7	Repairs and renovations	157%	>		
8	Upgrade and additions	0%			-
9	Storm damage repairs	367%	>		
10	Storm damage repairs	283%	>		
11	Storm damage repairs	360%	>		
12	Storm damage repairs	33%	>		
13	Storm damage repairs	0%			-
14	Storm damage repairs	20%	>		
15	Storm damage repairs	400%	>		
16	The Construction of ECD	22%	>		
17	The Construction of ECD	222%	>		
18	Upgrade staff Residence	83%	>		
19	Repairs and renovations	307%	>		
20	Construction of Staff Residence	47%	>		
Percentage in total			**90%**		**10%**

4.4 Summary of findings on estimates, final accounts, variations and schedule

Figure 4-1 indicates that 75% projects were awarded below the quantity surveyor's estimate suggesting that the estimates prepared by the surveyor are not being used as guidelines for the award of tender since the lowest tenderer is awarded the project irrespective of the estimates made. This finding is suggestive of the conservative estimating methodology followed by quantity surveyors and/or the costs basis that they had used to compile the estimate being out of touch with market trends.

Relative to final accounts the results suggest that 45% of project were completed with cost overruns, 40% below the tender amount and only 15% finished within the tender amount.

The analysis of variations indicates that 50% of project had variations that either increased or decreased the project cost while about 50% of projects did not have any variation.

It was also found that with regard to the project schedule about 90% of projects were not completed within project schedule with only the remaining 10% being completed on time.

Figure 4 - 1: Estimates, final account, variations and time schedule
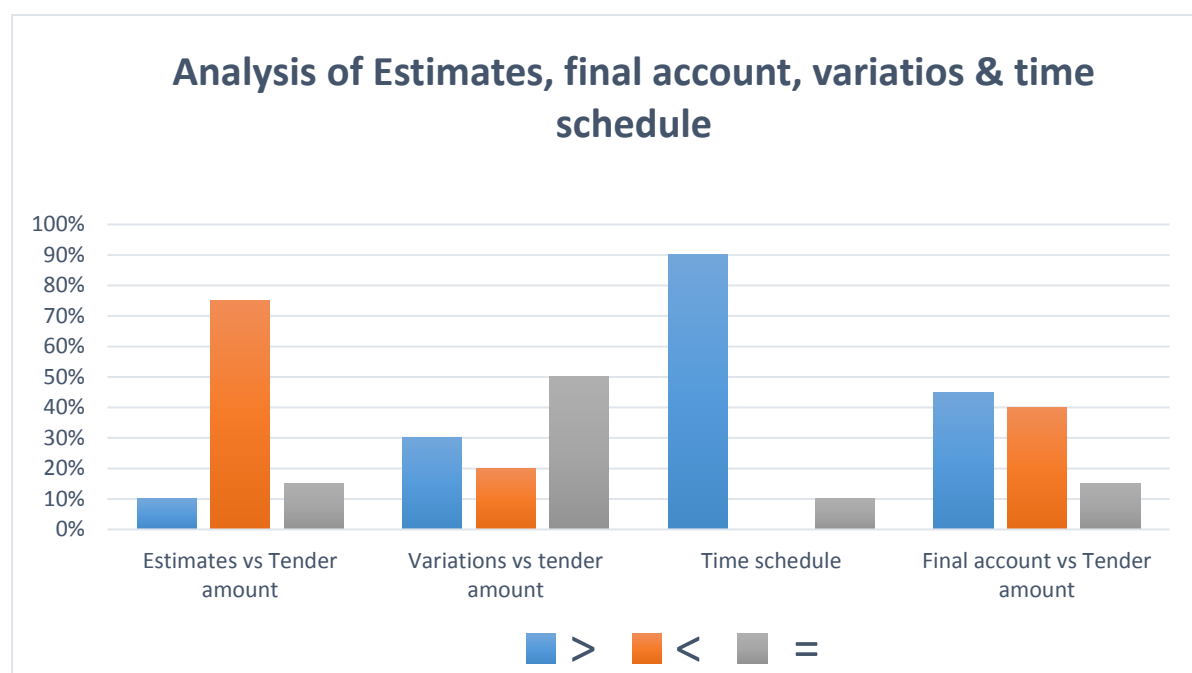
4.4.1. Origin of cost overruns based on client, consultant and contractor's role

The origin of cost overruns were grouped according to the roles of the parties involved in the project namely the client, consultant, contractor and others. Clients included Department of Public Works as an implementing department or the user department who was the initiator and the project sponsor. Consultants included the professional team from all disciplines who were involved in the implementation of the project. Contractors included the main contractor and the sub-contractors. Others included weather conditions, change in regulations and any other condition beyond the control of either party of the contract. The analysis of records for reasons of cost overruns was done based on the causes for variation.

The analysis of records for reasons of cost overruns confirmed many of the causes that were identified in the literature and included the following, namely:

- Increase or change of scope of work;

- The time delays between the planning and project implementation

- Estimates based on incomplete designs, changes, errors or omission.

- Construction changes which are initiated to improve constructability due to site conditions.

- Other includes change in regulation and damage caused by accident or inclement weather.

There were 6 projects with variation orders that led to cost increases. These projects included project 1 and 5 which were renovations of hospitals. The other projects were for upgrades, repairs and renovations to staff residences as well as the construction of new hospital staff residence. The list of these projects with variation is shown in Table 4 - 5.

Table 4 - 6: Projects with variation orders

Project number	Project Description	Variation orders	Variations increased cost more than tender amount
1	Alterations and renovations	161%	>
5	Complete renovation	2%	>
7	Repairs and renovations	5%	>
18	Upgrade staff Residence	20%	>
19	Repairs and renovations	134%	>

20	Construction of Staff Residence	9%	>

The data regarding project 1 was limited and therefore could not be analysed in this regard.

4.4.2 Origin of cost overruns based on client, consultant and contractor's role

Project 5:

The initial scope of work was the alterations and renovations to the hospital. This was to be done while the hospital continued with its operations. The hospital only had capacity to make available one building at a time to be worked on. This restriction required one building to be renovated and completed at a time before the work commenced on work on the next building. In trying to make available other spaces temporary accommodation was required which resulted in a variation of R337,307. The project had total variations of R697,473 caused by different reasons.

The accepted project tender sum was R31,676,323 which was 16% less than the estimate. The cost overruns were 30% including 2% variation orders. The 28% of the total claims during the final account of R8.6million included: the escalation based on the extension of time, preliminaries and general costs; as well as other disbursements is a reflection of the delays due to the challenges encountered during the project. The original planned duration for completion of the project was 24 months but the contractor could not finish on time resulting in a delay of two months, it was only on the 26 month (108%) more than the scheduled period that the project was completed. The details on variation orders are shown in Table 4 - 6.

Table 4- 7: Variation orders' origin and causes – Project 5

Origin	Amount	%	VO no.
A	R 119 223	65%	2
B	R 0	0%	0
C	R 36 684	20%	2
Other	R 27 513	15%	4

Total	R 183 420	100%	8
Cause	Amount	%	VO no.
1	R 119 223	65%	2
2	R 0	0%	0
3	R 18 342	10%	1
4		0%	
5	R 45 855	25%	5
Total	R 183 420	100%	8

Keys: Origin: A. Client, B. Consultant, C. Contractor, D. Others

Cause:

1   Increase or change of scope of work;

2   The time delays between the planning and project implementation

3   Estimates based on incomplete designs, changes, errors or omission

4   Construction changes and errors

5   Other includes change in regulation and damage caused by accident or inclement weather

Project 7:

The initial scope of work was alterations and renovations to office accommodation. The tender sum for the renovations was R3,678,998 which was 16% less than the estimate, completed with 10% cost overruns and 5% variation orders. The original planned duration was 7 months and the contractor completed the project on time.

Table 4- 8: Variation orders' origin and causes – Project 7

Origin			
	Amount	%	VO no.
A	R 119 223	65%	2
B	R 0	0%	0
C	R 36 684	20%	2
Other	R 27 513	15%	4
Total	R 183 420	100%	8
Cause	Amount	%	VO no.
1	R 119 223	65%	2
2	R 0	0%	0
3	R 18 342	10%	1

4		0%	
5	R 45 855	25%	5
Total	R 183 420	100%	8

Origin	Amount	%	VO no.
A	R 119 223	65%	2
B	R 0	0%	0
C	R 36 684	20%	2
Other	R 27 513	15%	4
Total	R 183 420	100%	8
Cause	Amount	%	VO no.
1	R 119 223	65%	2
2	R 0	0%	0
3	R 18 342	10%	1
4		0%	
5	R 45 855	25%	5
Total	R 183 420	100%	8

Keys: Origin: A. Client, B. Consultant, C. Contractor, D. Others

Cause:

1   Increase or change of scope of work;

2   The time delays between the planning and project implementation

3   Estimates based on incomplete designs, changes, errors or omission

4   Construction changes and errors

5   Other includes change in regulation and damage caused by accident or inclement weather

Project 18:

The initial scope of work was the upgrade of the staff residence. Initially the scope was for the replacement of the roof and renovations to the top floor. The designs were done but the project did not start as planned due to the change of priorities. The project started 36 months after the design completion. The project was then reprioritised and was advertised based on the initial design taking into consideration the escalation. During construction, additional work was necessary in order to not compromise the integrity of the work carried out.

The tender sum for the renovations was R47, 747, 747 equal to the estimate. The cost overruns were 26% included 20% variation orders during construction and 6% for the claims during project final account. The original planned duration was 9 months but the contractor could not finish on time and the extension of time was 95 days. The project had variations amounting to R9, 318,857 caused by numerous reasons and claims of R2, 913, 221. The detailed information is indicated in Table 4 - 8.

Table 4- 9: Variation orders' origin and causes – Project 18

Origin	Amount	%	VO no.
A	R 5 591 314	60%	10
B	R 2 124 609	23%	0
C	R 652 320	7%	2
Other	R 950 614	10%	4
Total	R 9 318 857	100%	16
Cause	Amount	%	VO no.
1	R 3 065 652	33%	3
2	R 3 625 003	39%	3
3	R 1 000 062	11%	4
4	R 950 614	10%	2
5	R 677 526	7%	4
Total	R 9 318 857	100%	16

Keys: Origin: A. Client, B. Consultant, C. Contractor, D. Others

Cause:

1   Increase or change of scope of work;

2   The time delays between the planning and project implementation

3   Estimates based on incomplete designs, changes, errors or omission

4   Construction changes and errors

5   Other includes change in regulation and damage caused by accident or inclement weather

Project 19:

The initial scope of work was the repair and renovation to the hospital including removal of asbestos fibre. Initially the scope was the replacement of roof and renovations to the top floor. After the top floor were finished the client indicated that it was sensible to renovate the lower floors. The tender sum for the renovations was R20,042,326 at 5% more than an estimate with cost overruns of R26, 803, 070. The 134 project variations were more than double of the tender sum.

Table 4- 10: Variation orders' origin and causes – Project 19

Origin	Amount	%	VO no.
A	R 16 081 842	60%	4
B	R 5 360 614	20%	3
C	R 3 216 368	12%	2
Other	R 2 144 246	8%	2
Total	R 26 803 070	100%	11
Cause	Amount	%	VO no.
1	R 7 236 829	27%	3
2	R 12 061 382	45%	2
3	R 4 020 461	15%	2
4	R 1 608 184	6%	2
5	R 1 876 215	7%	2
Total	R 26 803 070	100%	11

Keys: Origin: A. Client, B. Consultant, C. Contractor, D. Others

Cause:

1   Increase or change of scope of work;

2   The time delays between the planning and project implementation

3   Estimates based on incomplete designs, changes, errors or omission

4   Construction changes and errors

5   Other includes change in regulation and damage caused by accident or inclement weather

Project 20:

The project the construction of staff accommodation which was going to be done on phases. The project was phase 3B dependent on phase 3A completion. The delays and the court order of phase 3A meant that the retaining wall, electrical and other civil works were to be accommodated in the phase 3B. The tender sum for the renovations was R91,249,423 at 23%

less than an estimate (R118 173 295 with cost overruns of 18%. The contractor completed the project within schedule. The project had variation of R7,844,504 caused by different reasons.

Table 4- 11: Variation orders' origin and causes – Project 20

Origin	Amount	%	VO no.
A	R 5 883 378	75%	4
B	R 1 961 126	25%	3
C		0%	2
Other		0%	2
Total	R 7 844 504	100%	11
Cause	Amount	%	VO no.
1	R 7 236 829	92%	8
2	R 607 675	8%	3
3		0%	
4		0%	
5		0%	
Total	R 7 844 504	100%	11

Keys: Origin: A. Client, B. Consultant, C. Contractor, D. Others

Cause:

1   Increase or change of scope of work;

2   The time delays between the planning and project implementation

3   Estimates based on incomplete designs, changes, errors or omission

4   Construction changes and errors

5   Other includes change in regulation and damage caused by accident or inclement weather

4.4.3 Cost overruns based on macro-economic factors only

There were project with cost overruns due to macro-economic factors only. Project 1, 3, 5 and 8 did not start as planned. The cost overruns were due to claims and escalations. Project 2, 4 and 7 was stopped for 252, 268 and 98 days respectively by the client since there were financial constraints. The client's lack of funding resulted in claims and escalations. Project 18 and 20 had escalations and other claims. The details of overruns on each projects are listed in Table 4 -12.

Table 4- 12: Cost overruns based on non-variation order factors

Project number	Project Description	Cost overruns due to micro-economic factors
1	Alterations and renovations	8%
2	Alterations and renovations	2%
3	Repairs to roof	8%
4	Alterations and renovations	4%
5	Complete renovation	18%
7	Repairs and renovations	4%
8	Upgrade and additions	5%
18	Upgrade staff Residence	4%
20	Construction of Staff accommodation	6%

Project number	Project Description	Cost overruns due to micro-economic factors
1	Alterations and renovations	8%
2	Alterations and renovations	2%
3	Repairs to roof	8%
4	Alterations and renovations	4%
5	Complete renovation	18%
7	Repairs and renovations	4%
8	Upgrade and additions	5%
18	Upgrade staff Residence	4%
20	Construction of Staff accommodation	6%

4.4.4 Cost overruns per agent

Project number	Project Description	Cost overruns due to micro-economic factors
1	Alterations and renovations	8%
2	Alterations and renovations	2%
3	Repairs to roof	8%
4	Alterations and renovations	4%
5	Complete renovation	18%
7	Repairs and renovations	4%

8	Upgrade and additions	5%
18	Upgrade staff Residence	4%
20	Construction of Staff accommodation	6%

It was found that the client contributes about 71% to increasing or changing the project scope followed by the consultants contributing 20%. Projects that are delayed between planning and project implementation are mostly being delayed by the client followed by consultants. About 70% of projects with cost overruns due to the incomplete designs, changes, errors or omissions are caused by consultants followed by the client and the contractor at 20% and 10% respectively. The agent that is most likely to cause construction changes and errors is the contractor at 44% followed by the consultant at 31% and the client at 25%. The detail on cost overruns causes and origins are shown in Table 4 – 13

Table 4- 13: Origin-Cause matrix of cost overruns

Key	Causes of cost overruns	Client	Consultant	Contractor
1	Increase or change of scope of work	71%	20%	9%
2	The time delays between the planning and project implementation	65%	18%	15%
3	Estimates based on incomplete designs, changes, errors or omission	20%	70%	10%
4	Construction changes and errors	25%	31%	44%

The origin-cause matrix of cost overruns is shown graphically on figure 4 - 2
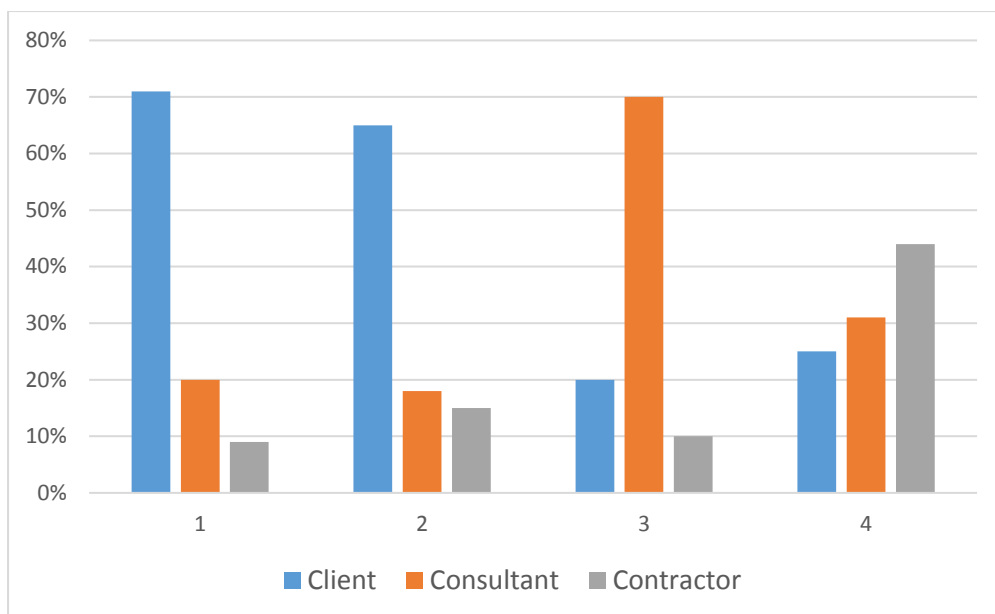
Figure 4- 2: Overruns per agent

Keys: Origin: A. Client, B. Consultant, C. Contractor, D. Others

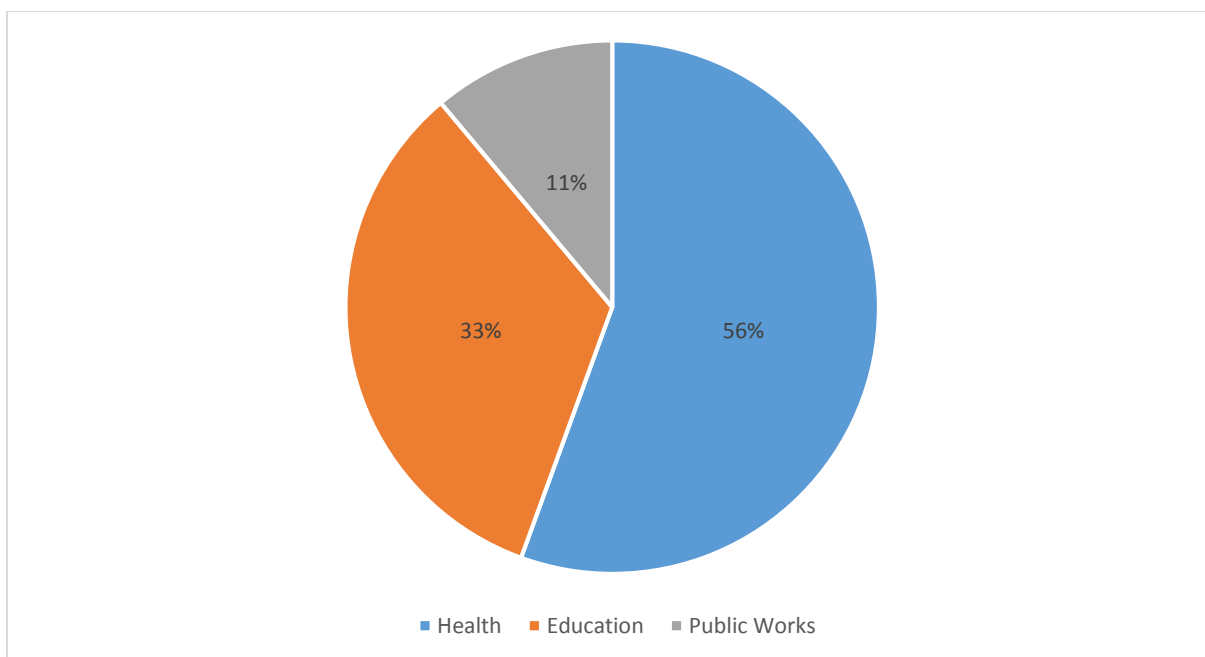Cause:

1   Increase or change of scope of work;

2   The time delays between the planning and project implementation

3   Estimates based on incomplete designs, changes, errors or omission

4   Construction changes and errors

4.4.5 Cost overruns per public sector client

Of the 20 projects about nine (45%) of them were found to have cost overruns. The projects with cost overruns comprised of projects from the Departments of Health, Education and the department of Public Works. The Department of Health were responsible for 56% of projects with cost overruns followed by the Departments of Education (33%) and Public Works (11%).

Figure 4- 3: Cost overruns per public sector client

Health ■ Education ■ Public Works

4.4.6 Summary on origin of cost overruns

(i)   Origin:

Variation are mostly caused by the public sector clients averaging at 62% followed by the consultants at 21%, the contractor and others are at 9%.

Table 4- 14: Value of variation orders and its origin

VO origin	Project					
	5	7	18	19	20	Total Average
	VO amount in %					
A	49%	65%	60%	60%	75%	62%
B	37%	0%	23%	20%	25%	21%
C	4%	20%	7%	12%	0%	9%
Other	10%	15%	10%	8%	0%	9%
Total	100%	100%	100%	100%	100%	100%

Keys: Origin: A. Client, B. Consultant, C. Contractor, D. Others

(ii) Causes of overruns:

Cost overruns and variation are mostly caused by the increase or change of scope of work, followed by the time delays between the planning and project implementation. Incomplete designs, changes, errors or omission by consultants averaged14%, construction changes and errors, change in regulation and damage caused by accidents or inclement weather made up 11%.

Table 4- 15: Value of variation order and its cause

Cause	Project					Total Average
	5	7	18	19	20	
	VO amount in %					
1	15%	65%	33%	27%	92%	46%
2	0%	0%	39%	45%	8%	18%
3	33%	10%	11%	15%	0%	14%
4	37%	0%	10%	6%	0%	11%
5	15%	25%	7%	7%	0%	11%
Total	100 %	100%	100%	100%	100%	100%

Other Causes of overruns:

1) The Increase or change of the scope of work;
2) The time delays between the planning and project implementation
3) Estimates based on incomplete designs, changes, errors or omission
4) Construction changes and errors
5) Other includes changes in the regulations which guide the project and any damage caused by an accident or inclement weather

(iii) Cost overruns that are not based on variations

Some cost overruns are not caused by variation by any of the agents but factors that are beyond any of the stakeholders' control. Mainly escalations and resultant claims result in cost overruns.

4.5 Interviews

These interviews focused on understanding the reasons for cost overruns based on the findings emerging from the analysis of the 20 cases and to establish the views of the public sector on other procurement methods as alternatives to the traditional procurement system as well as the perceptions of cost management in the public sector. Four individuals were interviewed who were directly involved in all the projects. Prior to conducting the interviews, the Chief Director in charge of the Infrastructure Unit was first phoned seeking for a permission to interview the senior manager as well as herself and the purpose of the interview also explained.

The telephone conversation was thereafter confirmed in writing in a letter indicating the main points that would be covered during the interview. The main objective of the interview was to explore whether or not there were construction projects which experienced cost overruns and to understand what perceptions the respondents had in terms of towards the cost overruns.

4.5.1 Interview with senior managers

A group interview of two senior managers took place on the 5th September 2017 in one of the manager's office. The managers were concerned with confidentiality of the discussion therefore preference was given to note taking together with the recording. Even though they spoke freely but there was an element of caution of the information shared. The manager responsible for planning is referenced as Manager A and the manager responsible for the delivery of infrastructure projects is referenced as Manager B. Both managers were involved in all 12 of the projects sampled. Manager A is responsible for planning and Manager B's role is the actual delivery of projects. Both managers indicated the following:

(i)   Estimates and cost overruns

During the tender stage cost estimates are used only as a guideline. The procurement committees would award projects to the lowest tenderer since they are not acute but rather exaggerated. The project's cost estimates are not accurate due to the traditional method of

estimation and the system used to pay consultants. The consultants are paid on a percentage basis, the more expensive the project the higher the amount paid to the consultants involved.

In some cases, the time given to consultants to design and prepare an estimate is not adequate enough as some projects become an emergency due to various political pressure or the nature of the projects such as, for instance, storm damages after severe inclement weather. In addition to this:

- Estimates are done based on escalated amounts as a contingency allowance or the amount is used for other activities that are not necessarily part of the projects.
- The lead time between the preparation of estimates and the actual site handover to the contractor is normally lengthy due to budgetary constraints, procedures and processes that need to be followed before the contractor commences work on site cause cost escalations which become an issue.
- There is always pressure on government to spend the whole allocated budget before the end of the financial year. This pressures project and programme managers to place expenditure as a priority rather than savings and cost management.

(ii)   Procurement methods

The traditional procurement system is the most widely used approach in the public sector since it allows the public sector to have some control on both the contractor and consultants. The newly introduced Standards for infrastructure Procurement and Delivery Management (SIPDM) allows for different procurement strategies and methods which have yet not become pervasive on public sector projects.

(iii)   Cost management

During the interview the two managers indicated that there was a 20% threshold on variation orders which is set by the Treasury regulations. This treshold allows a maximum

cost variation of 20% or R20 million including Value added tax but exception are allowed on approved written motivation.

It was also revealed that client may lose track of the control budget as the focus may be on the current year expenditure. Unlike the private sector, the emphasis in government is rather not to save but to spend. Managers are measured on spending rather than saving. Unless government especially Treasury's mind-set changes and instead focuses on value for money the status quo will remain.

4.5.2 Interview with a manager responsible for some of the projects

A second interview took place on the 2nd October with a project manager who is responsible for four of the sampled projects. The project manager is referred to as Manager C.

    (i)   Cost estimates and overruns:

The manager indicated that besides the legislation that guides the procurement processes and the PPPFA which gives preference to the disadvantaged minority groups, the estimates are typically way above the market rate for government. He added that this inflation is caused by the Council for Built Environment payment of consultants' guidelines which makes it difficult to manage consultants. Furthermore the compartmentalisation or fragmentation of the functions of the contractor and the consultant, and the lack of competitiveness in the procurement system for consultants in the public sector contributes to the lack of cost management.

Amongst other factor that put pressure on the government system he indicated:

- Political interference: It was mentioned that the government system has various changes of power, authority and priority. When there is change in leadership some projects that were planned to be executed would be delayed due to changes in priorities by the new leadership.

- Pressure to spend budget: The pressure to spend the whole budget before the end of the financial year makes it difficult to manage costs. It leads to focus on spending more than managing cost and getting value for money.

4.5.3 Interview with procurement manager

The interview with the procurement managers took place on the 22nd September 2017. The manager responsible for procurement is referenced Manager D.

(i)   Estimates and cost overruns:

Manager D claimed that the cost estimates during tender were inaccurate. In most cases they were based on previous projects of similar type. However, each project is different especially for renovation or upgrades. He indicated that it was difficult to do accurate estimates for existing buildings leading to exaggerated estimates. Therefore, the Department takes the lowest tenderer. He also added that the internal quantity surveyors have a system to check these estimates meaning that the Department takes whatever estimate the quantity surveyor produces. He also indicated that consultants are in business. Therefore, the more expensive the project the higher the profit for them. As long as the current status quo remained it was difficult for government to control costs.

(ii)   Procurement methods:

Manager D claimed that the traditional procurement system was the most used approach in the public sector. This allowed the public sector to have some control on both the contractors and consultants. If government could start exploring other procurement methods it would of benefit since they would be able to compare the results in terms of risks and value for money.

(iii)   Cost management

Manager D also retaliated the 20% threshold on variation orders and indicated that it does not yield the desired results as the project delays between the planning stages and the actual implementation makes it difficult to minimise the variations. For instance on maintenance of a build, the time between the investigation on the magnitude of work to undertaken and the actual execution of the project is critical, the longer delays the more dilapidated the building will be. He indicated that the delays result in difficulty in cost control and management.

4.5.4 Summary of findings of interviews

The findings revealed that cost overruns were likely to happen in the public sector construction projects due to the change of scope by the client. Typically, this is due to the time it takes from the initial designs and the actual implementation of projects. The change of priorities due to political change of power and the pressure to spend makes it difficult for the managers to focus on cost management.

The Traditional Procurement method is predominantly used by the provincial government and the method in which consultant's payments are structured makes it difficult to manage costs.

4.6 Conclusion

The case study of 20 projects revealed that estimates generated by the public sector professional service providers are predominantly inaccurate. Most predominantly, the client award to the lowest tenderer .The cost overruns are most predominantly caused by the time it takes between the planning and the actual implementation of the project. The traditional procurement method is predominantly used leads to inefficiency in cost control. Cost management is not a priority but to realise expenditure.

Chapter Five – Conclusions and recommendations

5.1 Introduction

This chapter summarises and concludes the study with recommendations for future study. The hypotheses are tested and the study is summarized in this chapter. A total of four hypotheses are analysed based on the findings. The conclusion captures the major findings from the exploratory study, the interviews, research instrument and the analysis of the different case studies links all these factors to the objectives of the research study. The recommendations section highlights the implications of the study and makes suggestions for further research studies to be done in the future.

The research problem for the study was indicated as:

Considering that budgets for public sector construction projects are determined by estimates done at various stages of the procurement process, with arguably increasing levels of accuracy, the reasons for the frequent cost overruns during the construction phase of projects need to be investigated.

Hypotheses to be tested were:

- H1: Estimates based on incomplete designs during pre-tender stage result in cost overruns.

- H2: There is a correlation between the traditional procurement method and the inefficiencies in cost control and management during the construction phase of public sector projects.

- H3: Estimates generated by public sector Professional Service Providers affect the overall cost management and performance of projects.

- H4: The cost management techniques implemented in the public sector are ineffective.

The primary objective of the study is to investigate the effectiveness of cost management techniques that are implemented in the construction projects in public sector in KwaZulu Natal. The following specific objectives guided the study:

- To determine the level of accuracy of estimates based on incomplete designs

- To establish the correlation between the traditional procurement method and the inefficiencies in cost control and management during the construction projects phase of public sector projects.

- To assess the effect of estimates generated by the public sector Professional Service Provider on the overall cost management and performance of projects.

- To investigate the effectiveness of the cost management techniques implemented in the public sector.

An extensive review of literature was conducted and a theoretical framework provided for the study on which findings of the study were compared against. A qualitative study was conducted through the analysis of 20 case studies.

5.2 Hypothesis testing

- **Hypothesis 1: Estimates based on incomplete designs during pre-tender stage result in cost overruns.**

It was found that incomplete designs, changes, errors and omission contributed 14 % to cost overruns. However, the increase or change of scope is the major contributor to cost overruns at 46 %, followed by the time delays between the planning and project implementation at 18%, construction changes; and changes in regulation and damages caused by accidents or inclement weather were minimal contributors both at 11%.

The hypothesis that estimates based on incomplete designs during pre-tender stage result in cost overruns cannot be rejected.

- **Hypothesis 2: There is a correlation between the traditional procurement method and the inefficiencies in cost control and management during the construction phase of public sector projects.**

It was found that the traditional method is mostly used in the public sector and there were no projects that were implemented using other procurement methods. It was not possible to compare the relationship of these procurement routes and the inefficiencies. Therefore, it is plausible to accept that the inefficiencies that occur are due to the dominant procurement method, namely the traditional approach.

The hypothesis that there is a correlation between the traditional procurement method and the inefficiencies in cost control and management during the construction phase of public sector projects cannot be rejected.

- **Hypothesis 3: Estimates generated by public sector professional service Providers are inaccurate**.

The findings of the study suggested that 75% of the estimates by the quantity surveyors were higher than the market-related rates. On a sample of 20 projects it was found that the tender amount for 15 projects were lower than the estimate, 2 were less than the estimate and 3 were equal to the estimate. Out of the sample, 10% of projects were greater than the estimate, 75% were less and only 15% were equal to the estimate. The findings suggest that quantity surveyors were out of touch with market trends and costs.

The hypothesis that the estimates generated by public sector professional service providers are inaccurate cannot be rejected.

- **Hypothesis 4: The cost management techniques implemented in the public Sector are ineffective.**

Approximately 45% of projects were found to have cost overruns. The projects with cost overruns comprised of projects from the Departments of Health, Education and Public.

The Department of Health were responsible for 56% of projects with cost overruns followed by the Departments of Education (33%) and Public Works only (11%). From the archival data and interviews it was evident that a 20% threshold on variation was the main cost control technique that was used but during on the analysis of case studies the variations were about 46%. The public sector focus on the outputs and the pressure on budget spending before the end of the financial year supersedes the control and management of cost in construction projects.

The hypothesis that the cost management techniques implemented in the public sector is ineffective cannot be rejected.

5.3 Conclusions

From the analysis of 20 case studies the estimates based on incomplete designs, changes, errors or omission contribute about 14% in cost overruns. The total number of projects with overruns were dominated by the department of Health's projects at 56%, followed by the department of Education. Estimates based on incomplete designs during pre-tender stage result in cost overruns. A comparative analysis of different causes of overruns identified several causes that were grouped into:

- Increase or change of scope of work;
- The time delays between the planning and project implementation
- Estimates based on incomplete designs, changes, errors or omission
- Construction changes and errors
- Other includes change in regulation and damage caused by accident or inclement weather

It was confirmed by the managers during the interview that, the traditional method was the preferred approach as it allowed the public sector to have some control on both the contractor and consultants. The traditional procurement method was the approach most used in the public sector. The senior managers however indicated that they are interested in exploring other methods that would of the benefit since they would be able to compare the results in terms of risks and value for money.

During the analysis of the of 20 projects 75% of projects were awarded less that the tender cost estimate yet 45% were completed below the tender amount and 15% were awarded an equal to

the tender amount while only 40% were completed on cost overruns. The interviews also confirmed that the cost estimates are way above the market related rates. It was also indicated that in most project the contingency amount are commonly used for other works which were not initially part of the project which result in misleading historical project cost data.

During the interviews with senior managers it was found that the pressure to spend the whole budget before the end of the financial year makes it difficult to manage costs. It leads to focus on spending more than managing cost and getting value for money. The cost management should become part of the whole employee performance management system rather than just the spending element. A value against the outputs as per initial plans should be considered

5.4 Recommendations

5.4.1   Recommendations for future research

Based on the findings of this study, future research should be undertaken namely:

- It should be interested in investigating factors that lead to cost overruns in the department of Health projects. This would help to identify areas with a high impact on cost overruns and therefore contribute to the overall improvement in cost management.
- Since the study was undertaken in the Provincial government of KwaZulu Natal, a similar studies could be conducted with a sample populations from other levels of government and across South Africa to determine whether the findings of the study would be evident consistent nationally.
- There is also need to investigate whether the traditional procurement method preference by the public sector is optimally benefiting the sector. Based on the findings of this study, the public sector should be flexible to adopt other procurement methods instead of relying only on the traditional method.

5.4.2   The recommendations for potential beneficiaries of the study

For effective cost management of public sector construction projects it is recommended that the management of project cost should become part of the cost and project manager's performance management system rather than the outputs and spending. The project managers, cost managers and other stakeholders should focus on each individual cost control and

management as oppose to spending all budgetary allocations before the end of the year in order not to risk lower budget allocations in the following year. This will improve cost management and increase value for money in the public sector construction projects.

5.5 Contribution to knowledge

This study takes into consideration that the budget for public sector construction projects is determined by estimates done at various stages of the procurement process, with arguably increasing levels of accuracy. The level of accuracy of estimate that is used to inform budgets and the reasons for the frequent cost overruns during the construction phase of a project were investigated.

The study intended to contribute to increasing knowledge in the field of construction cost management. The study would assist in minimising the inefficiencies in cost control and management in the construction projects of the public sector.

The two key findings of the study that have strong implication for cost management in public sector construction projects that were beyond the peculiarities of the case study were:

- The poor estimating technique used result in setting inaccurate budget or cost benchmark at onset and
- The pressure to spend all budgetary allocations before the end of the financial in order not to risk lower budget allocation the following year.

5.6 Summary

This chapter summarised the main findings of this research project. The studies main objective was to investigate the effectiveness of cost management within the public sectors by using construction projects as case studies. Among the things which were central to the investigation of the study was the budget outlines and the reasons for frequent cost overruns during the construction phase.

The findings of the study imply that the public sector should take an active role in cost management from the planning stage, the selection of a cost effective procurement method, through the construction phase until the project has been completed.

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APPENDICES