AN APPRAISAL OF COST MANAGEMENT TOOLS AND TECHNIQUES USED ON BUILDING PROJECTS BY SMMES IN GAUTENG

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

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DECLARATION

I declare that this dissertation is my own unaided work. It is being submitted for the Degree of Master of Science in Building to the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination to any other University.

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16TH day of AUGUST 2021

ABSTRACT

The aim of this study was to investigate the cost management tools and techniques that small, medium, and micro enterprises (SMME) construction organisations can apply, in order to control cost overruns, and enhance the cost management profitability of the SMME construction industry.

The study adopted the mixed research method, which incorporated both quantitative and qualitative research methodologies. Quantitative data was collected through 305 questionnaires. Qualitative data was collected from 10 managers using the in-depth interview guide.

The study established that SMME construction organisations do not apply cost-estimating tools. The findings showed that cost management was not practiced by 96 percent of the respondents.

The study recommended that cost management tools and techniques be widely practiced facilitating the control of cost overruns in the construction SMME organisations in Gauteng.

DEDICATION

I would like to dedicate this dissertation to my beloved wife, Dzani Mulaudzi, and children, Edza, Vhubvo, Isha, and Thikho, for the support and encouragement I got from you all. My special thanks also goes to my father, Ntakuseni Mulaudzi.and mother, Tshiseselo Mulaudzi, who brought me up. Without your patience and encouragement, this dissertation could never have been a reality. To my sisters and brother, Lara, Tshira and Mvuko Mulaudzi, thanks for being together in the time of need.

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NOMENCLATURE

BOQ	Bill of Quantities
CIDB	Construction Industry Development Board
DID	Department of Infrastructure Development
FIFA	Federation Internationale de Football Association
GDP	Gross Domestic Product
SMME	Small, Micro, and Medium Enterprises
UK	United Kingdom
USA	United States of America

CHAPTER ONE: INTRODUCTION

1.1 Introduction

The study was designed to appraise the cost management tools and techniques that are used on building projects by SMME construction firms in the Gauteng province of South Africa. Building projects are incurring cost overruns; hence, the need to carry out a study to establish if the project managers use cost management tools and techniques to reduce cost overruns in their operations. The reason for Gauteng being selected as the focal area of the study was, because Gauteng is the corner stone of the South African economy and most SMMEs, in excess of 50 per cent, are registered at the Construction Industry Development Board (CIDB) in Gauteng (CIDB, n.d.).

There was a need to carry out the study and analyse the factors that influence the cost overruns and their impact on the performance of SMME construction firms in Gauteng, in order to propose solutions that would establish and grow the construction industry in Gauteng. This chapter provides the background information pertaining to the area of study by deliberating on issues that affect the SMME construction industry in Gauteng. Furthermore, it stipulates the research problem, aims and importance of the study, research questions, research objectives, and delimitations of the study. Finally, the organisation of the study is given before concluding the chapter.

1.2 Background

In both developed and developing economies, it is generally accepted that small-, medium-, and micro-sized enterprises (SMMEs) are becoming increasingly important if not central in terms of employment creation,

generation of new wealth, and the development of innovation (Tshikhudo, Aigbavboa & Thwala, 2015). SMMEs, especially those that operate in the construction sector are an important contributor to economic growth but also to the development of key pillars of the economy such as infrastructure development. The construction industry contributes approximately36.4 per cent to the overall gross domestic product (GDP) of the country (Scott, 2015). As such, the construction sector is considered a driver for reducing unemployment in South Africa. Other formal sectors are continuing to shed jobs when business transactions are not favourable (Aigbavboa & Thwala, 2014).

The sustainability of the construction sector is subject to cost efficiency within construction projects and undertakings (Doloi, 2013). One of the widely debated and well-researched topics in construction management literature is the subject of poor cost performance (Azis, Memon, Rahman & Karim, 2013; Doloi, 2013; Memon & Rahman, 2013). Organisations face a major challenge in controlling and managing project budgets over the time span of project life cycles. Determining how cost will change with output or the measurable factors of activity is of vital importance for decision-making, planning, and control (Drury, 2014). The preparation of budgets, production performance reports, the calculation of earned value management, and the provision of relevant costs for pricing and other decisions all depend on reliable estimates of costs (Ahiaga-Dagbui & Smith, 2014). Distinguishing between fixed and variable costs at different activity levels of any given construction project or undertaking is critical for project cost management (Ahiaga-Dagbui & Smith, 2014). Unfortunately, construction costs are not easy to predict, as they behave differently under different circumstances. Cost behaviours respond to different forms of controls exerted on the construction project life cycle, ranging from tight controls to relaxed or removed controls. This study was set to debate construction cost management (Memon & Rahman, 2013).

SMMEs play a crucial role in almost all economies, particularly in developing countries with major employment and income distribution challenges, such as South Africa (Cant & Wiid, 2013). SMMEs performance becomes important for economic growth because of the significant contribution to the GDP.

The study focused on appraising the tools and techniques and analysing the factors that influence the cost overruns and their impact on the SMME construction firms' performance in Gauteng, South Africa. A vast amount of research, undertaken over the years, focuses mainly on the identification of factors that cause cost overruns (Memon & Rahman, 2013). However, there remains a considerable gap in understanding the challenges faced by SMMEs within the construction sector, particularly in emerging economies such as South Africa. Literature confirms that SMMEs in this sector are riddled with an array of challenges such as inadequate managerial skills, poor planning capabilities, lack of access to work opportunities, prolonged economic recession, lack of financial skills, completion, incompetent employees, and lack of basic business, technical and pricing skills (Aigbavboa, Oke & Kakanyo, 2016; Ramabodu & Verster, 2010).

In this context, the study sought to expand on the factors identified as causes of cost overruns by further classifying them either into two key categories: financial management and project control (Rahman, Memon & Karim, 2013). Financial management in this context involves the process of determining the costs per trade of each activity, which is analysed for calculating the variances. While project controls are the data gathering, management, and analytical processes used to predict, understand, and constructively influence the time and cost outcomes of a project or program through the communication of information in formats that assist effective management and decision making. The approach to financial management or project control starts with an assumption that costs are a function of monitoring and evaluation, and effective project financial management. If

these aspects are managed, the performance of SMMEs in the construction sector, specifically cost/financial performance, would improve.

There was a need to assess and appraise cost management, cost estimating, and monitoring and evaluating cost overruns in the South African SMME construction industry. This facilitated the exploration of the cost estimate method and control mechanisms including regression analysis, earned value, and other applicable methods to be applied on historic project data from SMMEs, by juxtaposing the original estimation and the final costs resulted in what should have been the desired cost performance outcome. This study explored, in detail, the trades within the bill of quantities (BOQ) that are mostly affected by these cost overruns.

1.3 Problem Formulation

SMMEs in the South African construction industry have high mortality and low performance rates. These emanate largely from the non-application of cost management tools and techniques resulting in low-cost performance as evidenced by cost overruns. SMMEs in this sector are riddled with an array of challenges such as inadequate managerial skills, poor planning capabilities, lack of access to work opportunities, prolonged economic recession, lack of financial skills, non-completion, incompetent employees, and lack of basic business, technical and pricing skills (Aigbavboa, Oke & Kakanyo, 2016). The study examined how efficient construction project cost management tools and techniques are applied and investigated the areas where most cost variances arose.

1.4 Problem Statement

SMMEs in the South African construction industry have high mortality and low performance rates. These may emanate largely from the tools and techniques used in cost management resulting in low-cost performance as evidence by cost overruns.

1.5 Aim of the Study

The study sought to identify the cost management tools and techniques used by SMMEs, and the impact on their performance by analysing the variances arising during the course of the projects.

1.6 The Importance of the Study

The construction industry has been hard hit by recession and registered a fifth consecutive quarter of negative growth. The construction industry contributed a total value of R106 billion in the 2019 third quarter, lower than the R110 billion high recorded in the fourth quarter of 2016 (constant 2010 prices, annualised) (Stats SA, 2019). The quarterly annualised growth rates for the construction industry have reached a -5.9 per cent, which has adversely affected the growth rate (South African Market Insights, 2020). By focusing on the influence of cost estimation and monitoring and evaluation factors on cost overruns, and in turn assessing their impact on SMME performance, the study contributed towards comprehending how to improve, and not only the survival rate of SMMEs but their sustainability in Gauteng. The study made methodological contributions by consolidating the multiple categories of cost overrun causes that are ubiquitous in extant literature, reducing them to two key categories: cost estimation (project finance management competency) and monitoring and evaluation (project management and planning competency) factors. By focusing the research on SMME performance in relation to managing costs accurately, the study also contributed toward construction sector SMMEs' sustainable performance by identifying the areas, per trade, in which these cost overruns happen.

1.7 Research Questions

Extant literature on the study of construction project cost overruns in relation to construction firm performance confirms a gap in the understanding of both theory and concepts that could explain this phenomenon in pursuit of

improving SMME sustainability within the construction sector (Rahman, Memon & Karim, 2013). It is in this context that this study was formulated to research, examine, and describe the influence of cost estimation and monitoring, evaluate factors on cost overruns, and in turn assess their impact on SMME performance in the construction sectors. In order to do so, the following research questions were formulated:

(1) What cost management tools and techniques do SMME construction firms in Gauteng use?

(2) What are the sources of cost variances, by trade, on projects of SMME construction firms in Gauteng?

(3) What recommendations can be made to improve the cost management practices of SMME construction firms in Gauteng?

1.8 Research Objectives

The purpose of this research was to determine the impact that cost management tools and techniques (cost estimation, and monitoring and evaluation mechanisms) has on building projects or programs undertaken by SMMEs, in relation to cost overrun and levels of firm performance, and to investigate the areas, per trade, that have most variances. The objectives of this study are as follows:

(1) To identify the cost management tools and techniques used by SMME construction firms in Gauteng.

(2) To determine the areas per trade, where most variances arise on building projects of SMME construction firms in Gauteng.

(3) To recommend improvements to the cost management practices of SMME construction firms in Gauteng.

1.9 Stating the Null Hypotheses

The following null hypotheses were generated in this study:

H_o1: There are no causes for cost overruns in the SMME construction sector in Gauteng.

H_o2: The SMMEs in the construction sector in Gauteng use cost management tools and techniques effectively.

H_o3: SMME construction industries in Gauteng use cost budgeting tools and techniques effectively.

H_o4: SMME construction managers in Gauteng apply resource tools and techniques.

1.10 Delimitation

The study made the following delineations:

- The study focused on building projects undertaken by SMMEs in Gauteng, South Africa. The reason for Gauteng being selected as the geographical area was that it is the corner stone of the South African economy, and in excess of 50 per cent of SMMEs are registered in Gauteng (CIDB, n.d.).

- The focus was on building projects as in the majority of emerging contractors are registered as builders, as opposed to other disciplines such as civil.

- The SMMEs were those registered with CIDB in Gauteng with a general building grading of less than six. The selection comprised two BOQs per building grade, based on random selection on the CIDB or the Department of Infrastructure Development (DID) database.

- The study did not draw any cause-and-effect relationship conclusions.
- The results were not generalizable to the construction sector in South Africa.
- Only causes of cost overruns related to cost management were covered in this study

1.11 Methodology Summary

The study adopted the mixed research method, which incorporated both quantitative and qualitative research methodologies. The sample size selected for the collection of quantitative data was 364 respondents, of which 305 questionnaires were duly completed and returned; these comprised 245 respondents in the employees' segment and 60 respondents in the management segment. The simple random sampling technique was used to select the respondents, who were given the closed-ended questionnaires to complete. Quantitative data was analysed through the Statistical Programme for Social Sciences (SPSS).

Qualitative data was collected through the in-depth interview guide, that was designed to collect the data from the purposively selected sample of 10project managers. The data obtained was analysed through themes and sub-themes. Document analysis was done to obtain the required data from 10 BOQs.

1.12 Organisation of the Study

This section provides a summary of the arrangement of the five chapters in this dissertation.

1.12.1 Chapter 1: Introduction

This chapter provides the context of the study, problem statement, aims of the study, importance of the study, research questions, and research

objectives. Delimitations of the study as well as the organisation of the study and the conclusion of the chapter are presented in this chapter.

1.12.2 Chapter 2: Literature review

This chapter reviews the current and relevant literature pertaining to the topic understudy.

1.12.3 Chapter 3: Research methodology

Chapter 3details the research methodology employed in the study and gave reasons for the choice of all the methodological processes followed. It presents strategy on the research structure, the target population, sampling strategy, research mechanism, data exploration, and ethical concerns of this study.

1.12.4 Chapter 4: Presentation of Results and interpretation of findings

Chapter 4 analyses and presents the data obtained for the study, presents results, and discusses the data relative to the literature reviewed in Chapter 2, to explore any gaps.

1.12.5 Chapter 5: Conclusions and recommendations

Chapter 5 presents the summarised findings from the secondary and primary research of this study to draw conclusions, discuss the findings and make recommendations.

1.13 Chapter Summary

This chapter introduced the background of the study on the factors that influence the cost overruns and their impact on the performance of SMME construction firms in Gauteng. The chapter provided insights into the research problem, aims of the study, and importance of the study. Further to that, the research questions, research objectives, and delimitations of the

study were given. Finally, the organisation of the study was given, which led to the conclusion of the chapter.

The next chapter focuses on the review of literature related to the factors that influence the cost overruns as well as tools and techniques and their impact on the performance of SMME construction firms in Gauteng, South Africa.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The construction industry contributes a significant portion towards the GDP of the South African economy; the main driver is the SMME. The South African SMME construction industry has a high rate of business failures (Tustin, 2015), the causes of which are important to examine. The effectiveness and efficiency of cost management tools and techniques application in this sector is of paramount importance. This will give the industry a brief idea of where most of the cost variance arises and how the construction tools and techniques are being applied by SMMEs.

The subsections that follow comprise descriptions of the different concepts and explanations on their relationships to build up the theoretical framework for this study.

2.1.1 Cost performance

Cost performance is among the major considerations throughout the project management life cycle and can be regarded as one of the most important parameters of a project and the driving force of project success (Azhar, Farooqui & Ahmed, 2008). Cost performance is defined as a measure used to evaluate whether the project is being performed within budgeted cost, or whether it is in line with the actual costs. Gido and Clements (2005) mentioned that cost performance is an effective technique used in project management. Cost control, cost estimating, and cost budgeting are three cost related processes that are applied with other scopes of construction projects.

Cost performance means that the company's total cost is less than the revenue, and it generates performance by utilising the assets under its control. Costs greater than income mean negative costs performance and

the inverse mean positive cost performance; the latter is good for business as this means profit and cash flow (Murphy, 2020).

2.1.2 Cost overrun

Cost overrun is a very common phenomenon and the majority of projects in the construction industry face this problem. Cost overrun usually occurs when the final account cost for the projects exceeds the original estimation (Avotos, 1983; Shah, 2016). Cost overrun is one of the main problems found in the construction industry and these problems are observed from developed to developing countries (Angelo &Reina, 2002). The problem is serious, such that on-going study is required until this problem is resolved to acceptable levels.

2.1.3 Monitoring

Monitoring is the systematic collection and analysis of information as a project progress. It is aimed at improving the efficiency and effectiveness of a project or organisation. It is based on targets set and activities planned during the planning phases of work. It helps to keep the work on track and assists management to know when things are going wrong. If done properly, it is an invaluable tool for good management, and it provides a useful base for evaluation (Shapiro, 2014).

2.1.4 Evaluation

Evaluation is the comparison of actual project progress against the agreed strategic plans (in the context of this study, it compared the initial BOQ against the final account BOQ, per trade). It looks at what was to be done at the outset, what has been accomplished, and how it was accomplished. It can be formative, taking place during the life of a project or organisation, with the intention of improving the strategy or way of functioning of the project or organisation. It can also be summative, drawing lessons from a completed project or an organisation that is no longer functioning (Shapiro, 2014).

The following trades were evaluated in broad categories: preliminaries, building, external work, expanded public works program, electrical works, mechanical works, and provisional sums. Building was further split into concrete, formwork and reinforcement, masonry, waterproofing, roof covering and other according to the project.

2.1.5 Cost management

Cost management involves the process of planning and controlling the budget of a project or business. It includes activities such as planning, estimating, budgeting, financing, funding, managing, and controlling costs of costs so that the project can be completed within the approved budget (Drury, 2014).

2.2 SMMEs in South Africa – Include origin and history of SMME's

SMMEs in South Africa are defined by the number of full-time employees, annual turnover, and gross asset value, as defined in the National Small Business Act of 1996 (RSA, 1996). The information is presented in Table 2.1 below.

In South Africa SMMEs has been placed in government priority list as a centre of job and economic creation. Government expect SMMEs to deliver more than 500 000 jobs early. In 2008, the DTI published a comprehensive report on the Small, Medium and Micro Enterprises (SMME) sector of South Africa (The DTI, 2008).

In South Africa, government recognises the importance of SMMEs by creating a new ministry of Small Business Development in 2014. Government policy on South African SMME was initially developed and documented in 1995 White Paper on SMME development.

Table 2.1 Definition of contractor size

Size or class of contractor	Total annual full time employees	Total annual turnover less than (R)	Total gross asset value less than(R)
Medium	50	7.50 million	1. million
Small	20	2 million	0.4 million
Micro	5	0.15 million	0.10 million

RSA(1996)

2.3 Global performance of SMME Construction Industry

In the United States of America (USA), arguably the world's most economically influential country, SMMEs contribute more than 50 per cent of private employment (Moloi, 2013), and in countries like China, Austria, and Canada, SMMEs employ over 50 per cent of the workforce. It is recorded that 99 per cent of the business body in Nigeria are SMMEs, which has been an instrumental component of GDP and a hub for work opportunities (Eniola & Entebang 2015). For instance, in Europe, SMMEs represent over 80 per cent of the total number of firms within the manufacturing sector, accounting for around 60 per cent of the employment (European Commission, 2016).

In New Zealand, SMMEs represent 86 per cent of its 259 000 businesses and these firms account for approximately 27 per cent of the total employment, and in Morocco, 93 per cent of firms are SMMEs and account for 38 per cent of production, 33 per cent investment, 30 per cent export and 46 per cent employment. In Bangladesh, firms of less than 100 employees account for 99 per cent of all the enterprises and 58 per cent employment (Hamilton & Dana, 2003, Ufot, Reuben & Michael 2014). These data support the argument that SMMEs are a crucial sector in any economy that seeks to attain sustainability and growth. This further confirms the significance of studying the performance and factors related to performance

of SMMEs in the construction sector of Africa's economic hub in Gauteng, South Africa.

2.4 SMMEs Performance in South Africa

SMMEs have been identified as a key component to advancing inclusive growth and development in South Africa (Bhorat, Asmal, Lilestein & Van der Zee, 2018). The contribution of the SMME sector cannot be sustained without the creation and sustainability of new SMMEs. New SMMEs are seen as a significant component of the solution to South Africa's development issues, which include poverty, income inequality, and unemployment (Tustin, 2015). The high mortality concerns highlighted previously are exacerbated given only 12.8 per cent of South Africans have the entrepreneurial intention to start a business within the next three years (Amorós & Bosma, 2014).

SMMEs play a crucial role in almost all economies, particularly in developing countries with major employment and income distribution challenges, such as South Africa (Cant & Wiid, 2013). From a South African perspective, SMMEs are important in the development of the construction industry as well as the overall development of the country (Tshikhudo et al., 2015). SMME performance ultimately leads to economic growth because of their significant contribution to the GDP. From almost every perspective, it can safely be argued that the performance and growth of SMMEs is a major driver and index for the level of industrialisation, modernisation, urbanisation, gainful and meaningful distribution of income, and the welfare and quality of life enjoyed by the citizenry (Aremu & Adeyemi, 2011). SMMEs play a key role in the development of the economy and are a significant contributor to employment. In South Africa, SMMEs employ more than 68.2 per cent of the work force in the private sector (Ndlovu, 2015).

The five main reasons for the failure of construction projects are, first poor project management, second poor leadership, third poor performance,

fourth poor accounting, and fifth poor planning (Construction Executive, 2017).

Another significant fact relates to the survival rate of SMMEs, which has been too low in the South African context (Herrington & Kew, 2016). Less than half of newly established businesses survive beyond five years (Tshikhudo et al., 2015). This is not only true for South Africa, but also a common phenomenon in the rest of the world (Burke, 2006). Mbonyane (2006) found that in South Africa, on average 50 per cent of small businesses that are started eventually fail, and there are those businesses that do not grow beyond the survival stage.

2.5 Project Cost Management Process

In planning a project, there are four most useful techniques, which complement each other and when used together, provide the best chance of covering every aspect of the project. These are brainstorming, cause and effect diagrams, critical path analyses, and Gantt charts. In the construction practice, at the planning stage of a construction project, planners are trying to consider the possibility of unfavourable situations and their consequences during the project execution. Therefore, planning decisions should use appropriate tools for uncertainty modelling as well as consider alternative options for the implementation of the entire undertaking or the most sensitive (critical) works (Ibadov & Kulejewski, 2019).

Cost management focuses on the identification of the right projects, which must be precisely implemented. It incorporates processes such as planning, estimating, budgeting, financing, funding, managing, controlling, and benchmarking of costs to enable completion of the projects on time within the approved budgets, and improved project performance. Cost management includes the full project life cycle from the initial planning stages to the measurement of the actual project cost performance and the projection completion (PMI, 2000; Cleopatra Enterprises, 2020).

Figure 2.1 Cost management process steps

Cleopatra Enterprises (2020, p.1)

Figure 2.1 illustrates the cost management process steps, which are discussed in the subsection that follow.

2.5.1 Step 1: Resource planning

Resource planning entails the identification of resources that are needed by the organisation or the project for future use. Evaluation and planning of the physical, such as human resources, the financial base, and information resources needed to accomplish the work-based activities and tasks is attended to at this stage. Most activities are performed by people, while other activities are done through engineering or software designs (Cleopatra Enterprises, 2020).

2.5.2 Step 2: Cost estimating

Cost estimating predicts and quantifies costs and prices the required resources of activities or projects. It entails the application of techniques that convert technical and programmed information of a project into financial and resource information. The estimating outputs are used for planning, cost analysis, project scheduling, and cost controlling purposes (Cleopatra Enterprises, 2020; Ibadov & Kulejewski, 2019).

2.5.3 Step 3: Budgeting

Budgeting is an estimating sub-process designed to allocate estimated resource costs into cost accounts. It is the baseline for cost control. Budgets are aligned with the schedule to address budget and cash flow limitations (Cleopatra Enterprises, 2020; Ibadov & Kulejewski, 2019).

2.5.4 Step 4: Cost control

Cost control involves the measurement of variances from the cost baseline to take corrective measures with the view of achieving minimum costs. Expenditure and performance of all projects is monitored through the application of procedures. All changes to the cost baseline need to be documented and the anticipated and continuous forecasting of final total costs needs to be performed (Cleopatra Enterprises, 2020; Ibadov & Kulejewski, 2019).

2.6 Project Cost Management Tools and Techniques

Project cost management tools and techniques include the process required to ensure that projects are executed within the approved budget (PMI, 2000). These involve determining what resources and quantities of each aspect involved should be used to perform the project activities. The resource planning tools and techniques are expert judgment and alternative identification, which are discussed in the two subsections that follow.

2.6.1 Expert judgment

Expert judgment is a method of estimating where judgment is used based on the predetermined set criteria, which has been acquired in the specific field and it is based on the expertise acquired overtime in that area. The use of expert judgement in forecasting and decision-making is well established (French, 2012).

2.6.2 Alternative identification

Alternative identification involves the searching for different choices available to achieve a specific objective, being a project or alternative course of action. The method is analytical as it compares different aspects: costs, risks and others (Christine, 2020).

2.7 Cost Estimating Tools and Techniques

This involves developing an approximation of the cost of the resources needed to complete project activities. These help in carrying out the cost accounting function. Cost accounting, as the name implies, is primarily concerned with determination of the cost of something, which may be a product, service, process, or operation, according to the costing objective of management (Drury, 2014).The following sub sections detail the tools and techniques under cost estimating: analogous estimating, parametric modelling, bottom-up estimating, and computerised tools.

2.7.1 Analogous estimating

Analogous estimating is the process of comparing past projects with current projects in order to estimate time and cost. Analogous estimating is done when there is limited data on the current project; it also measures variety of project parameters and measures of scale. The project parameters that can be measured include those of project cost, project budget, scope of the project, and expected project duration. The project measures that can be estimated using this technique can range from the size of the project, the project weight, and the project complexity (Christine, 2020). The estimates are made by comparing the current activity to that of a smaller activity that took place previously and drawing proportionate comparisons. It is frequently used to estimate the size of a particular parameter when information on a particular parameter within the current project is limited or unavailable until a later date. Analogous estimating is typically a form of

expert judgment that is most reliable especially when the previous activities are similar to the current activity (Christine, 2020).

2.7.2 Parametric modelling

Various estimation methods have been proposed to improve the estimation accuracy of software effort, which provided useful experiences for software development practice. Parametric estimating is an accurate technique for estimating cost and duration, as it uses the relationship between variables to calculate the cost or duration (Sehra, Brar, Kaur, & Sehra, 2017). Essentially, a parametric estimate is determined by identifying the unit cost or duration and the number of units required for the project or activity (Sehra et al., 2017). Based on a comprehensive review, these estimation methods could be classified into six types: expert judgment, regression-based methods, parametric models, case-based reasoning methods, dynamics-based models, and composite methods (Boehm et al., 2000).

2.7.3 Bottom-up estimating

Bottom-up estimating is a project management technique in which the people who are going to do the work take part in the estimating process. Typically, those people are the project team members. The estimates are developed at the task level in the work breakdown structure (WBS). The process begins by determining the task level estimates, followed by rolling them up into an overall project estimate (Christine, 2020).

2.7.4 Computerised tools

Computerised tools are sophisticated computer driven programmes characterised by computer-aided software engineering maintenance toolkits, which provide a range of tools for evaluating and maintaining the systems, including a performance monitor, programme analyser, interactive debugging analyser, restructuring or reengineering tool, automated documentation tool, network activity monitor, and workload forecasting software. The computer-aided programs have the system analysis, systems

design, system implementation, and system operation and support components, which make the computerised tools efficient and effective (Adwan & Al-Soufi, 2018).

2.8 Cost Budgeting Tools and Techniques

This involves allocating the overall cost estimate to individual work items to ensure it is executed within the project budget limits. Most organisations use budget control as the primary means of corporate internal controls, it provides a comprehensive management platform for efficient and effective allocation of resources. Budgetary controls enable the management team to make plans for the future through implementing those plans and monitoring activities to see whether they conform to the plan. Effective implementation of budgetary control is an important guarantee for the effective implementation of budget in the organisation (Cleopatra, 2020).

Performance measurement is an important budgeting technique, which has been widely defined in the wealth of literature on this subject. The following three definitions define the concept.

(1) “Performance measurement is generally defined as regular measurement of outcomes and results, which generates reliable data on the effectiveness and efficiency of programs” (Evaluation Division Bureau of Education and Culture Affairs. (2020:1).

(2) “Performance measurement is a process of quantifying and reporting the effectiveness and efficiency of the action performed towards influencing organizational objectives” (Liu, Love, Davis, Smith &Regan; 2015:16).

(3) “The process of quantifying the efficiency and effectiveness of past actions” (Neely, Adams, & Kennerley, 2002:xiii).

For the purpose of this study, cost control performance measurement involved a measure of cost effectiveness and efficiency on the project. It

was calculated by comparing the reported reality and the pre-defined cost baseline.

2.9 Cost Overruns in the Construction Industry

Due to frequent poor cost management, the construction industry is facing a huge amount of cost overrun (Shibani & Arumugam, 2015). Cost overruns reduce the effectiveness of investment and require additional finance to be raised; on public works contracts, overruns divert funds from other projects, creating negative knock-on effects in the wider economy (Cunningham, 2017). The construction industry is in a crisis due to poor cost management, which is a driver of large cost overruns (Azis et al., 2013). Cost performance is the most important indicator of project success (Frimpong, Oluwoye & Crawford, 2003; Olawale & Sun, 2010). It shows how the project has been managed in relation to profitability and budget. Overall, the construction industry has been facing poor cost performance, which is the result of an inability to complete the projects within budget (Frimpong et al., 2003; Olawale & Sun, 2010). If cost performance is not managed, this in turn affects the growth of construction firms and industry in general.

Alex, Al Hussein, Bouferguene, and Fernando (2010) reviewed the cost performance on more than 800 construction projects of Canada's Drainage and Maintenance Department and observed a discrepancy of up to 60 per cent between estimated and actual cost of projects completed between 1999 and 2004.More recently, Hangtao (2014) examined various causes of cost overruns on Irish building construction projects and showed that the two most popular causes of overruns is the complexity and scale of projects and the quality of the tender documentation. It is clear that variances will always exist; however, it is important to note that much of the current literature and media furore on cost overruns seems to oversimplify its rather complex causes (Ahiaga-Dagbui & Smith, 2014).

Mahamid (2011) investigated the statistical relationship between actual and estimated costs of road construction activities based on a sample of 100 road construction projects awarded in the West Bank in Palestine. The findings revealed that the average cost deviation in these investigated activities was as follows: earthworks: 15.7 per cent, base works: 12.9 per cent, asphalt works: 18.5 per cent and furniture works: 36.4 per cent. This study investigated the activities in the building sector in which the SMMEs operated to determine where the cost deviations arise.

Based on an investigation of the transport infrastructure across 258 rail, bridge, tunnel, and road projects in Denmark, three key factors that affect cost performance are highlighted. Flyvbjerg, Holm and Buhl (2004) asserted that a longer project implementation phase, large project size, and public ownership factors are highly susceptible to cost overruns. However, relationships between clients, contractors, and consultants in addressing these factors and minimising the impact of cost overruns were excluded in the investigation.

Gunduz and Maki (2017) reviewed the list of 39 cost overrun attributes in order to determine the most significant cost overrun. The following where the most significant:

- Schedule delays;
- Improper planning and scheduling;
- Frequent design changes;
- Frequent changes to scope of work; and
- Inaccurate time and cost estimate of projects.

This reflects the importance of hiring skilled and experienced planners and estimators to accurately estimate the required time and budget to complete the projects.

Doloi (2013) identified 23 factors associated with cost overruns based on Australian building industry. These costs where further categorised as follows:

- Accurate project planning and monitoring;
- Design efficiency;
- Effective site management;
- Communication;
- Contractor's efficiency;
- Project characteristics;
- Due diligence; and
- Market completion (Doloi, 2013).

In a study of infrastructure projects in Nigeria, it was found that the major factors of cost performance were price fluctuations, financing and payments of completed works, poor contract management, schedule delays, change in site conditions, and inaccurate estimates. In addition, shortage of material, imported materials and plant items, additional works, design changes, subcontractors and nominated suppliers, mistakes and discrepancies in contract conditions, and fraudulent practices played a major role (Omoregie & Radford, 2006).

In Kenya, the number of construction projects is increasing radically. However, it becomes difficult to complete projects within the allocated cost and time (Kogi & Were, 2017). The trend is more acute in developing countries where these overruns sometimes exceed 100 per cent of the estimated project costs. Lack of management systems and lack of ability to prevent cost overruns or to control construction costs cause construction companies to fail. This highlights the need to have effective cost

management systems and cost control systems (Kogi & Were, 2017). Thus the appraisal of tools and technique is critical to establish the effect if the systems are implemented. Variances calculated per trade will help SMMEs to prioritise areas for future management.

A study in South Africa by Baloyi and Bekker (2013) on the 2010 FIFA world cup stadia projects, identified the following factors causing the cost overruns, divided into two categories, cost and time overruns. The study identified 10 factors of cost overruns. In a study on the United Kingdom (UK) construction industry, Olawale and Sun (2010) identified 21 major causes of cost overruns. In a similar study in Ghana, Frimpong et al. (2003) identified five key factors that impact cost performance in the building sector.

From this review, it is clear that there are detailed studies across different economies from developed to developing countries that assess the root causes of cost performance, assessment, and management (Doloi, 2013). However, there remains a gap in consolidating these various factors into comprehensible categories split mainly between financial (cost estimation) and non-financial (monitoring and evaluation) categories. Overall, the outcome of this study would guide SMME contractors in the building sub-sector towards effective or efficiency in managing financial cost factors distinct from non-financial factors that reside in efficiency in monitoring and evaluation by SMMEs in South Africa.

To achieve the purpose of this study, there was a need to consolidate and reduce the categories to two: cost estimating, and monitoring and evaluation. The reason for this proposition was that cost overruns in the construction industry have been attributed to multiple sources; however, the constant factors seem to arise due to original poor estimation, and monitoring and evaluation of the project process (Tengan & Aigbavboa, 2018).

Further to this categorisation, cost overruns included cost estimation and monitoring, and compared various trades within BOQs of various SMMEs within the building sub-sector in Gauteng, to access the dominant areas within which these cost overruns occur. This was achieved by drawing a limited case exploratory sample of the SMMEs within the building sub-sector in Gauteng, South Africa.

Table 2.2 compares the factors that cause the cost overruns as presented by different scholars.

Table 2.2 Factors of cost overruns identified by various scholars

Cost factors	**Mulenga(2014) South Africa**	**Alzebdeh, Bashir and Al Siyabi(2015) Middle East**	**Mukuka, Aigbavboa, and Thwala(2015) South Africa**	**Gunduz and Maki(2017) Qatar**	**Moschouli, Soecipto, Vanelslander and Verhoest(2018) Belgium**
Factor 1: Accurate project planning and monitoring					
Planning and scheduling deficiencies	X	X	X	X	X
Methods/techniques of construction	X		X	X	X
Complexity of design and construction	X		X	X	X
Contractors deficiencies in planning and scheduling at tender stage	X			X	X
Effective monitoring and feedback process	X			X	X

Cost factors	Mulenga (2014) South Africa	Alzebdeh, Bashir and Al Siyabi (2015) Middle East	Mukuka, Aigbavboa, and Thwala(2015) South Africa	Gunduz and Maki (2017) Qatar	Moschouli, Soecipto, Vanelslander and Verhoest (2018) Belgium
Factor 2: Design efficiency					
Extent of completion of pre-contract design	X		X	X	X
Mistakes and discrepancies in construction documentations	X			X	X
Client-initiated variations	X		X	X	X
Design changes within development period	X	X	X	X	X
Buildability (including on-site prefabrication)	X			X	X
Factor 3: Effective site management					
Improper control over site resource allocations	X		X	X	X
Escalation of material and labour prices	X	X	X	X	X
Cash flow during construction	X			X	X
Lower labour productivity	X			X	X
Delays in work approval waiting for information	X			X	X
Factor 4: Communication					
Lack of communication	X	X	X	X	X

Cost factors	Mulenga (2014) South Africa	Alzebdeh, Bashir and Al Siyabi (2015) Middle East	Mukuka, Aigbavboa, and Thwala(2015) South Africa	Gunduz and Maki (2017) Qatar	Moschouli, Soecipto, Vanelslander and Verhoest (2018) Belgium
between client and contractor					
Poor site management and supervision	X			X	X
Poor contract management	X			X	X
Lack of communication between design team and clients in design phase	X	X		X	X
Factor 5: Contractor efficiency					
Inadequate contractor's experience	X		X	X	X
Low speed at decision-making, involving all project teams	X			X	X
Project team's experience in development stages	X		X	X	X
Deficiencies in cost estimates prepared	X	X	X	X	X
Contractor's financial difficulties	X		X	X	X
Factor 6: Project characteristics					
Scale and scope of project	X		X	x	X
Type of structure	X			X	X

Cost factors	Mulenga (2014) South Africa	Alzebdeh, Bashir and Al Siyabi (2015) Middle East	Mukuka, Aigbavboa, and Thwala(2015) South Africa	Gunduz and Maki (2017) Qatar	Moschouli, Soecipto, Vanelslander and Verhoest (2018) Belgium
Location of project	X		X	x	X
Unexpected geological conditions	X			X	X
Factor 7: Due diligence					
Understanding responsibilities by all teams	X			X	X
Labour and management relations	X	X	X	X	X
Non-adherence to contract conditions	X		X	X	X
Factor 8: Market competition					
Tender period and market condition	X	X	X	X	X
Poor procurement programming of materials	X	X	X	X	X
Lead times for delivery of materials	X	X		X	X
Delay in subcontractors work	X			X	X
Other					
Unreliable sources of material on the local market				X	X
Political insecurity and instability		X		X	X

Cost factors	Mulenga (2014) South Africa	Alzebdeh, Bashir and Al Siyabi (2015) Middle East	Mukuka, Aigbavboa, and Thwala(2015) South Africa	Gunduz and Maki (2017) Qatar	Moschouli, Soecipto, Vanelslander and Verhoest (2018) Belgium
Bad weather			X	X	X
Site accidents				X	X
Bureaucracy - rulesregarding approvals of changes				X	X
Contractors work load			X	X	X
Fuel shortages				X	X

Sources: Moschouli, Soecipto, Vanelslander & Verhoest (2018, pp.537-539; Gunduz & Maki, 2017, p.1831-1832; Mukuka, Aigbavboa, & Thwala (2015, pp. 112-113 ; Alzebdeh, Bashir & Siyabi, 2015, pp. 56-58 & Mulenga, 2014, pp. 8-10).

Cost overruns occur because of differing reasons on different types of projects. Table 2.2 shows the various factors that contribute to cost overruns. These factors are grouped according to countries. The X indicates the factors that cause the costs overruns per country, according to the views of the respective authors. Based on this, the following issues are common factors: cash flow challenges, lack of proper estimation of costs, lack of proper budgeting, and hikes in labour and materials prices.

2.9.1 Consequences of cost overruns

Cost overruns do not simply occur, a number of factors during the construction process, if not managed properly, can lead to cost overruns (Mukuka et al., 2015). Project cost overrun is the most common problem in the construction industry. Project overruns due to time and cost result in

delays during project execution. In developing countries, project overruns are serious where implementation of projects face many uncertainties. It results in wastage of scarce financial resources, delays in providing facilities, slow development, and costlier construction (Tejalel, Khandekar & Patil, 2015).

The trend of overruns in construction projects has become a global concern, it also has negative impacts on the low or middle class achieving the basic need for proper housing (Memon & Rahman, 2014).

Cost overruns have negative consequences for stakeholders and the construction industry (Nega, 2008). Cost overruns are an additional cost to the client, above the initial agreed costs and this has a negative effect on the returns on investment. Cost overruns are passed on to the end users of the properties, which result in higher costs in rentals and increased lease costs. To the professional construction organisations, cost overruns are a sign of their inability to provide clients with value for money, which tarnishes the image of the contractor through a lack of confidence by the clients. Loss of profit due to failure to complete the project on time and defamation will jeopardise the contractor's chances of securing future jobs. Cost overruns have an adverse effect on the entire construction industry as it could result in abandonment and reduction of construction activities, as well as the inability of the industry to secure funding as it is seen as a high-risk industry (Memon & Rahman, 2014; Nega, 2008).

Nega (2008) identified further cost overrun consequences: delays occurring during the construction period, additional costs, supplementary agreements, budget deficits, negative relationships emanating from the project participants, loss of reputation to the contracting organisation, consultants regarded as incompetent by the project owners, consultants facing high project supervision and administration costs, and delayed contract payments. Cost overruns negatively affect the growth of the construction industry, as resources are channelled to current work at the

expense of future construction projects (Memon & Rahman, 2014; Nega, 2008).

The consequences of cost overruns need to be identified if the construction industry is to thrive. Pourrostam and Ismail (2011) categorised and classified the cost overruns as follows: time overrun, cost overrun, disputes and claims, arbitration, litigation, and total project abandonment. These are briefly described:

- *Time overrun*: A situation when the completion time of the project is pushed forward as a result of the schedule overruns (Sunjika & Jacob, 2013). Schedule overrun is the late completion of a construction project. Schedule overruns are mainly caused by financial constraints, late payments of work in progress to contractors, changes in orders, as well as organisational changes (Haseeb,Lu, Bibi, Dylan, & Rabbani, 2011).

- *Cost overrun*: Is the completion of a construction project at a cost higher than the budgeted amount (Sunjika & Jacob, 2013). Kikwasi (2012), identified the major factors that cause cost overruns as changes in the scope of work, incomplete designs at the time of tender, contractual claims, lack of adequate planning and monitoring of funds, and delays in the costing of variations and delayed works. Cost overruns can be traced to the preliminary stages of construction, which are poor estimation of quantities, design variations, changes in scope, unexpected conditions at the site, rising costs of labour and materials due to inflation, and other unforeseen contingencies (Pourrostam & Ismail, 2011). Haseeb et al. (2011) viewed changes in orders, contract mistakes, and changes in drawings as the major causes of cost overruns.

- *Disputes and claims*: These arise as a result of losses incurred due to schedule overruns (Sunjika & Jacob, 2013). Disputes arise when assessing who was at fault or who caused the overrun, quantification

of the occurrence of the delay and estimation of the value to be made (Ahmed, Azhar, Castillo, &Kappagantula,2002). The critical path method can be used to determine the monetary value that can be awarded (Ahmed et al., 2002). Haseeb et al. (2011) noted that the major causes of disputes in projects are delays in payments for work in progress and completed work, interferences by clients, changes in requirements, subcontractor challenges, work distribution and inadequate communication between the parties.

- *Arbitration*: In the event that disputes arise between the client and the contractor, there are extra costs that need to be met in order to engage professional arbitrators to settle the dispute. This becomes costly and time consuming for the project (Sunjka & Jacob, 2013).

- *Litigation*: Disputes that arise as a result of schedule overruns are usually resolved at court. There is a lot at stake since large penalties are claimed (Sunjka & Jacob, 2013). Litigations are negotiations held at a court with a view to solve contract disputes; these negotiations are usually time-consuming. The main causes of these litigations are late payments, non-payments of completed work and work in progress, and changes in orders (Haseeb et al., 2013).

- *Total project abandonment*: Schedule overruns can lead to a total abandonment of the project if issues regarding the causes of the cost overruns are not resolved in time (Sunjka & Jacob, 2013). Total abandonment of the entire construction project means suspension of every work for the project or stopping the construction work for a long period. Construction projects permanently or temporarily abandoned are due to natural disasters, changes in the organisation, inadequate funding, non-payment of completed work and work in progress, and unprecedented changes in the organisation (Haseeb et al., 2011).

2.9.2 Minimisation of cost overruns

Identification of the causes and effects of cost overruns should eventually lead to the detection as well as placement of measures that lead to the minimisation of the cost overruns on construction projects. Measures that can be applied to remedy cost overruns are adequate funding, good planning and adherence to specifications, constant budget updates, militating against economic risks, risk identification and management, owner involvement and commitment, project manager's experience and competency, and setting up realistic objectives. The minimisation of cost overruns on construction projects involves effective project costing, adequate financing, proper cost controls in the project execution phase, appropriately defined project scope, and a competent workforce (Arcila, 2012).

Olawale and Sun (2010) identified four types of measures that can be utilised to minimise cost overruns in construction projects:

(1) *Preventive measures*: These deterrent measures are put in place during the project planning stages to ensure that overrun factors arising are dealt with meticulously (Olawale & Sun, 2010). These are applied at the project resource planning stage.

(2) *Predictive measures:* These measures, similar to preventive measures, are designed to spot prospective problems that might affect the control process in the future. Measures can be put in place to stop these potential problems from happening. Tools and techniques are used to look into the current situation with a view of spotting the future potential problems (Olawale & Sun, 2010).

(3) *Corrective measures*: These reactive measures are used to correct events that have already occurred. These measures are not as effective as predictive measures and are designed to remedy the

occurrence of situations (Olawale & Sun, 2010). These are applied during the project cost control stage.

(4) *Organisational measures*: These measures entail practices that go beyond control processes; they are effective in the control of the project. These are aligned with the organisation's beliefs, philosophies, orientations, and management style (Olawale & Sun, 2010). These are applied during the project control, and sometimes during cost budgeting stages, depending on the organisation.

2.10 Chapter Summary

Based on the above literature review, it is evident that massive attributes relate to cost management and underlying cost estimation. Much work has been done on the factors that affect cost overruns, and many authors in order of importance have ranked these factors.

Much research has gone into the generic causes of cost performance issues over the construction aspects of projects (Cheung, Wong, & Skitmore, 2008; Doloi, 2013; Skitmore & Wilcock 1994). However, little has been done regarding the investigation of root causes of the underlying problem of cost overruns (Doloi, 2013). An insignificant amount of work has been performed, with respect to where these costs occur within the BOQ per trade. As to whether the SMMEs apply the tools and techniques in managing the project, very little work has been done. This study explored those areas in relation to SMME construction firms in Gauteng, South Africa. Furthermore, the study sought to identify and recommend ways in which SMME construction firms in Gauteng should improve on cost management in order to enhance their performance.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

The study sought to find out what cost management tools and techniques the SMMEs use and the impact there of on their performance by analysing the variances arising during the course of the project. The research was designed as a survey study with limited cases of the building sub-sector of the construction industry of Gauteng, South Africa. The building sub-sector is earmarked because of the high number of SMMEs, which are affected by high frequency of cost overruns in relation to their performances. The research design, research philosophy, methodological choice, and research strategies are discussed in this chapter. Further to these the data collection, target population, and sample size are reviewed. Finally, data analysis, validity and reliability, and ethical considerations are presented in this chapter.

3.2 Research Design

Research design relates to the route followed, the direction taken, approach pursued, and processes and procedures chosen in the process of carrying out the study (Creswell & Creswell, 2018). A research design is a roadmap used to collect data from participants (Leedy & Ormrod, 2015). Research design is an overall research strategy to consolidate different parts of the study in a lucid and logical manner; and ensure that the research problem is addressed. This process incorporates the blueprint for data collection, data measurement, and data analysis. The research design gives guidance as to how the research has to be conducted using the chosen research methodology. The research design is also the glue that binds the research together and enables appropriate address of the research aim and objectives (Saunders, Lewis &Thornhill, 2016).

In quantitative research, there are four main types of research design: experimental, quasi-experimental, correlational, and descriptive. The main differences in these designs are related to the way the variables in the study would need to be controlled (Saunders et al., 2016).

The main quantitative and qualitative research designs are discussed below:

- *Correlational research design*: Seeks to establish the relationship that exists among the variables within the study, and if correlated why and to what extent they are correlated (Saunders &Bezzina, 2015; Saunders et al., 2016).

- *Descriptive research design*: Describes the phenomenon status; hypotheses formulation is conducted after data collection (Saunders & Bezzina, 2015; Saunders et al., 2016).

- *Exploratory research design*: Helps research an area that has not been researched before, is not an in-depth study; it does not provide conclusive results. It is a preliminary study that would open room for more conclusive studies to be carried out (Saunders & Bezzina, 2015, Saunders et al., 2016).

- *Explanatory research design*: This focuses on the development of hypotheses instead of testing of hypotheses. Brainstorming sessions, in-depth interviews, surveys, and document analysis are carried out (Saunders & Bezzina, 2015; Saunders et al., 2016).

The mixed research design combines both quantitative and qualitative research designs (Creswell, 2014). The quantitative methodology focuses first on the generalisation of study results to the target population, and then diversifies to the qualitative approach which concentrates on interviews and document analysis (Creswell, 2014).

The mixed research design was applied in this study as it allowed triangulation of quantitative and qualitative data, with a view of delivering a balanced study. The research methods also complemented each other and were capable to merge quantitative and qualitative data into one study.

3.2.1 Research philosophy

There are four philosophies available for the purposes of conducting research:

(1) *Positivism*: This is concerned with gaining knowledge in an objective world, and pursuing scientific methods of enquiry. This philosophy is deductive, highly structured, comprises large samples, and is typically a quantitative method of analysis.

(2) *Realism*: This relies on the idea of independence of reality from the human mind. As a branch of epistemology, this philosophy is based on the assumption of a scientific approach to the development of knowledge. Realism can be divided into two groups: direct and critical (Saunders et al., 2016).

(3) *Interpretivist*: This is concerned with understanding the world as it is from subjective experiences of individuals. It uses meaning (versus measurement) oriented methodologies, such as interviewing or participant observation, that rely on a subjective relationship between the researcher and subjects.

(4) *Pragmatism*: This is generally regarded as the philosophical partner for the mixed methods approach. It provides a set of assumptions about knowledge and enquiry that underpins the mixed methods approach, and which distinguishes the approach from purely quantitative approaches that are based on a philosophy of post-positivism and purely qualitative approaches that are based on interpretivist or constructivist philosophies (Johnson & Onwuegbuzie, 2004; Maxcy, 2003; Rallis & Rossman, 2003).

In this study, the philosophical approach used was pragmatism because the research focused on problem solving, informed future practice contribution, and provided a set of assumptions about knowledge and enquiry that underpinned the mixed method approach as reflected in Figure 3.1.

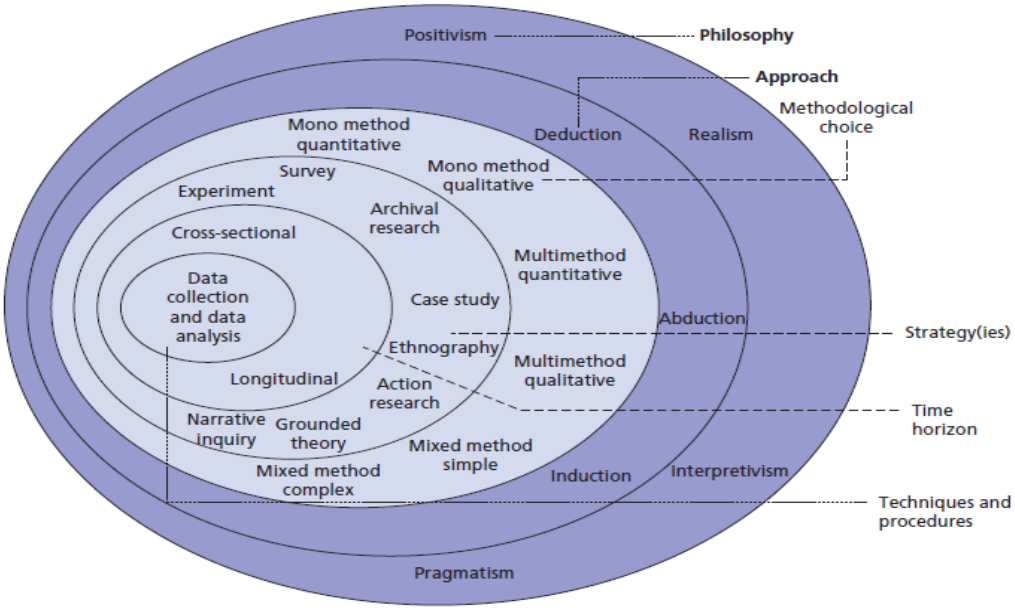

Figure 3.1: Research philosophy in the research onion

Source: Saunders et al. (2015:164).

3.2.3 Methodological choice

The approaches to research studies are, qualitative, quantitative and mixed method research (Saunders et al, 2020).

Qualitative research

Qualitative research is used to uncover trends in thought and opinions, and dive deeper into the problem. Qualitative data collection methods vary using unstructured or semi-structured techniques. Some common methods include focus groups (group discussions), individual interviews, and participation/observation. Qualitative research takes an inductive (seek to achieve a probable truth) approach, a constructivist epistemological

position, and a subjectivist ontological position Bell, Saunders et al., 2020; Bell, Bryman & Harley, 2018).

Quantitative research

The quantitative method, in natural sciences and social sciences, is the systematic empirical investigation of observable phenomena via statistical, mathematical, or computational techniques. Quantitative data is any data that is in numerical form, such as statistics, percentages, among others. Generally, a quantitative study takes a deductive (objective pursuit or seeks to achieve a guaranteed truth) approach, a positivist epistemological position, and an objectivist ontological position (Saunders et al, 2020; Bell et al., 2018).

Mixed method research

Mixed methods research is a methodology for conducting research that involves collecting, analysing and integrating quantitative (experiments, surveys etcetera) and qualitative (focus groups, interviews etcetera) research. Mixed methods research includes collecting, analysing, and interpreting data using both quantitative and qualitative methods in a single study or series of studies in order to investigate a phenomenon or attempt to answer a research question (Creswell, 2018).

The mixed research design was applied in this study as it allowed triangulation of quantitative and qualitative data, with a view of delivering a balanced study. The research methods also complemented each other and were capable to merge quantitative and qualitative data into one study.

3.3 Research strategies

In deciding on the study strategy, the nature of perceived connection between theory and research questions, as well as epistemological and ontological considerations is influential as quantitative and qualitative research strategies differ greatly in each of these respects (Bryman& Hardy,

2004). Research strategies comprise experiment, survey, archival, ethnography, action research, grounded theory, narrative inquiry, and case study.

This research was survey-based with limited document analysis of the BOQs. It focused on establishing the factors that were attributed to cost management, estimation, monitoring, and evaluation of cost overruns in SMMEs' construction performance. The objective was to collect primary data on project cost estimations from top management and employees of the selected SMME companies. Primary cost estimation data enabled comparisons between the original cost estimations, the final cost calculations, and juxtapose the results against the ideal cost estimation and desired project cost performance figures. In this study, qualitative research method assisted to view cost estimation events and situations in the participating SMMEs "through the eyes of the people that created the estimations that we will be studying" (Bryman & Bell, 2003:293). Dubois and Gadde (2002:554) stated, "The interaction between a phenomenon and its context are best understood through in-depth case studies".

The survey of the building sub-sector was designed to identify the relationship between costs estimate performance and the monitoring and evaluation of SMME building projects performance as a function of the overall SMME sustainable performance.

Following the study objectives, it was clear that the survey and case data collection BOQ was relevant since the study sought to explain the present circumstances regarding the questions that affect the factors of cost estimation and monitoring and evaluation work as functions of building projects cost overruns, which in turn affects the performance of the SMMEs. This required an in-depth description of these phenomenon with a focus on understanding these construction management phenomenon.

3.3.1 Collection of data

Figure 3.2 illustrates how the data for the study was obtained. Quantitative and qualitative data was collected by the use of a survey through the closed-ended questionnaires, interviews by using the interview guide and document analysis by BOQs. The questionnaire was used to collect the data. These questionnaires were distributed by e-mail to the respondents, who were given approximately a month to respond. Once the questionnaires were duly completed, the respondents sent them back for analysis.

In order to conduct the interviews appointments were made telephonically two weeks prior to the appointments. In-depth face to face interviews were conducted from Monday to Friday interviewing two participants per day. It took a maximum of thirty-five minutes to conduct an interview. The interviews were recorded through a tape recorder with the consent of the participants and then latter transcribed by transcribers.

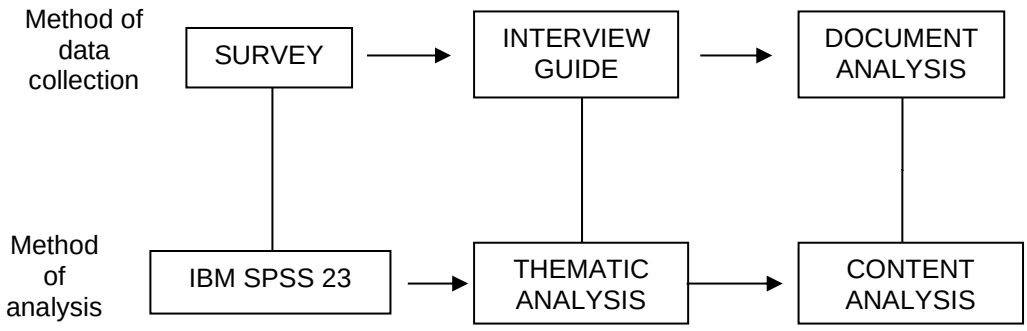

Figure 3.2: Primary Data collection and analysis

3.3.2 Target population

The target population is “the entire aggregation of respondents that meet the designated set of criteria” for inclusion in a study (Burns & Grove 1997:236). The population of the study was all the SMMEs operating within the building subsector of the construction industry in Gauteng, South Africa. The population was generated from the CIDB provincial database. The

focus on the building sub-sector was because Gauteng carries and executes the infrastructure development projects through the Department of Infrastructure Development (DID). This department spends the bulk of its budget on building projects such as development of schools, clinics, and hospitals in comparison to other construction sub-sectors, such as roads and infrastructure. The study targeted SMMEs who are in the construction industry; SMMEs in other fields of operations were not considered. Furthermore, additional primary panel data was requested from the DID in Gauteng for projects which had been executed and decommissioned in previous financial years.

Table 3.1 shows the spread of the population of SMMEs operating in Gauteng classified by CIDB grading, which included grades 1 to 6 only as this applies to SMMEs.

Table 3.1CIDB grading of Gauteng SMMEs

Grade	Population Size	Sample Size (5.5%of Population Size)	Category
Grade 6	251	14	General Building
Grade 5	190	10	General Building
Grade 4	298	17	General Building
Grade 3	219	12	General Building
Grade 2	656	36	General Building
Grade 1	5000	275	General Building
TOTALS	6614	364	

Adapted from CIDB (n.d.)

3.3.3 Sample

Sampling is defined as the process of selecting certain members or a subset of the population to make statistical inferences and to estimate characteristics of the whole population. Sampling involves a process of

selecting a sub-section of a population that represents the entire population, to obtain information regarding the phenomenon of interest (Polit & Hungler 1995).

For the purposes of this study, the simple random sampling technique was used to come up with the sample size for the quantitative data collection. The following formula was used to calculate a sample size with the desired confidence level of 95 per cent:

Sample Size = (Z-score)2 * StdDev*(1-StdDev) / (margin of error)$_2$

The calculation of the sample sizes per CIDB grade is seen in Table 3.1.

The questionnaires (Appendix A) were distributed to 364 respondents, who represent about 5.5 per cent of the population size. The respondents duly completed and returned 305 questionnaires, resulting in a return rate of 84 per cent. This constituted the quantitative data.

Qualitative data was collected through in-depth interviews. An interview guide (Appendix B) was used to interview 10 project managers who were purposively selected. Purposive sampling is the selection of participants who have the relevant information who will be interviewed, rather than interview participants who cannot provide the relevant information (Creswell, 2018). Only project managers were selected since they had the relevant information, and they are the custodians of the most important information that is needed for this study.

3.3.4 Data collection (BOQ)

For the purposes of calculating variances per trade within the building industry, 10 Gauteng-based SMME BOQs were collected from the DID from projects which were already completed.

Data was extracted from the original cost estimation and final project financial data, which was standardised and captured in MS Excel (Appendix

C). The variances were calculated by comparing the original estimates against the final costs.

In terms of project management, cost variance is defined as the difference between budgeted costs and actual costs, or costs expected to be incurred, versus what was incurred. The variance calculated could be either negative or positive; the variance will be negative if the cost incurred is greater than the cost budgeted on that activity or trade, and positive if the cost incurred is less than what was budgeted. Usually, the negative cost variance means management needs to find out what went wrong as those variances mean the firm had spent more money or time than was initially budgeted for to complete the activity. Whereas the positive cost variance means management had done well in performing the activities below the budgeted costs. The variance calculation gives insight into possible areas where management needs to pay attention if the variance is negative.

For the purpose of this study, the focus was on negative cost variances, which were calculated as depicted in Figure 3.3.

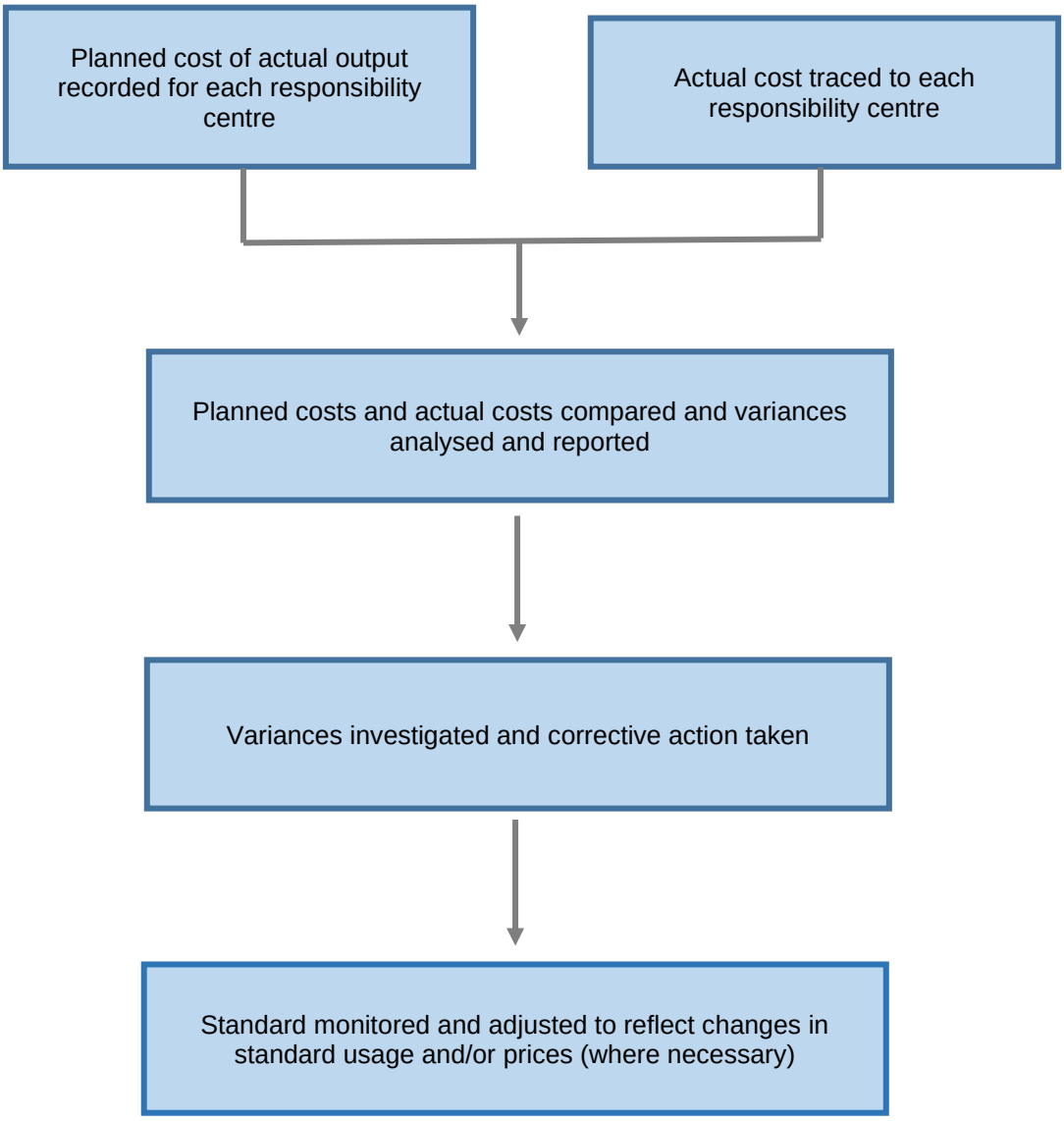

Figure 3.3 Cost variance calculations

Adapted from Drury (2014).

The formula for calculating the total cost variance was:

Total cost variance = budgeted cost less actual cost

The budgeted cost was the amount as provided in the initial tender stage and actual cost was the amount provided in the final account.

3.4 Data Analysis

Data analysis is “the systematic organisation and synthesis of the research data and testing of research hypotheses, using those data” (Polit & Hungler 1995:639). Walliman (2011) defined data analysis as a process of answering research questions through the examination and analysis of data. Data analysis encompasses the detection of issues, assessment of information suitability, selection of suitable approaches for answering research. The analytical process involves the detection of matters, assessment of suitability of information, selecting the suitable approaches for responding to the research investigations, application and evaluation of the research methodologies to be used, and summarising as well as communicating the results obtained in the analysis.

The IBM Statistical Programme for Social Sciences (SPSS) 23 was used for the frequency analysis to cleanse the data and report on the primary research. The null hypotheses were stated and tested with the non-parametric Kolmogorov-Smirnov test, providing quantitative results. The following steps were adopted in testing the hypotheses:

(1) Stating the null hypothesis, H_o. The null hypothesis is formulated with a view of rejecting it. The test of a H_o can be either one- or two-tailed, depending on whether deviations are investigated in one or both directions. H_o: $\mu=\mu o$ where μ is the hypothesis value.

(2) Specifying the level of significance. The purpose of this is to provide a basis for deciding whether an observed difference between a sample statistic and a hypothesised parameter is a chance difference or a statistically significant difference. This study used 0.05 per cent.

(3) Selecting the test statistic to be used by determining the type of sampling distribution followed.

(4) Stating the decision rule and defining the region of rejection based on significance, that is accepting the H_A or rejecting the H_o for

possible values of the test statistic. The cut-off point between the acceptance and rejection regions is called the critical value and it depends on the size of the rejection region.

(5) Computing the value of the test statistics.

(6) Deciding to accept or reject the H_o by comparing obtained values of the test statistic with the value from the statistic table.

(7) Stating the conclusion.

For the qualitative analysis, a thematic analysis was done, through the creation of themes and sub-themes. The seven steps advocated by Creswell (2014) in the thematic analysis are as follows:

- *Step 1*: Validating primary data obtained for the study to determine its accuracy.
- *Step 2*: Verifying all responses to obtain the meaning of data in the in-depth interviews.
- *Step 3*: Sorting the data into various themes/categories in accordance with what was asked in the in-depth interview guide, to answer the main research questions.
- *Step 4*: Establishing the ideas, general trends, and patterns that emerged from the data, its overall meaning, as well as its credibility.
- *Step 5*: Outlining the coding system and coding the themes and the sub-themes that were applied in the study.
- *Step 6*: Establishing memo summaries and constructing meaningful sentences for a sound content analysis.
- *Step 7*: Matching data from themes and sub-themes with information provided by the participants to establish similarity.

3.5 Validity and Reliability (Internal and External)

Validity in quantitative research (which assumes objective reality that can be measured) refers to internal and external validity. Internal validity depends on the strength of the relation between the cause and effect, and external refers to the possibility of generalising the findings. According to Stebbins (2011), validity in a quantitative study refers to how well a test measures what it intended to measure. Validity is necessary in a study, but validity alone is not sufficient. For a study to be valid, it also has to be reliable. Reliability refers to the degree to which an assessment produces stable and consistent results.

According to Saunders et al. (2016), to ensure the quality of the analysis, reliability and validity are considered. Qualitative validity means that the data is analysed to ensure certainty of the findings by employing specific mechanisms, while the qualitative reliability illustrates that the approach is consistent across different research and different projects (Creswell, 2014).

To ensure that the results are valid, the relationship between participants and researcher was kept at the level where the participants are able to provide feedback independently of the researcher. Information received was of good quality by having a trial run to ensure that the questionnaire can be completed on time and ensure that all ambiguities and difficult wording are eliminated.

The Cronbach's Alpha was used to measure the reliability of the research instrument. A co-efficient value of 0.7 and above is regarded as good according to Saunders et al. (2016). The test results indicated a co-efficient value of 0.99, which indicated that the research instrument is capable of generating reliable and generalizable results. The results of the Cronbach’s Alpha statistical tests are indicated in Chapter 4.

3.6 Ethical Considerations

Research ethics is concerned with what is permissible and acceptable when conducting research. Part of research ethics concerns the honesty and integrity of the researcher. Mouton (2001) stated that researchers should act responsibly and be accountable to society when conducting research. Human action and perceptions of the research should always be considered from three sides: that of the researcher, that of the participants in the study, and that of the people that will be using the design (Oates, 2006; Rule, Moran, Freeman, Whitfield-Gabrieli, Gabrieli, &Ambady,2011).

3.6.1 Consent issues

The ethical issues inherent in this study included informed consent, confidentiality of information, and the anonymity of participants. Participants were informed of the purpose and extent of the study and their involvement in it.

The participants voluntarily participated, and consent forms were signed prior to the request of the respondents' participation. Time was given for them to decide to participate or not. The participants were not pressurised into participating, nor was a mere verbal consent sufficient (Miller & Bell, 2002). Participants were given the information regarding the research, allowed to decide whether to participate or not, and were able to withdraw their participation at any stage.

3.6.2 Confidentiality issues

Usually, confidentiality is addressed as part of consent in keeping with best practice (Oliver, 2006). The data collected was treated and handled confidentially. The device where the information was stored was properly secured, and access was only gained by password, to ensure that confidentiality was not compromised. Anonymity of companies and individuals was protected at all costs.

3.7 Chapter Summary

This chapter presented the research design, research philosophy, and research methodology applied in carrying out this study. The data collection tools and techniques used in collecting the data were also presented. Further to that, the target population and sample sizes of the study were discussed. The validity and reliability as well as the ethical considerations were deliberated. The next chapter deals with presentation and discussion of results pertaining to the study.

CHAPTER FOUR: PRESENTATION OF RESULTS

4.1 Introduction

This chapter focuses on the presentation of primary research data that was obtained from an appraisal of cost management tools and techniques used on building projects by SMMEs in Gauteng. Quantitative data was obtained from 305 questionnaires completed and returned from the 364 distributed, resulting in a return rate of 84 per cent. Qualitative data was obtained through interviewing 10 project managers. The primary results obtained are discussed in this chapter in line with the reviewed literature, to ascertain the relationships that exist between the literature review and the results obtained from the primary research. The data collected was analysed and interpreted in accordance with the research objectives and research questions.

The study aimed to address the following research objectives:

(1) To identify the cost management tools and techniques used by SMME construction firms in Gauteng.

(2) To determine the areas, per trade, where the most variance arises on building projects of SMME construction firms in Gauteng.

(3) To recommend improvements to the cost management practices of SMME construction firms in Gauteng.

4.2 Testing the Null Hypotheses

The stated null hypotheses were tested using the Kolgorov-Smirnov one sample test statistic and the results are reflected in Table 4.1below.

Table 4.1 Null hypotheses test results

Hypotheses	Sig	Decision
H_o1: There are no causes for cost overruns in the SMME construction sector in Gauteng.	.000	Rejected as (p < .01)
H_o2: The SMMEs in the construction sector in Gauteng use cost management tools and techniques effectively	.000	Rejected as (p < .01)
H_o3: SMME construction industries in Gauteng use cost budgeting tools and techniques	.000	Rejected as (p < .01)
H_o4: SMME construction managers in Gauteng apply resource tools and techniques	.000	Rejected as (p < .01)

4.2.1 Response rate and reliability

An 84 per cent response rate was achieved on the quantitative data collection, and all 10 project managers were interviewed for the qualitative data. Both quantitative and qualitative data collection was successful due to constant follow-ups and reminders that were sent to the respondents. Regular reminders on interview scheduling were also sent to the project managers. Reminders were sent via telephone calls and emails, which resulted in higher return rates.

The Cronbach's alpha was used to measure the reliability of the research instrument. The test results indicated a co-efficient value of 0.99, which indicated that the research instrument was capable of generating reliable and generalised results. The results of the Cronbach’s alpha are indicated in Table 4.2.

Table 4.2 Cronbach's alpha statistical test results

Case Processing Summary		
Cases	**N**	**%**
Valid	305	100.0
Excluded	0	0
Total	305	100.0
Reliability Statistics		
Cronbach's Alpha	N of Items	
.994	53	

4.2.2 Gender

Figure 4.1 results indicated that 90 per cent were male and 10 per cent were female. This might have been caused by the possibility of fewer women in the construction industry, compared to the men who dominate the industry.

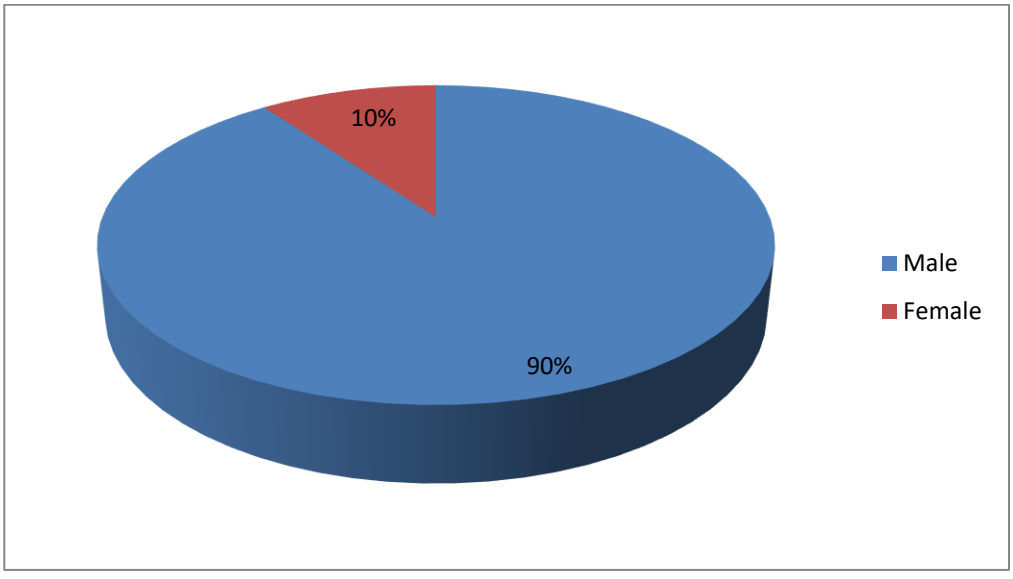

Figure 4.1: Gender

4.2.3 Age

Figure 4.2 suggests that 10per cent of the respondents were in the age group of 18 to 25 years, while 16 per cent were 26 to 35 years, 52 per cent were in the 36 to 45 year age group, 16 per cent were in the 46 to 55 year age group and six per cent were in the 56 years and above age group.

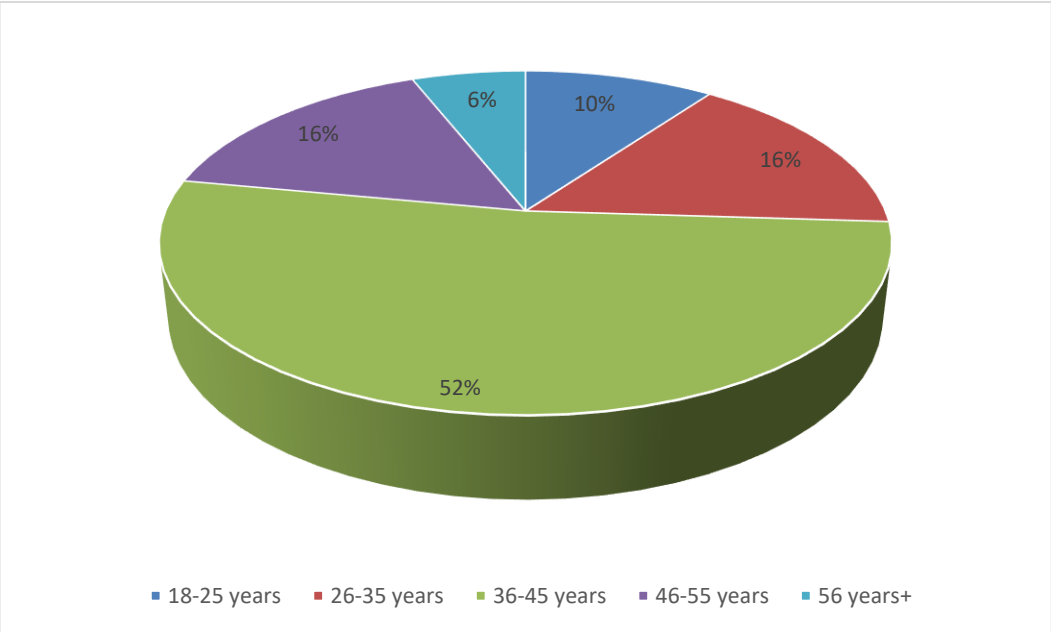

Figure 4.2: Age

The results indicated that over half (52 per cent) of the respondents were in the middle age group of 36 to 45 years. They still had a significant amount of time to work for the organisation before retiring. These were followed up by 16 per cent who were younger, in the 26 to 45 year age group and capable of serving the organisation much longer than their older counterparts could. The 46 to 55 year age group also amounted to 16 per cent, and still had a reasonable time to offer their services to their respective organisations. The 18 to 25 years age group, who had served for a long period in their organisations, followed these and they constituted 10per cent of the respondents. Finally, the 56 years and above age group was the smallest with six per cent, they were able to offer their services and expertise for a shorter period before retirement.

4.3 Test of Normality

A test of normality was carried out to determine the distribution of data. The test of normality statistical results reflected that not all the data was normally distributed as indicated in Table 4.3.

Table 4.3 Tests of Normality (n = 305)

Variable	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Company main scope	.240	305	.000	.870	305	.000
Job title	.365	305	.000	.766	305	.000
Company experience in construction industry	.256	305	.000	.797	305	.000
Your work experience	.257	305	.000	.796	305	.000
Average turnover past three years	.427	305	.000	.648	305	.000
Performance evaluation	.287	305	.000	.852	305	.000
Level of satisfaction	.173	305	.000	.878	305	.000
Area with the most cost overrun	.189	305	.000	.872	305	.000
Cost control tools and techniques used	.307	305	.000	.813	305	.000
Cost estimating tools and techniques used	.369	305	.000	.734	305	.000
Cost budgeting tools and technique	.421	305	.000	.625	305	.000
Resource planning tools and techniques used	.382	305	.000	.665	305	.000
Average percentage profit past three years	.350	305	.000	.798	305	.000
Main cases of cost overrun	.403	305	.000	.696	305	.000

a. Lilliefors Significance Correction

4.3.1 Job title

Figure 4.3 illustrates that the majority of the respondents were project managers who constituted 58 per cent; these had a larger representation as they are the custodians and leaders of the project management teams. Architects constituted 22 per cent, these were followed by quantity surveyors at 12 per cent, and then finally contract managers at 8 per cent of the respondents.

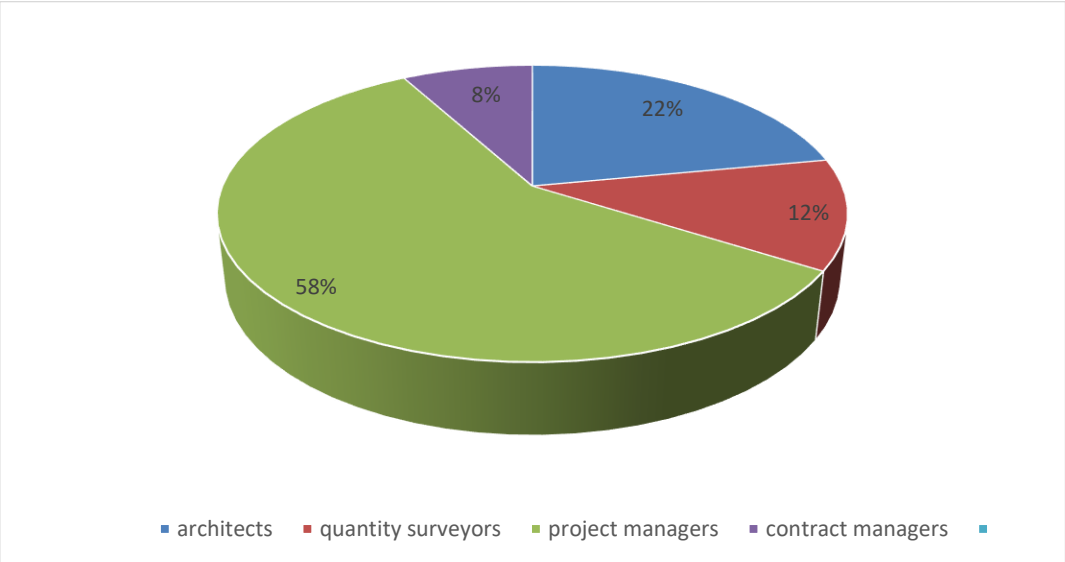

Figure 4.3: Job title

The sample size was well balanced since it was made up of architects, quantity surveyors, project managers, and contract managers, who were instrumental in the building projects and could, validate responses effectively.

4.3.2 Work experience

Figure 4.4 results reflected that 16 per cent of the respondents had worked with the organisations for less than three years, 49 per cent had worked for a period of three to five years, and 35 per cent of the respondents had worked for a period of six to 10 years.

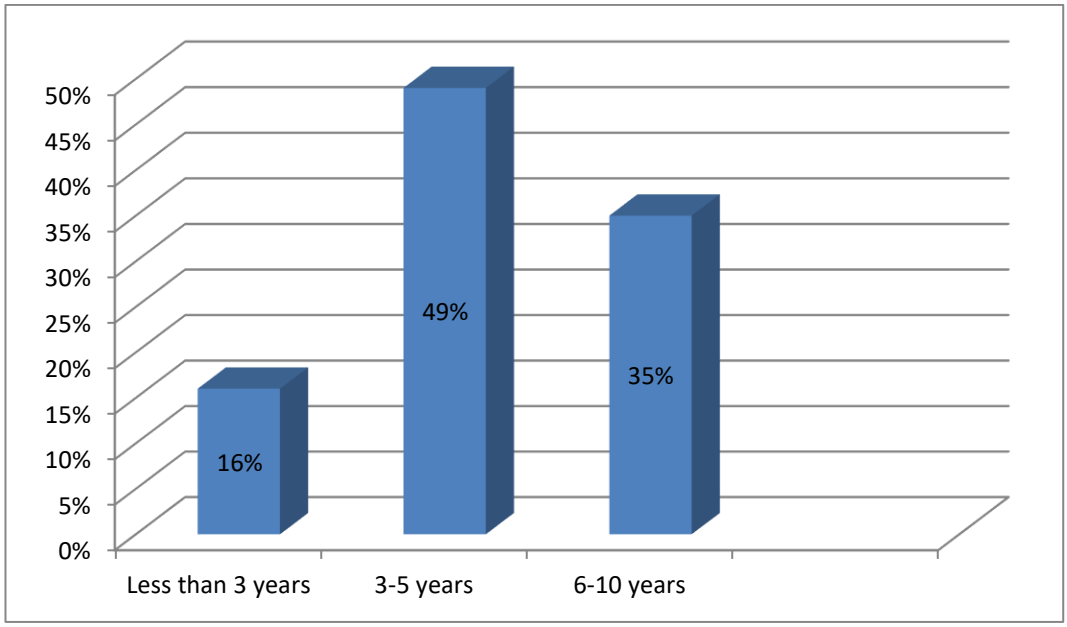

Figure 4.4: Work Experience

The majority of the respondents, who constitute 84 per cent, had worked for a period of between three and 10 years, and might be able to provide first-hand information since they have worked for the organisation for a long period of time.

4.3.3 Company main scope

The results reflected Figure 4.5 indicate that 68 per cent of the company's main scope was main services (building related services), while 11 per cent was mechanical, eight per cent was civil, seven per cent was plumbing, and six per cent was electrical.

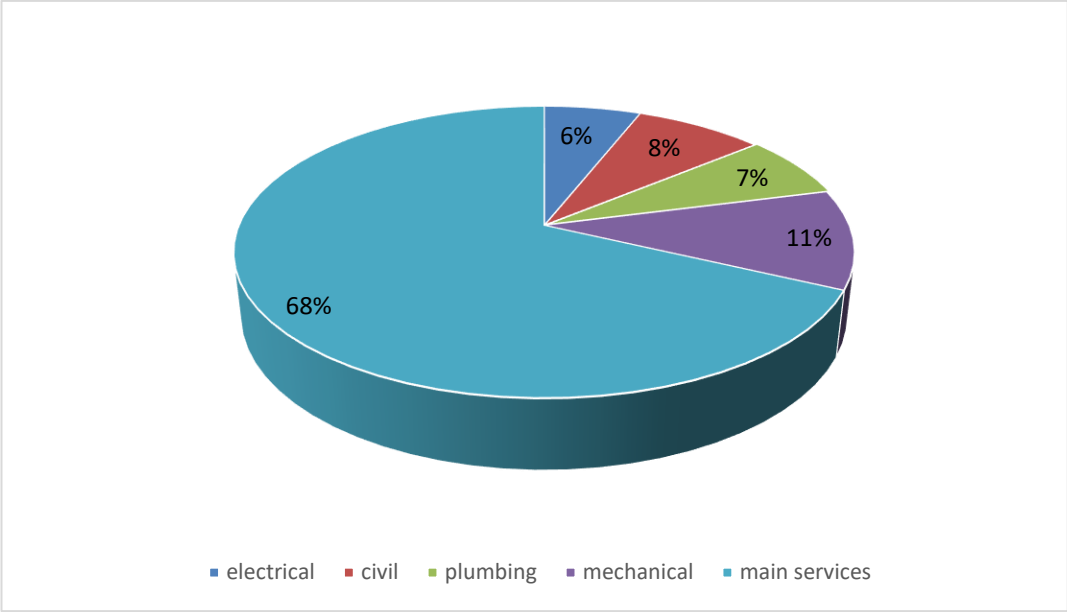

Figure 4.5 Company's main scope

The major services, the building related services, represented the majority (68 per cent) while the other 32 per cent was shared among the other services.

4.3.4 Company experience in construction industry

Figure 4.6 illustrates that 17 per cent of the respondents indicated that their companies had less than three years' experience in the construction industry, while 49 per cent indicated that they had between three and five years' experience and 34 per cent indicated that they had six to 10 years' experience in the construction industry.

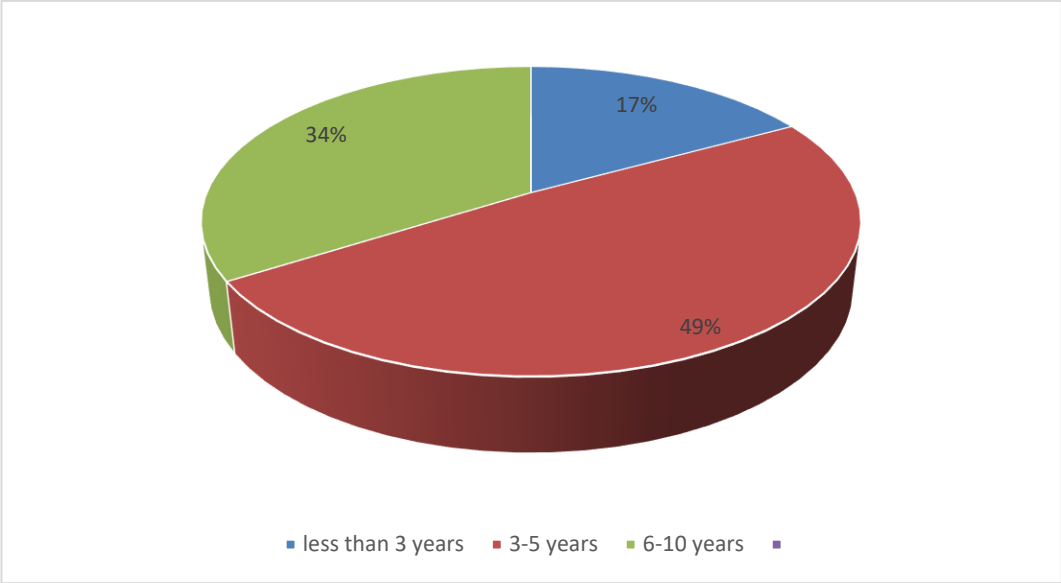

Figure 4.6: Company experience in construction industry

The results reflected that the majority of the organisations (83 per cent) had been in the industry for periods between three and 10 years.

4.3.5 Average turnover for past three years

Figure 4.7 suggests that one per cent of the respondents indicated that they had an average turnover for the past three years of R151 000 toR550 000, while 70 per cent of the respondents had an average turnover for the past three years of R2million to R25million. Furthermore, 26 per cent had an average turnover for the past three years of R25.5million to R50million and three per cent of the respondents had an average turnover for the past three years of R51million and above.

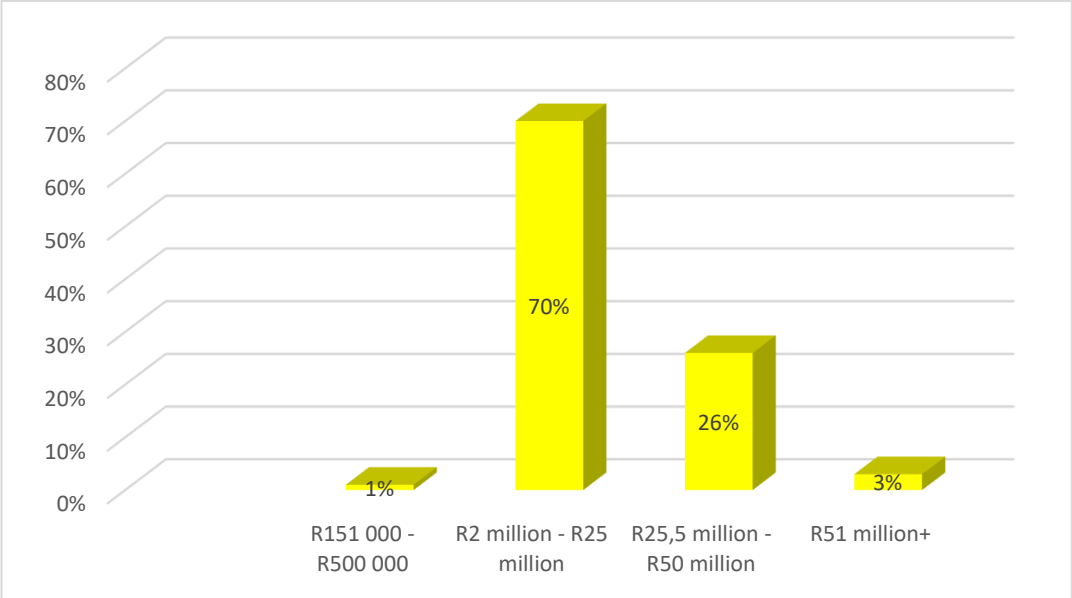

Figure 4: Average turnover for past three years

Considering that the rate of expenditure in the construction industry is very high, the average turnover that the SMMEs had realised for the past three years is not sufficient if they are to be viable and remain operational.

4.3.6 Average percentage profit for past three years

Figure 4.8 suggests that 19 per cent of the respondents indicated that the average percentage profit for the past three years was less than five per cent, 57 per cent indicated that they had an average percentage profit of between five and10 per cent for the past three years. Organisations that indicated an average percentage profit of between 11 and15 per cent amounted to10 per cent, and a further 10 per cent had an average percentage profit of between 16 and20 per cent for the past three years. The final respondents, amounting to fur per cent, indicated that they had an average percentage profit of 20 per cent and above for the past three years.

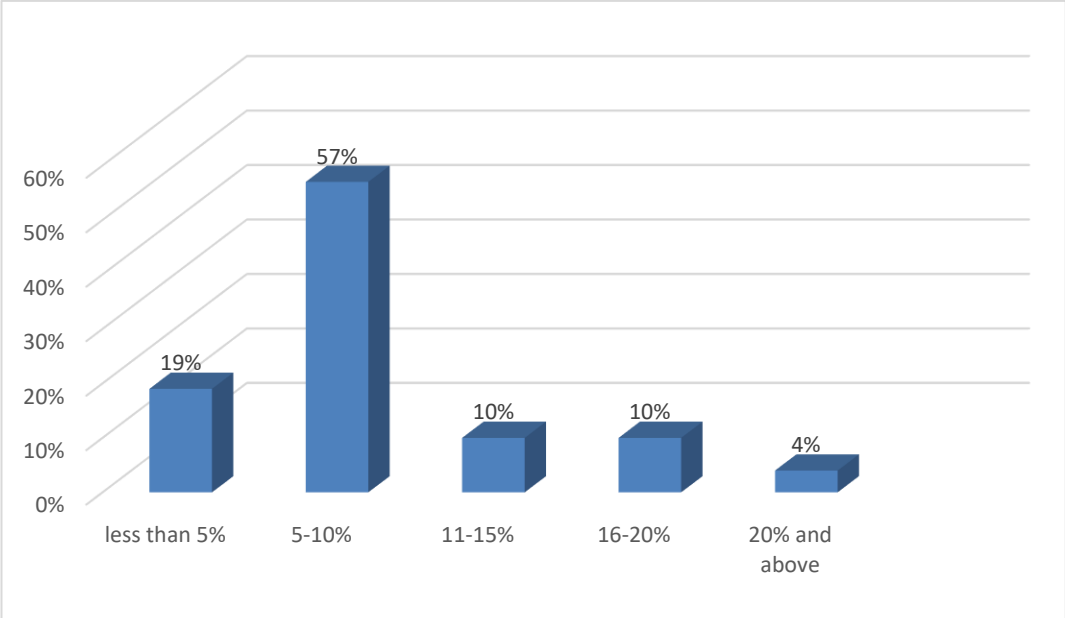

Figure 4.8: Average percentage profit for past three years

The average percentage profit realised by the SMME construction organisations was very low. It is necessary to increase the profit levels for the organisations to remain competitive and productive in the market. If nothing is done these organisations might be driven out by competitors.

4.3.7 Performance evaluation

Figure 4.9 suggests that 10 per cent of the respondents indicated that performance evaluation on return on investment, cashflows, operating profit, sales growth rate, market share and investments was not at all important. A further 12 per cent indicated that it was slightly important, 63 per cent indicated that it was important, and 15 per cent of the respondents indicated that performance evaluation on return on investment was moderately important.

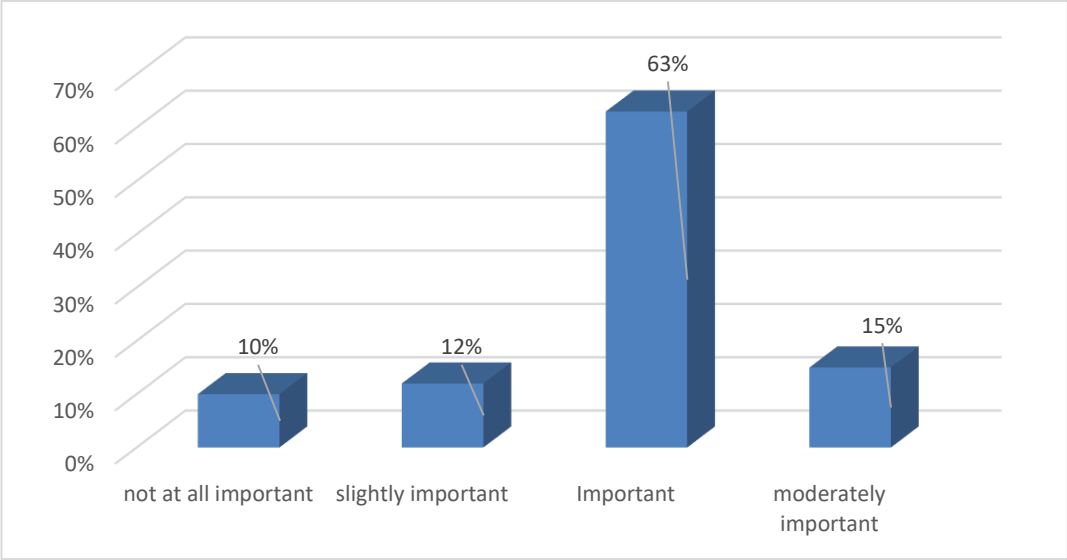

Figure 4.9: Performance evaluation

4.3.8 Level of satisfaction

Figure 4.10 suggests that 13 per cent of the respondents indicated that they were extremely dissatisfied with the return on investment, cashflows, operating profit, sales growth rate, market share, and investments. Of the remaining respondents, 22 per cent were slightly dissatisfied,20 per cent were satisfied, 13 per cent were moderately satisfied, and 32 per cent were extremely satisfied with the return on investment.

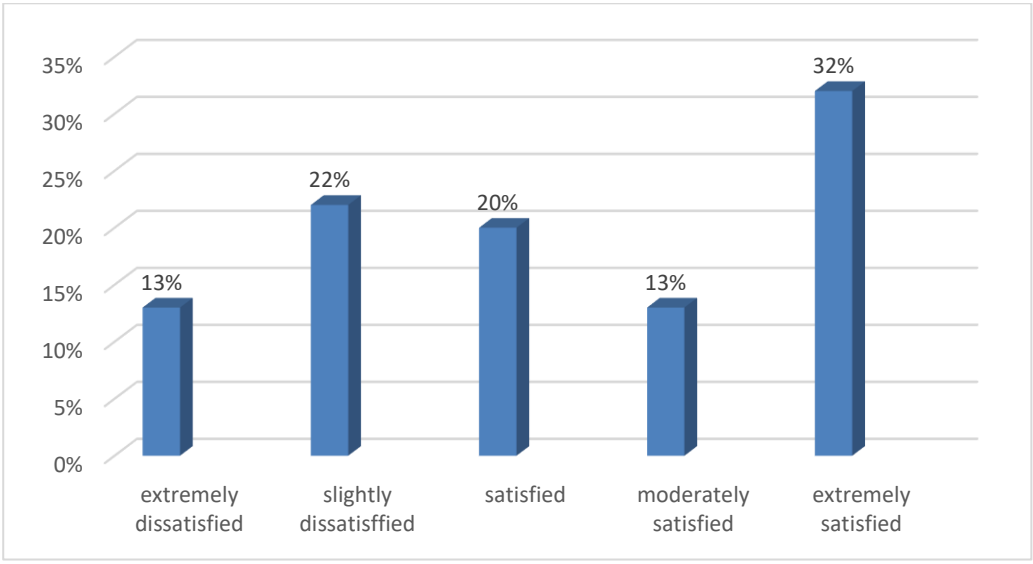

Figure 4.10: Level of satisfaction

4.4 Cost Overrun Areas

Cost overruns were distributed as follows: masonry 13 per cent, concrete, framework and reinforcement 12 per cent, preliminaries 10 per cent, roof covering eight per cent, and external works seven per cent. Earthworks six per cent, waterproofing six per cent, ceiling, partitioning and access flooring five per cent, while mechanical works constituted another five per cent. Carpentry and joinery had four per cent, glazing four per cent, plumbing and drainage four per cent, tiling three per cent, paintwork three per cent, while another three per cent represented electrical works. Plastering had two per cent, floor covering, and plastic linings had two per cent, while metal works represented one per cent, structural steel works one per cent, and finally ironmongery represented one per cent.

The top five cost overruns are shown in Figure 4.11.

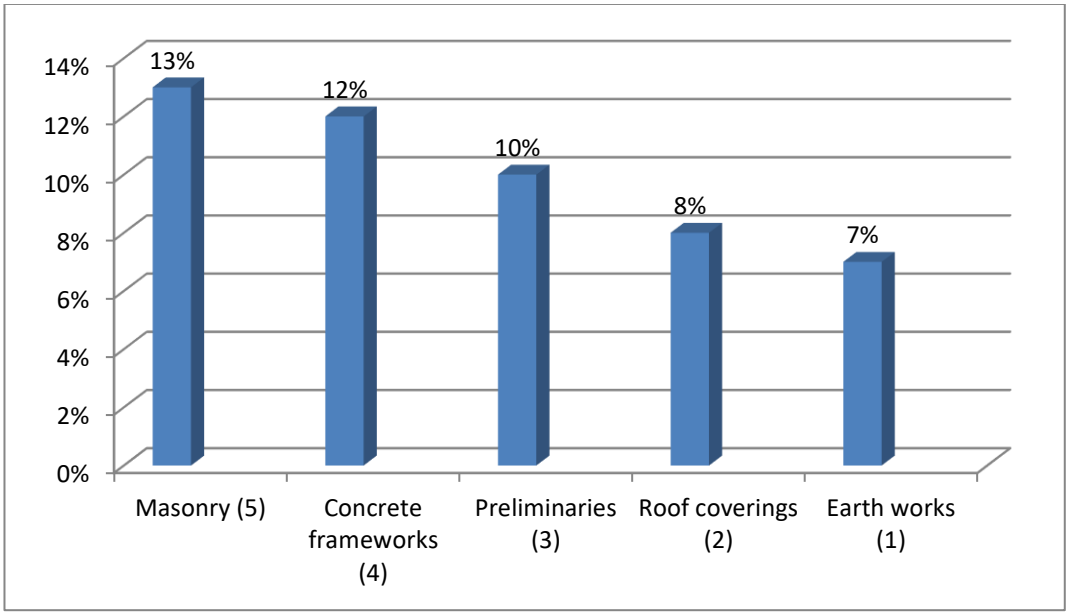

Figure 4.11: Cost overrun rating

Figure 4.11 indicates that masonry, which had the most cost overruns, is rated five followed by concrete, frameworks, and reinforcements a four, preliminaries a three, followed by roof coverings two and finally earth works rated one.

4.4.1 Cost control tools and techniques

Cost management control tools incorporate planning, estimating, budgeting, financing, funding, managing, and controlling of costs. Most of the respondents, constituting 61 per cent, indicated that they use excel as a cost control tool and technique, while 13 per cent used earned value management, seven per cent used cost change control, five per cent used additional planning and five per cent used other tools and techniques, which could be construed as trial-and-error methods. Performance measurement was used by three per cent of the respondents, another three per cent used estimator 360, while two per cent used pro contractor estimator, and finally one per cent of the respondents used Microsoft project.

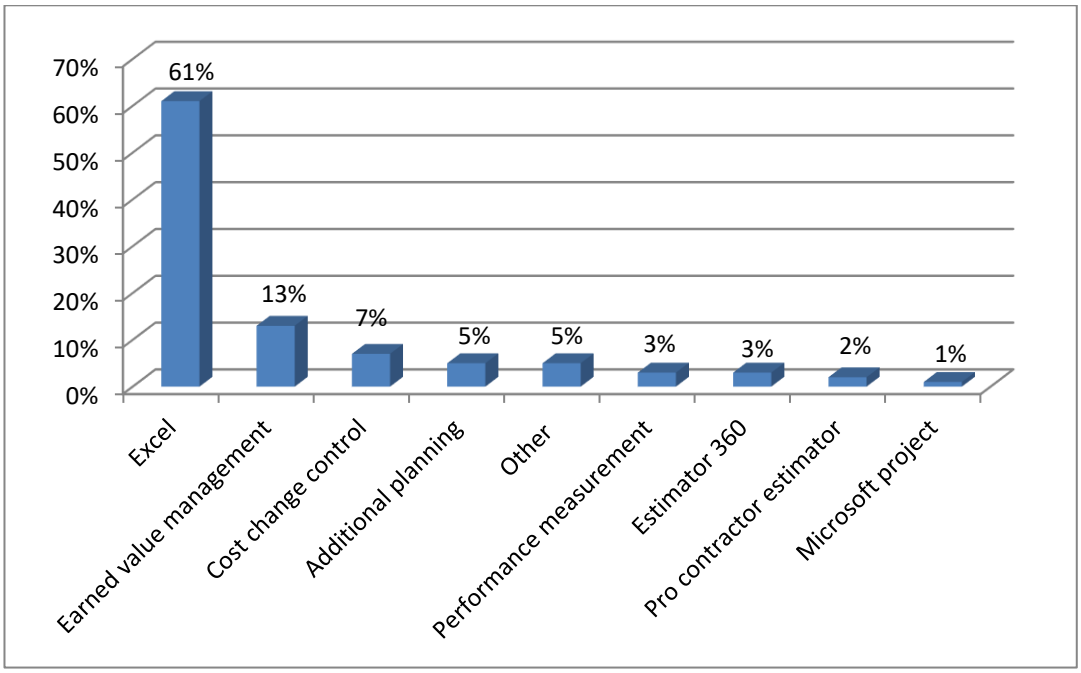

Figure 4.12: Cost control tools and techniques

4.4.2 Cost-estimating tools and techniques

Figure 4.13 indicates that 69 per cent of the respondents used excel as a cost-estimating tool, seven per cent of the respondents used parametric modelling, another seven per cent used bottom-up estimating, while six per cent used analogous estimate. Of the respondents, two per cent used

estimator 360, three per cent used Microsoft project, three per cent used pro contractor estimator, and another three per cent of the respondents used other methods; trial and error, which amount to guess work.

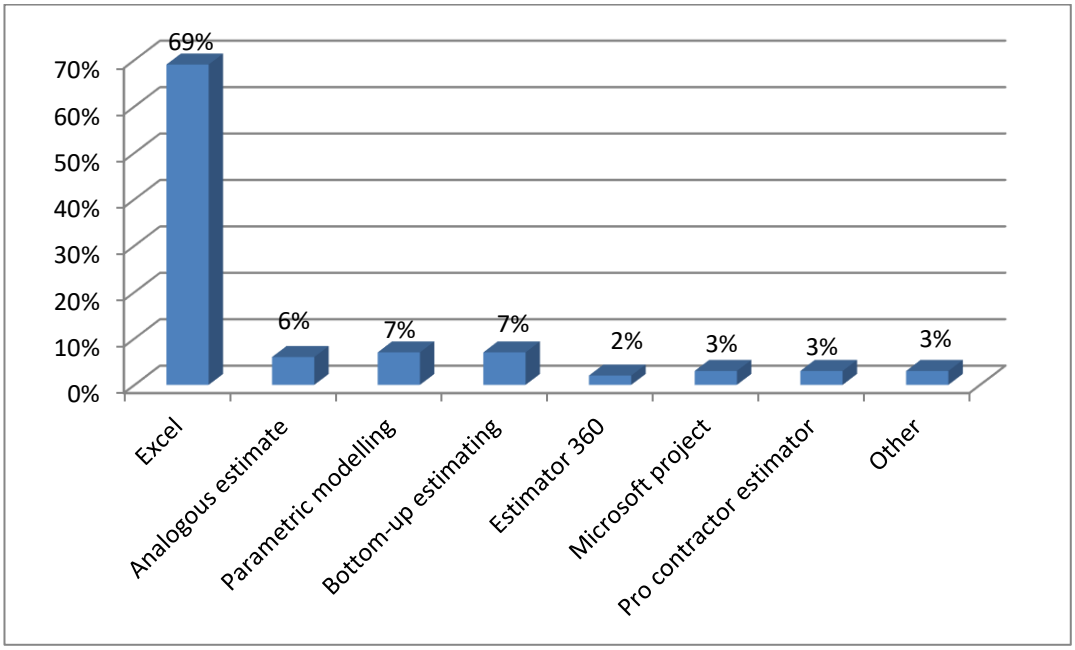

Figure 4.1Cost-estimating tools and techniques

4.4.3 Cost budgeting tools and techniques

Figure 4.14 illustrates that 70 per cent of the respondents used incremental budgeting, while 13 per cent of the respondents used activity-based budgeting, 12 per cent of the respondents used value proposition budgeting, and five per cent of the respondents used zero-based budgeting.

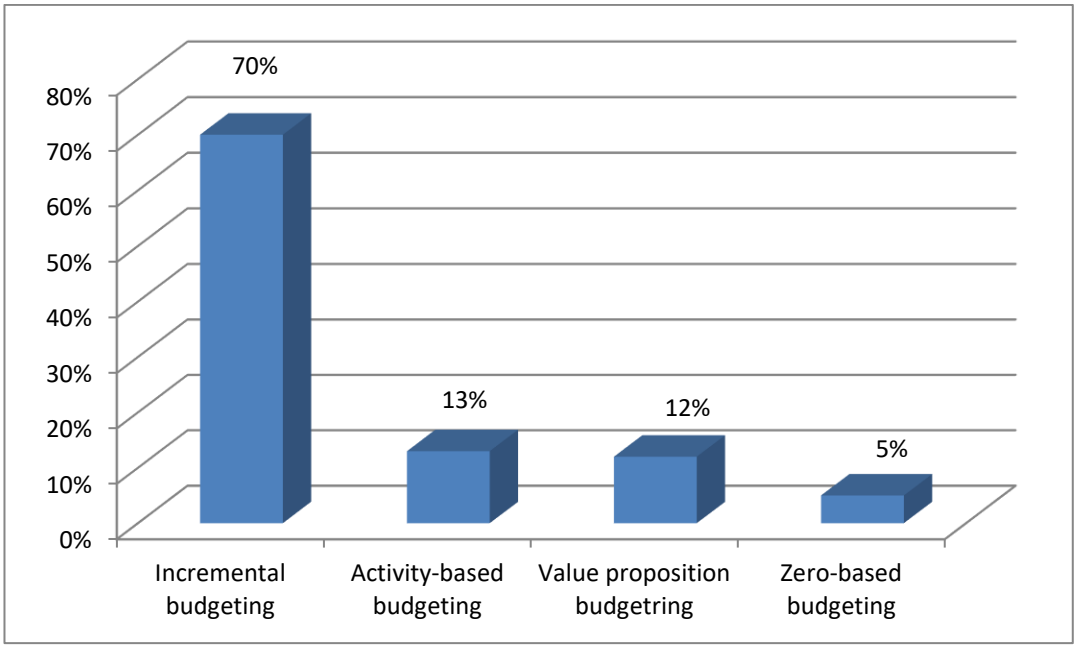

Figure 4.15: Cost budgeting tools and techniques

4.4.4 Resource planning tools and techniques

Figure 4.15 suggests that 65 per cent used trial and error methods, while eight per cent indicated that they used pro work flow, seven per cent used expert judgement, six per cent used hive, six per cent used jira, five per cent alternative identification, and the final three per cent used office timeline.

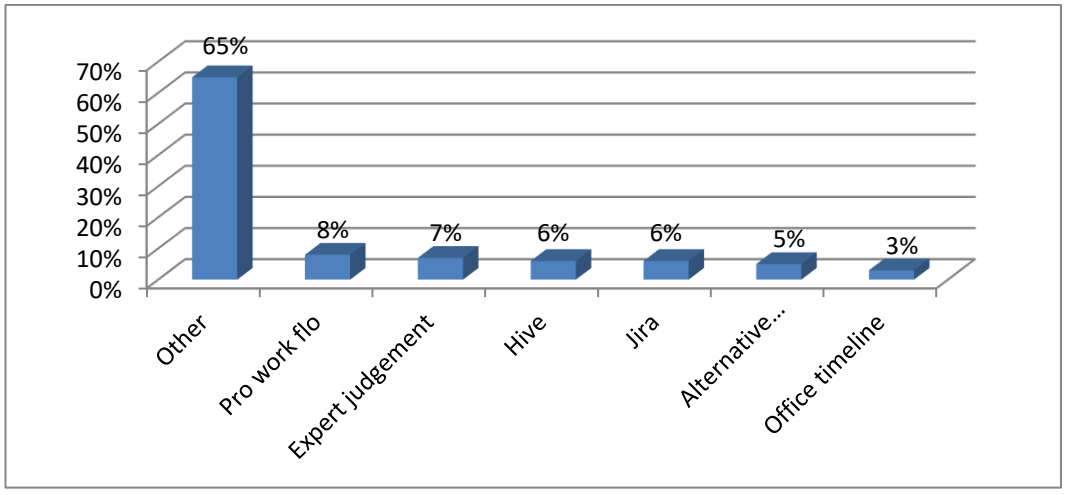

Figure 4.5 Resource planning tools and techniques

4.4.5 Main causes of cost overruns

Figure 4.16 indicates that 35 per cent of the respondents indicated that inaccurate or poor estimation of original costs are the main causes of cost overruns, while 25 per cent indicated construction cost underestimation. Another 25 per cent indicated poor project management, and 15 per cent of the respondents indicated improper planning as the causes of cost overruns.

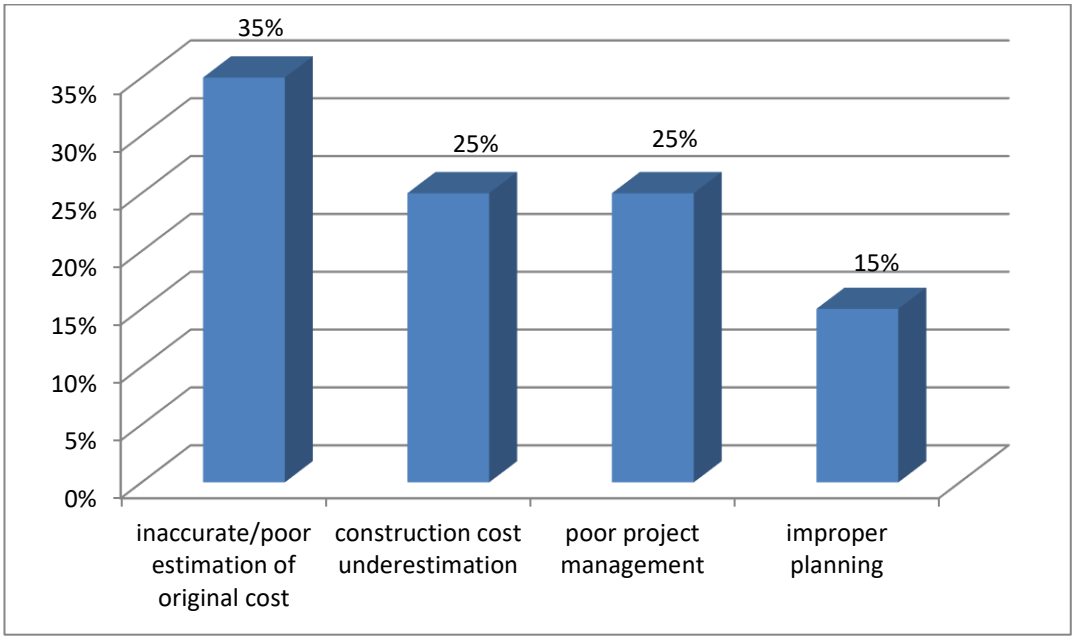

Figure 4.2 Causes of cost overruns

4.5 Presentation of Qualitative Results

The 10 project managers interviewed were in the age group of between 30 and 35 years, they had worked for a period of between three and five years in their respective organisations. These participants were project managers who manage various projects at their respective organisations. Five of the participants had honours degrees in business management, while the other five had diplomas in business management; however, they did not have any qualifications in construction management or project management. The interviews were done on 24and 25 April 2020. Each participant was

interviewed for forty-five minutes. A phone was used to record the interviews and the file was uploaded onto a laptop. The participants were notified that they were being recorded to collect data for study purposes only. Frequency tables are presented in Appendix D.

The major themes that emerged from these in-depth interviews were cost estimating tools, cost overruns, costing system, and performance evaluation. For the sake of anonymity, project managers were labelled A, B, C, D, E, F, G, H, I, and J. Table 4.4 provides a detailed profile of interviewees.

Table 4.4 Interviewee profile

Interviewee	Years of Experience	Primary profession	Contractor category grade	Nature of Building projects
A	3	Business Management Degree	6	New Construction Building Projects
B	5	Business Management Diploma	5	New Construction Building Projects
C	3	Business Management Degree	4	Renovations and Additions
D	5	Business Management Diploma	3	New Construction Building Projects
E	5	Business Management Diploma	2	Renovations and Additions
F	5	Business Management Diploma	6	New Construction Building Projects
G	5	Business Management Degree	6	New Construction Building Projects
H	5	Business Administration Degree	5	New Construction Building Projects
I	3	Business Administration Degree	6	New Construction Building Projects
J	3	Business Administration Degree	5	New Construction Building Projects

4.5.1 Cost control tools and techniques

Participant B and I indicated that they used excel as a cost control tool and technique, while participant A used earned value management, and

participant C used cost change control. Participant E used additional planning, participant F, estimator 360, and participant G applied additional planning. Participant H indicated that they used pro contractor estimator 360, while participant D indicated that they used performance measurement, and participant J indicated that they used Microsoft project. The participants indicated that although they used these tools as a cost control technique, they were not fully utilised.

4.5.2 Cost estimating tools

Only Participants A and J indicated that they used the multiple regression analysis cost estimating tool. Other participants commented as follows:

> "The size of our operations makes it difficult for us to engage the services of qualified personnel as well as equipment to enable us to do proper cost estimations. We are mainly let down by our inability to attract competent staff, and as a result we end up incurring heavy losses and our performance at the end of the day remains dismal." (Participant B)

> "Limited resources are a great hindrance to our operations. We do not have the capacity to effectively make use of cost estimating tools, as we are unable to get the services of experts who can manage and make of the cost estimating tools." (Participant C)

> "We are a very small construction organisation that has no capacity to use advanced cost estimating tools and techniques. We incur cost overruns due to our inability to fully utilise the cost estimating tools." (Participant D)

Participants E, F, G, H, and I concurred with the responses of participants B, C, and D. The responses obtained from the participants are evident that the size of their businesses affects their application of relevant cost estimating tools, and engagement of expert services to help them to reduce

their cost overruns. This affects their operations as they have exorbitant uncontrolled expenses, which have an adverse effect on their operations.

4.5.3 Cost budgeting tools and techniques

In the interviews conducted with the project managers participants C, D, E, F, G, and J, indicated that they used incremental budgeting as a cost budgeting control measure. Participants H and I used activity-based budgeting, while participant A, used value proposition budgeting, and participant B, used zero-based budgeting as cost budgeting control tools. The participants were of the view that the cost budgeting tools and techniques were not effectively utilised, hence their organisations were not getting the desired results.

4.5.4 Resource planning tools and techniques

The resource planning tools and techniques are not well utilised, and this has resulted in the organisations incurring cost overruns. Participants C, D, E, and I indicated that they applied trial and error in their resource planning operations. Participant A applied pro work flo, while participant B, used expert judgement, participant F used hive, participant G applied jira, and participants H and J used alternative identification and office timeline respectively. The resource planning tools and techniques were not adequately utilised and this in turn caused cost overruns in their respective organisations.

4.5.5 Cost overruns

The quantitative results reflected differently from the BOQ analysis in terms of the areas that have the most cost overruns. The respondents ranked the cost overruns from one to five, with five being the highest cost overrun area. Masonry was ranked five, followed by concrete framework and reinforcement, ranked four, preliminary works came next with a ranking of three, followed by roof covering ranked two, and external works with the lowest cost overrun ranked one. The BOQ analysis results however,

reflected that masonry contributed 28 per cent to the cost overruns, followed by tiling with 15 per cent and external works with 12 per cent of the cost overrun contribution. Concrete framework and reinforcement contributed 11 per cent to the cost overruns, earthworks nine per cent, carpentry and joinery eight per cent, and plumbing and drainage contributed six per cent to the cost overruns. Preliminaries had a five per cent contribution to the cost overruns, followed by structural steel works with four per cent and electrical works with two per cent of the cost overrun contributions.

All 10 participants indicated the negative effect that the cost overruns had on their businesses. Participants commented as follows:

> “Cost overruns are our greatest enemy. The more we try to excel the more affected we are by the cost overruns. Cost overruns have affected the levels of our performance. We are unable to maximise on the profitability of our business venture. Our operating profit has reached diminishing levels, and this is caused by continuous rises in cost overrun costs, which we have found difficult to control.” (Participant D)

> “We are experiencing cost overruns, and this has a negative effect on our operations. We need to make use of costing tools and techniques in order to ascertain the reduction of the cost overruns.” (Participant F)

> “I am sure that we are affected by cost overruns due to lack of resources that can help us to procure cost control tools as well as to hire trained construction personnel who can help to do proper cost estimations.” (Participant I)

The results from the in-depth interviews reflected that the participants were not happy with their performance. Participants A, B, E, G, H, and J concurred with the responses of participants D, F, and I. Their turnovers were being eroded by the ever-increasing cost overruns. They are currently

operating at a loss, which might force some to liquidate their construction enterprises.

4.5.6 Most frequent cost overruns

The quantitative results reflected differently from the BOQ analysis, as discussed in section 4.5.5. The qualitative results reflected that nine out of 10 BOQs contributed to the masonry, carpentry, and joinery cost overruns. Tiling, concrete framework and reinforcement, and plumbing and drainage had six BOQs each that contributed to the cost overruns. Electrical works had five BOQs, external works had four BOQs, followed by earthworks with three BOQs that contributed to cost overruns. Preliminaries and structural steelworks each had two BOQs, which contributed to the cost overruns.

4.5.7 Suitability of tools and techniques used

The tools and techniques that the SMME construction companies in Gauteng used were ideal for these organisations. Each organisation should choose the tools and techniques ideal for their operations. The major challenge is that the personnel who use these tools and techniques are not experts. They are not competent enough to operate and apply these tools and techniques to obtain the best possible results. Cost overruns are not well controlled because cost control measures, cost estimating measures, cost budgeting measures, and resource planning tools and techniques are not fully utilised, in order to achieve the best cost overrun control measures.

4.6 Chapter Summary

This chapter concentrated on the presentation, and analysis of quantitative and qualitative results obtained from this study. The results reflected the importance of the application of cost estimating tools towards the control of cost overruns in the building construction SMME sub-sector. The main causes of cost overruns in the SMME construction organisations in Gauteng were identified as inaccurate or poor estimation of original costs,

construction cost underestimation, poor project management, and improper planning.

Most of the participants did not employ cost management tools used for estimating, monitoring, and evaluation of construction projects. Only two participants indicated that they used the Multiple Regression Analysis cost estimating tool. Cost overruns were escalating, as there were no tools and techniques to estimate and control costs in these organisations. The sizes of the organisations hindered the use of these tools as they could not afford and did not have the trained personnel to use these tools and techniques.

The negative sources of variances, as established from the BOQs, were masonry, roof coverings, carpentry and joinery, earthworks, preliminary works, electrical works, structural steel works, plumbing and drainage, external works, and waterproofing. The positive overruns were provisional sums, concrete frames and reinforcements, ceilings, partitions and access flooring, paintwork, plastering, floor covering and plastic lining, metal work, tiling, ironmongery, and glazing.

The next chapter presents the findings summary, conclusions, and recommendations of the study.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The study sought to establish the cost management tools and techniques that the SMMEs use and the impact on their performance by further analysing the variances arising during the course of the project in Gauteng. The purpose of this final chapter is to provide a summary of the major findings and recommendations of the study.

5.2 Objectives of the Study Restated

The study addressed the following research objectives:

(1) To identify the cost management tools and techniques used by SMME construction firms in Gauteng.

(2) To determine the areas, per trade, where most variance arises on building projects of SMME construction firms in Gauteng.

(3) To recommend improvements to the cost management practices of SMME construction firms in Gauteng.

5.3 Testing the Null Hypotheses

The stated null hypotheses were tested with the Kolmogorov-Smirnov one-sample test statistic and the results are as follows:

- H_o1: There are no causes for cost overruns in the SMME construction sector in Gauteng. The hypothesis was rejected as $p < .01$. It was concluded that there were causes for cost overruns in the SMME sector in Gauteng.

- H_o2: The SMMEs in the construction sector in Gauteng use cost management tools and techniques effectively. The hypothesis was rejected as $p < .01$. It was concluded that the SMMEs in the

construction sector in Gauteng did not use cost management tools and techniques effectively.

- H_o3: Project managers in the SMME construction industry in Gauteng use cost budgeting tools and techniques effectively. The hypothesis was rejected as $p < .01$. It was concluded that project managers in the SMME construction industry in Gauteng did not use cost budgeting tools and techniques.

- H_o4: SMME construction managers in Gauteng apply resource tools and techniques effectively. The hypothesis was rejected as $p < .01$. It was concluded that SMME construction managers in Gauteng did not apply resource tools and techniques.

5.4 Summary of major findings

The key findings from the study are as follows:

5.4.1 Tools and techniques used

Overall, cost management, which includes planning, estimating, budgeting, financing, funding, managing, and controlling of costs, was not fully practiced by the respondents. However, this has helped to fuel the cost overruns as there were no effective control measures in place. The following major findings were established from the primary study:

- Most of the respondents (61 per cent) indicated that they used excel as a cost control tool and technique, while 13 per cent used earned value management, seven per cent used cost change control, five per cent used additional planning and five per cent used other, which was considered as trial and error methods. Performance measurement was used by three per cent of the respondents, another three per cent used estimator 360, while two per cent used pro contractor estimator, and one per cent used Microsoft project. There are high-cost overruns due to the fact that the cost control and

planning control measures that these organisations used were not effectively applied and the people that used them were not competent enough to operate them.

- Excel was used as a cost estimating tool by 69 per cent of the respondents, while seven per cent of the respondents used parametric modelling, another seven per cent used bottom-up estimating, while six per cent used analogous estimate, and two per cent used estimator 360. Three per cent of the respondents used Microsoft project, another three per cent used pro contractor estimator, and a further three per cent used other, which were trial and error methods essentially amounting to guess work.

- Most of the respondents (70 per cent) used incremental budgeting, while 13 per cent used activity budgeting, 12 per cent used value proposition budgeting, and five per cent used zero based budgeting, as cost budgeting tools and techniques.

- There was no resource planning tool and technique used by 65 per cent of the participants who instead indicated that they used the unorthodox trial and error method, while eight per cent indicated that they used pro work flo, seven per cent used expert judgement, six per cent hive, six per cent jira, five per cent alternative identification, and the final three per cent used office timeline.

5.4.2 Causes for cost overruns

Inaccurate or poor estimation of original costs was viewed as the main cause to cost overruns by 35 per cent of the respondents, 25 per cent indicated construction cost underestimation, another 25 per cent indicated poor project management, and 15 per cent indicated improper planning as one of the main causes of cost overruns.

5.4.3 Trades contributing the most overruns

The BOQs reflected negative cost overruns per trade: masonry was the highest, followed by roof coverings, carpentry and joinery, earthworks, and preliminary works. The positive cost overruns were realised in provisional sums, concrete frameworks and reinforcement, ceilings, partitions and access flooring, paintwork, and plastering.

5.5 Discussion of Findings

5.5.1 Objective 1

- To identify the cost management tools and techniques used by SMME construction firms in Gauteng.

The results obtained reflected that SMME construction firms in Gauteng did not apply cost management practices as evidenced by their performance levels and the levels of satisfaction with their average turnover and percentage profit for the past three years. Empirical evidence supported the fact that project managers failed to control cost overruns and to apply cost-estimating tools, budgeting, monitoring, and evaluation tools. H_o2 concluded that the SMMEs in the construction sector in Gauteng did not use cost management tools and techniques. H_o3 concluded that SMME construction industries in Gauteng did not use cost budgeting tools and techniques. H_o4 concluded that SMME construction managers in Gauteng did not apply resource tools and techniques. These results aligned with the findings that emanated from the study. SMME construction companies need to engage people who can run the organisational finances efficiently and effectively in order to maximise profits.

Literature review support that organisations face a major challenge in controlling and managing project budgets over the time span of project life cycles. Determining how cost will change with output or the measurable factor of activity is of vital importance for decision-making, planning, and control (Drury, 2014). Proponents of construction basing on empirical

evidence have concluded that the preparation of budgets, the construction of production performance reports, the calculation of earned value management, and provision of relevant costs for pricing and other decisions all depend on reliable estimates of costs (Ahiaga-Dagbui & Smith, 2014). Unfortunately, construction costs are not easy to predict, as they behave differently under different circumstances. Cost behaviours respond to different forms of controls exerted on the construction project life cycle, ranging from tight controls to relaxed or removed controls. This study is set in this context to debate construction cost management (Memon & Rahman, 2013).

Cost management control tools incorporate planning, estimating, budgeting, financing, funding, managing, and controlling of costs. Most of the respondents, constituting 61 per cent, indicated that they use excel as a cost control tool and technique, while 13 per cent used earned value management, seven per cent used cost change control, five per cent used additional planning and five per cent used other tools and techniques, which could be construed as trial-and-error methods. Performance measurement was used by three per cent of the respondents, another three per cent used estimator 360, while two per cent used pro contractor estimator, and finally one per cent of the respondents used Microsoft project.

Cost control involves the measurement of variances from the cost baseline, to take corrective measures with the view of achieving minimum costs. Expenditure and performance of all projects is monitored through the application of procedures. All changes to the cost baseline need to be documented and the anticipated and continuous forecasting of final total costs needs to be done (Cleopatra Enterprises, 2020; Ibadov&Kulejewski, 2019). Empirical evidence underpins that the four most useful techniques for project planning, complement each other and when used together, provide the best chance of covering every aspect of the project. These are brainstorming, cause and effect diagrams, critical path analyses, and Gantt charts. In the construction practice, at the planning stage of a construction

project, planners try to take into account the possibility of unfavourable situations and their consequences during the project execution. Therefore, planning decisions should use appropriate tools for uncertainty modelling as well as consider alternative options for the implementation of the entire undertaking or the most sensitive (critical) works (Ibadov & Kulejewski, 2019).

Lack of application of proper efficient and effective cost estimating tools in the Gauteng SMMEs has negatively affected the performance of the industry in Gauteng Province. Cost estimating tools predict and quantifiy costs, and prices the required resources of activities or projects. It entails the application of techniques that convert technical and programmed information of a project into financial and resource information. The estimating outputs are used for planning, cost analysis and project scheduling, and cost controlling purposes (Cleopatra Enterprises, 2020; Ibadov & Kulejewski, 2019). Cost estimating involves developing an approximation of the cost of the resources needed to complete project activities. These help in carrying out the cost accounting function. Cost accounting, as the name implies, is primarily concerned with the determination of the cost of something, which may be a product, service, process, or operation, according to the costing objective of management (Drury, 2014).

Cost budgeting is an estimating sub-process designed to allocate estimated resource costs into cost accounts. It is the baseline for cost control. Budgets are aligned to the schedule in order to address budget and cashflow limitations (Cleopatra Enterprises, 2020; Ibadov & Kulejewski, 2019).

Resource planning entails the identification of resources that are needed by the organisation or the project for future use. Evaluation and planning of the physical such as the human resource base, the financial base, and information resources needed to accomplish the work-based activities and tasks,is attended to at this stage. Most of the activities are performed by people, while other activities are done through engineering or software

designs (Cleopatra Enterprises, 2020). There is a need to put preventive measures in place during the project resource planning stage to ensure that overrun factors arising are meticulously dealt with (Olawale & Sun, 2010). This measure is applied at the project resource planning stage.

The SMME construction industry is experiencing huge cost overruns. These do not just occur and is in line with empirical evidence that supports that there are a number of factors during the construction process, which if not managed properly, can lead to cost overruns (Mukuka et al., 2015). Project cost overrun is the most common problem in the construction industry. Project overruns occur due to time and cost constraints that result in delays during project execution. In developing countries project overruns are serious where implementations of projects face many uncertainties. It results in wastage of scarce financial resources, delays in providing facilities, interruptions in development and makes construction costlier(Tejalelet al., 2015).This trend of overruns in construction projects has become a global concern; it has negative impacts on the low- or middle-class in achieving their basic needs, like housing (Memon & Rahman, 2014).Major causes of cost overruns identified in this study were improper planning and scheduling, and inaccurate time and cost estimate of projects (Gunduz & Maki, 2017).

Empirical evidence derived from the quantitative data reflected the major areas of weaknesses affecting the SMME construction industries in Gauteng Province as inability to apply cost control tools and techniques, cost estimating tools, cost budgeting tools and techniques, resource planning tools and techniques, cost management practices ana Inability to impress effective cost budgeting tools and techniques. The qualitative data results also confirmed the findings from the quantitative data.

Most of the SMMEs in the Gauteng construction industry are not pleased with their average turnover for the past three years as reflected by the quantitative data. Only 3% of the institutions had an average turnover of R51 million and above, 26% had an average turnover of between R25, 5

million to R50 million. The remaining 71% had an average turnover between R151 000 to R25 million. The results reflect that the organisations are not doing very well bearing in mind the heavy construction costs that are associated to the industry. The average percentage profits are wiped out by the cost overruns, with only 10% of the construction SMMEs realising profits ranging from 16-20% for the past three years. Most of the respondents constituting 90% have realised profits ranging from less than 5% to 15% for the past three years which is not good enough. Performance results such as return on investments, cashflows, operating profit, sales growth rate and the market share as well as investments was not at all important due to lack of resources to sustain the industry. Most of the companies were not able to break-even. The performance evaluation results were not satisfactory at all.

The quantitative results reflected differently from the BOQ qualitative analysis in terms of the areas that have the most cost overruns. The respondents ranked the cost overruns from one to five, with five being the highest cost overrun area. Masonry was ranked five, followed by concrete framework and reinforcement, ranked four, preliminary works came next with a ranking of three, followed by roof covering ranked two,and external works with the lowest cost overrun ranked one. The BOQ analysis results however, reflected that masonry contributed 28 per cent to the cost overruns, followed by tiling with 15 per cent and external works with 12 per cent of the cost overrun contribution. Concrete framework and reinforcement contributed 11 per cent to the cost overruns, earthworks nine per cent, carpentry and joinery eight per cent, and plumbing and drainage contributed six per cent to the cost overruns. Preliminaries had a five per cent contribution to the cost overruns, followed by structural steel works with four per cent and electrical works with two per cent of the cost overrun contributions.

5.5.2 Objective 2

- To determine the areas, per trade, where most variances arise on building projects of SMME construction firms in Gauteng.

Empirical evidence obtained in the study indicated that the project managers in the SMME construction sub-sector were not effectively applying the cost management practices on projects. The BOQ analysis reflected that the main areas affected by cost overruns were masonry, tiling, external works, concrete framework and reinforcement, earthworks, carpentry and joinery, plumbing and drainage, preliminaries, structural steel works, and electrical works. However, this reduced the profitability of the businesses because of uncontrolled costs. This was witnessed by the fact that most of the respondents were dissatisfied with the performance of their organisations. The respondents cited inaccurate or poor estimation of original costs as the major drivers to increased cost overruns. The other factors identified were construction cost underestimation, poor project management, improper planning, and lack of experience and expertise to run these construction projects. $H_o1$concluded that there were causes of cost overruns in the SMME construction sector in Gauteng.

5.6 Conclusions and Recommendations

Most of the respondents (63 per cent), viewed return on investment, cashflow projections, operating profit, sales growth rate, and market share as important. The other respondents did not regard these variables as critical, which might have contributed to the SMMEs' negative performance. Satisfaction levels were largely ignored. The respondents cited lack of the use of computerised estimating tools as a major area of concern that causes cost overruns in the SMME construction companies in Gauteng. The results reflected that inability to apply cost-estimating tools created cost overruns; the main cause of which was inaccurate or poor estimation of original costs, construction cost underestimation, inflation of project costs, poor project

management, improper planning, and lack of experience. These factors were the cost overrun drivers that SMMEs experienced in this study.

5.6.1 Objective 3

- To recommend improvements to the cost management practices of SMME construction firms in Gauteng.

Since objective sought to make recommendations, the following are made to help address the cost overrun problems at the SMME building construction sub-sector:

- It is highly recommended that cost management tools and techniques, which include planning, estimating, budgeting, financing, funding, managing, and controlling of costs be adequately practiced as this facilitates the control of cost overruns in the construction SMME organisations in Gauteng.

- The construction industry is capital intensive; however, there is a need to ensure that resources are adequately used in order for the sector to remain in business, become viable, and grow.

- Project management teams in the SMME construction sub-sector should make use of the cost estimating techniques: analogous estimates, parametric modelling, and bottom-up estimating to enable them to do accurate costing and reduce the cost overruns. The organisations can choose their preferred cost estimating techniques, and remain consistent in the use of the system, as all three techniques are equally good. The computerised tools available for use by the SMME construction companies are excel, Microsoft project, estimator 360, and pro contractor estimator. The companies can choose from these programs a system that is most suited for them to use. Consistent use of the chosen computerised tool will yield positive results in the long-term. Reduction in cost overruns will yield to a higher turnover, which will eventually lead to the high

profitability levels of the organisations. High-cost overruns are a deterrent to the SMME construction sub-sector growth as it might lead to the failure and closure of some of the organisations.

- There is a need for the SMME construction sub-sector to put cost control measures in place to enable them to take control of costs and enhance their performance in terms of sales growth, profitability, return on investment, market share, and cashflow. The available cost control techniques, from which the companies can choose are cost change control system, performance measurement, earned value management, and additional planning. All the techniques are equally good. The organisations need to be consistent in the use of the chosen technique to get good results. The main computerised tools from which the organisations can choose are excel, Microsoft project, estimator 360, and pro contractor estimator. Consistency is vital in the application of the chosen computerised tool.

- It is a requirement that these organisations embrace the cost budgeting tools and techniques. The main cost budgeting techniques available are incremental budgeting, activity-based budgeting, value proposition budgeting, and zero-based budgeting. The most suitable budgeting technique for the SMME construction sub-sector is the incremental budgeting. It is evident that they have not been operating consistently on budgets and as a result, this has contributed to the escalation of costs.

- Resource planning tools and techniques should be put in place to enhance the organisations' planning control measures. Lack of planning results in the total failure of organisations; planning should be adhered to no matter how small the organisations may be. The main resource planning techniques available are expert judgement and alternative identification. The organisations can make their choices regarding the best option that can work for their

organisations. The main computerised tools that can be used are project management, pro work flo, jira, office timeline, and hive. They can make their choices by engaging the computerised tool that is ideal for them, as the tools are all equally good.

- There is a need to embrace cost control tools and techniques, cost estimating tools and techniques, cost budgeting tools and techniques, and resource planning tools and techniques to ascertain the control of cost overruns on areas where the most cost overruns occur. There is a need to carry out monitoring and evaluation exercises constantly to ensure that these cost overruns are controlled.

5.7 Areas of Further Study

This study adopted a mixed-method research approach.

A qualitative research methodology approach would be recommendation as it affords the participants the opportunity to air their views, and the researcher to give their opinion.

A quantitative study with a larger population and sample size instead of a sample size of only 364 respondents would be recommended.

A mixed-method research methodology combining both qualitative and quantitative approaches comprising a larger population and sample sizes would be recommended as the methodology triangulates both methodologies and complements the weaknesses of each research.

A complimentary study with an increased population size and sample size and coverage would be recommended for future studies.

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APPENDIX A: QUESTIONNAIRE

An Appraisal Cost Management Tools and Techniques Used on Building Projects by SMMEs in Gauteng.

I am a final year MSc Building (Project Management) from the department of Construction Management at the University of Witwatersrand. I am undertaking a research for my dissertation which is appraisal of cost management tools and techniques used on building projects by SMMEs in Gauteng.

Your expertise in the building industry is extremely valuable in assisting me to unpack the impact of cost management tools and techniques used on building the projects by SMMEs in Gauteng.

Please don't hesitate to contact me if you have any queries regarding the survey questions. I sincerely thank your valuable time.
*Required

1. Company's main scope of service. *
Electrical
Civil
Plumbing
Mechanical
Main service (building related services)
Other:

2. What is your designation/job title? *
Architect
Quantity Surveyor
Project Manager
Company owner
Other:

3. What years of experiences of the company within the construction industry? *
Less than 3 year
3 to 5 years
5 to 10 years
Other:

4. Respondent's years of experiences in building constructions. *
Less than 3 years
3 to 5 years
5 to 10 years
Other:

5.a.Please indicate average project value of Private Building Projects your firm is involved in per year. Please average in the past 3 years(Private Building Projects). *

Less that R5million
R5million – R25million
R25million – R50million
R 50 million and above
New Construction building projects
Renovations or Additions
New Construction building projects
Renovations or Additions

5.b. Please indicate the number of private building projects your firm is involved in per year (average in the past 3 years). *

1 - 4
5 - 9
10 - 14
15 - 17
New Construction building projects
Renovations or Additions
New Construction building projects
Renovations or Additions

6.a. Please indicate average Cost Over Runs Per Private Projects.

Less than 0%
0% to less 5%
5% to 10%
Above 10%
Less that R5million
R5million – R25million
R26million – R50million
R 50 million and above
Less that R5million
R5million – R25million
R26million – R50million
R 50 million and above

If you have not done any private project state so

Your answer

6.b. Please indicate average Cost Over Runs Per Public Projects category.

Less than 0%
0% to less 5%
5% to 10%
Above 10%
Less that R5million
R5million – R25million
R26million – R50million
R 50 million and above
Less that R5million

R5million – R25million
R26million – R50million
R 50 million and above

If you have not done any private project state so

Your answer

7. Please Indicate How Important are the following Performance Evaluation in your firm? *

Not all Important
Slightly Important
Important
Moderately Important
Extremely Important
Return on Investment (ROI)
Cash Flows
Operating Profit
Sales Growth Rate
Market Share
Return on Investment (ROI)
Cash Flows
Operating Profit
Sales Growth Rate
Market Share

8. Indicate your level of satisfaction with the performance areas in your business. *

Extremely Dissatisfied
Slightly Dissatisfied
Satisfied
Moderately satisfied
Extremely Satisfied
Return on Investment
Cash flows
Operating profit
Sales growths rate
Market share
Return on Investment
Cash flows
Operating profit
Sales growths rate
Market share

9. In your projects which area has the most cost overruns? Rank your answer from 1 to 5 - 5 being the most cost overrun and 1 being the least *

1
2
3
4
5
Preliminaries
Earthworks
Concrete, formwork & reinforcement

Masonry
Waterproofing
Roof covering
Carpentry and joinery
Ceiling, partitions and access flooring
Floor covering, plastic linings, etc.
Ironmongery
Structural steelwork
Metal work
Plastering
Tiling
Plumbing and drainage
Glazing
Paintwork
External works
Expanded public works program
Electrical works
Mechanical works
Provisional sums
Preliminaries
Earthworks
Concrete, formwork & reinforcement
Masonry
Waterproofing
Roof covering
Carpentry and joinery
Ceiling, partitions and access flooring
Floor covering, plastic linings, etc.
Ironmongery
Structural steelwork
Metal work
Plastering
Tiling
Plumbing and drainage
Glazing
Paintwork
External works
Expanded public works program
Electrical works
Mechanical works
Provisional sums

10. Which of the following cost control tools and techniques do you use? *
Cost change control system (procedure and rules to introduce cost changes of the baseline to the project)
Performance measurement (compare the reported reality and the (pre)defined cost baseline)
Earned value management (Compare planned costs (Budgeted costs) against actual costs)
Additional planning (Analysis of alternative approaches or revised costs estimates)

Computerized tools
Excel

Microsoft project
Estimator 360
Pro contractor estimator
Other:

11. Which of the following cost estimating tools and technique do you use? *
Analogous estimate (compare a past similar project to your current project)
Parametric modelling (relationship between variables (a unit cost/duration and the number of units) to develop the estimate)
Bottom-up estimating (Estimating individual tasks to overall project)

Computerized tools
Excel
Microsoft project
Estimator 360
Pro contractor estimator
Other:

12. Which of the following Cost budgeting tools and techniques do you use?
Incremental budgeting (Previous budget is used as a base of current budget)
Activity-based budgeting.(Prepared using activity based costing, i.e. past year not considered)
Value proposition budgeting.(Line items on the budget must deliver value)
Zero-based budgeting. (Line item are justified for each new item, i.e. budget start from zero)

13. Which of the following resources planning tools and technique do you use? *
Expert judgment (Use of experience and knowledge to estimate costs)
Alternative identification (Scope defining and product analysis)

Project management
Pro work flow
Jira
Office timeline
Hive
Other:

14.Which of the following would best describe your business in the past 3 years? *
Growing(Consistent growth in the past 3 years)
Declining(Loss in the past 3 years)
Not stable(Both growth and decline in the past 3 years)
Stable(Breakeven in the past 3 years)

15. What was your average turnover for the past 3 years? *
Less than R150 000
R151 000 - R500 000
R2 million to R25 million
R25 million to R50 million
Greater than R50 million

16. What was your average profit as a percentage of turnover for the past 3 years? *

Less than 5%
5% to 10%
10% to 15%
15% to 20%
Over 20%

17. What are the main causes of cost overruns in your organisations? *

Inaccurate/poor estimation of original cost
Construction cost underestimation
Inflation of project costs
Poor project management
Improper planning
Lack of experience
Other:

18. How do you perceive your cost management abilities? *

Your answer

19. Where does the most variance arise per trade/main line item on the project undertaken in the building industry within the BOQ? *

Your answer

SUBMIT

APPENDIX B: INTERVIEW GUIDE

Interview Guide on an Appraisal Cost Management Tools and Techniques Used on Building Projects by SMMEs in Gauteng

1. Which cost management practices do you use in your organisation?

2. To what extend do you apply cost management practices in your organisation?

3. What are the effects of cost management practices on cost overruns as a function of performance in your organisation?

4. Which are the cost overrun drivers in your organisation?

5. What are the major factors that cause cost overruns in your organisation?

6. Which cost estimating tools do you use to control cost overruns?

7. How skilled and experienced is your project management team?

8. To what extend do you enlist the services of consultants in your organisation?

APPENDIX C: BOQ DOCUMENT ANALYSIS TEMPLATE

Table C.1 Consolidated Overruns

DESCRIPTION	Initial costs estimate	Final costs	Variance
Preliminaries	**7,536,066.21**	**7,936,429.22**	**- 400,363.01**
Buildings			
Earthworks	**1,499,248.00**	**2,229,650.00**	**- 730,402.00**
Concrete, Formwork & Reinforcement	**3,794,077.00**	**4,604,546.99**	**- 810,469.99**
Masonry	**5,246,737.86**	**7,373,723.32**	**- 2,126,985.46**
Waterproofing	**93,274.00**	**135,714.04**	**2,825.00**
Roof Coverings	**3,658,508.00**	**3,636,358.30**	**22,149.70**
Carpentry and Joinery	**4,014,261.50**	**4,582,321.40**	**- 568,059.90**
Ceilings, Partitions and Access Flooring	**3,813,303.60**	**2,995,277.31**	**670,766.69**
Floor Coverings, Plastic linings, etc.	**3,475,839.00**	**3,103,359.50**	**126,325.00**
Ironmongery	**930,292.00**	**785,339.00**	**143,847.00**
Structural Steelwork	**1,243,300.00**	**1,535,963.50**	**- 292,663.50**
Metalwork	**3,042,190.00**	**2,673,910.00**	**231,780.00**
Plastering	**2,231,094.00**	**2,049,517.48**	**- 109,594.50**
Tiling	**1,551,497.40**	**2,659,393.60**	**- 1,107,896.20**
Plumbing and Drainage	**1,891,215.03**	**2,335,543.30**	**- 444,328.27**

Glazing	**816,193.00**	**709,438.60**	**69,354.40**
Paintwork	**4,226,291.89**	**3,478,254.51**	**733,825.93**
	40,455,632.28	**44,078,120.85**	**- 154,671.79**
External Works	**5,329,674.00**	**6,256,961.49**	**- 927,287.49**
Expanded Public Works Program	**-**	**-**	**-**
Electrical Works	**12,621,442.47**	**12,775,827.07**	**- 154,384.60**
Mechanical Works	**1,099,927.00**	**1,099,927.00**	**-**
Provisional Sums	**16,927,625.00**	**12,885,573.80**	**4,042,051.20**
SUB TOTAL	**35,978,668.47**	**24,833,029.44**	**11,145,639.03**
SUB-TOTAL	**83,970,366.96**	**65,797,438.26**	**18,172,928.70**
VALUE ADDED TAX			
Provision for Value-Added Tax (VAT) at 15 percent			
TOTAL			

Table C.1BOQ 1

DESCRIPTION	Initial costs estimate	Final costs	Variance
Preliminaries	**1,500,000.00**	**1,829,863.01**	**- 329,863.01**
Buildings			
Earthworks	220,063.00	1,208,810.00	**- 988,747.00**
Concrete, Formwork & Reinforcement	1,403,985.00	1,819,415.10	**- 415,430.10**
Masonry	713,262.00	1,317,182.62	**- 603,920.62**
			-
Waterproofing	72,545.00	95,150.00	
Roof Coverings	733,495.00	733,495.00	**-**
Carpentry and Joinery	741,270.00	1,232,705.00	**- 491,435.00**
Ceilings, Partitions and Access Flooring	594,820.00	667,585.00	**- 72,765.00**
			-
Floor Coverings, Plastic linings, etc.			
Ironmongery	152,070.00	152,070.00	**-**
Structural Steelwork	820,100.00	792,600.00	**27,500.00**
Metalwork	828,740.00	721,110.00	**107,630.00**
			-
Plastering	255,850.00	246,425.00	
Tiling	697,435.00	631,360.00	**66,075.00**
Plumbing and Drainage	351,165.00	351,165.00	**-**
Glazing	23,860.00	26,980.00	**- 3,120.00**

			-
Paintwork	338,680.00	287,904.82	**50,775.18**
	7,947,340.00	**10,283,957.54**	
External Works	3,592,146.00	**4,055,851.00**	**- 463,705.00**
Expanded Public Works Program			-
Electrical Works	2,728,263.00	2,728,263.00	-
			-
Mechanical Works	1,099,927.00	1,099,927.00	
Provisional Sums	36,300.00	36,300.00	-
SUB TOTAL	7,456,636.00	7,920,341.00	**- 463,705.00**
			-
SUB-TOTAL	16,903,976.00	20,034,161.55	**- 3,130,185.55**
VALUE ADDED TAX			-
Provision for Value-Added Tax (VAT) at 15 percent			-
TOTAL			-

Table C.1BOQ 2

DESCRIPTION	Initial costs estimate	Final costs	Variance
Preliminaries	**470,000.00**	**540,500.00**	**- 70,500.00**
Buildings			
Earthworks			**-**
Concrete, Formwork & Reinforcement	140,000.00	13,790.00	**126,210.00**
Masonry	251,880.00	311,488.54	**- 59,608.54**
			-
Waterproofing	-	13,800.00	
Roof Coverings	114,000.00	114,564.30	**- 564.30**
Carpentry and Joinery	139,330.00	147,441.20	**- 8,111.20**
Ceilings, Partitions and Access Flooring	135,800.00	102,398.76	**33,401.24**
			-
Floor Coverings, Plastic linings, etc.	288,000.00	470,400.00	
Ironmongery	281,550.00	159,533.00	**122,017.00**
Structural Steelwork			**-**
Metalwork	81,400.00	22,800.00	**58,600.00**
			-
Plastering	57,400.00	45,536.00	
Tiling	318,950.00	593,652.50	**- 274,702.50**
Plumbing and Drainage	81,600.00	495,492.80	**- 413,892.80**
Glazing	27,400.00	12,669.00	**14,731.00**

			-
Paintwork	539,100.00	521,039.02	**18,060.98**
	2,456,410.00	**3,024,605.12**	
External Works	665,712.00	**780,137.49**	**- 114,425.49**
Expanded Public Works Program			-
Electrical Works	875,663.00	873,657.00	**2,006.00**
			-
Mechanical Works			
Provisional Sums	936,125.00	464,131.25	**471,993.75**
SUB TOTAL	2,477,500.00	2,117,925.74	**359,574.26**
			-
SUB-TOTAL	5,403,910.00	5,683,030.86	**- 279,120.86**
VALUE ADDED TAX			-
Provision for Value-Added Tax (VAT) at 15 percent			-
TOTAL			-

Table C.1BOQ 3

DESCRIPTION	Initial costs estimate	Final costs	Variance
Preliminaries	**320,000.00**	**320,000.00**	**-**
Buildings			
Earthworks	1,239,340.00	999,100.00	**240,240.00**
Concrete, Formwork & Reinforcement	394,990.00	415,150.00	**- 20,160.00**
Masonry			**-**
			-
Waterproofing			
Roof Coverings			**-**
Carpentry and Joinery			**-**
Ceilings, Partitions and Access Flooring			**-**
			-
Floor Coverings, Plastic linings, etc.			
Ironmongery			**-**
Structural Steelwork			**-**
Metalwork			**-**
			-
Plastering			
Tiling			**-**
Plumbing and Drainage			**-**
Glazing			**-**

			-
Paintwork			-
	1,634,330.00	**1,414,250.00**	
External Works	445,236.00	**607,353.00**	**- 162,117.00**
Expanded Public Works Program			-
Electrical Works			-
			-
Mechanical Works			
Provisional Sums	110,400.00	85,100.00	**25,300.00**
SUB TOTAL	555,636.00	692,453.00	**- 136,817.00**
			-
SUB-TOTAL	2,509,966.00	2,426,703.00	**83,263.00**
VALUE ADDED TAX			-
Provision for Value-Added Tax (VAT) at 15 percent			-
TOTAL			-

Table C.1BOQ 4

DESCRIPTION	Initial costs estimate	Final costs	Variance
Preliminaries	**1,527,924.95**	**1,527,924.95**	**-**
Buildings			
Earthworks			**-**
Concrete, Formwork & Reinforcement	1,297,720.00	1,956,219.89	**- 658,499.89**
Masonry	2,460,925.00	4,106,192.16	**- 1,645,267.16**
			-
Waterproofing	14,659.00	23,519.04	
Roof Coverings	798,780.00	829,955.00	**- 31,175.00**
Carpentry and Joinery	1,459,916.10	1,360,202.50	**99,713.60**
Ceilings, Partitions and Access Flooring	1,137,500.00	601,694.55	**535,805.45**
			-
Floor Coverings, Plastic linings, etc.	757,260.00	512,350.50	
Ironmongery	37,080.00	38,720.00	**- 1,640.00**
Structural Steelwork	423,200.00	743,363.50	**- 320,163.50**
Metalwork	419,750.00	462,000.00	**- 42,250.00**
			-
Plastering	660,760.00	444,167.98	
Tiling	23,220.00	256,343.30	**- 233,123.30**
Plumbing and Drainage	299,522.03	317,932.00	**- 18,409.97**
Glazing	39,920.00	60,869.60	**- 20,949.60**

			-
Paintwork	885,234.69	401,350.92	**483,883.77**
	10,715,446.82	**12,114,880.94**	
External Works	453,440.00	**453,440.00**	-
Expanded Public Works Program			-
Electrical Works	2,975,533.67	3,188,656.07	- **213,122.40**
			-
Mechanical Works			
Provisional Sums	1,939,000.00	2,071,000.00	- **132,000.00**
SUB TOTAL	5,367,973.67	5,713,096.07	- **345,122.40**
			-
SUB-TOTAL	17,611,345.44	19,355,901.96	- **1,744,556.52**
VALUE ADDED TAX			-
Provision for Value-Added Tax (VAT) at 15 percent			-
TOTAL			-

Table C.1BOQ 5

DESCRIPTION	Initial costs estimate	Final costs	Variance
Preliminaries	**172,296.83**	**172,296.83**	**-**
Buildings			
Earthworks			**-**
Concrete, Formwork & Reinforcement			**-**
Masonry	99,625.00	87,570.00	**12,055.00**
			-
Waterproofing			
Roof Coverings			**-**
Carpentry and Joinery	11,310.00	19,140.00	**- 7,830.00**
Ceilings, Partitions and Access Flooring	41,740.00	15,530.00	**26,210.00**
			-
Floor Coverings, Plastic linings, etc.			
Ironmongery	30,540.00	25,680.00	**4,860.00**
Structural Steelwork			**-**
Metalwork	36,550.00	40,400.00	**- 3,850.00**
			-
Plastering	50,890.00	24,245.00	
Tiling	76,345.00	20,325.00	**56,020.00**
Plumbing and Drainage	62,905.00	81,165.00	**- 18,260.00**
Glazing	450.00	2,700.00	**- 2,250.00**

			-
Paintwork	125,490.00	88,340.00	**37,150.00**
External Works		**116,020.00**	**- 116,020.00**
Expanded Public Works Program			-
Electrical Works			-
			-
Mechanical Works			
Provisional Sums	924,500.00	1,164,129.21	**- 239,629.21**
SUB TOTAL	924,500.00	1,280,149.21	**- 355,649.21**
			-
SUB-TOTAL	1,096,796.83	1,452,446.04	**- 355,649.21**
VALUE ADDED TAX			-
Provision for Value-Added Tax (VAT) at 15 percent			-
TOTAL			-

Table C.1BOQ 6

DESCRIPTION	Initial costs estimate	Final costs	Variance
Preliminaries	**172,296.83**	**172,296.83**	**-**
Buildings			
Earthworks			**-**
Concrete, Formwork & Reinforcement			**-**
Masonry	99,625.00	87,570.00	**12,055.00**
			-
Waterproofing			
Roof Coverings			**-**
Carpentry and Joinery	11,310.00	19,140.00	**- 7,830.00**
Ceilings, Partitions and Access Flooring	41,740.00	15,530.00	**26,210.00**
			-
Floor Coverings, Plastic linings, etc.			
Ironmongery	30,540.00	25,680.00	**4,860.00**
Structural Steelwork			**-**
Metalwork	36,550.00	40,400.00	**- 3,850.00**
			-
Plastering	50,890.00	24,245.00	
Tiling	76,345.00	20,325.00	**56,020.00**
Plumbing and Drainage	62,905.00	81,165.00	**- 18,260.00**
Glazing	450.00	2,700.00	**- 2,250.00**

			-
Paintwork	125,490.00	88,340.00	**37,150.00**
External Works		**116,020.00**	**- 116,020.00**
Expanded Public Works Program			-
Electrical Works			-
			-
Mechanical Works			
Provisional Sums	924,500.00	1,164,129.21	**- 239,629.21**
SUB TOTAL	924,500.00	1,280,149.21	**- 355,649.21**
			-
SUB-TOTAL	1,096,796.83	1,452,446.04	**- 355,649.21**
VALUE ADDED TAX			-
Provision for Value-Added Tax (VAT) at 15 percent			-
TOTAL			-

Table C.1BOQ 7

DESCRIPTION	Initial costs estimate	Final costs	Variance
Preliminaries	**189,257.60**	**189,257.60**	**-**
Buildings			
Earthworks	39,845.00	21,740.00	**18,105.00**
	-	-	**-**
Concrete, Formwork & Reinforcement	58,670.00	85,520.00	**- 26,850.00**
Masonry	138,558.00	126,297.00	**12,261.00**
			-
Waterproofing	6,070.00	3,245.00	**2,825.00**
Roof Coverings	69,680.00	33,900.00	**35,780.00**
			-
Carpentry and Joinery	73,140.00	46,170.00	**26,970.00**
Ceilings, Partitions and Access Flooring	17,180.00	5,540.00	**11,640.00**
			-
Floor Coverings, Plastic linings, etc.	-	-	
Ironmongery	25,900.00	6,750.00	**19,150.00**
			-
Structural Steelwork			
Metalwork	39,800.00	12,800.00	**27,000.00**
			-
Plastering	27,375.00	22,135.00	**5,240.00**
Tiling	59,940.00	44,600.00	**15,340.00**
			-
Plumbing and Drainage	93,982.00	83,787.00	**10,195.00**
Glazing	1,000.00	500.00	**500.00**

			-
Paintwork	54,196.00	55,030.00	- **834.00**
	705,336.00	**548,014.00**	
External Works	173,140.00	128,140.00	**45,000.00**
Expanded Public Works Program			-
Electrical Works			-
Mechanical Works			-
			-
Provisional Sums	1,073,500.00	874,654.41	**198,845.59**
SUB TOTAL	1,246,640.00	1,002,794.41	**243,845.59**
			-
SUB-TOTAL	2,141,233.60	1,740,066.01	**401,167.59**
VALUE ADDED TAX			-
Provision for Value-Added Tax (VAT) at 15 percent			-
TOTAL			-

Table C.1BOQ 8

DESCRIPTION	Initial costs estimate	Final costs	Variance
Preliminaries	**1,461,290.00**	**1,461,290.00**	**-**
Buildings			
Earthworks	-	-	**-**
Concrete, Formwork & Reinforcement	498,712.00	314,452.00	**184,260.00**
Masonry	762,827.86	766,153.00	**- 3,325.14**
Waterproofing	-	-	**-**
Roof Coverings	1,942,553.00	1,924,444.00	**18,109.00**
Carpentry and Joinery	649,755.40	676,017.70	**- 26,262.30**
			-
Ceilings, Partitions and Access Flooring	386,493.60	380,894.00	
			-
Floor Coverings, Plastic linings, etc.	789,169.00	764,449.00	
			-
Ironmongery	119,172.00	118,066.00	
			-
Structural Steelwork			
			-
Metalwork			**-**
Plastering	560,119.00	786,259.50	**- 226,140.50**
Tiling	299,262.40	1,092,787.80	**- 793,525.40**
Plumbing and Drainage	939,136.00	924,836.50	**14,299.50**
Glazing	199,513.00	193,320.00	**6,193.00**

			-
Paintwork	1,668,095.20	1,647,171.75	
	8,814,808.46	**9,588,851.25**	**- 774,042.79**
External Works			-
Expanded Public Works Program			-
Electrical Works	6,041,982.80	5,985,251.00	**56,731.80**
Mechanical Works			-
			-
Provisional Sums	2,684,100.00	2,200,008.92	**484,091.08**
SUB TOTAL	8,726,082.80		**8,726,082.80**
			-
SUB-TOTAL	19,002,181.26		**19,002,181.26**
VALUE ADDED TAX			-
Provision for Value-Added Tax (VAT) at 15 percent			-
TOTAL			-

Table C.1BOQ 9

DESCRIPTION	Initial costs estimate	Final costs	Variance
Preliminaries	**861,500.00**	**861,500.00**	**-**
Buildings			
Earthworks	-	-	**-**
	-	-	
Concrete, Formwork & Reinforcement			**-**
Masonry	286,880.00	235,145.00	**51,735.00**
Waterproofing	-	-	**-**
Roof Coverings			**-**
Carpentry and Joinery	469,065.00	529,545.00	**- 60,480.00**
Ceilings, Partitions and Access Flooring	720,465.00	578,805.00	
Floor Coverings, Plastic linings, etc.	808,480.00	649,555.00	
Ironmongery	141,840.00	141,840.00	
Structural Steelwork			
Metalwork	795,560.00	659,060.00	
Plastering			
Tiling			
Plumbing and Drainage			
Glazing	181,900.00	144,500.00	

Paintwork	241,156.00	247,868.00	
	3,645,346.00	**3,186,318.00**	
External Works			
Expanded Public Works Program			**-**
Electrical Works			**-**
Mechanical Works			**-**
			-
Provisional Sums	4,149,600.00	2,414,854.00	**1,734,746.00**
SUB TOTAL	4,149,600.00	2,414,854.00	**1,734,746.00**
			-
SUB-TOTAL	8,656,446.00	6,462,672.00	**2,193,774.00**
VALUE ADDED TAX			**-**
Provision for Value-Added Tax (VAT) at 15 percent			**-**
TOTAL			**-**

Table C.1BOQ 10

DESCRIPTION	Initial costs estimate	Final costs	Variance
Preliminaries	**861,500.00**	**861,500.00**	**-**
Buildings			
Earthworks	-	-	**-**
	-	-	
Concrete, Formwork & Reinforcement			**-**
Masonry	433,155.00	336,125.00	**97,030.00**
Waterproofing	-	-	**-**
Roof Coverings			**-**
Carpentry and Joinery	459,165.00	551,960.00	**- 92,795.00**
Ceilings, Partitions and Access Flooring	737,565.00	627,300.00	**110,265.00**
Floor Coverings, Plastic linings, etc.	832,930.00	706,605.00	**126,325.00**
Ironmongery	111,600.00	117,000.00	**- 5,400.00**
Structural Steelwork	-	-	**-**
Metalwork	803,840.00	715,340.00	**88,500.00**
Plastering	567,810.00	456,504.00	**111,306.00**
Tiling	-	-	**-**
Plumbing and Drainage	-	-	**-**
Glazing	341,700.00	265,200.00	**76,500.00**

Paintwork	248,850.00	141,210.00	**107,640.00**
	4,536,615.00	3,917,244.00	619,371.00
External Works			**-**
Expanded Public Works Program			**-**
Electrical Works			**-**
Mechanical Works			**-**
			-
Provisional Sums	4,149,600.00	2,411,266.80	**1,738,333.20**
SUB TOTAL	4,149,600.00	2,411,266.80	**1,738,333.20**
			-
SUB-TOTAL	9,547,715.00	7,190,010.80	**2,357,704.20**
VALUE ADDED TAX			**-**
Provision for Value-Added Tax (VAT) at 15 percent			**-**
TOTAL			**-**

AAPENDIX D: FREQUENCY ANALYSIS:TABLE D.1 NORMALITY TEST

Companymainscope

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	electrical	55	18.0	18.0	18.0
	civil	73	23.9	23.9	42.0
	plumbing	119	39.0	39.0	81.0
	mechanical	58	19.0	19.0	100.0
	Total	305	100.0	100.0	

Job title

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	architect	67	22.0	22.0	22.0
	quantity surveyor	34	11.1	11.1	33.1
	project manager	180	59.0	59.0	92.1
	company manager	24	7.9	7.9	100.0
	Total	305	100.0	100.0	

Companyexperienceinconstructionindustry

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 3 years	52	17.0	17.0	17.0
	3 -5 years	149	48.9	48.9	65.9
	6-10 years	104	34.1	34.1	100.0
	Total	305	100.0	100.0	

Yourworkexperience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-5 years	50	16.4	16.4	16.4
	6-10 years	149	48.9	48.9	65.2
	11-15 years	106	34.8	34.8	100.0
	Total	305	100.0	100.0	

Averageprojectvalueprivatenewconstruction

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than R5 million	76	24.9	24.9	24.9
	R5 million-R25million	214	70.2	70.2	95.1
	R25 million-R50 million	15	4.9	4.9	100.0
	Total	305	100.0	100.0	

Averageprojectvalueprivate renovations additions

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than R5 million	61	20.0	20.0	20.0
	R5 million-R25 million	244	80.0	80.0	100.0
	Total	305	100.0	100.0	

Privatebuildingprojectsnewconstructions

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-4	85	27.9	27.9	27.9
	5-9	153	50.2	50.2	78.0
	10-14	37	12.1	12.1	90.2
	15-17	30	9.8	9.8	100.0
	Total	305	100.0	100.0	

Privatebuildingprojects renovations andadditions

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-4	91	29.8	29.8	29.8
	5-9	214	70.2	70.2	100.0
	Total	305	100.0	100.0	

Table D.1 Cost overruns frequencies

Costoverrunslessthanfivemillion

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 0%	24	7.9	7.9	7.9
	0%-less than 5%	15	4.9	4.9	12.8
	5% -10%	116	38.0	38.0	50.8
	above 10%	150	49.2	49.2	100.0
	Total	305	100.0	100.0	

Costoverrunssixtotwenty-fivemillion

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 0%	13	4.3	4.3	4.3
	0%-less than 5%	25	8.2	8.2	12.5
	5%-10%	114	37.4	37.4	49.8
	above 10%	153	50.2	50.2	100.0
	Total	305	100.0	100.0	

Costoverrunstwenty-sixtofiftymillion

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 0%	9	3.0	3.0	3.0
	0-less than 5%	30	9.8	9.8	12.8
	5-10%	69	22.6	22.6	35.4
	above 10%	197	64.6	64.6	100.0
	Total	305	100.0	100.0	

Cost overrunsabovefiftymillion

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 0%	12	3.9	3.9	3.9
	0-less than 5%	9	3.0	3.0	6.9
	5-10%	63	20.7	20.7	27.5
	above 10%	221	72.5	72.5	100.0

Total	305	100.0	100.0	

Table D.1 Average cost overruns frequencies

Averagecostoverrunslessthanfivemillion

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 0%	18	5.9	5.9	5.9
	0-less than 5%	12	3.9	3.9	9.8
	5-10%	114	37.4	37.4	47.2
	above 10%	161	52.8	52.8	100.0
	Total	305	100.0	100.0	

Averagecostoverrunfivetotwenty-fivemillion

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 0%	9	3.0	3.0	3.0
	0- less than 5%	24	7.9	7.9	10.8
	5-10%	114	37.4	37.4	48.2
	above 10%	158	51.8	51.8	100.0
	Total	305	100.0	100.0	

Averagecostoverrunstwenty-sixtofiftymillion

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 0%	9	3.0	3.0	3.0
	0-less than 5%	30	9.8	9.8	12.8
	5-10%	69	22.6	22.6	35.4
	above 10%	197	64.6	64.6	100.0
	Total	305	100.0	100.0	

Averagecostoverrunsabovefiftymillion

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 0%	12	3.9	3.9	3.9
	0-less 5%	9	3.0	3.0	6.9
	5-10%	63	20.7	20.7	27.5
	above 10%	221	72.5	72.5	100.0
	Total	305	100.0	100.0	

Table D.1 Performance evaluation frequencies

Performanceevaluationreturnoninvestments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	not at all important	31	10.2	10.2	10.2
	slightly important	37	12.1	12.1	22.3
	important	192	63.0	63.0	85.2
	moderately important	45	14.8	14.8	100.0
	Total	305	100.0	100.0	

Performanceevaluationcashflows

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	not at all important	27	8.9	8.9	8.9
	slightly important	46	15.1	15.1	23.9
	important	198	64.9	64.9	88.9
	moderately important	34	11.1	11.1	100.0
	Total	305	100.0	100.0	

Performanceevaluationoperatingprofit

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	not at all important	35	11.5	11.5	11.5
	slightly important	28	9.2	9.2	20.7
	important	195	63.9	63.9	84.6
	moderately important	47	15.4	15.4	100.0
	Total	305	100.0	100.0	

Performanceevaluationsalesgrowthrate

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	not at all important	31	10.2	10.2	10.2
	slightly important	32	10.5	10.5	20.7
	important	172	56.4	56.4	77.0
	moderately important	41	13.4	13.4	90.5
	extremely important	29	9.5	9.5	100.0
	Total	305	100.0	100.0	

Performance evaluation marketshare

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	not at all important	24	7.9	7.9	7.9
	slightly important	26	8.5	8.5	16.4
	important	202	66.2	66.2	82.6
	moderately important	53	17.4	17.4	100.0
	Total	305	100.0	100.0	

Table D.1 Level of satisfaction frequencies

Levelofsatisfactionreturnoninvestments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	extremely dissatisfied	40	13.1	13.1	13.1
	slightly dissatisfied	67	22.0	22.0	35.1
	satisfied	60	19.7	19.7	54.8
	moderately satisfied	40	13.1	13.1	67.9
	extremely satisfied	98	32.1	32.1	100.0
	Total	305	100.0	100.0	

Levelofsatisfactioncashflows

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	extremely dissatisfied	40	13.1	13.1	13.1
	slightly dissatisfied	58	19.0	19.0	32.1
	satisfied	78	25.6	25.6	57.7
	moderately satisfied	40	13.1	13.1	70.8
	extremely satisfied	89	29.2	29.2	100.0
	Total	305	100.0	100.0	

Level of satisfactionoperatingprofit

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	extremely dissatisfied	36	11.8	11.8	11.8
	slightly dissatisfied	77	25.2	25.2	37.0
	satisfied	66	21.6	21.6	58.7
	moderately satisfied	34	11.1	11.1	69.8
	extremely satisfied	92	30.2	30.2	100.0
	Total	305	100.0	100.0	

Levelofsatisfactionsalesgrowth

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	extremely dissatisfied	40	13.1	13.1	13.1
	slightly dissatisfied	71	23.3	23.3	36.4
	satisfied	47	15.4	15.4	51.8
	moderately satisfied	44	14.4	14.4	66.2
	extremely satisfied	103	33.8	33.8	100.0
	Total	305	100.0	100.0	

Levelofsatisfactionmarketshare

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	extremely dissatisfied	44	14.4	14.4	14.4
	slightly dissatisfied	69	22.6	22.6	37.0
	satisfied	64	21.0	21.0	58.0
	moderately satisfied	45	14.8	14.8	72.8
	extremely satisfied	83	27.2	27.2	100.0
	Total	305	100.0	100.0	

Table D.1 Area with the most cost overrun frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	preliminaries	30	9.8	9.8	9.8
	earthworks	18	5.9	5.9	15.7
	concrete, framework & reinforcement	35	11.5	11.5	27.2
	masonry	40	13.1	13.1	40.3
	waterproofing	17	5.6	5.6	45.9
	roof covering	25	8.2	8.2	54.1
	carpentry & Joinery	13	4.3	4.3	58.4
	ceiling, partitions & access flooring	16	5.2	5.2	63.6
	floor covering, plastic lining etc.	7	2.3	2.3	65.9
	ironmongery	3	1.0	1.0	66.9
	structural steel works	4	1.3	1.3	68.2
	metal works	5	1.6	1.6	69.8
	plastering	6	2.0	2.0	71.8
	tilling	9	3.0	3.0	74.8
	plumbing & drainage	11	3.6	3.6	78.4
	glazing	12	3.9	3.9	82.3
	paintwork	8	2.6	2.6	84.9
	external works	21	6.9	6.9	91.8
	electrical works	10	3.3	3.3	95.1
	mechanical works	15	4.9	4.9	100.0
	Total	305	100.0	100.0	

Table D.1 Cost control tools and techniques frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	cost change control	20	6.6	6.6	6.6
	performance measurement	10	3.3	3.3	9.8
	earned value management	40	13.1	13.1	23.0
	additional planning	15	4.9	4.9	27.9
	excel	187	61.3	61.3	89.2
	Microsoft project	5	1.6	1.6	90.8
	estimator 360	8	2.6	2.6	93.4
	pro contractor estimator	6	2.0	2.0	95.4
	other	14	4.6	4.6	100.0
	Total	305	100.0	100.0	

Table D.1 Cost estimating tools and techniques frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	analogous estimate	12	3.9	3.9	3.9
	parametric modelling	20	6.6	6.6	10.5
	bottom-up estimating	22	7.2	7.2	17.7
	excel	212	69.5	69.5	87.2
	Microsoft project	12	3.9	3.9	91.1
	estimator 360	8	2.6	2.6	93.8
	pro contractor estimator	9	3.0	3.0	96.7
	other	10	3.3	3.3	100.0
	Total	305	100.0	100.0	

Table D.1 Cost budgeting tools and techniques frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	incremental budgeting	214	70.2	70.2	70.2
	activity based budgeting	40	13.1	13.1	83.3
	value proposition budgeting	36	11.8	11.8	95.1
	zero based budgeting	15	4.9	4.9	100.0
	Total	305	100.0	100.0	

Table D.1 Resource planning tools and techniques frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	expert judgment	20	6.6	6.6	6.6
	alternative identification	15	4.9	4.9	11.5
	pro work flo	23	7.5	7.5	19.0
	jira	17	5.6	5.6	24.6
	office timeline	13	4.3	4.3	28.9
	hive	20	6.6	6.6	35.4
	excel	197	64.6	64.6	100.0
	Total	305	100.0	100.0	

Table D.1 Business description frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	growing	31	10.2	10.2	10.2
	declining	15	4.9	4.9	15.1
	not stable	214	70.2	70.2	85.2
	stable	45	14.8	14.8	100.0
	Total	305	100.0	100.0	

Table D.1 Average turnover frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	R151 00-500 000	3	1.0	1.0	1.0
	R2 000 000- 25 000 000	214	70.2	70.2	71.1
	R26 000 000- 50 000 000	79	25.9	25.9	97.0
	R51 000 000+	9	3.0	3.0	100.0
	Total	305	100.0	100.0	

Table D.1Average percentage profit frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 5%	58	19.0	19.0	19.0
	5-10%	173	56.7	56.7	75.7
	10-15%	30	9.8	9.8	85.6
	15-20%	32	10.5	10.5	96.1
	21% and above	12	3.9	3.9	100.0
	Total	305	100.0	100.0	

Table D.1 Main causes of cost overrun frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	inaccurate/poor estimation of original cost	107	35.1	35.1	35.1
	Construction cost underestimation	76	24.9	24.9	60.0
	poor project management	76	24.9	24.9	84.9
	improper planning	46	15.1	15.1	100.0
	Total	305	100.0	100.0	