

**Evaluating the use of Project Management
Techniques in Infrastructure Delivery by
South African Small and Medium sized
contractors.**

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2006

Evaluating the use of Project Management Techniques in Infrastructure Delivery by South African Small and Medium sized contractors.

by

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A DISSERTATION

submitted in fulfillment
of the requirements for the Degree

MAGISTER TECHNOLOGIAE

in

CONSTRUCTION MANAGEMENT

in the

FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT

at the

UNIVERSITY OF JOHANNESBURG

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JANUARY 2006

Abstract

South Africa is currently faced with the challenge of reducing the huge backlog of infrastructure delivery to communities that were previously disadvantaged. Given the prioritization of empowerment by the South African government, the previously disadvantaged and marginalized sector of the construction industry that comprises mainly, Small and Medium Enterprises (SMEs) is the preferred vehicle of delivery. However, consequent to their historic position outside of the mainstream construction industry, they lack the requisite project management expertise and experience to make good on this objective.

This study investigates the characteristics of the personnel managing SMEs and the SMEs themselves, the usage, necessity, importance and adequate use of the techniques, effectiveness and potential applicability of various project management techniques to improve the performance of the SMEs in delivering the much-needed infrastructure. The study also identifies those external and internal factors that are detrimental to the effective implementation of project management techniques.

Given the aforementioned, a descriptive survey was conducted among contractors who were either registered members of the Gauteng Master Builders Association (GMBA) or the National Home Builders Registration Council (NHBRC) in Gauteng. The data was collected using a semi-structured, structured and open-ended interview questionnaire, and analysed using descriptive analysis, severity index and content analysis respectively.

The findings indicate that experienced and educated personnel manage SMEs. There is usage of essential project management techniques, which the contractors agreed are necessary and important in managing their projects. There is inadequate use of project management techniques among the SMEs. When used, the techniques brought about improvement in the delivery of projects. The research also established various factors that deterred the adequate implementation of project management techniques, namely, lack of adequate project information from professionals, time and financial constraints.

The research concludes by suggesting that if significant improvements in the delivery of construction projects are to be attained, the findings stated need to be taken into consideration.

Keywords: project management techniques, small and medium, infrastructure delivery

Declaration

“I declare that, apart from the acknowledged assistance, this dissertation submitted by me for the MAGISTER TECHNOLOGIAE: **Construction Management** degree to the University of Johannesburg is my own work and has not been submitted before by me for a degree at another university or higher education institution.”

Author’s signature.....Date.....

Dedication

This research project is dedicated to the fraternity of the South Africa construction industry mainly the small and medium contractors who are striving hard to ensure that there is improvement in the delivery of the much-needed infrastructure. It is hoped that the industry will utilize the outcome of this research to improve infrastructure delivery.

Acknowledgements

In completion of this research I note with great appreciation the help I received from my research Supervisor Mr. F.C. Fester who is also my academic colleague and head of department and the Co-Supervisors Prof. FAO Otieno and Mr. I.O. Adegoke, for their tireless effort to ensure that this piece of work was completed. My sincere thanks to the Department of Construction Management and Quantity Surveying (University of Johannesburg) for allowing me to use their facilities to enable me complete this research.

Last but not least, I would like to register my deep appreciation and thanks to my parents Mr. and Mrs. Otiende and my three brothers Micheal, Peter and Antony and my two sisters Winnie and Mary and friends for the moral support they bestowed on me to ensure that this piece of work becomes a great success.

Lastly, I thank the Lord for bestowing me with the desired knowledge.

Mr. Justus Ngala Agumba

2006

Table of Contents

<i>Abstract</i>	<i>i</i>
<i>Declaration</i>	<i>iii</i>
<i>Dedication</i>	<i>iv</i>
<i>Acknowledgements</i>	<i>v</i>
<i>Table of Contents</i>	<i>vi</i>
<i>List of Tables</i>	<i>ix</i>
<i>List of Abbreviations</i>	<i>xi</i>
CHAPTER 1	1
1. INTRODUCTION	1
1.1 Background and importance of the research	1
1.2 The research question	7
1.3 Research limitations	7
1.4 Outline of the research report.	8
CHAPTER 2	9
2. LITERATURE REVIEW	9
2.1 Introduction	9
2.1.1 <i>The structure of small and medium organizations globally</i>	10
2.1.2 <i>Global view of small and medium enterprises</i>	10
2.1.3 <i>The causes/factors of success and failure of small firms operating globally</i>	12
2.1.4 <i>Global view of infrastructure delivery</i>	14
2.1.5 <i>Global overview of the construction industry</i>	14
2.2 An overview of the South African economy	15
2.2.1 <i>General view of SMEs in South Africa</i>	15
2.2.2 <i>The South African construction industry environment</i>	17
2.2.2.1 <i>The structure of the construction industry in South Africa</i>	17
2.2.3 <i>Historical review of Infrastructure delivery in South Africa Construction Industry</i>	19
2.2.3.1 <i>The role of SMEs in the South Africa construction industry</i>	20
2.2.4 <i>Problems encountered by SMEs in South African construction industry</i>	21
2.3 Project Management	24
2.3.1. <i>Project management techniques</i>	30

2.3.1.1 Project management techniques used at different phases of a project	33
2.3.2 <i>Project performance measures</i>	46
2.3.2.1 Managing time	49
2.3.2.2 Managing cost	50
2.3.2.3 Managing quality	52
CHAPTER 3	56
3. RESEARCH METHODOLOGY AND DESIGN	56
3.1 Introduction	56
3.2 Selection of the research methodology	56
3.2.1 <i>Data collection method</i>	57
3.2.2 <i>Methods of collecting primary data</i>	58
3.2.3 <i>Research approach on structured interview</i>	59
3.3 The sample to be interviewed	59
3.3.1 <i>Target group</i>	60
3.3.2 <i>Sample size and method of sampling</i>	61
3.4 Pilot Survey	62
3.5 Classification of the collected data	64
3.5.1 <i>Classification according to attributes</i>	64
3.5.2 <i>Classification according to class-intervals</i>	65
3.6 Methods used to analyze the data obtained from the research	65
3.6.1 <i>Descriptive analysis</i>	65
3.6.2 <i>Severity index</i>	66
3.6.3 <i>Content analysis</i>	68
CHAPTER 4	69
4. ANALYSIS OF THE DATA	69
4.1 Introduction	69
4.2 Semi-structured questionnaire analysis	69
4.3 Structured interview questionnaire analysis	80
4.4 Open-ended interview questionnaire analysis	104
CHAPTER 5	122
5. INTERPRETATION OF THE ANALYZED DATA	122
5.1 Characteristics and background of the contractors	122
5.2 Use of project management techniques by SMEs on construction projects	123
5.3 Effectiveness of project management techniques in delivering projects among SME construction companies	126

5.4 Internal and external factors hindering implementation of project management techniques.	128
CHAPTER 6	129
6. FINDINGS AND RECOMMENDATIONS	129
6.1 Findings	129
6.2 Areas recommended for further research	131
REFERENCES	132
Appendix A	141
<i>Letter of Introduction</i>	141
Appendix B	142
<i>Questionnaire interview for pilot survey</i>	142
ANALYSIS OF PILOT SURVEY DATA	146
<i>Semi-structured questionnaire</i>	146
<i>Open-ended interview</i>	149
INTERPRETATION OF THE PILOT SURVEY DATA	151
Objective one	151
Objective two	154
Objective three	155
Appendix C	156
<i>Questionnaire interview for the research project</i>	156
Semi-structured questionnaire	156
Structured interview	158
Open-ended interviews	162

List of Tables

<i>Table 3.3.1 Statistics of contractors</i>	60
<i>Table 4.2.1. Titles of personnel responsible for planning</i>	69
<i>Table 4.2.2 Nature of business conducted by the SMEs (contractors)</i>	70
<i>Table 4.2.3 The range of annual turnover of the different SMEs' (contractors) interviewed</i>	71
<i>Table 4.2.4 Number of permanent employees in respondent companies</i>	72
<i>Table 4.2.5a Number of projects completed by the contractors in the last 3 years.</i> ..	73
<i>Table 4.2.5b Approximate value of the largest project completed in the last three years</i>	74
<i>Table 4.2.6 Average value of the current projects</i>	75
<i>Table 4.2.7 Number of projects the contractors are engaged in at present.</i>	76
<i>Table 4.2.8 Job titles of the personnel interviewed.</i>	76
<i>Table 4.2.9 Years of experience of the personnel interviewed.</i>	77
<i>Table 4.2.10 Level of education at qualification of the personnel interviewed</i>	78
<i>Table 4.2.11 Years of experience of the personnel interviewed in the construction industry.</i>	79
<i>Table 4.2.12 Attendance of management courses by the personnel.</i>	80
<i>Table 4.3.1 Necessity of using project management.</i>	82
<i>Table 4.3.2 Necessity of using project management techniques.</i>	83
<i>Table 4.3.3 The need to manage construction projects in stages/phases</i>	83
<i>Table 4.3.4 Project management life cycle for SMEs projects</i>	84
<i>Table 4.3.5 Use of project management techniques during the project management phases.</i>	84
<i>Table 4.3.6 Project management techniques used during the initiation phase</i>	85
<i>Table 4.3.7 Project management techniques used during the design/planning phase.</i>	86
<i>Table 4.3.8 Project management techniques used during the construction phase.</i> ..	88
<i>Table 4.3.9 Project management techniques used during the handover/closeout phase.</i>	90
<i>Table 4.3.10 Necessary project management techniques for projects undertaken by SMEs</i>	92

<i>Table 4.3.11 Important project management techniques for projects undertaken by SMEs.</i>	<i>96</i>
<i>Table 4.3.12 Project management techniques adequately used by SMEs.</i>	<i>100</i>
<i>Table 4.4.1 Project management techniques for managing time.....</i>	<i>105</i>
<i>Table 4.4.2 Project management techniques for managing cost.....</i>	<i>109</i>
<i>Table 4.4.3 Project management techniques for managing quality</i>	<i>112</i>
<i>Table 4.4.4 Factors hindering the implementation of project management techniques.</i>	<i>118</i>

List of Abbreviations

CCs	Closed Corporations
CBS	Cost Breakdown Structure
CBE	Council for the Built Environment
CETA	Construction Education Training Authority
CI	Construction Industry
CIDB	Construction Industry Development Board
CPM	Critical path method
DoF	Department of Finance
DoH	Department of Housing
DPW&T	Department of Public Works and Transport
DTI	Department of Trade and Industry
DWAF	Department of Water Affairs and Forestry
DBSA	Development Bank of Southern Africa
EUR	Euro (currency)
GDFI	Gross Domestic Fixed Investment
GDP	Gross Domestic Product
GMBA	Gauteng Master Builder Association
ICIOB	Incorporate chartered Institute of Building
LOSC's	Labour Only Subcontractors
MBSA	Master Builders South Africa
NAS	Network Analysis System
NASA	National Aeronautical Space Administration
NHBRC	National Home Builders Registration Council
OBS	Organizational Breakdown Structure
OECD	Organization for Economic Co-operation and Development
PERT	Program Evaluation and Review Technique
PMI	Project Management Institute
PMT	Project Management Techniques
Pty Ltds	Private companies
QA	Quality Assurance
SAFCEC	South Africa Federation of Civil Engineering Contractors
SAPOA	South Africa Property Owners Association
SME	Small and Medium Enterprises
SMME	Small Medium and Micro Enterprises
StatsSA	Statistics South Africa
US	United States
WBS	Work Breakdown Structure

CHAPTER 1

1. INTRODUCTION

1.1 Background and importance of the research

Sustainable development and management is a critical component of society. Moreover regional, provincial and national development is a key challenge to the government of the day in every country across the globe. South Africa is faced with the challenge of developing infrastructure in previously disadvantaged communities as well as upgrading the existing infrastructure to cope with the high demand (Agumba et al, 2003). According to the Construction Industry Development Board (CIDB, 2004), the nature and demands of infrastructure are: housing, potable water, sewerage disposal, electrification, health, education and productive employment.

The Department of Public Works White Paper (1999) on creating an enabling environment for reconstruction, growth and development in the construction industry, argues that the post-1994 government initiated a range of infrastructure delivery measures at both national and provincial level in an attempt to address some of the demands highlighted above. The departments that initiated this were Department of Housing (DoH), Department of Water Affairs and Forestry (DWAf), and Department of Public Works and Transport (DPW & T). The policies also emphasized the importance of the creation of opportunities for previously marginalized small and medium enterprises. The Department of Housing (DoH, 1994) and Department of Public Works (DPW, 1999) extended this emphasis and also addressed clients' concerns about the cost and quality of the construction goods and services delivered to them. These departments recognize the positive impact of infrastructure development on growth in South Africa and they explicitly recognize the importance of, and commit to, improving the quality and quantity of South Africa's infrastructure. Miles (1997) supports this position.

Khosa (2000) indicates that infrastructure can be categorized into two types, namely economic and social infrastructure, both of which have different impacts on society. The Department of Finance (DoF, 1998) describes *economic infrastructure* as that

part of the economy's capital stock that produces services which facilitate economic production, or which serve as inputs to either production e.g. water, electricity and ports, or services consumed by households e.g. water, sanitation and electricity.

According to the Development Bank of Southern Africa (DBSA, 1998) the categories of economic infrastructure are:

- Public utilities i.e. gas, electricity, water, telecommunications, sanitation, sewerage and solid waste disposal;
- Public works i.e. water catchment in dams, irrigation and roads; and
- Transport sub-sectors i.e. railways, roads, airports and urban transport systems.

According to Khosa (2000), a feature that distinguishes the economic infrastructure cluster is that various departments engage primarily with parastatal and private agencies in the delivery of infrastructure investment. These parastatals currently deliver economic infrastructure independent of the government budget.

On the other hand *social infrastructure* provides services such as education, health and recreation, and has both a direct and an indirect impact on the quality of life of its people. Indirectly, social infrastructure streamlines activities and outcomes such as recreation, education, health and safety. Directly, social infrastructure supports the conduct of trade as indicated by the Development Bank of Southern Africa (DBSA, 1998).

Since 1994, emphasis has been placed on providing work opportunities to small-scale black contractors (Department of Public, Works (DPW), 1999). The government, industry and clients are all seeking to bring about change in the construction industry in order to improve quality, competitiveness and profitability, and to increase value for the clients. Implementation of such change is carried out through the Council for the Built Environment (CBE), Construction Industry Development Board (CIDB), Construction Education Training Authority (CETA), National Home Builders Registration Council (NHBRC), Master Builders South

Africa (MBSA), and the South Africa Property Owners Association (SAPOA). These institutions are seeking to create a culture of cooperation and teamwork, and to continuously improve the performance of the construction industry.

The infrastructure backlog is currently estimated to be R170 billion, and the South African government is dissatisfied with its infrastructure delivery, according to the Minister of Public Works (Sigcau, 2003). This sentiment has been echoed by the chief executive officer of National Home Builders Registration Council, Phetola Makgathe, (SA, Builder/Bouer, 2005) and the Director General of the Department of Public Works, Lydia Bici in a speech delivered on behalf of the Minister of Public Works (Sigcau, 2002). The government's policy is to empower emerging contractors who normally form small and medium construction enterprises (SME) in the construction industry and according to the Construction Industry Development Board (CIDB, 2004) who find it difficult to deliver infrastructure appropriately. According to the Department of Public Works (1999), the South African government has prioritized the empowerment of the previously disadvantaged and marginalized sector of the construction industry comprised mainly of SMEs. This sector is the preferred vehicle of delivery of infrastructure to communities.

However, consequent to their historic position outside of the mainstream of the construction industry, SMEs lack the requisite management skills in the industry (Construction Industry Development Board (CIDB), 2004) which also prevents the effective implementation of various project management techniques. Such techniques could improve the performance of the SME sector in delivering much needed infrastructure installations on a community participation basis quality efficiently and effectively.

A number of factors point to the need both for tighter control of construction projects and improved management. As a major employer and client in the construction industry, the government would like to ensure value for money of its products. This concern has made the professional management of construction projects imperative (CIDB, 2004). Hence, it is vital to use project management techniques adequately for the entire duration of project activity, from inception to

completion. This can save the client a large proportion of project costs, regardless of the size of the project.

Cost, time, quality, utility, health (of both worker and the public), safety (project and public), environmental considerations and client satisfaction have to be optimized in order to establish an effective balance between available resources (CIDB, 2004). This will require significant utilization of project management techniques for planning, scheduling and controlling. It will also require dedication on the part of the personnel which becomes more complex as the size and scope of the project increases.

The time value of money has made the professional management of construction projects imperative. Inflation has been brought under control to a large extent in recent years. The recent decrease in interest rates from 17.0 percent in January 2003 to 11.5 percent in December 2003 should stimulate property investment (Construction Industry Development Board (CIDB), 2004). Consequently, there is an urgent need to examine very closely the effects of lengthy periods of construction on the final cost of development.

Quality is another factor that has to be considered in projects. In order to achieve the required quality for the client, there is a need for a better workmanship on projects. Hence, better planning and controlling of projects is required. According to the National Home Builders Registration Council (NHBRC) Builders Bulletin (2004), the formation of the NHBRC was an attempt to solve issues such as:

- Poor quality of workmanship;
- Bond and rent boycotts as a result of ostensibly poor workmanship; and
- Establishment of a warranty fund to provide assistance to housing consumers where home builders fail to meet the required building regulations.

The prime activity of the NHBRC is to manage its risk exposure in terms of the warranty scheme in order to ensure that it is not unduly exposed to claims (SA

Builder/Bouer, 2004). The need to set up a home builders warranty scheme, which would provide consumers with protection from poor workmanship, was recommended by the Department of Housing's white paper (1995).

Phetola Makgathe chief executive officer of the NHBRC assured the public that they will introduce a grading system that will encourage good building practice. The system will look into the registered contractors with NHBRC within a minimum period of three years to establish those that have a good record of quality work. These contractors will be entitled to a reduction on the enrolment fee. This will enable the consumers to opt for builders who will deliver quality products (SA Builder/Bouer, 2004).

Management tools and techniques have undergone dramatic changes in recent years, and there have been significant advances in this field. This is borne out by many modern management texts and successful managers have to keep abreast of such developments. An area of concern is whether small, medium and emerging building contractors have the expertise or facilities to keep abreast of these changing techniques.

The poor image of small and medium enterprises in the construction industry in South Africa in terms of infrastructure delivery stems from a failure to plan, control and schedule their construction projects using formal, recognized project management techniques. These builders often price a project "on the back of a cigarette packet" and hence make unrealistic delivery promises, without proper analysis, in order to secure a contract. As a result, the contractor does not start or complete the project on time and must compromise on quality in order to make an acceptable profit or vice versa. Consequently Mongalo Thato national training coordinator of NHBRC, estimates that most homebuilders have a life span of six months in the industry because of lack of professionalism and sustainability since they experience cash flow problems in their projects and consequently have to leave the industry (SA Builder/Bouer, 2004).

A review of the various definitions of small business reveals that, in the first place, preference is given to an economic or qualitative concept; and that secondly, as a

result of the need for statistical verification, certain maximum quantitative guidelines are laid down. The statistical guidelines, however, often differ as a result of the heterogeneity of the small business sector. Some sectors incorporate total annual turnover, total gross asset value (fixed property excluded) and the total full-time employees (National Small Business Act, 1996).

Weisswange's definition (1997) concurs with the National Small Business Act (1996), in terms of the economic and quantitative definition, i.e. a small business firm can be regarded as an independent economic unit whose aim is to account for profit and for risk attached. It also manifests distinctive characteristics such as independent ownership, independent management, a simple organization structure, and a relatively small influence on the market. Further, according to Weisswange (1997) owners can be identified with the entrepreneurs, the suppliers of capital, the management of the business, the decision makers and those who share in the profits. He further defines a small firm *quantitatively* according to the maximum number of permanent employees stipulated.

According to Organization for Economic Co-operation and Development (OECD, 2000), the definition of small and medium contractors varies from one country to another. The definition adopted for the enterprises investigated in this research study will be based on turnover and the number of permanent employees. Dlungwana *et al.* (2002) define small construction companies in South Africa as those with an annual turnover of less than R10 million while medium contractors have an annual turnover of between R10 million to R50 million. In terms of permanent employees, the National Small Business Act (1996) indicates that small contractors employ between five (5) and fifty (50) permanent employees while medium construction companies employ between fifty (50) and two hundred (200) permanent employees.

1.2 The research question

The purpose of this research is to answer the following question:

Are formal project management techniques, used adequately in small and medium firms to deliver infrastructure in the South African construction industry?

The following sub-questions have been formulated to answer the above question

- I. What combined characteristics currently exist within small and medium sized building enterprises and their personnel?
- II. How adequately do small and medium contractors use project management techniques to manage their projects?
- III. To what extent can project management technique(s) improve the delivery of projects in terms of time, quality and cost?
- IV. What are the external and internal factors that hinder the implementation of project management technique(s)?

1.3 Research limitations

- The sample has been restricted to small and medium contractors in Gauteng, formally registered either with the Gauteng Masters Builders Association or the National Home Builders Registration Council;
- The informal sector of contractors was not targeted, because tracing them was difficult as they were not formally registered; and
- The research was confined to Gauteng because of the cost implications of covering the entire country. The results for Gauteng will be taken as representative of the whole country, and, if necessary, further research can cover the whole country.

1.4 Outline of the research report.

The remaining chapters of the report are as follows:

- Chapter Two will provide an overview of the literature relevant to this research problem.
- Chapter Three provides details of the research methodology employed in order to answer the objectives formulated in Chapter One.
- The analysis of the results obtained from the questionnaire is tabulated in Chapter Four. These will be used to verify the research objectives derived in Chapter One.
- Interpretation of the results will be presented in Chapter Five. In view of Chapters Two and Three it will enable one to pick up the key elements from what has been stipulated.
- Chapter Six summarizes the findings of the research with conclusions being drawn. Recommendations for further research work are also given.
- References.
- Appendices.

CHAPTER 2

2. LITERATURE REVIEW

2.1 Introduction

The need to develop Small and Medium Enterprises (SMEs) and emerging contractors has to be understood in the light of the government's policy of providing infrastructure in underdeveloped areas in order to improve the standard of living in these areas. One should also bear in mind the public works policy on labour intensive projects, which will be driven by small and medium emerging contractors (DPW, 1999). Miles (1997), Gounden (1997) and Van Wyk (2003) argue that small and medium organizations are vital for economic growth. While such organizations have features in common with large organizations, they also have unique characteristics that are reflected in the manner in which they are organized and managed. Furthermore, the importance of small and medium enterprises and emerging contractors in the light of the government policies is to create employment and hence promote economic development in an integrated and cohesive fashion.

According to Miles (1997), the construction industry normally operates in a complex and generally project-specific environment. The construction industry is heavily dependent on labour and, hence, each new project faces different challenges in terms of size and scope, location and terrain, and the range of skills and materials required. The complexity of the industry is derived from the fact that it is not static and every project involves the assembly of a new combination of role players and resources. The complexity is compounded by the competitive and high-risk nature of the business for both client and contractor.

This chapter discusses the importance of small and medium companies to economies both globally and locally. The chapter concludes with valuable information on formal project management techniques that can be used by small and medium contractors for infrastructure delivery in terms of managing time, cost and quality during the various phases of project management in the construction industry.

2.1.1 The structure of small and medium organizations globally

Introduction

Many small and medium firms do not have an organizational structure, as large firms do. Small and medium firms usually employ personnel to perform multiple tasks while large firms tend to use specialists to perform the same activities. This structural feature of small and medium businesses arises because of their size.

According to Ehlers (2000), cited in Herbst (2001), small organizations break their tasks into functional subsections and assign employees to the selected tasks. However, specialization is only economically feasible if the organization is large enough. If expertise is sought, it can be externally sourced, but experts are very expensive either on a contract basis or in full time employment. If the work does not warrant an expert in full time employment, it has to be carried out either by a non-specialist, a consultant or the owner him/herself. Since the non-specialist will not be as effective and efficient as a specialist, some of the cost advantages of specialization will be lost to the small organization.

In managing small and medium firms, creativity, adaptation, change, ambiguity, flexibility, problem solving and collaboration occur regularly. These activities are the result of the changing environment, in which obtaining business orders is difficult and making predictions, planning and formalizing are even more difficult. As a result of these factors, small and medium enterprises need to have strong management and also utilize the various project management techniques available.

2.1.2 Global view of small and medium enterprises

Small and Medium Enterprises (SMEs) play a major role in the economic growth of the member countries of the Organization for Economic Co-operation and Development (OECD) which is constituted of the superpower nations of the world and its allies such as United States of America, France, United Kingdom, Australia, Canada, Turkey and Germany. The SMEs are a source of job creation. More than

95% of OECD enterprises are SMEs, which also account for 60%-70% of employment in most countries. Downsizing and outsourcing of services by large enterprises increase the number of SMEs in the economy. In addition, productivity growth and economic growth is strongly influenced by the competition inherent during the birth and death, entry and exit of smaller firms (OECD, 2000).

According to the OECD (2000), an SME is a non-subsidiary independent firm, which employs fewer than a given number of employees. The stipulated number varies from one country to another. Across the European Union 250 employees is the upper limit. Some countries set a limit of 200 employees, while the United States considers organizations with fewer than 500 employees to be SMEs. Small firms are generally those with fewer than 50 employees, while micro-enterprises have at most 10 employees. Financial assets also contribute to the definition of SMEs. In the European Union, SMEs must have an annual turnover of EUR 40 million or less and /or a balance sheet of valuation not exceeding EUR 27 million. The definitions stated above differ slightly from those stated in the National Small Business Act (1996) in South Africa. While the turnovers are lower in South Africa, the number of permanent employees resembles those countries where medium companies employ between 50 and 200 employees and small companies employ between 10 and 50 permanent employees.

According to the OECD (2000), DPW (1999), and Miles (1997), reasons for the importance of small and medium firms in any country include:

- Small and medium firms form a large population of suppliers of employment and creators of work opportunities, innovators and initiators. Subcontractors for large firms are responsible for the entry point into the business world, thus playing an important socio-economic role;
- Small and medium firms can have a multiplying effect on the economy; and
- Small and medium firms provide economic stability and a better distribution of economic activities.

According to Griffin (1990), the role of small firms in the global market economy includes the following:

- Contribution to big business. There has been a shift in the size distribution of firms away from large firms towards smaller ones;
- Better financial performance because of lower cost of service;
- Innovation. Small firms are at least as innovative as large firms on an employee basis and they generally have the innovative advantage found in high-technology industries;
- Job creation. The small firm's share of employment is growing faster in the goods-producing sectors than for the economy as a whole; and
- New business formation. Organizational survival is positively related to organizational age. Small firms produce at least a proportionate share of new jobs.

2.1.3 The causes/factors of success and failure of small firms operating globally

Small firms differ from large firms according to their legal forms, market position, staff capability, managerial styles, organizational structure and financial resources.

Small firms have the following unique success factors according to Griffin (1990):

- Hard work and dedication on the part of the entrepreneur. The entrepreneur has a desire to work;
- Better customer service - a small firm can be more flexible than a large firm, allowing it to tailor its products and services to the exact needs of potential and current customers;
- Market demand because of lower cost. Small firms can often provide products and services at cheaper prices than large firms can. Small firms usually have lower costs and can earn profits on lower prices than large firms;
- Managerial competence is vital, as this will enable the manager to manage growth, control costs and make difficult choices and decisions.

It is likely that an entrepreneur who has a product with high demand might be able to survive for a while without managerial skills; and

- Filling of isolated niches where large firms are excluded from the market. This situation provides substantial opportunities for small firms with lower overhead costs.

Griffin (1990) further argues that, despite the successes of small firms, there are also risks encountered by small firms. The following are some of the demerits that he considers:

- Poor management is a common reason for the failure of small firms. A lack of business training and knowledge often leads to insolvency. The utilization of outside professionals is essential;
- Inadequate financing in many small firms eventually causes the firms to run short of money. They often lack the resources to survive through tough economic times or to expand if they are successful;
- Negligence occurs among many small enterprises when management ignores aspects of operations. They may ignore key areas like inventory control and collections, customer dissatisfaction, worker unrest or financial difficulties, while hoping that things will improve on their own with time. Such neglect can lead to major problems; and
- Weak control systems occur when the systems that are in place do not provide adequate information on a timely basis. Hence an entrepreneur may be in trouble before he or she knows it, e.g. customers not paying on time may cause cash flow problems, employee theft, poor quality products, plummeting sales and inadequate profit margins. If the control system cannot detect the problem or alert the entrepreneur, recovery may be difficult or impossible.

2.1.4 Global view of infrastructure delivery

As the world population is expected to increase by another 2 billion between 2003 and 2015 (Van Wyk, 2003), infrastructure development in developing countries is a great challenge. It is estimated that approximately 1.2 billion people globally lack access to safe water, 2.4 billion lack access to adequate sanitation, 2.5 billion lack access to energy supply and 900 million people in rural areas have no reliable roads to give them access to jobs or markets for their products in sub-Saharan Africa, where less than 85% of the population is connected to power grid (Van Wyk, 2003).

It is estimated by the World Bank that investment in infrastructure needs to be doubled from about US\$ 15 billion to US\$ 30 billion to reach the Millennium Development Goals aimed at reducing poverty by 2015 (Van Wyk, 2003).

2.1.5 Global overview of the construction industry

According to Van Wyk (2003), construction constitutes more than half of the total national capital investment in most countries and can amount to 10% of Gross Domestic Product (GDP). Employment sector is estimated at about 111 million people worldwide and accounts for almost 28% of all industrial employment with 75% of construction workers found in developing countries. Micro construction firms account for 90% of construction workers, which normally employ less than 10 people, whereas small and medium enterprises constitute 97% of all construction firms globally, with 95% of firms being micro firms. This sentiment is true of developed countries such as France and Germany, where there are fewer than 10 large national contracting firms who employ thousands of employees. The construction industry is viewed as an economic multiplier as one job in construction gives rise to two other jobs in construction and elsewhere in the economy. On the basis of this, as much as 20% of all employment can be ascribed to construction activities, although the nature of construction activities differs between developed and developing countries. In developed countries building work is oriented towards renovation and maintenance, whereas in developing countries it is oriented to new construction.

2.2 An overview of the South African economy

The South African economy consists of many different economic activities. The major sectors participating in these economic activities are: agriculture, mining, manufacturing, wholesale, retail, transport, business services, personnel services and imports and exports (Ntsika, 2001).

The year 2003 saw South Africa's best economic performance since the advent of democracy in 1994. The economy is currently buoyant albeit producing a growth rate below that anticipated and the rand has progressively strengthened. Interest rates are at an all-time low and the official rate of inflation is at its lowest in 45 years and well within the range set by government (Van Wyk, 2003). Statistics South Africa (Stats SA, 2005) indicates that the real annual GDP increased to 3.7% in 2004, whereas in 2003 it was 2.8%. The annual real value added by the construction industry increased by 6.3% in 2004 compared with 5.2% in 2003. Apart from the above statistic the construction industry in 2002 delivered an output of excess of R57 billion, of which approximately 30% came from the public sector, 13% from public corporations and 58% from the private sector (Van Wyk, 2003).

According to Van Wyk (2003):

- South Africa has the second biggest income gap between the rich and the poor after Brazil; hence a growth rate of 6% is required to alleviate this disparity; and
- The unemployment rate is on the increase with people who are actively seeking employment constituting 31% of the population.

2.2.1 General view of SMEs in South Africa

Introduction

Small, medium and micro enterprises (SMMEs) account for over 50% of employment and Gross Domestic Product (GDP) in South Africa. This sector has been targeted as an avenue for stimulating economic growth, enabling the fair

distribution of wealth and attaining more equitable growth as well as being a means of addressing rising unemployment since large corporations' demand for labour does not increase in proportion to their growth (Ntsika, 2001 and DPW, 1999).

Survivalists and single person micro enterprises constitute the informal sector whereas medium and large firms are grouped in the formal sector. Micro enterprises employing between one (1) and four (4) people, very small and small enterprises are considered to be a mixture of formal and informal sectors. SMMEs constitute 95.3% of overall enterprises. Micro enterprises and survivalists constitute the majority of enterprises as they contribute 70.2% of all enterprises. The agriculture, mining, construction, trade, transport, community and social services form the majority of enterprises in this sector. In contrast, finance, catering and accommodation, and wholesale trade are normally classified as small, very small and micro enterprises (Ntsika, 2001).

It is worth noting that new registration of small firms is influenced by takeovers, relocation or changes in activities or legal status and hence this does not translate into growth. For ease of recording the number of enterprises, Pty Ltds (private companies) constitutes medium and large enterprises and closed corporations (CCs) represent small, very small and micro enterprises. The data is as follows: there was a sharp increase in the registration of CCs in 2001 from 78 730 in 2000 to 94 696 in 2001. In contrast, the number of Pty Ltds has decreased significantly from 32 419 in 2000 to 25 669 in 2001 (Ntsika, 2001).

Large increases in registrations of new CCs occurred in the trade, agriculture and construction sectors. Transport and mining had a smaller increase in registrations. The trade sector saw an increase from 29 933 in 2000 to 44 214 in 2001. The decrease in the number of CC registrations was in the finance and manufacturing sectors (Ntsika, 2001).

2.2.2 The South African construction industry environment

Introduction

Since the advent of South Africa's first democratically elected government, the construction sector has been expecting a sustained revival its the economy. After experiencing the longest economic recession since the 1940s, which left the construction sector at perhaps a third to a half of its 1980 capacity, the industry now faces the prospect of vastly increased demand from both the public and private sector if the policy objectives of the new government are to be realized (Merrifield, 1999). This section will therefore try to describe the structure of the construction industry in South Africa, provide an historical review of infrastructure delivery, review the role of small and medium firms in the construction industry and in delivering infrastructure. Subsequently, the section will attempt to assess the construction industry's ability to deliver infrastructure in terms of the government's stated policy objectives, and examine constraints on small and medium enterprises in the South African construction industry.

2.2.2.1 The structure of the construction industry in South Africa

According to Merrifield (1999), the South African construction industry is highly skewed with a few large firms dominating an industry comprised of a very large number of much smaller firms. This assertion has been verified in the Ntsika report (2001), which estimates that 78.5% of the companies in the construction industry are small, medium and micro enterprises. Large contractors account for 0.3% and survivalist contractors constitute 21.1% of the industry (Ntsika, 2001).

Construction industry contractors can be divided broadly into civil, building, drilling and refractory contractors. 12 368 contractors are formally registered and active in the industry. This study will only consider formal civil and building contractors that are either small or medium in size, whose number is estimated to be 8 769 (CETA, 2003).

Khosa (2000) states that 14% of firms were responsible for more than 75% of the total construction output although this varied for each sector. Approximately 19% of civil engineering firms accounted for 80% of civil engineering works, while 17% of general contractors accounted for 70% of general contracting work, and 18% of home-builders accounted for 70% of home builders work.

Merrifield (1999) indicates that construction companies can be divided into a number of categories according to their size. There are large contracting companies with an annual turnover of between R400 million and R1 600 million from construction activities. They can be referred to as the national contractors since they have divisions operating in most regions. The structure of these companies is like that of holding company with operational divisions (with an annual turnover of between R50 million and R100 million) which act as separate business units. These firms serve both the building and civil engineering sectors, and have several specialist contracting entities, centralized plant facilities and a common source of funds. These are all publicly listed companies. All these companies can handle projects greater than R100 million, and their competitive advantage becomes evident in projects greater than R20 million. According to CIDB (2004), these companies earn 30 to 50 percent of their turnover outside South Africa.

National firms have a property development division as well as industrial or commercial interests. A significant amount of their work comes from negotiation or own development and they generally tender on invitation only. Large regional contractors are next in size to the national contractors. They have an annual turnover of between R30 and R80 million, and may be capable of competing with the national companies in their specific region, on contracts of between R10 and R40 million. Most of them are privately owned, and are family companies or still owned by the original founder(s) (Merrifield, 1999).

The regional divisions of national companies are slightly smaller. These firms allow greater flexibility when competing with the regional firms of large contractors because of their lower overhead structures (CIDB, 2004). The regional firms tend to specialize as building or civil engineering contractors. Many of these firms obtain their work through negotiation and, like the national firms, they generally tender on

projects above R2 million. Self-initiated property development rarely exceeds 20% of their turnover (Merrifield, 1999).

According to Dlungwana *et al.* (2002), the categorization of firms can be broadened to include smaller regional contractors with a turnover of less than R10 million. Merrifield (1999) further believes that these firms compete for contracts in the range of R0.5-5 million and their competitive advantage seems to rest around the R1-2 million level. Until 1994 the categories of firms mentioned above were predominantly white in composition and ownership. According to South Africa Federation of Civil Engineers Contractors (SAFCEC, 2004), currently 35% of their members are black-owned and black managed firms at present. This is in line with the government's policy of empowering black contractors in the construction industry. Further down the structure are small-scale contracting enterprises in the informal sector who compete for work below the R500 000 level (Merrifield, 1999).

According to Merrifield (1994), cited in Merrifield (1999), although we may distinguish the informal sector from the formal sector, there is a clear productive relationship, between the informal sectors' labour only subcontractors and the formal industry that employs them. It is at this level that the majority of black owned firms are concentrated, while many of the formally registered firms would be white owned and white managed. Merrifield (1999) further argues that interviews which have been conducted suggest that the vast majority of the firms operating in the range of R500 000 and less are specialist contractors or subcontractors. There are however no clear statistics indicating the prevalence of subcontracting in the building industry.

2.2.3 Historical review of infrastructure delivery in the South African construction industry

Introduction

Investment in construction goods and services, as measured by gross domestic fixed investment, grew consistently between 1946 and the early 1980s. From the mid 1980s gross domestic fixed investment (GDFI) in construction goods and services

declined significantly until 1994 when, with the advent of the new government's policies, some sectors began to revive. The historical evidence presented indicates that investment in all sectors declined by at least 50% since the early 1980s. However, since 1994, investment in civil engineering works and non-residential buildings has increased steadily (Khosa, 2000).

According to the Construction Industry Development Board (2004), total construction spending in 2002 exceeded R57.5 billion, of which 29.5 percent came from the public sector, 13.6 percent from public corporations and 56.9 percent from the private sector. The amount spent on South African construction and construction related activities amounted to 5.1 percent of GDP in 2002, up from 4.9 percent in 2001.

2.2.3.1 The role of SMEs in the South African construction industry

Introduction

Small and Medium Enterprises (SMEs) represent an important vehicle through which, to address the challenges of job creation, economic growth and equity in South Africa. As stated earlier, SMEs can play a critical role in absorbing labour, penetrating new markets and generally expanding economies in creative and innovative ways.

The government believes that, with the right enabling environment, SMEs in South Africa can follow these examples and make an indelible mark on the economy. Since public and private sector corporations in South Africa initiate 40%-50% of construction related GDFI, the South African government, as a major procurer of construction goods and services, is well positioned to impact on the development of the construction industry. Gounden (1997) states that the construction industry has been identified as one of the public sector interventions that could play a catalytic role in the transformation of the construction industry, and could also enable government to realize some of its broader socio-economic objectives, such as the promotion of small and medium enterprises owned by previously disadvantaged individuals.

The DTI (1995) indicates that the South African government is of the view that investment in and the active promotion of already established and emerging contractors operating SMEs, can contribute to the realization of key economic and re-distributive objectives for the following reasons:

- They are powerful generators of income and employment opportunities and they generally use less capital investment per unit of output than larger enterprises;
- SMEs can be more competitive than larger firms on certain types of small disparate and geographically dispersed projects because they generally have lower overheads; and
- SMEs can provide a foundation to de-racialise the South African construction industry and provide a platform for the development of future medium and large companies, owned and controlled by historically disadvantaged people.

The DPW (1999) states that years of declining demand and uncertainty halved the capacity of the traditional construction industry while, at the same time, there has been the introduction of a large number of new, much smaller firms. Many of these firms are either Labour Only Subcontractors (LOSCs) or small and medium enterprises specializing in other areas of construction. This assertion is supported by OECD (2000), Miles (1997), and Griffin (1990) who state that SMEs should be innovative and hence contribute to the economy.

2.2.4 Problems encountered by SMEs in the South African construction industry

Demand decline and volatility in production relation

It has been estimated that more than 35% of all construction employees were lost to the industry during the recession of the mid 1970s and that at least a further 30% of employees were again lost in the late 1980s and early 1990s. Together with the wasteful loss of skilled personnel, South Africa has lost the capacity of thousands of

construction companies that were unable to survive the volatility of demand (DPW, 1999).

DPW (1999) and Gounden (1997) argue that subcontractors in South Africa have very little negotiating power with the prime contractors. As subcontracting is an effective means of involving SMEs in public sector procurement activities, the public sector is currently looking at measures that need to be taken, to address the shortcomings in current subcontracting arrangements. Serious consideration is being given to measures such as mechanisms to deal with late payment to SMEs and protection against prime contractor insolvency.

Although LOSC practice has been adopted internationally with great success, the institutional environment of South African industry in the late 1980s and early 1990s ensured that, by using unregistered LOSC, firms were able to avoid negotiated labour obligations. Thus, cost savings are achieved through lower wage rates rather than higher productivity. This has contributed to a decline in health and safety, productivity and quality standards in the industry since the employees of such LOSC have historically been unable to access available training schemes (DPW, 1999).

Lack of access to work opportunities

Construction related SMEs face difficulties in gaining access to the market, because of inexperience, lack of managerial and marketing ability and lack of access to capital which contributes to a vicious cycle limiting their growth and development. Between 20% and 30% of the firms in each sector (civil engineering, general contractors and home builders) accounted for more than 80% of output in 1991 (DPW, 1999). Recent figures show that civil engineering activities have declined by 5% since the end of 2002 while residential buildings seem to have benefited from the loose monetary control. This is due to the high interest rate in 2002 but as the interest rates have decreased, civil works will gradually start to increase towards the end of 2004 (SAFCEC, 2004).

Lack of managerial expertise among SMEs in the construction industry

Lack of management skills result in problems such as poor cash flow management, inadequate labour supervision and, hence, insufficient turnover. Consequently programs have been established to support SMEs. These programs are designed to support SMEs in the low-income housing sector and to equip them with the skills of risk management that will enable them to survive in a competitive market. Most of these programs support managerial skills but restrict enterprise operations to a level that does not guarantee self-sufficiency (DPW, 1999).

Inability to access training

Access to training is a key hindrance preventing SMEs from improving their business skills and developing trade skills within their labour force. Small contractors are often unregistered and unaffiliated to the main employer bodies. They pay no levies and have limited or no access to training programs offered by the current industry training boards. Hence they are not in a position to improve their productivity (DPW, 1999).

Many subcontracting firms train their own operatives on the job. However, the erratic availability of construction work diminishes the value of job training in the informal sector. In contrast to the continuity and depth provided by the old apprenticeship system, it is unlikely that new generation of semi- skilled labour will be sufficiently experienced to pass on adequate skills to their operatives in the future (DPW, 1999).

Business failure and growth patterns in developing new contractors

International research indicates that between 30% and 50% of small firms fail in their first three years, and only 40% to 45% of firms remain in the business after ten years. Since these figures are derived from relatively sophisticated samples it is likely that small business development in South Africa will experience a much higher failure rate as a result of a lack of profits and poor management, which is mainly caused by poor planning (DPW, 1999). Van Wyk (2003) further states that

532 companies were liquidated in the construction industry in year 2000, 554 in 2001 and 371 in 2002. Thus 1 400 companies could not remain viable over the past three years.

2.3 Project Management

Introduction

Project management is a relatively modern managerial concept which adopts new approaches to management restructuring and adopts special management techniques to specific tasks. Its origins can be traced to the building of the pyramids in Egypt and the Great Wall of China. Although the study of the subject started just before the Second World War in the chemical industry, project management techniques were applied in the First World War when Henry Gantt drew diagrams of projects, mainly to assist in the building of freighters (Burke, 2003). The origins of project management can also be traced back to the works of the United States (U.S) Department of Defense in major weapons system development, the National Aeronautical Space Administration (NASA) in space exploration, and other major construction and maintenance efforts (Kerzner, 1995).

According to Healy (1997), the concept of project management is not new, but it is viewed as a new invention, as a special form of management, which originated in the 1940s or 1950s during the invention of the Program Evaluation and Review Technique (PERT). However, Kerzner (1995) states that the growth of project management was slow and developed mainly out of the necessity for management to solve complex tasks. The major reason offered for this slow growth was the reluctance of management to adapt to new techniques and the fear of the unknown. Bates *et al*, (1999) and Haupt (2001) further argue that the construction industry continues to be one that characteristically resists change.

Project management is increasingly being adopted by all sectors of the construction industry because of the importance of delivering projects that meet predetermined objectives. It is being seen as the most effective way of implementing changes in business, whatever their nature. While project management has been implemented

by many business sectors over the last few decades, it is interesting to note that its beginnings are generally regarded as being in the construction and engineering industries (Chaffey, 1997).

According to the Egan Report (1998), the United Kingdom government has pointed out that in recent years, some sectors of the economy, particularly manufacturing, have made significant improvements in their productivity and ability to deliver high quality products at the right price to meet the client's requirement. This is less apparent in the construction industry which John Prescott, the deputy prime minister, perceived as being stuck in some sort of 'time warp', unaffected by the great forward march of other industries (Construction Industry Board, 1999).

The focus of project management was initially on construction, but numerical techniques gradually developed which made the process generically applicable. Today, project management has multidisciplinary application value. Burke (1999) insists that rapidly changing technology, fierce competition in the market and a powerful environmental lobby have all encouraged companies to change their management systems. Waldt and Knipe (1998), provide the recent example of the 1996 Olympic Games in Atlanta where project management was used to build sports facilities and to manage the Games in general.

South Africa has seen a dramatic increase in the use of project management in the construction, information technology, defence and development sectors. In education, publishing and the government sector, principles of project management are also being applied. It was only in the 1990s that project management gained dramatically in popularity in the government sector. While the concept of project management is not new in South Africa, the terminology is perhaps not yet universally used comfortably. The tools and techniques, however, have been in use for a number of years and for this reason project management should not be alien to most people (Knipe *et al.* 2002).

South Africa has seen a marked move towards the usage of project management techniques in construction projects in recent years. This move had its origins in the development of contracting companies into larger organizations which offered

clients more specialized services and skills. These organizations found a need for specialist management teams to control the many areas of the construction services they offered.

According to Bates *et al.* (1999), more than two hundred years ago the mason was both designer and manager on a building site, but today the construction industry is fragmented into a multiplicity of trades, skills, professions and functional groups. The fragmentation has brought with it great benefits to the industry as a whole, but has resulted in a variety of new problems related to coordination, planning and interface relationships. Alshawi and Ingirige (2003) argue that problems such as delays in projects are caused by interference by clients, stringent deadlines set by clients, time constraints and professional interference. They further state that a lack of fully integrated procurement systems tends to impact on the stock control policies (e.g. carrying a high quantity of stock) of construction firms because of the inability to make accurate predictions of resource requirements for projects. The main reason for this is poor communication and coordination among the supply chain partners and a lack of an overall integrated system to cater for this need.

Faniran (1999) and Miles (1997) indicate that the project environment in many developing countries presents special challenges for project managers that almost presuppose extensive cost and time overruns even before a project commences. These challenges arise mainly due to inherent risks such as political instability, excessive bureaucratic contract procedures and a lack of adequate infrastructure. In recognition of these unique problems, therefore, there is a need to develop appropriate project management techniques and tools specifically tailored to the project environment of developing countries.

The concept of project management has emerged as a specialist management function to deal with planning, organizing, directing and controlling the complex relationships and activities in a project. In its practical essence the concept is not new since the contractors of old served much the same type of function. However they were unable to maintain project management techniques as technology changed, and new specialized skills developed, and hence the time and cost element of construction became of primary importance (Kerzner, 1995).

Project management today can be seen as an adaptation of and development from the management of the old master builder to modern day management tools and techniques and expertise. In order to describe project management in the context of construction, a definition of a project is provided followed by a holistic definition of project management.

– *Defining a project*

According to Rwelamila (2002), it is very difficult to define a project as one can write half a page without deriving a correct definition. Why are projects such as road construction or aeroplane construction considered to be projects whereas social environment endeavours encompassing human activities such as cultivating and harvesting crops, or offering services in a post office are not viewed as projects? This is because most of the projects that we normally handle at work or at home are usually small and hence may not have the following features:

- specific objectives to be completed within certain specifications;
- defined start and finishing dates;
- funding limits (if applicable); and
- Consume resources in terms of money, people and plant (Kerzner, 1995).

PMI (2000) defines a project as a temporary endeavour undertaken to achieve a particular aim. Every project has a definite beginning and end date. While projects are similar to operations in that they are both performed by people and have limited resources, projects are planned, executed and controlled. Projects differ from operations in that operations are ongoing and repetitive while projects are temporary and unique.

The definition of project management is not simply the amalgamation of the definitions of project and management, nor is it formed from the two definitions. Three important dimensions have to be added to complete the definition i.e. time, cost and quality. According to Smallwood (2000), these three dimensions or

parameters mentioned are considered to be the traditional project performance measures.

– *Definition of project management can be stipulated as follows:*

The Chartered Institute of Building (CIOB, 2002) and Kerzner (1995) define project management as the process of planning, organizing, directing and controlling human, material and financial resources as well as the safety elements in the project. This will enable the construction facility to serve a specific function for the purpose of meeting a predetermined objective within the constraints of time, cost and quality. Further more, project management utilizes the systems approach to management by having functional personnel (the vertical hierarchy) assigned to a specific project (the horizontal hierarchy).

However, according to the Project Management Institute (PMI, 2000), project management is the application of knowledge, skills, tools and techniques to a broad range of activities in order to meet the requirements of the particular project. Project management knowledge is best described in terms of its component processes. These processes can be placed into five groups: initiating, planning, executing, controlling and closing.

The Project Management Institute (PMI, 2000) further points out that the skills required depend on each specific project and the resources available at that time. The greater the adjustment required in the parent organization in order to fulfill the objectives of the project, the greater the chance of failure of that project. The form of project management will be unique for every project endeavor and will change throughout the project.

A project proceeds through a sequence of activities the phases of a project which vary from project to project. A control framework is applied to each phase in turn. Each phase must then transfer to the subsequent phase a delineation of what that next phase must achieve. As the first phase has no preceding phase, it must find its own objective. The application of the control framework to the phases is cyclic (Healy, 1997).

Belout and Gauvreau's (2004) research indicated that the relationship between the independent variables and project success will vary according to the life cycle stage, e.g. at the planning stage, project leaders and their teams concentrate on breaking down the project into work packages i.e. structural planning or work breakdown structure in order to allocate resources to the project before executing it. It is worth considering the life cycle when analyzing the factors inherent in a projects success. It is also important at this stage to fully grasp clients' needs and to establish the projects limits and priorities (expected quality standards, schedules, risk acceptance, method of project management to be adopted, monitoring conditions and communications) among key players in the project.

The cyclical nature of a project is known as the project life cycle. In the construction and engineering industries the four subgroups of tasks are often referred to as the four project phases of a project. The typical four phases to be considered in the project management process will be:

- *Initiation phase* of the project: this is when the project is identified and its feasibility tested (Healy, 1997; PMI, 1996). The project manager performs several activities that assess the size, scope and complexity of the project. Some initiation activities and techniques may be unnecessary while others may be significantly involved (Hoffer *et al.* 2002);
- *Design/planning phase* is when the drawings and specifications for the work are prepared (Healy, 1997; PMI, 1996). The planning will entail defining clear, discrete activities and the work needed to complete each activity within a single project. It often requires making numerous assumptions about the availability of resources (Hoffer *et al.* 2002);
- *Implementation/executing phase* is when the building is physically being constructed (Healy, 1997; PMI, 1996), thus putting the baseline project plans developed during the initiation and design phase into action (Hoffer *et al.* 2002); and
- *Handover/close down phase* is when the structure (product) is handed over to the client. (Healy, 1997; PMI, 1996). The project can be

concluded when all the requirements of the project have been met and it is a success or it may be stopped before completion if the project team learns that the assumption used to guide the project proved to be false or that the performance of the development group was inadequate. The most likely reasons for the unnatural termination of a project relate to running out of time or money, or both (Hoffer *et al.* 2002).

The PMI (1996) and Belout and Gauvreau (2004), argue that the delineation between one phase and another is an issue of judgment. One has to be very objective when implementing the phases of the project. The phases should be appropriate for the management of the particular project. The project life cycle is supposed to assist in the management of the tasks needed to complete the project as well as in identification of the work required and when it is to be done. In each phase of the construction project there will be a variety of project management techniques to be implemented. It is worth noting that a more positive approach to project management could lead to a greater use of project management techniques rendering these techniques more viable and helpful.

2.3.1. Project management techniques

Introduction

Project management is a challenging task with many complex responsibilities. Fortunately, there are many techniques available to assist with accomplishing the tasks and hence executing the responsibilities. Such techniques include project planning, scheduling and controlling. The elements that need to be planned, scheduled and controlled are time, cost and quality. Different methods have therefore to be used in cost planning and control systems, time planning, scheduling and controlling systems, and quality planning and control system.

Organisational techniques will enable the project resources such as labour, material and plant to be ordered at the right time and when directing the resources for work it will be ideally stated. A chain of command will exist when organisational structure is in place (Oberlender, 1993). These techniques have sprung up at an ever-

increasing rate. When perusing any engineering or project management magazine or browsing on the internet one will be amazed by the number of software packages offering various project management techniques implemented through project management software.

According to Reiss (1992), a range of project management techniques and concept are applied to a wide range of tasks that really do not have any singularity. The techniques and tools have spread into areas where there is a degree of repetition. Walker (2002) agrees with this sentiment, and states that these techniques are aimed at making the management of construction projects more effective and at providing clients with the means to make more rational and objective decisions. The opportunity and ability to apply techniques depends upon a receptive management structure and an appropriate configuration of contributors to a project. It is evident that the construction industry is slower than many, other industries to implement new ideas and techniques. This is the consequence of the traditional professional roles which inhibit the implementation of management techniques.

It is worth noting that the person charged with the sole task of project planning, scheduling and control has to recognize the need for project planning, scheduling and control techniques and be able to evaluate and implement those techniques that will help him/her in the task of overall management of a project.

– *Scheduling a project*

The scheduling of the activities must be realistic and consider the resources that are available. There are always practical limits to resources and the plan and schedule has to recognize this. It is vital for each activity to be shown on the plan and schedule, and the interdependence of each of the activities must be taken into account in determining the sequential progression of project activities. The plan and schedule of the client will be developed from the project manager's working schedule (not the reverse) in order to keep the client well informed of the actual progress (Chartered Institute of Building (CIOB), 2002).

It is important to review the plan and schedule periodically so that potentially adverse impacts such as new activities not previously anticipated, client or vendor transmittal delays, changes in man-hours required to complete the activities and scope changes in the project, etc., are recognized early so that timely corrective action can be taken to minimize adverse impacts on completion and budget. Scheduling is carried out in advance of the project commencing and involves identifying the tasks that need to be carried out, estimating how long they will take, allocating resources and scheduling when the tasks will occur (Chartered Institute of Building (CIOB), 2002).

– *Controlling a project*

Project control consists of determining the standard for each element, measuring the performance, testing for a deviation and reacting to deviations. Complete project management is achieved when the project manager manages the project in terms of time, cost and quality. The management of these parameters will involve setting yardsticks or measures of performance in these areas against which actual performance can be compared. It also involves making decisions based upon the available information and thinking about decision making for the work that remains to be done. Once the project is underway, control needs to be exerted to ensure that the plan continues to represent the best prediction of what will occur in the future. This will depend upon what occurs during the project development hence necessitating revision of the plan (Chartered Institute of Building (CIOB), 2002).

– *Planning for a project*

According to Kerzner (1995), planning is determining what needs to be done, by whom and by when in order to fulfill one's assigned responsibility. Planning is customarily defined as strategic, tactical or operational. Strategic planning is generally for five years or more, tactical planning can be between one to five years, and operational planning is between six months to one year. Although most projects are operational, they can also be considered as strategic especially if spin-offs or follow-up work is promising. Belout and Gauvreau, (2004) argue that clients'

acceptance is an important success factor in the planning and execution stages of the project.

If project planning is strictly operational, then the following factors have to be well-defined: competitive situation, marketing, research and development, production, financing, personnel and management structure. If strategic planning is necessary, then the future economic outlook can vary from year to year and hence re-planning must be conducted at regular intervals because the goals and objectives are bound to change (Kerzner, 1995).

In order to achieve the performance parameters of time, cost and quality successfully, whether as an in-house project or a customer request, one must utilize effective planning techniques. The quantitative and qualitative tools for project planning must be identified (Kerzner 1995).

According to Kerzner (1995) and Alskani *et al.* (2004), detailed planning processes produce a comprehensive schedule in which the plan reflects the work as it should be implemented in project controlling and reporting, and changes are accommodated to enable proactive and reactive schedule steering when deviation occurs. Faniran (1999) agrees with Kerzner (1995) and Alskani *et al.* (2004), but argues that quantitative techniques such as bar charts and critical path networks make it possible to plan for the resources in advance and for them to be delivered on site when required.

2.3.1.1 Project management techniques used at different phases of a project

Different project management techniques are used in different phases of a project from inception (initiation) to completion (handover) of the project. The tools and techniques outlined have been exhaustively collected from relevant literature to include those techniques that are considered most appropriate for construction projects. The tools and techniques (including even “hardcore” methods) relevant to each phase of project management formed the basis of the structured interview questionnaire. No one technique addresses all project management needs. According to Bates *et al.* (1999), the techniques and tools will differ from one

project to the next, depending upon the projects nature, complexity and cost. Project managers should choose project management techniques that suit their management style.

The following are some of the essential techniques used during a construction project by most contractors. The project management techniques related to the project *initiation phase* will include project administration meetings, establishing project initiation plans, establishing management procedures, establishing the project management environment and workbook, establishing project selection methods and expert judgment (Hoffer *et al.* 2002; PMI, 1996).

The project management techniques related to the *design or planning phase* will include describing the project scope and feasibility, dividing the project into tasks i.e. work breakdown structure, estimating resources and creating a resource plan, developing a preliminary schedule, determining project standards and procedures, budget/cost analysis, creating a preliminary budget, developing a statement of work, setting a baseline project plan, drawing up a bar chart/gantt chart, critical path method, organizational breakdown structure, cost breakdown structure, brainstorming, specifications and standards and determining project planning methodology (Hoffer *et al.* 2002; PMI, 1996).

The project management techniques during *construction/implementation* or execution phase will include establishing reporting procedures, monitoring project progress against the baseline project plan, managing the project workbook, communicating the project status, monitoring and tracking, earned value analysis, inspection of work, control charts, performance measurement and status review meetings (Hoffer *et al.* 2002; PMI, 1996).

Project management techniques related to the project *handover or close down phase* are closing down the project, conducting post project reviews and closing the clients' contract (Hoffer *et al.* 2002; PMI, 1996).

Some of the techniques stated in the project management phases have been described below:

Management procedures are established in order to ensure effective team communication and reporting procedures, establish job assignments and roles, determine project change procedures, and establish how project funding and billing will be handled (Hoffer *et al.* 2002).

Project management environment and workbook is established to ensure that all tools that will be used while managing the project are collected and organized so that the project workbook is constructed. The project workbook can be stored as an on-line electronic document or in a large three-ring binder. The project workbook is used by all team members and is useful for project audits, orientation of new team members, communication with management and customers, identifying future projects, and performing post-project reviews. The establishment and recording of all project information in the workbook are the two most important activities that will be performed by a project manager (Hoffer *et al.* 2002).

According to the PMI (1996), *project selection methods* generally fall into two categories, *viz*:

- *Benefit measurement methods* which comprise comparative approaches, scoring models, benefit contribution, or economic models; and
- *Constrained optimization methods*, which comprise mathematical models using linear, non-linear, dynamic, integer, and multi-objective programming algorithms.

These methods are often described as decision models. They include generalized techniques as well as specialized ones.

Expert judgment will be required to assess the inputs to this process. Such expertise may be provided by any group or individual with specialized knowledge or training and is available from many sources including:

- Other units within the performing organization;
- Consultants;
- Professional and technical associations; and

- Industry groups (PMI, 1996).

Project definition (project scope and feasibility) is vital to the success of a project. A comprehensive definition should be developed from the start, stating the project's purpose, ownership, technology, cost, schedule duration, financing, sales and marketing, and resource requirements. If this is not done key issues essential to the viability of the project may be omitted or given inadequate attention, resulting in poor performance. Through the project definition, the vision for the project is created, the purpose of the project is defined, and the project plans are aligned with the business plans and the basis of cooperation is agreed on (PMI, 1996). Project definition is achieved by:

- Setting the project's objectives;
- Defining the scope through a strategic or milestone plan;
- Setting the functional strategies and assessing technical risks;
- Carefully managing the design process; and
- Managing resources and the context (PMI, 1996).

Estimating resources and creating a resource plan according to Hoffer *et al.* (2002), is used to estimate the resource requirements for each project activity. This information is used to create a project resource plan. The resource plan helps to assemble and deploy resources in the most effective manner, e.g. bringing in electrical designers when the architectural drawings are not complete. People are the most important, and expensive, resource in planning project time estimates for task completion and overall system quality. It is ideal to give people tasks that allow them to learn new skills (Hoffer *et al.* 2002). Small and medium contractors are seen to be more innovative hence they will be able to plan their resources to suit their innovation.

Preliminary schedule development is used to assign time estimates to each activity on the work breakdown structure. These time estimates will allow target starting and ending dates for the project to be created. Target dates can be revisited and modified until the schedule produced is acceptable to the customer. Determining an

acceptable schedule may require additional or different resources or that the scope of the project be changed. The schedule may be represented as a Gantt chart or as a Program Evaluation Review Technique (PERT) chart, both of which are graphical depiction of project tasks and their interrelationships (Hoffer *et al.* 2002).

Project standards and procedures will specify how various deliverables are produced and tested by the project team. The team must decide on which tools to use, how the team members will report the status of their assigned activities, and terminology. Setting the project standards and procedures for work acceptance is a way to ensure the development of a high-quality system. It is also much easier to train new team members when clear standards are in place. Organizational standards for project management and conduct make the determination of individual project standards easier and the interchange or sharing of personnel among different projects feasible (Hoffer *et al.* 2002). This is a technique that needs to be implemented by small and medium contractors as they need to produce high quality projects. Standards need to be set in order to avoid disputes.

Creating a preliminary schedule budget (budget/cost analysis) will outline the planned expenses and revenue associated with the project. The project justification will demonstrate that the benefits are worth these costs (Hoffer *et al.* 2002). The small and medium contractors will need to create a budget in the form of bills of quantity to assist them in planning the expenses of the project they are to undertake.

The Statement of work is developed primarily for the client. It outlines the work that will be done and clearly describes what the project will deliver. The statement of work is useful to make sure that the contractor, client and other project team members have a clear understanding of the intended project size, duration and outcomes. This technique will be produced towards the end of the design or planning phase of the project (Hoffer *et al.* 2002).

Setting a baseline project plan is important in order to provide an estimate of the project's tasks and resource requirements and is used to guide the next project phase- construction or execution. As new information is acquired during project construction or execution, the baseline plan will continue to be updated. A review of

the baseline project plan can be used to double-check all information in the planning phase of the project (Hoffer *et al.* 2002). This is a technique that overlaps both the planning and the construction or execution phase.

Bar chart (Gantt charts)

According to Burke (2003) and Model (1996) a Gantt chart is a matrix which lists on the vertical axis all the tasks to be performed. Each row contains a single task identification, which usually consists of a number and a name. The horizontal axis is headed by columns indicating estimated task duration, the skill level needed to perform the task, and the name of the person assigned to the task, followed by one column for each period of the project's duration. Each period may be expressed in hours, days, weeks, months or other time units depending on the nature of the project. In some cases it may be necessary to label the period of the columns as period 1, period 2, etc.

Burke (2003) and Modell (1996) further indicate that the graphic portion of the Gantt chart consists of a horizontal bar for each task connecting the period start and period ending column. The chart is marked to indicate both the estimated and actual start and finishing times of an activity. Each bar is on a separate line, and the name of each person assigned to the task is on a separate line. It is worth noting that when this type of project plan is used, a blank row is left between tasks so that progress of the project can be indicated in this row. This will enable the contractor to compare the estimated start and end date and the actual start and end date of a particular task.

The Gantt chart was invented during the First World, War when Henry L. Gantt drew diagrams of projects. These charts were used mainly to build freighters during the war (Burke, 2003). Gantt charts are commonly known as bar charts and are mostly used for planning and scheduling. The bar chart has both advantages and disadvantages such as: it's easy to interpret but it is difficult to update; it does not show the interdependence of activities; and does not integrate costs or resources with the schedule. It is an effective technique for overall project scheduling, but has limited application for detailed construction work because the many

interrelationships between activities that are required for construction work are not defined (Hore *et al.* 1997).

Many project managers prefer to use a bar chart for scheduling engineering design work because of its simplicity, ease of use and because such work does not require extensive interrelation of activities. However, it can require significant time for updating since the interrelationship of activities is not defined. A change in one activity on the bar chart will not integrate costs with the schedule nor does it provide information about resources, such as labour hours, which are important for the management of design (Oberlender, 1993).

Most designers argue that they cannot define the interrelationship between the activities which make up a design schedule and that resources change constantly on a design project, resulting in a schedule which is too difficult to maintain. Either of these situations may occur at times on some projects. However, if these situations do occur on every project, it is likely that the projects are not well planned, managed or controlled (Oberlender, 1993).

Critical Path Method (CPM)

The critical path method (CPM) chart depicts task, duration and dependency information. Each chart starts with an initiation node from which the first task, or tasks, originates. If multiple tasks begin at the same time, they are all started from the node or branch, or fork out from the starting point. Each task is represented by a line which states its name or other identifier, its duration, the number of people assigned to do it and, in some cases, the initials of the personnel assigned. The other end of the task line is terminated by another node, which identifies the start of another activity, or the beginning of any float time, that is waiting time, between activities (Oxley *et al.* 1986).

In a CPM chart, the critical path is indicated, consisting of a set of dependent activities which, together, take the longest time to complete. Activities that fall on a critical path should be noted in some way, so that they may be given special attention. The critical path is drawn using a double line instead of a single line. It is

vital for activities that fall on the critical path to be given special attention by the project manager and the personnel assigned to them. The critical path for any project may shift as the project progresses. This may occur if the tasks are completed either behind or ahead of the schedule, causing other tasks on the schedule to fall on the new critical path (Oxley *et al.* 1986).

The Dupont Company, with Remington Rand as consultants, developed this technique in 1956. This method is commonly used in the engineering and construction industry. In 1957 Booz, Allen and Hamilton management consultants developed a similar method known as the Program Evaluation and Review Technique (PERT) for the US Navy as an alternative approach to scheduling. It is more commonly used by the manufacturing industry; however, it can be used for risk assessment of highly uncertain projects. Both methods are often referred to as Network Analysis System (NAS) (Oberlender, 1993).

The critical path chart depicts the interrelationship of activities and scheduling, and the detailed scheduling of construction. However it does have some limitations when applied to engineering design work during the early stages of a project because it requires an extensive description of the interrelationship of activities.

CPM requires more effort than a bar chart; however it provides the more detailed information that is required for effective project management. Using a CPM to plan a project, forces the project team to identify conflicts in resources before they occur. The project manager must use his or her own judgment to select the method of scheduling that best defines the work to be done and that communicates project requirements to all participants (Hore *et al.* 1997).

CPM is the most commonly used NAS technique in project management. The concept is simple, the computation requires only basic arithmetic and a large number of computer programs are available to automate the work required by CPM scheduling. The difficult task in the use of CPM is in identifying and interfacing the numerous activities that are required to complete a project, that is, development of the CPM network diagram. If a well-defined WBS is developed first, the task of developing a CPM diagram is greatly simplified (Oberlender, 1993).

Work breakdown structure

Work Breakdown Structure (WBS) is a hierarchic decomposition or breakdown of a project or major activities into successive levels, in which each level is a finer breakdown of the preceding one. In final form a WBS is very similar in structure and layout to a document outline. Each item at a specific level of WBS is numbered consecutively (e.g. 10, 20, and 30). Each item at the next level is numbered within the number of its parent item (e.g. 10.1, 20.1, and 30.1) (Modell, 1996).

The concept of WBS is simple: in order to manage a whole project, one must manage and control each of its parts. WBS is the cornerstone of the project work plan. It defines the work to be performed, identifies the expertise required, assists in the selection of the project team and establishes a base for project scheduling and control. It is a graphical display of the project which shows the division of work in a multi-level system. The number of levels in a WBS will vary depending upon the size and complexity of the project. The smallest unit in a WBS is a work package (Modell, 1996).

A work package must be defined in sufficient detail so that the work can be measured, budgeted, scheduled and controlled. The development of WBS is a continuing process that starts at the project planning and controlling stage. It is an effective means of defining the whole project by its component as well as parts, providing an effective communication channel for the exchange of information that is necessary for the management of the project (Oberlender, 1993).

WBS is the foundation of a project management system. Code numbers can also be used to relate the WBS to the organizational breakdown structure (OBS) for the management of people. Code numbers can also be used to relate the WBS to the cost breakdown structure (CBS) for the management of cost. WBS provides a systematic approach to identifying work, compiling the budget and developing an integrated schedule. Since the WBS is developed jointly by the project team, the people who will actually perform the work, it is an effective tool for relating work

activities to ensure that all work is included and that work is not duplicated. Most importantly it provides a basis for measurement of performance (Oberlender, 1993).

Organizational breakdown structure (OBS)

Each project manager is affected by the environment in which he or she works. If a company is product oriented, it will be organized around manufacturing and marketing of the product, with decision-making about products prioritized. A company that is service oriented will be organized around providing customer service (Oberlender, 1993).

The design and construction of a project is a means to an end for the company to provide a product or service, and does not represent the primary function of that company. The secondary emphasis on a project can hamper the work of a project manager (Oberlender, 1993).

There are different types of organizational breakdown structure, *viz*:

- Traditional management organization;
- Functional organization;
- Discipline organization; and
- Matrix organization.

The purpose of project organization is to marshal adequate resources (human, material and financial), of the appropriate type, to undertake the work of the project in order to deliver its objectives successfully. The ideal OBS to be used in small and medium design firms is the discipline organization firm (Oberlender, 1993).

Project planning methodology is any structured approach used to guide the project team during development of the project plan. It may be as simple as standard forms and templates or as complex as a series of required simulations. Most planning methodologies make use of a combination of “hard” tools such as project

management software and “soft” tools such as facilitated start-up meetings (PMI, 1996).

Monitoring the project progress against the baseline project plan is a vital technique to implement, as the progress of the project should be checked to determine if the project is ahead of or behind schedule. The resources, activities and budget may have to be adjusted accordingly. Monitoring the activities can result in modification of the existing plan. Measuring the time and effort expended on each activity will help to improve the accuracy of estimations for future projects. Project schedule charts, e.g. gantt chart make it possible to show progress against plan. Monitoring the progress of work means that the team leader must evaluate and appraise each team member, occasionally change work assignments or request changes in personnel, and provide feedback to the employee’s supervisor (Hoffer *et al.* 2002).

Maintaining the project workbook in a project is vital as the workbook provides the documentation for new team members who will be required to assimilate project tasks quickly. It explains why design decisions were made and is a primary source of information for producing all project reports (Hoffer *et al.* 2002).

Communicating the project status will require the project manager to keep the team members abreast of the project status. Clear communication is required in order to create a shared understanding of the activities and goals of the project; such an understanding assures better coordination of activities. This means that the entire project plan should be shared with all members of the project team and any revisions to the plan should be communicated to all parties involved. The procedures for communicating project activities vary from formal meetings to informal hallway discussions. Some procedures are useful for informing others of the project status, others are appropriate for resolving issues and others for keeping permanent records of information and events (Hoffer *et al.* 2002). The need to inform the project team members of the status of the project is vital in order to prevent conflict.

Earned value analysis as outlined by the PMI (1996) is a performance measurement technique. It is used to integrate scope, cost and schedule measures to help the project management team assess project performance. Earned value involves calculating three key values for each activity:

- The budget, also called the budgeted cost of work scheduled, is that portion of the approved cost estimate planned to be spent on the activity during a given period;
- The actual cost, also called the actual cost of work performed, is the total of the direct and indirect costs incurred in accomplishing work on the activity during a given period; and
- The earned value, also called the budgeted cost of work performed, is a percentage of the total budget equal to the percentage of the work actually completed.

These three values are used in combination to provide measures of whether or not work is being accomplished as planned. The cost performance index is used to forecast project cost at completion. In some application areas, the schedule performance index is used to forecast the project completion date (PMI, 1996).

Inspection of work includes activities such as measuring, examining and testing which are undertaken to determine whether results conform to requirements. Inspections may be conducted at any level e.g. the results of a single activity may be inspected or the final product of the project may be inspected. Inspections can be given various names namely: reviews, product reviews, audits, and walk-throughs. In some application areas these terms have narrow and specific meanings (PMI, 1996).

Control charts are graphic displays of the results, over time, of a process. They are used to determine if the process is under control and to monitor any type of output variable. When the process is under control it should not be adjusted. The process may be changed in order to ensure improvements but it should not be adjusted when it is under control. Although used frequently to track repetitive activities such as

manufactured lots, control charts can also be used to monitor cost and schedule variances, volume and frequency of scope changes, errors in project documents, or other management results to help determine if the project management process is under control (PMI, 1996).

Performance measurement techniques are used to assess the magnitude of any variations which do occur. An important part of scope change control is to determine what is causing the variance and to decide if the variance requires corrective action (PMI, 1996). Earned value analysis is useful for cost control. Again, an important part of cost control is to determine what is causing the variance and to decide if the variance requires corrective action (PMI, 1996).

Status review meetings are scheduled meetings held to exchange information about the project. On most projects, status review meetings will be held at varying frequencies and on different levels e.g. the project management team may meet weekly by itself and monthly with the client (PMI, 1996).

Closing down the project may signify job and assignment changes for some team members. It may require assessment of each team member and the provision of an appraisal for personnel files and salary determination. Providing career advice to team members and writing letters to supervisors praising special accomplishments of team members may be required. It may be necessary to handle any negative personnel issues such as termination of work, especially if the project was not successful. It is essential to notify all interested parties that the project has been completed and to finalize all project documentation and financial records so that a final review of the project can be conducted (Hoffer *et al.* 2002).

Post project review is a vital technique which is conducted once the project has been closed down. It is used to review and determine the strengths and weaknesses of the project deliverables, the processes used to create them and the project management process. It reveals to the project team what went right and what went wrong in order to improve the process in the next project (Hoffer *et al.* 2002).

Closing the client's contract is used to ensure that all contractual terms of the project have been met. A project governed by a contractual agreement is typically not completed until agreed to by both parties, often in writing (Hoffer *et al.* 2002).

2.3.2 Project performance measures

In order for the project management techniques discussed above to be used in a logical way in the different phases of the project they have to be analysed, bearing in mind the traditional parameters of time, cost and quality. These parameters should be managed throughout the project till completion. This is to ensure that the effort being applied and the activity being done are accomplished successfully. In the context of the management of time, cost and quality, the description of these parameters is as follows:

Time:

In order for the time aspect of a project to be attained it will involve planning, scheduling and controlling of the program. According to The Chartered Institute of Building (CIOB, 2002), planning of work over the anticipated duration requires a full appreciation of the resources needed and the resources available. Planning for utilization sets the basis or plan against which progress can be monitored and assessed. This might entail the use of a short-term plan, medium term plan and a master program to enable monitoring of the work and comparing the work undertaken against the plan to allow for the redistribution of resources, if necessary, in order to speed up the work if it is falling behind plan.

Cost:

In order for cost of a project to be attained cost planning and cost control is required. Cost planning of the work will involve the development of a financial budget against which cost variances may be considered and future forecasts made in terms of using cash flow forecast. Cost control involves measuring the actual cost expenditure using interim payment certificates, and the final account against the cost budget. This cost plan i.e. a budget will be interactive with the time plan i.e. the

program of the project (Chartered Institute of Building (CIOB), 2002 and Forster, 1991).

Quality:

Kerzner (1995) states that quality management concepts are vital in order for a project manager or construction project manager to achieve good quality work at the first attempt. The concepts that need to be considered are quality plans, quality audits, quality objectives, quality policies, quality control procedures and the use of quality assurance systems. These concepts will also involve assessing the performance of the workforce using recognised performance measures. Defining the expected standard of quality, workmanship and performance for the works, in relation to the client's needs and with adequate consideration to authoritative legislation in terms of the building regulations, is also vital.

It must always be remembered that achieving a good outcome in small project starts with the planning of the work, in order to achieve the notional elements of time, cost and quality envisaged by the client. Planning, irrespective of its orientation, does not just happen because a cash flow forecast, a bar chart or quality standard specification has been prepared, but rather requires the following inputs:

- There must be a recognized programme that meets the genuine needs of both the client's personnel and the contractor's staff with regard to the main objectives of the project and the needs of the client; and
- Ensuring that people consciously work to the program, and are reassigned in case of any deviation from the original program to ensure the effectiveness of the programme in the course of the project (Hore *et al.* 1997).

The inputs stated above are both of equal importance as there is little use in specifying quality standards that need to be met if no comparison is made, and there is little use in developing a programme, cost budget or a cash flow forecast if they will not be used for managing the project parameters previously stated. It is

therefore essential to the organisation and management of small building projects that the contractor fully understands his inner plan in the context of the project and meeting the client's objectives (Weisswange, 1997).

This view comes in the "wake" of the labour intensive projects that the government has instituted in order to deliver infrastructure. Most of these developments are geared towards SMEs in the form of emerging contractors in the construction industry.

It should be understood that a plan in the form of a programme (bar chart) is the basis for planning, controlling and scheduling project activities. This plan can be incorrect in certain aspects. It will be insignificant if the arrangements for working to the plan are ineffective. It is worth noting that a plan can be manipulated by the implementation of effective management and good working practice in order counteract the ineffectiveness (Burke, 2003).

The following factors are also important in terms of planning, scheduling and controlling of time, cost and quality. These factors are:

- Project management techniques should incorporate a warning mechanism in order to detect clearly any problems when they arise. It is better to note the problems detected in the early stages of the project which can be rectified on time; and
- There must be sufficient flexibility in any project management technique to allow it to be redirected to meet changing conditions and circumstances. If planning, controlling and scheduling have these elements, it will be easy to work around small projects that have inadequate planning, controlling and scheduling techniques to produce successful results at the end of the project.

2.3.2.1 Managing time

Project sequence is a finite, time-ordered and interrelated set of tasks. The project end date may not be known for a long time, but it is assumed that it will end and it is expected to end. A project manager has to recognize that the time sequence is a key factor. Time presents a framework for the management of the project sequence and also a driving force behind the project. The management of time by networks such as the critical path method is a critical characteristic of project management (Healy, 1997).

An important factor to be noted here is that output from one phase becomes the input objective for the next phase. As the project proceeds there is a build up of greater detail in control of time and, hence, progressive elaboration is needed. It is also required that time and resources are devoted to reaching an agreement and understanding and to the maintenance of control data (Healy, 1997).

Planning is not synonymous with small building projects. This is caused by the nature of some small projects which are difficult, and sometimes impossible, to plan. This does not mean that planning is not applicable to small works. Short-term planning may be useful to the organisation and management of individual subcontractors, whilst long term and medium term planning techniques are certainly recommended for small fixed-term contracts (Weisswange, 1997).

According to The Chartered Institute of Building (CIOB, 2002), the bigger picture of project management is to ensure that, as far as possible, work is carried out effectively and efficiently with maximum time, cost and quality management to meet the genuine needs of the client, and to that extent, small works should be treated no differently. An effective and efficient project management approach for small projects will involve the client, professional team and contractor. They have to address the following:

- The requirements of the client in the project;

- An appointed expert i.e. a project manager, a quantity surveyor, an architect etc. or client will present the following requirements working drawings, specifications and contract conditions; and
- The finalized product is the interpretation of the working drawings by the contractor to accurately build the physical building on the site.

Timing is a vital aspect at the start of a project life cycle. Timing will be very unclear but an overall target start and finish date may be set (Reiss, 1992). Once the project has been confirmed and signed for, actual start and finishing times are set. Different people involved in a project are pulled in different directions. A client wants a factory to be cheap, while the architect wants to see good quality of work and the building contractor wants to finish the project as quickly as possible.

Some of the time management techniques that will be used for planning, scheduling and controlling the project will be bar charts/Gantt charts, networks (critical path network), earned value analysis, progress reporting and work breakdown structure. These techniques form part of the analysis of this research.

2.3.2.2 Managing cost

Cost is usually an important factor and therefore a section indicating the target budget is usually a good thing. A budget is prepared for each task and by adding up all the tasks you have a cash flow envelope. The actual expenditure of the project has now to be monitored and compared with the actual flow of the cash in the budget. If there are any tasks that frequently experience cost overruns, an investigation should be undertaken; likewise when some tasks are well under the budget an investigation should be conducted (Reiss, 1992).

When planning and monitoring cost, one needs to check the way in which the system provides for this need. The systems being used should be handled with care. The allocation of costs to tasks and perhaps to resources may require one to be able to total the costs of part of the project and for the whole project. One should have the ability to enter actual costs with the original budget (Reiss, 1992).

The cost control system is concerned with the control of expenses on current projects as well as the gathering of production information for use in estimating the cost of new work. The application of cost controls to a construction project actually begins when the costs are initially estimated. It is then that the project budget is established. This is the budget used by the project manager for cost control purposes during construction. Hore *et al.* (1997) argue that by maintaining a continuous check on production costs for cost-control purposes, the project cost system yields valuable information needed for the estimating of the costs of future construction work. Average production rates and unit costs are obtained from complete projects and are maintained in permanent files. These records of past experience are an individual resource for the estimator when new projects are being priced (Hore *et al.* 1997).

Good cost control therefore entails good management which take cognisance of good cost planning in terms of a cash flow forecast. Good financial planning ensures that sufficient funding is available at the right time to meet the needs of the client or contractor for short, medium and long-term capital. Short-term finance may need to be made available for the purchase of plant or machinery. In the medium or long-term the organization may need to finance the construction of a new head office. Planning the flow of cash in the organization is one of the major functions of management. The necessity of using the right personnel and management techniques is vital in order for one not to experience *incorrect cash flow* that might lead to *loss of profit* and the subsequent failure of a company (Hore *et al.* 1997).

The process of preparing a cash flow involves predicting cash flows for individual projects, which, in turn, are amalgamated into the master cash flow for the company. The master cash flow will also provide for those general overheads, which cannot be allocated to individual projects. In order to prepare a cash flow forecast information required will be the contract budget in monthly or cumulative form, contract period, payment periods, retention details, defects liability period, anticipated profit release and delay in meeting the cost committed (Hore *et al.* 1997).

Effective cash planning and control will provide visible benefits to the business such as increased efficiency and a more stable financial structure. The extent to which small and medium building contractors use the above techniques in a project for cost planning and control systems will form an integral part of this research project.

Some of the cost management techniques that are used for cost planning and controlling are: budgets, cash flow forecasts, networks, earned value analysis, interim valuations and cost breakdown structures which will form part of the analysis of this research.

2.3.2.3 Managing quality

The bitterness of quality remains long after the sweetness of meeting the schedule has been forgotten (Reiss, 1992). A high quality product or service in the market place does not, on its own guarantee either sales or business success. To this end quality and total quality must be placed in the context of a business environment. In order to achieve a quality product that meets the above requirements we will consider the following generic terms:

- Quality control; and
- Quality assurance.

- *Quality of work being done*

Quality planning and control is concerned with the techniques and activities which sustain quality to specified requirements. It is the practical means of sectoring products and services as laid down in a product specification. The basis of quality control is inspection. The outcome of this statement is that quality control is an after the fact activity which measures a product that has not been produced to customer satisfaction. Defects will be detected by post-production inspection using quality

control systems rather than being prevented (Bell *et al.* 1997). The following are typical activities in a quality control environment:

- Determination of inspection points;
- Inspection method development;
- Prevention of chronic problems; and
- Data collection analysis.

Practical quality management by small building contractors is essentially a supervisory function of the contractors' site management which consists of the following aspects:

- Provision for clear instruction and communication;
- Creating a positive working environment; and
- Inspection during work.

The last aspect mentioned above is the most crucial for small project quality control. In terms of quality performance it will be concerned with the following two aspects:

- The level of effectiveness of the work methods; and
- The input of the workforce.

According to Bell *et al.* (1997), since quality control is essentially not a prevention-based system, the process of measuring, examining, testing and comparing with relevant standards must be accurate and precise. Employing more inspectors and detecting more defects does not promote or improve quality in the medium or long term. It is believed that the inspection process is costly and adds no value to the organisation or the product. Even if all the defective parts are removed before delivery to the customer, the cost of incurring the defective products in the first place will be passed to the customer in some way (Bell *et al.* 1997). Hauptfleisch (1999) further states that quality control is of equal importance to refurbishments, alterations, repairs, maintenance and even “re-do” work.

According to Alshawi and Ingirige (2003), reworking or redoing the work may be caused by conflicting information not received in time by the parties concerned. They further state that the projects are normally managed according to the experience of the project managers who are specifically appointed for this task. Each project manager, even within the same organization, prefers to follow his/her own experience, which has been developed over a long period of time. These practices lead to large variations in management practices which can have a significant impact on the ability to coordinate and control project information in order to achieve the desired results.

Small works do not readily facilitate accurate measurement of performance as works may differ widely, they have a broad range of values and sizes, and different construction methods may be used. These differences make precise definition and quantitative evaluation difficult; a simple method before and after assessment is needed. Although this approach may be considered somewhat rudimentary, it is paramount that any method used to assess performance be simple and intelligible to both management and the workforce (Weisswange, 1997).

According to Wessel (2002), costs of quality are incurred throughout the construction process with some easily identified while others are difficult to define and quantify. Costs are incurred before the actual construction of the building. Prevention costs have to be investigated. These are normally comprised of quality planning, quality assurance, inspection of work, training and improvement.

– *The control of the performance of the workforce*

Quality assurance (QA) recognizes that inspection is not enough in itself to remedy quality problems. Quality assurance focuses on procedure compliance and product conformity to specification through product and operations. Management tracking assists in preventing quality problems from arising rather than detecting these problems as is the focus in quality control. Inspection and quality control are important tools, but more planning and systematic actions are required to prevent these problems. Quality assurance activities consider the following:

- How an organisation develops policies in respect of quality;
- The allocation of responsibilities within the organisation structure;
- Procedures used to carry out the needs of the business;
- The standards to be attained in the workplace; and
- The documentation required to demonstrate both the operation and maintenance of the system and the attainment of quality (Bell *et al.* 1997).

In terms of any project, total quality management will focus on the interaction of the external customer, the external supplier, stockholders, society at large and the organisation itself and, specifically, on the effective and efficient management of the process to satisfy the needs of this enterprise. For the services and products to be delivered on time, at the projected budget and to the right quality there must be an internal customer relationship (Bell *et al.* 1997).

An analysis of the formal quality management techniques used by small and medium, building contractors formed part of this research study. Some of these techniques are inspection, specification, performance measurement, project standards and procedures of the project.

CHAPTER 3

3. RESEARCH METHODOLOGY AND DESIGN

3.1 Introduction

This chapter provides details of the research methodology outlining the methods employed in analyzing the data that was gathered during the pilot survey and during the actual research project.

3.2 Selection of the research methodology

The first step in conducting this research involved the selection of the appropriate methodology in order to gather information about the project management techniques used by small and medium sized building firms. Because of the vast geographical area of South Africa such firms were not easily accessible. It was therefore decided to conduct the research in Gauteng. It was also decided to employ a descriptive survey method to gather data. A pilot survey was conducted based on semi-structured and open-ended interviews (*see appendix B*) with two small contractors to ascertain how accurate and adequate the data collected would be. The pilot survey revealed the need for the research to incorporate a structured interview questionnaire in order to refine the research instrument to assist with the in-depth collection of all the relevant project management techniques and tools that may be utilized by small and medium construction enterprises. These techniques were obtained from relevant literature.

According to Kothari (1995), the major purpose of descriptive research is to describe the state of affairs as they currently exist, including fact-finding and surveys of different kinds. The researcher utilizing this method has no control over the variables as one can only report what has happened or what is happening. Descriptive research is also ideal to investigate causes even when variables can not be controlled. The methods of descriptive research include comparative and correctional methods.

Leedy (1993) further describes the rationale underlying this method as allowing the researcher to judge based on what has happened and what may happen again in future since there is, within limits, conformity and uniformity in life process. Drawing conclusions from one transitory collection of data allows one to extrapolate what is likely to happen again under similar circumstances. Although this is conjecture which can be hazardous it is one way in which to generalize what we see.

On the basis of this, it was decided that a sample of small and medium sized building construction firms undertaking projects related to either civil or building works or both would be selected. Data would be gathered from senior managers of these companies which would allow the researcher to formulate some general views about these firms relevant to the research questions formulated in chapter one. Leedy (1993) supports this methodology by arguing that when one selects from a large sample a well chosen few and then observe with insight, they will tell you more than all the multitudes together. This is the way we must learn, by sampling judiciously, by looking intently with the inward eye. Then from the few that you have, tell us what you see to be the truth.

3.2.1 Data collection method

There are two types of data that can be collected *viz:*

- Primary data; and
- Secondary data.

Primary data are those data which are collected for the first time, hence they have to be original in character, while secondary data are those data which have already been collected by someone else and have already been passed through the statistical process (Kothari, 1995).

3.2.2 Methods of collecting primary data

From the many methods of collecting primary data available, this research used the following types of interview questionnaires:

- Semi-structured interview questionnaires;
- Structured interview questionnaires; and
- Open-ended interview questionnaires.

The decision to use the above methods was reached for the following reasons:

- As much as interviewing is suitable for quantitative data collection, it is also very useful when collecting qualitative data; and
- The flexibility of the tool when interviewing the selected sample i.e. interviewing the respondents either by:
 - Telephone or
 - Face-to-face (Kothari, 1995).

Open-ended interview

This method was decided upon because of the need to explore the situation and obtain information which cannot be predicted (Frankfort-Nachmias and Nachimas, 1994).

Semi-structured interview

This method falls between the structured and the open-ended interview. The aim of choosing this method is to achieve defined answers to defined questions, while allowing for the further development of the answers provided.

Structured interview questionnaire

Litkowski (1991) states that the structured interview can be conducted either through face-to-face or by telephone. The researcher asks the same questions of numerous individuals representing numerous organizations in a precise manner, offering the interviewees the same set of possible responses.

3.2.3 Research approach to the structured interview

It was decided to incorporate a model of project management phases, distilled from the relevant literature reviewed into the structured interview. This allowed for a comprehensive assessment of the application of project management techniques based on the responses provided.

It was stated in the literature review that project management techniques differ from one project to the next depending upon the nature, complexity and cost of the project. Detailed information on project management techniques was provided in the literature review and will be used in the model below (Healy, 1997):

- *Initiation phase* is when the project is identified and its feasibility tested;
- *Design or planning phase* is when the drawings and specifications for the project are prepared;
- *Implementation or construction phase* is when the building is physically being constructed; and
- *Handover or close out phase* is when the completed structure is handed back to the client.

3.3 The sample to be interviewed

Introduction

The literature review revealed that there are 8 769 small and medium enterprises i.e. formal contractors in South Africa (CETA, 2003).

Table 3.3.1 Statistics of contractors

Size	Number of active enterprises	Employment
Very small	416	1355
Small	1174	4579
Medium	7595	69 270
Large	2673	102663
Very large	510	102 464
Total	12368	280 331

Source: Construction Education Training Authority (CETA Website, 2003)

The target sample size for this research was thirty (30) contractors, however only fifteen (15) contractors agreed to be interviewed. This represented a 50% usable response rate. Some contractors claimed that they were too busy to be interviewed while others were not interested in participating in the research. The contractors interviewed were either members of the Gauteng Master Builders Association (GMBA) or the National Home Builders Registration Council (NHBRC) in Gauteng. It was pre-determined that the companies selected were categorized as small and medium companies according to the definition presented previously. The sample was obtained from the GMBA website. The various companies were contacted telephonically in order to make an appointment for the interview.

3.3.1 Target group

As stated in the literature review many construction companies fail within the first three years of business. Consequently the small and medium contractors selected for this study had to have been in business for at least one year. It was important to know the status of the company as the liquidation rate has decreased from 554 in the year 2000 to 371 in 2002 (Van Wyk, 2003).

It was decided to gather data from the senior managers of small and medium sized building and civil contractors (SMEs), in order to allow the researcher to formulate some general opinions about these companies. The target companies should have been in business for a minimum period of one year and have carried out various projects, as newly registered firms might not yet have completed any projects.

3.3.2 Sample size and method of sampling

A sample is a selected number of cases in a population. Sampling must be carried out whenever information is required from only a fraction of the population which you want to study. Ideally the select sample should be free of bias (Kothari, 1995).

The sampling design that was adopted was non-probability sampling. This sampling technique does not show any bias in estimating the probability that each member of the population has of being included in the sample (Frankfort-Nachmias and Nachmias, 1994).

The contractors were deliberately chosen to be representative of small and medium contractors. Kothari (1995) indicates that, when using non-probability sampling, the researchers purposively choose the particular units of the population which constitute the sample on the basis that the small mass that they select will be typical or representative of the whole population. Walliman (2001) also believes that purposive sampling gives the researcher a typical sample to rely upon in terms of in-depth study of the form and substance of a phenomenon.

The information gathered from the sample target group utilizing various methods of data collection was analyzed in order to answer the following research objectives:

- To determine the combined characteristics that currently exists in small and medium enterprises and their personnel;
- To determine the adequacy of the project management techniques utilized by SMEs to manage their projects;
- To determine whether using formal project management techniques as a management tool will improve delivery of projects in terms of time, cost and quality; and
- To determine the external and internal factors that affect the implementation of project management techniques.

3.4 Pilot Survey

Introduction

A pilot survey was conducted using one semi-structured and one open-ended questionnaire interview. The researcher decided to conduct one of the interviews via telephone and the other via e-mail. This was decided since time was a crucial factor as the contractors approached for face-to-face interviews, which are cited as being the most effective, replied that they had no time.

The interview questionnaire was constructed using the theory base drawn from the literature review. The pilot questionnaire and results of the two pilot study interviews are attached in **appendix B**. The purpose of the pilot questionnaire was to test the tool to be used during the research. The researcher ensured that all relevant theoretical areas were covered. In order to respect the respondents' time and to avoid the possibility of losing the attention of the interviewee, the range of open-ended questions was purposely limited. The questionnaire was structured into two main sections as follows:

Section A, which was semi-structured, aimed to ascertain the following:

- The type of business conducted by the company;
- The respondent's position, level of expertise, academic background and experience; and
- Whether the company selected did in fact fall within the definition of a small or medium sized construction company.

Section B consisted of open-ended questions which aimed to establish the following:

- The extent to which respondents used formal project management techniques to manage their particular projects, how effective the

techniques used were and whether they improved the delivery of their projects; and

- The factors that hinder the implementation of formal project management techniques. These factors might either be internal or external.

The data collected were analyzed as follows:

The responses to section A biographical questions of the interview questionnaires were analyzed using descriptive analysis technique.

The responses to section B open-ended questions were analyzed manually using content analysis to identify any recurring themes (Richardson, 1998). The recurring themes would be either adequately used techniques or the success of the various techniques in use. Factors hindering the implementation of project management techniques were analyzed to obtain the recurring factors.

The analysis and interpretation of the data gathered from this pilot interview questionnaire identified difficulties with collecting data about the various project management techniques used at different phases of a project. The questionnaire was therefore reviewed and the questionnaire in *appendix C* was then adopted for this research. The research instrument used was then structured as follows:

Section A, which was semi-structured, aimed to ascertain the following:

- The type of business conducted by the company and whether the contractors were small or medium enterprises; and
- The respondent's position, level of expertise, academic background and experience.

Section B was formulated to be a structured interview questionnaire which intended to ascertain the following:

- The usage, necessity, importance and adequacy of use of the various project management techniques.

Section C was as open-ended questionnaire interview, which was a follow up to section B, to establish the:

- The extent to which respondents used formal project management techniques to manage their particular projects how effective the techniques used were and whether they improved the delivery of their projects; and
- The factors that hinder the implementation of formal project management techniques. These factors might either be internal or external.

The nature of the questions in section A of the interview questionnaire necessitated the classification of the data as follows:

3.5 Classification of the collected data

The following methods were used to classify the data collected using the semi-structured interview questionnaire:

3.5.1 Classification according to attributes

Collection according to attributes allows data to be classified on the basis of common characteristics, which can either be descriptive (such as literacy, sex and profession) or numerical (such as annual turnover, working experience and income). Descriptive characteristics refer to qualitative phenomenon, which cannot be measured quantitatively (Kothari, 1995).

3.5.2 Classification according to class-intervals

Unlike descriptive characteristics, the numerical characteristic refers to quantitative phenomena, which can be measured utilizing statistical units. Such data is known as statistics of variables and are classified on the basis of class intervals. In this research the exclusive type class interval was adopted.

An exclusive type class interval is where items whose values are equal to the upper limit of a class are grouped in the next, higher class e.g. an item whose value is exactly 30 would be put in the 30-40, class interval and not in the 20-30 class interval (Kothari, 1995).

3.6 Methods used to analyze the data obtained from the research

Descriptive analysis was used to analyze the data in section A semi-structured interview questionnaire.

3.6.1 Descriptive analysis

Descriptive analysis was adopted to analyze the data collected from the semi-structured interview. Kothari (1995) states that descriptive analysis is largely the study of the distribution of one variable, it allows for the analysis of company profiles, work groups and other subjects according to any of the following multiple characteristics such as size, composition and efficiency. This sort of analysis may be in respect of one variable, two variables and even more than two variables. In this context we work out measures that show the size and shape of the distribution(s) as well as measuring relationships between two or more variables.

A severity index was used to analyze section B of structured interview questionnaire.

3.6.2 Severity index

A severity index was used to analyze the data in section B which was obtained from the structured questionnaire interview. The project management techniques were classified as either extremely important, slightly important, neutral, slightly not important and not at all important. The categorization also applies to the other variables. For each project management technique, a severity index is determined by calculating the percentage of respondents giving responses of either extremely important, slightly important, neutral, slightly not important and not at all important (Baldwin *et al.* 1971). The severity indices were used to rank the project management techniques in order of necessity, importance and adequacy of use, using the mean of each project management technique. This data was analyzed manually. A weighted score was calculated manually to analyze the data in Table 4.3.1 and 4.3.2, and Table 4.3.10 to 4.3.12 by multiplying the number of respondents and the rank score to get the weighted score. The weighted scores of each technique were then added and divided by the number of respondents in order to obtain the mean score. The mean scores were then ranked to attain the position of each project management technique.

In analyzing the data in Tables 4.3.1, 4.3.2, 4.3.10 and Table 4.3.12, equations 1, 2 and 3 were used i.e.

Computation of Mean Score

$$Wt. Sc. = Sc./Y.....Equation (1)$$

$$MS = \frac{\sum Wt.Sc}{TR}Equation (2)$$

Adopted from Frankfort-Nachmias and Nachmias (1994).

Wt. Sc. = weighted score

Sc. = number of respondents per technique

Y = weight given to each possible response e.g. 1 = Totally unnecessary, 2 = unnecessary etc.

MS = mean score of each variable i.e. technique

TR = Total response

Computation of standard deviation

$$s^2 = \frac{1}{n-1} \left[\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{\sum f_i} \right] \dots \dots \dots \text{Equation (3)}$$

Adopted from Frankfort-Nachmias and Nachmias (1994).

*s*² = the variance which needs to be rooted to find the standard deviation

n = the sample size

f_i = the frequency of the respondents

x_i = the weight of the variables i.e. 1 = unnecessary etc.

Computation of the percentage response

Equation 4 was used to analyze the data in Table 4.3.3 to Table 4.3.9 in order to establish the frequency of the response. The percentage response of each technique was then ranked using the percentage outcome of the yes answers. The percentage response of each variable was also calculated by dividing the number of responses of a variable by the total number of respondents multiplied by 100 i.e.

$$X = \frac{W}{Y} \times 100 \dots \dots \dots \text{Equation (4)}$$

W = Number of respondents in a column of the table

X = percentage response

Y = total number of respondents interviewed

Content analysis was adopted to analyze the data in section C which consisted of open-ended questions

3.6.3 Content analysis

Content analysis is a method of examining records of all kinds (e.g. radio and television programs), documents or publications. A checklist is prepared to allow the researcher to count how frequently certain ideas, words, phrases, images or scenes appear in order to be able to draw conclusions from the frequency of their appearance e.g. the perception of modern architecture in the media (Walliman, 2001).

It is worth noting that the analysis of content is a central activity whenever one is concerned with the study of the nature of verbal materials in a text. A review of research in any area, for instance, involves the analysis of the contents of research articles that have been published. The analysis may be at a very simple level or at a subtle one (Kothari, 1995).

The steps followed in content analysis methodology include:

- Transferring the data onto a matrix in which the columns denote the emergent themes, and the rows the respondents;
- Entering data evidence into the relevant columns by building short sentences recorded from the interview; and
- Analyzing the data to establish where the consistency of the respondents lies.

CHAPTER 4

4. ANALYSIS OF THE DATA

4.1 Introduction

The data gathered during the interview was analyzed using the various methods described in chapter three which are descriptive method, severity index and content analysis hence the results are presented in this chapter.

4.2 Semi-structured questionnaire analysis

In this section, the description of the questions the respondents were asked is outlined, and hence explanation of the purpose of each question before outlining the responses obtained from the respondents. This section was to establish the personnel in charge of planning, verify the definitions of small and medium contractors given in the introduction chapter in terms of annual turnover and number of permanent employees. Furthermore, to establish the education background, experience of the interviewee, magnitude of projects at present and in the past, current projects being undertaken by their own company and if the recipient has attended any management courses.

Question 1

Who in your company is responsible for project planning on given projects?

To identify who is in charge of planning the project

Table 4.2.1. Titles of personnel responsible for planning

Title of personnel	Size of firm		Total
	Small construction firm	Medium construction firm	
Construction manager	2	0	2
Contracts manager	3	3	6
Managing director/partner	5	2	7
Other	0	0	0
Total	10	5	15

The small and medium sized enterprises were purposively sampled, which was a pre-determined exercise and hence it was to verify if the contractors were in their respective categories. The categorization was obtained from the Gauteng Master Builders Association web site and the definition from relevant literature. From the result in, Table 4.2.1, it can be inferred that, planning in many small and medium enterprises is carried out by contract managers and managing directors. The aspect of using managing directors attests to the fact that many SMEs are managed single handedly. Griffin (1990), concurs with this result. He argues that in small firms they have managerial competencies, and work hard to enable growth to take place. Hence most personnel in charge of SMEs are multi-skilled. This aspect might also be detrimental to the managing of their projects because of the dependency of one personnel to manage the projects.

Question 2

What field of business does your company specialize in?

To find out what kind of business the contractor does.

Table 4.2.2 Nature of business conducted by the SMEs (contractors)

Type of business conducted	Size of firm		Total
	Small construction firm	Medium construction firm	
Home improvement	4	0	4
Building construction	6	4	10
Civil engineering construction	0	0	0
Other (commercial projects)	0	1	1
Total	10	5	15

From the result in, Table 4.2.2 above, most of the respondents’ (SMEs) interviewed are in the field of building construction as ten (10) of the contractors alluded to this, while four of the contractors were involved in home improvement and one contractor was involved in commercial projects. This suggests that SMEs who engage in home improvement and commercial properties are quite few, which might be due to the nature of the industry where majority of SMEs might not be able to tackle diverse types of projects that large contractors will be able to compete for.

Griffin (1990), concurs with this result as he indicates that SMEs are involved in different kinds of construction activities. From the result it can therefore be perceived that majority of small and medium contractors are involved in building construction projects, which might be of their capability.

Question 3

What is your company’s estimated annual turnover?

To identify if the contractor is either a small or a medium contractor

Table 4.2.3 The range of annual turnover of the different SMEs (contractors) interviewed

	Size of firm	Size of firm	
Turnover of the companies	Small construction firm	Medium construction firm	Total
Less than R1m	2	0	2
Between R1m-R 5m	6	0	6
Between R5m-R10m	1	0	1
Between R10- R50m	1	4	5
Above R50m	0	1	1
Total	10	5	15

From the result in, Table 4.2.3, it indicates that the turnover of the contractors concurs in terms of the range stated in the definition. Despite the fact that one of the medium contractors had a turnover of over R50 million and one of the small contractors had a turnover of over R10 million. As per this result it partially concurs with Dlungwana *et al.* (2002), definition, despite the observation of these two contractors. The sample selected was purposive hence the result was fulfilled of the ideal categorization of the contractors.

Question 4

How many permanent employees does your company have?

To further categorize a contractor as either a small or medium contractor

Table 4.2.4 Number of permanent employees in respondent companies

	Size of firm		
Range of permanent employees	Small construction firm	Medium construction firm	Total
Less than 20	8	1	9
Between 20-50	2	0	2
Between 50-200	0	3	3
More than 200	0	1	1
Total	10	5	15

From the result above, Table 4.2.4, the definition of small contractors concurs with the definition of DTI (1995), and National Small Business Act (1996), all the ten (10) small contractors had permanent employees between five (5) and fifty (50), only three (3) of the five (5) medium contractors were in the category of their appropriate definition. The other two (2) had either less than twenty (20) permanent employees or exceeded two hundred (200) permanent employees. From this analysis there is a slight disparity of the medium contractors permanent employees. This might have been attributed by the amount of work being undertaken by the contractors currently. Despite having exceeded two hundred (200) employees and one with less than fifty (50) employees the respondents were still medium contractors as this sample was purposive, hence the purpose was fulfilled.

Question 5

What is the average number of completed projects in the last 3 years and the approximate value of the largest?

To see if the contractors have been busy in the industry and hence the value of the largest project executed.

Table 4.2.5a Number of projects completed by the contractors in the last 3 years

Range of number of projects completed in the last 3 years	Real class limits of projects	Frequency	Cumulative frequency
1-20	0.5-20.5	9	9
21-40	20.5-40.5	4	13
41-60	40.5-60.5	0	13
61-80	60.5- 80.5	1	14
81-100	80.5-100.5	0	14
101-120	100.5-120.5	1	15
		$\sum f=15$	15

$$Md = L + [N(0.5) - cf_{below} / f]w \dots \dots \dots (5)$$

Adopted from Frankfort-Nachmias and Nachmias (1994).

Where

Md = the median

L = lower limit of the interval containing the median

cf_{below} = the cumulative sum of the frequencies below the interval containing the median

f = the frequency of the interval containing the median

w = width of the interval containing the median

n = the total number of cases

$$\text{Median} = 15/2$$

$$= 0.5 + [7.5 - 0/9] \times 20$$

$$= 0.5 + [7.5/9] \times 20$$

$$= 0.5 + 16.67$$

$$= 17.17 \text{ projects in the last 3 years i.e. approximately 6 projects per year}$$

From the result in, Table 4.2.5a, it reveals that nine (9) of the contractors had completed between one (1) and twenty (20) projects in the last three (3) years at an average of six (6) projects per year, four of the contractors had completed between twenty (20) and forty (40) projects and one had completed over hundred (100) projects in the last three years. The number of projects completed by these contractors enabled them to be in business and be active. The project sizes might have differed in size and nature to enable one small contractor to complete over hundred projects in the last three years. DPW's, (1999), concurs with this result, as its policy of promoting SMEs to cater for employment and work not being undertaken by large contractors.

Table 4.2.5b Approximate value of the largest project completed in the last three years.

Approximate range of the largest project	Real class limits of project cost	Frequency	Cumulative frequency
1-10m	0.5-10.5	10	10
11-20m	10.5-20.5	2	12
21-30m	20.5-30.5	1	13
31-40m	30.5- 40.5	2	15
		$\Sigma f=15$	15

Using *equation 5* to analyze the data in Table 4.2.5b

$$\text{Median} = 15/2$$

$$= 0.5 + [7.5-0/10] \times 10$$

$$= 0.5 + [7.5/10] \times 10$$

$$= 0.5 + 7.5$$

= R8 million worth of project were completed in the last 3 years by the contractors

From the result in Table 4.2.5b, it indicates that majority of small and medium contractors embarked on projects varying between R1 and R20 million. The values stated were the largest values of any project carried out in the last three years. This result suggests that the contractors were able to undertake projects that they were capable of. Only three contractors carried out projects that were between R20m – R40 million this result indicates that the government is achieving its policy of bringing small and medium contractors in the main stream of the economy.

Question 6

What is the average size of your current projects?

To be able to establish the magnitude of work being executed in terms of cost

Table 4.2.6 Average value of the current projects

	Size of firm		
Range of value of the current project	Small construction firm	Medium construction firm	Total
Less than R1m	4	0	4
Between R1m-R5m	4	1	5
Between R5m-R10m	2	2	4
Between R10m-R20m	0	0	0
Between R20m-R40m	0	2	2
More than R40m	0	0	0
Total	10	5	15

From the result in Table 4.2.6 above, all the small contractors are working on projects, which are less than R10 million. This result indicates that small contractors have a competitive advantage when undertaking projects that are less than R5 million, as verified by eight contractors. Whereas, medium contractors have the competitive advantage when undertaking projects, that are between R5 million and R40 million. The overlap of the various, range, of current projects may be attributable to the fact that the industry is competitive and hence the medium contractors would have an upper hand over the small contractors, even if the magnitude of work is more appropriate for small contractors.

Question 7

How many projects do you have running at this point in time?

To see if the contractor has some work at the present moment

Table 4.2.7 Number of projects the contractors are engaged in at present.

	Size of firm		
The range of projects being undertaken by the contractors at present	Small construction firm	Medium construction firm	Total
Between 0-2	5	2	7
Between 2-10	5	3	8
Between 11-20	0	0	0
More than 20	0	0	0
Total	10	5	15

From the result in Table 4.2.7 above, eight (8) of the contractors are undertaking between two (2) to ten (10) projects at the present moment and the other seven (7) contractors are busy with less than two projects. The results outlines that all the contactors have work to do at the present moment. There is definitely a reflection that the SMEs interviewed were busy with various projects. This sets the platform for one to have confidence in knowing the contractors are busy with various projects, hence implementing their managerial expertise.

Question 8

What is your current position in the company?

To verify the job title of the recipient

Table 4.2.8 Job titles of the personnel interviewed.

	Size of firm		
Current job description	Small construction firm	Medium construction firm	Total
Construction manager	3	1	4
Project manager	0	0	0
Managing director/partner	7	3	10
Other	0	1	1
Total	10	5	15

From the result in Table 4.2.8, of the personnel interviewed, ten (10) of them were managing directors, four were construction managers and one was a quantity surveyor who was involved in managing financial aspects of the company. The personnel interviewed were also involved in planning for their projects at the present time, and had been in the planning position in the past. Fourteen (14) of the personnel interviewed planned their projects. Griffin (1990), concurs with this result as these managers are exercising their managerial expertise. This result suggests that majority of SMEs are managed by managing directors.

Question 9

How many years of experience do you have in your current position?

To see if experience has an implication in delivery and management of SMEs project.

Table 4.2.9 Years of experience of the personnel interviewed.

	Size of firm		
Range of experience in the current position	Small construction firm	Medium construction firm	Total
Less than 3years	1	1	2
Between 3-6years	1	1	2
Between 6-10years	0	0	0
More than 10years	8	3	11
Total	10	5	15

From the results in Table 4.2.9 above, eleven of the personnel interviewed had more than ten years experience in their current position, two of the personnel had less than three (3) years experience and the other three had between three (3) – six (6) years of experience. This result indicates that there is ample experience among the personnel interviewed. Six of the managing directors had more than ten (10) years of experience in their current positions, three construction managers had more than ten (10) years in their current position and the quantity surveyor interviewed had more than ten (10) years of experience in his current position. This result indicates that eleven (11) of the personnel have been working in the same position for the last ten (10) years. This is an array of experience, which has been tapped in the small

and medium enterprises in the construction industry. The result signifies the essence of managing small and medium construction companies with experienced personnel. This result addresses research question *objective 1* formulated in chapter one. Weisswange (1998), concurs with this result that small and medium contractors are managed by experienced personnel.

Question 10

What is your highest educational qualification?

To see if education has a significance in management of projects

Table 4.2.10 Level of education at qualification of the personnel interviewed

Educational qualification	Size of firm		Total
	Small construction firm	Medium construction firm	
Grade 11 or standard 9 and below	1	0	1
Matric	1	0	1
Certificate	0	0	0
HND, Diploma	5	1	6
Bachelor's degree	2	2	4
Post-graduate degree or diploma	0	1	1
Other	1	1	2
Total	10	5	15

From the result in Table 4.2.10, only two of the contractors had a matric qualification and below whereas the other thirteen (13) personnel interviewed had a tertiary qualification i.e. from diplomas to post graduate qualifications. Thus many projects undertaken by SMEs are being managed and run by educated personnel. The personnel with matric qualification and below had over ten years of experience in the industry as well as in their current positions, which might have played a part in enabling them to manage their projects. They were also managing directors of their companies. The other eight (8) managing directors had tertiary qualifications. From this result it seems that education and experience do complement each other in projects carried out by SMEs, as the personnel have to be multi-skilled and innovative, according to Griffin (1990). This result addresses research question, *objective 1* formulated in chapter one.

Question 11

How many years of experience do you have in the construction industry?

Experience of SMEs personnel in construction industry

Table 4.2.11 Years of experience of the personnel interviewed in the construction industry.

	Size of firm		
Range of years of experience	Small construction firm	Medium construction firm	Total
Less than 3 years	1	0	1
Between 3-6 years	2	1	3
Between 6-10 years	0	1	1
Above 10 years	7	3	10
Total	10	5	15

From the results in, Table 4.2.11, the experience of the respondents in the construction industry (CI) had some similarity with the experience of the personnel in their current positions Table 4.2.9, ten of the respondents interviewed had more than ten (10) years of experience in the industry, three of the personnel had between three (3) – six (6) years of experience in the CI. Only one respondent had less than three (3) years of experience in the CI. Weisswange (1998), concurs with this result. The result suggests that majority of the personnel are experienced hence, able to be managing directors of their companies. It can also be suggested that years of experience in the construction industry and education might enable the personnel to have come across various challenges in their workplaces and hence able to solve problems that might arise. This result addresses research question *objective 1* formulated in chapter one.

Question 12

How often do you attend refresher courses of management?

To see if the recipients update themselves with current management aspects in the industry

Table 4.2.12 Attendance of management courses by the personnel.

	Size of firm	Size of firm	
After how long do the respondents attend refresher courses	Small construction firm	Medium construction firm	Total
After 6 months	3	0	3
After 1 year	1	0	1
After 1 ½ years	1	0	1
Not at all	5	5	10
Total	10	5	15

From the results in, Table 4.2.12, ten of the personnel interviewed haven't attended any refresher courses, whereas five (5) of the respondents interviewed have attended refresher courses pertaining to management in the last two years starting 2004. The result indicates that majority of personnel interviewed do not attend these courses. There is a need to keep abreast with what is taking place in management field due to the changing aspects of management activities. The techniques of, project management, are bound to be updated and, one needs to keep abreast with changes in this field of profession. Project management techniques are vast and they change rapidly and hence the need of the personnel updating themselves pertaining to the current management techniques, this enhances the management skills and leads to better ways of managing projects.

4.3 Structured interview questionnaire analysis

This section of the questionnaire interview was meant to explore the various project management techniques at different phases of project management when managing projects. The data has been analyzed manually using severity index for Tables 4.3.3 to 4.3.9, *equation 5* was used to analyze these data. The percentage of *yes* response,

were used to rank the various techniques at the different phases of project management. In Tables 4.3.1, 4.3.2, 4.3.10, 4.3.11 and 4.3.12 a weighted score was calculated, a mean score determined and a standard deviation calculated to determine the dispersion of the respondents response, which determined the necessity of project management, project management techniques, necessary, important and adequately used techniques respectively. *Equation 1, 2 and 3* were used to analyze these data. The weighted score of each variable were then added and divided by the number of respondents in order to obtain the mean score. The mean scores were then ranked to attain the required position of each project management technique.

Calculation of the Mean score

Wt. Sc. = $Sc./Y$*Equation (1)*

$$MS = \frac{\sum Wt.Sc}{TR} \dots\dots\dots \textit{Equation (2)}$$

Adopted from Frankfort-Nachmias and Nachmias (1994).

$$s^2 = \frac{1}{n-1} [\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{\sum f_i}] \dots\dots\dots \textit{Equation (3)}$$

Adopted from Frankfort-Nachmias and Nachmias (1994).

Calculation of the percentage response

Equation 4 was used to analyze the data in Table 4.3.3 to Table 4.3.9 to establish the frequency of the response. The percentage response of each technique, were then ranked using the percentage outcome of the *yes* variable. The percentage response of each technique was calculated by dividing the number of responses of a variable to the total number of respondents multiplied by 100 i.e.

$$X = W/Y \times 100 \dots \dots \dots \text{Equation (4)}$$

W= Number of respondents in a column of the table

X=percentage response

Y= total number of respondents interviewed

1. How necessary do you consider project management on a scale of 1-5?

1= Totally unnecessary; 2=unnecessary; 3=neutral; 4=necessary; 5=totally necessary

To verify the necessity of project management in managing small and medium enterprises projects

Table 4.3.1 Necessity of using project management.

Totally unnecessary	Unnecessary	Neutral	Necessary	Totally necessary	Mean	Std. Dev.
6.7%	0.0%	0.0%	13.3%	80.0%	4.60	1.06

The result in Table 4.3.1 above concurs with Kerzner (1995), and Knipe et al. (2002), that majority of the contactors agreed that project management is necessary as it attained a mean = 4.60, which was above the midpoint value of 3.0. This high response might have been caused by the good level of education of the personnel interviewed and the, availability of literature on project management. 6.7% of the contractors felt that project management is totally unnecessary this might indicate the misunderstanding of the concept of project management or the contractor not wanting to accept change. Bates *et al.* (1999), and Haupt (2001), concurs with the latter assumption.

2. How necessary do you consider project management techniques on a scale of 1-5?

1=totally necessary; 2=unnecessary; 3=neutral; 4=necessary; 5=totally necessary

To verify the necessity of project management in managing small and medium enterprises projects

Table 4.3.2 Necessity of using project management techniques.

Totally unnecessary	Unnecessary	Neutral	Necessary	Totally necessary	Mean	Std. Dev.
0.0%	0.0%	6.7%	20.0%	73.3%	4.67	0.61

The results in Table 4.3.2 above was a follow up to results in table 4.3.1, it indicates that majority of respondents agree that project management techniques (PMTs) are necessary in managing the projects they are undertaking as they attained a mean = 4.67. The necessity of PMT might have been attributed due to the education level of the personnel, years of experience of the personnel and available literature on project management techniques. However, it can be suggested that the respondents might not be using the techniques although they agree that they are necessary.

3. Should construction projects be managed in stages?

To see that contractors are aware of the life cycle of a project in project management.

Table 4.3.3 The need to manage construction projects in stages/phases.

Stages	Yes	No	Don't know	Ranking
Management of projects in stages	100%	0.0%	0.0%	1

From the result in Table 4.3.3, 100% of the respondents agree that their projects should be managed in stages/phases. The experience of the various personnel interviewed might have played a significant role as they have been in the industry for quite sometime as indicated in Table 4.2.11. This result suggests that different activities will be conducted in different phases of a project. Some activities will be intense in some phases, whereas in others they will be less intense in terms of the depth of the work involved. Healy (1997), Bates *et al.* (1999), Belout and Gauvreau (2004), concurs with this result.

4. If ‘yes’ tick the project management life cycle that you use in your projects?

To see which phases of the life cycle of project management suits the SMEs projects.

Table 4.3.4 Project management life cycle for SMEs projects.

	Yes	No	Ranking
Initiation, planning, construction & handover phases	100%	0.0%	1
Initiation and planning phase	0.0%	0.0%	2
Initiation phase	0.0%	0.0%	2
Initiation, planning, & construction phases	0.0%	0.0%	2

This question was a follow up of *question 3*, Table 4.3.3. From the results in Table 4.3.4 above, all the respondents hundred percent agreed that their projects should be managed using project management life cycle i.e. initiation, planning/design, construction and hand over phases. This response was complementary of the response given in Table 4.3.3. It is quite clear that the personnel are aware of these project management phases. This might be due to the project tasks having to be managed in the various phases and the intensity of one activity will differ from one phase to another. Even though two of the personnel had no tertiary education but they had vast experience in the CI concurred with the response of managing their projects in different phases. Healy (1997), Bates *et al.* (1999), and Belout and Gauvreau (2004), concurs with the result, that projects should be undertaken in phases.

5. Should project management techniques be used during the project management phases?

To explore essence of project management techniques during project management phases.

Table 4.3.5 Use of project management techniques during the project management phases.

Use of project management techniques	Yes	No	Don't know	Ranking
Project management techniques	100%	0.0%	0.0%	1

The result in Table 4.3.2 indicates that majority of contractors agreed that project management techniques are necessary in managing their projects and in Table 4.3.5, the respondents have agreed that the techniques should be used during the different phases of project life cycle. This positive result suggests that the respondents might have access to the range of literature on project management techniques that are available. Reiss (1992), and Walker (2002), concurs with this result.

6. If “yes” which project management techniques do you use during the initiation stage?

To explore the usage of project management techniques during the initiation phase.

Table 4.3.6 Project management techniques used during the initiation phase.

Technique	Yes	No	Ranking
Project administration meeting	93.3%	6.7%	1
Establish management procedures	80.0%	20.0%	2
Expert judgment	80.0%	20.0%	2
Establish project initiation plan	66.7%	33.3%	4
Project selection method	60.0%	40.0%	5
Establish the project management environment and workbook	40.0%	60.0%	6

The various project management techniques terminologies were described to the respondents where they did not understand the meaning. The cut off margin of analyzing the frequency of using the techniques was pegged at 80% or more of the response rate. This cut off was decided because of the number of respondents interviewed, which was fifty percent of the respondents.

From the result in Table 4.3.6, it indicates that of the six (6) techniques stated three (3) of them were widely used; these were project administration meeting, establishing management procedures and expert judgment. The other techniques reported usage but were infrequently used as they reported a usage of less than 80%. The infrequent use of some of the techniques might have been caused by the nature of projects undertaken by the SMEs and also probably by the overlap of some of the tools and techniques in use. The high incidence of using a project administration meeting is due to the fact that it is a tool or technique of bringing the personnel

together within a company in order for them to plan for the entire project. This is when the personnel to be involved in a project, however small it is, will need to share ideas. Aqua Group (1990), concurs with this result that meetings are of importance.

The high response rate on these techniques could have also been attributed to the level of education of the personnel interviewed as over 85% of the personnel had a tertiary education from diplomas to postgraduate degree and over ten (10) years of experience in the construction industry. The establishment of the project management environment and workbook could have been neglected due to the contractors not seeing the essence of using it at the initial phase of the project or the contractors did not understand the usage of this technique. It might have also been attributed to the size of firms and projects that they undertake. PMI (1996), argues that project management environment and workbook is quite an involved technique to use. Hence it may not have been ideal for SMEs.

7. Which of the following project management techniques do you use during the design/planning phase?

To explore the usage of project management techniques during design/planning phase.

Table 4.3.7 Project management techniques used during the design/planning phase.

Technique	Yes	No	Don't know	Ranking
Work breakdown structure (WBS)	100.0%	0.0%	0.0%	1
Budget/ cost analysis	100.0%	0.0%	0.0%	1
Cost breakdown structure	100%	0.0%	0.0%	1
Specifications and standards	100.0%	0.0%	0.0%	1
Bar chart/Gantt chart	93.3%	6.7%	0.0%	5
Project standards and procedures	86.7%	0.0%	13.3%	6

Continuation: Table 4.3.7 Project management techniques used during the design/planning phase.

Technique	Yes	No	Don't know	Ranking
Resource plan	80.0%	6.7%	13.3%	7
Baseline project plan	73.3%	13.3%	13.3%	8
Organizational breakdown structure	73.3%	13.3%	13.3%	8
Project planning methodology	66.7%	20.0%	13.3%	10
Project scope, feasibility	53.3%	46.7%	0.0%	11
Preliminary schedule	53.3%	33.3%	13.3%	11
Critical path method	53.3%	33.3%	13.3%	11
Brainstorming	46.7%	33.3%	20.0%	14
Statement of work	33.3%	46.7%	20.0%	15

The various project management techniques terminologies were described to the respondents where they did not understand the meaning. The cut off margin of analyzing the significance of the techniques was pegged at 80% or more of the response rate. From the result in Table 4.3.7 above, during this phase of project management, the PMTs that are widely used are seven (7) in number out of the fifteen (15) techniques outlined, whereas five of them are unpopular with most of the SMEs as less than 60% of the respondents agreed to have been using them. This result suggests that some project management techniques are frequently used during this phase of project management and some are not. The techniques, which are frequently used by all the contractors, (100%) are WBS, budget/cost analysis, cost breakdown structure and specifications and standards and they were ranked 1st. These techniques could have been used more often during this phase of the project, due to the planning taking place in order to manage the traditional parameters of time, cost and quality as outlined in the literature (Smallwood, 2000). These parameters are also client driven hence might have ensured that the respondents take part in utilizing these techniques frequently.

Five of the techniques were used by less than 60% of the respondents. These techniques are project scope and feasibility, statement of work, brainstorming, preliminary schedule and critical path method. These techniques might not have been used because of the magnitude of projects the SMEs are undertaking and at the same time not understanding the techniques in question. Statement of work received

a low response rate of 33.3% this might be due to the technique being client driven than contractor driven as indicated by PMI (1996). The nature of brainstorming might have been seen to be a complicated technique to apply in the meetings conducted by SMEs as it requires a brainstorming session.

A Preliminary Schedule might not have been used by majority of the contractors at this stage due to changes occurring as other activities are introduced. Krone (1996), concurs with this result, stating that this is a tool for planning complex projects and coordinating the work of the architect, owner, contractor and subcontractors. Based on this argument, some contractors would feel that the preliminary schedule shouldn't be used at this stage, as they are not involved in complex projects. Critical Path Method was not much used even though it can be used to plan and control both large and small projects. The need to use CPM might have been obviated by the use of a Gantt chart during this phase because it's easier to implement than CPM according to the literature review (see Faniran, 1999; Bates *et al.* 1999).

8. Which of the following project management techniques do you use during the construction phase?

To explore the usage of project management techniques during the construction phase.

Table 4.3.8 Project management techniques used during the construction phase.

Techniques	Yes	No	Don't know	Ranking
Inspection of work (quality control)	100.0%	0.0%	0.0%	1
Monitoring project progress against baseline plan.	93.3%	0.0%	6.7%	2
Monitoring and tracking	93.3%	6.7%	0.0%	2
Performance measurement	93.3%	6.7%	0.0%	2
Establishing reporting procedures	86.7%	0.0%	13.3%	5
Communicating the project status	86.7%	13.3%	0.0%	5
Status review meeting	86.7%	6.7%	6.7%	5
Managing the project workbook	73.3%	13.3%	13.3%	8
Earned value analysis	60.0%	33.3%	6.7%	9
Control charts	40.0%	60.0%	0.0%	10

The various project management techniques terminologies were described to the respondents where they did not understand the meaning. The cut off margin of analyzing the significance of the techniques was pegged at 80% or more of the response rate. This cut off was decided because of the number of respondents interviewed, which was fifteen (15).

From the result indicated in Table 4.3.8 above, during the construction phase of project management, of the ten (10) PMT outlined/stated, seven (7) of the techniques were used frequently by more than 80% of the contractors. The techniques that were infrequently used were earned value analysis and control chart. Bates *et al.* (1999), concurs with this result of the infrequent use of earned value analysis which he/she states is more a “hard core/robust method” of analysing project cost or performance measurement (variance) and hence more suitable for large projects. The least used technique was control chart, which the researcher thought might have been used more frequently than earned value analysis. This does not mean that the SMEs are not entitled to use this technique as it has proved to be a more comprehensive way of analysing a projects financial detail and performance measurement. It is more detailed in analysis but due to the nature and size of companies interviewed it could not have surpassed the use of control charts.

Control charts could have been used in a wider scale. The reason of having a lower response might have been caused by misunderstanding of the technique. The control charts should be used at the planning of the project site layout for both large and small construction projects hence SMEs should have used it frequently. The frequent use of inspection of work among SMEs is ideal as this tool is practical to the construction sequence. As stated in the literature review, control of work is essential in order to meet the requirements of the project, as agreed by Jenkins (1999).

Personnel in small or large projects will utilize these techniques in order to achieve good quality of work at the end of the project. During this phase, the physical construction has started and the techniques outlined are of vital use but more so inspection of work, being done so as to prevent discrepancies in the outcome of the project. The techniques used in conjunction with inspection of work are monitoring

and tracking, performance measurement and monitoring project progress against baseline plan. These techniques ensure that the planned activities are as per the bar chart or CPM. Inspection of work will entail that the specifications and standards of work are followed as specified. Bell *et al.* (1997), concurs with this result, that control of activities need to be undertaken and it also signifies that the SMEs are keen in controlling the traditional performance parameters of time, cost and quality. This result indicates that some project management techniques are used frequently by SMEs during this phase of project management.

9. Which of the following project management techniques do you use during the handover or closeout phase?

To explore the usage of project management techniques during handover/closeout phase.

Table 4.3.9 Project management techniques used during the handover/closeout phase.

Techniques	Yes	No	Don't know	Ranking
Conducting post project review/post mortem	66.7%	33.3%	0.0%	1
Closing the clients contract	60.0%	40.0%	0.0%	2
Closing down the project	60.0%	40.0%	0.0%	2

The various project management techniques terminologies were described to the respondents where they did not understand the meaning. The cut off margin of analyzing the significance of the techniques was pegged at 80% or more of the response rate. This cut off was decided because of the number of respondents interviewed, which was fifteen (15). The number of techniques stipulated during the closeout phase was kept to a minimum as few activities are carried out during this phase of construction.

The result in Table 4.3.9 above indicates, that the contractors do not frequently use the techniques as the techniques had a response rate of less than 80%. Of the three (3) techniques stated, conducting a post project review was used more often than the other two. The review of the projects should be a key factor as the project team tries to address the problems and successes of the completed project. The contractors

who did not use this technique might have found it difficult to revisit the problems encountered and also the success achieved. Closing of the project is vital and the researcher feels that it should have been used by, majority if not all the contractors. Hoffer *et al.* (2002) states that contractors should ensure that all the documents have been submitted to him and at the same time ensure that everything has been undertaken in the project. The response should have been higher if all the contractors understood what entailed these techniques during the handover/closing phase. It is vital for the contractors to carry out a post project review of their projects and ensure that the client's contract is closed and hence the project is closed down.

10. In your own opinion which of the following techniques should a small or medium construction company use for running their projects?
(1=unnecessary, 2=unsure, 3=necessary)

Explore the necessary techniques that small and medium companies should use in managing their projects.

Calculation of Mean score

Equation 1 and 2 were used to analyze these data. The weighted score of each technique were then added and divided by the number of respondents in order to obtain the mean score. The mean scores were then ranked to attain the required position of each project management technique.

Wt. Sc. = Sc./Y.....Equation (1)

$$MS = \frac{\sum Wt.Sc}{TR} \dots\dots\dots \text{Equation (2)}$$

Adopted from Frankfort-Nachmias and Nachmias (1994).

Calculation for the standard deviation

$$s^2 = \frac{1}{n-1} \left[\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{\sum f_i} \right] \dots \dots \dots \text{Equation (3)}$$

Adopted from Frankfort-Nachmias and Nachmias (1994).

Table 4.3.10 Necessary project management techniques for projects undertaken by SMEs

Techniques	Necessary	Unsure	Unnecessary	Mean	Std. Dev.	Ranking
Work breakdown structure	100.0%	0.0%	0.0%	3.00	0.00	1
Budget/ cost analysis	100.0%	0.0%	0.0%	3.00	0.00	1
Bar chart / Gantt chart	100.0%	0.0%	0.0%	3.00	0.00	1
Specifications and standards	100.0%	0.0%	0.0%	3.00	0.00	1
Reporting procedures	100.0%	0.0%	0.0%	3.00	0.00	1
Monitoring project progress against baseline plan	100.0%	0.0%	0.0%	3.00	0.00	1
Inspection of work (quality control)	100.0%	0.0%	0.0%	3.00	0.00	1
Performance measurement	100.0%	0.0%	0.0%	3.00	0.00	1
Project administration meeting	93.3%	6.7%	0.0%	2.93	0.26	9
Project initiation plan	93.9%	6.7%	0.0%	2.93	0.26	9
Management procedures	93.3%	6.7%	0.0%	2.93	0.26	9
Project standards and procedure	93.3%	6.7%	0.0%	2.93	0.26	9
Cost breakdown structure	93.3%	6.7%	0.0%	2.93	0.26	9
Managing the project workbook	93.3%	6.7%	0.0%	2.93	0.26	9
Communicating the project status	93.3%	6.7%	0.0%	2.93	0.26	9
Monitoring and tracking	93.3%	6.7%	0.0%	2.93	0.26	9
Status review meeting	93.3%	6.7%	0.0%	2.93	0.26	9
Baseline project plan	86.7%	13.3%	0.0%	2.87	0.35	18
Closing the clients contract	86.7%	13.3%	0.0%	2.87	0.35	18
Closing down the project	86.7%	13.3%	0.0%	2.87	0.35	18
Expert judgment	80.0%	20.0%	0.0%	2.80	0.41	21
Resource plan	86.7%	6.7%	6.7%	2.80	0.56	21

Continuation: Table 4.3.10 Necessary project management techniques for projects undertaken by SMEs

	<i>Necessary</i>	<i>Unsure</i>	<i>Unnecessary</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Ranking</i>
Techniques						
Organizational breakdown structure	80.0%	20.0%	0.0%	2.80	0.41	21
Brainstorming	80.0%	20.0%	0.0%	2.80	0.41	21
Conducting post project review	80.0%	20.0%	0.0%	2.80	0.41	21
Project selection method	80.0%	13.3%	6.7%	2.73	0.59	26
Project management & environment workbook	73.3%	20.0%	6.7%	2.67	0.62	27
Critical path network	73.3%	20.0%	6.7%	2.67	0.62	27
Project planning methodology	80.0%	6.7%	13.3%	2.67	0.72	27
Project scope and feasibility	80.0%	0.0%	20.0%	2.60	0.83	30
Statement of work	60.0%	13.3%	26.7%	2.33	0.90	31
Control charts	60.0%	6.7%	33.3%	2.27	0.96	32
Preliminary schedule	53.3%	13.3%	33.3%	2.20	0.94	33
Earned value analysis	53.3%	13.3%	33.3%	2.20	0.94	33

From the result in Table 4.3.10, it shows the ranking of the necessity of project management techniques (PMTs) for the entire sample using the mean rating in a likert scale. The cut off margin is pegged at a mid point value of 2.0. Thirty of the techniques had a (mean > 2.60) indicating that majority of the techniques were considered to be necessary. Techniques that had a mean = 3.0 were considered highly necessary in managing projects.

Of the thirty-four (34) PMT stipulated, eight of them were considered to be highly necessary as they attained (mean = 3.00) with a dispersion of high significance i.e. 0.00. These were Work breakdown structure, Budget/ cost analysis, Bar chart / Gantt chart, Specifications and standards Reporting procedures, Monitoring project progress against baseline plan, Inspection of work (quality control) and Performance measurement.

A few of the techniques that were considered not to be highly necessary were statement of work, control charts, preliminary schedule and earned value analysis as they fell in the band between 2.00 and 2.50, which reflects that the respondents were not sure of these project management techniques. The techniques that were considered not to be necessary had a standard deviation approaching 1.00. Preliminary schedule should have had a higher ranking, as scheduling is vital to ensure that resources have been scheduled prior to commencing the construction project. According to Bates *et al.* (1999) earned value analysis is considered a “hardcore” method of analysis of managing project resources and cost in construction, which is unnecessary to use for projects undertaken by small and medium contractors.

Brainstorming was not considered to be of high necessity and it was not highly used as indicated in table 4.3.10 and 4.3.7 respectively. The low use of this technique may be attributed to the nature of work conducted by these contractors and probably an overlap use of the techniques in different phases of the project. Project management environment and workbook might not have been used and not considered necessary because it is seen as a technique that is cumbersome to prepare and hence requires skilled personnel to use. Statement of work is not used and it's not considered highly necessary. This technique is client oriented or driven, hence it might be used when the client demands for it.

Critical path network is viewed as a necessary technique but not adequately used by the respondents. It's a tedious technique to produce compared to a bar chart/ Gantt chart, which is frequently used by the contractors, and is indicated as necessary by the contractors, and hence ranked first (1st) with a standard deviation of 0.00. Brainstorming was not frequently used but was considered necessary. Some techniques that were considered as being necessary by the contractors were not used by majority of the contractors. This contradiction might have been caused by other options of techniques available as some of them overlap in usage.

11. In your own opinion how important on a scale of 1 to 5 are the following project management techniques to small and medium construction companies? (1=not at all important; 2=slightly not important; 3=neutral; 4=slightly important; 5=extremely important)

Equation 1, 2 and 3 were used to analyze these data. The weighted score of each technique were then added and divided by the number of respondents in order to obtain the mean score. The mean scores were then ranked to attain the required position of each project management technique.

Calculation of the mean score

Wt. Sc. = *Sc./Y*.....*Equation (1)*

$$MS = \frac{\sum Wt.Sc}{TR} \dots\dots\dots \text{Equation (2)}$$

Adopted from Frankfort-Nachmias and Nachmias (1994).

Calculation for the standard deviation

$$s^2 = 1/n-1[\sum fxi^2 - \frac{(\sum fixi)^2}{\sum fi}] \dots\dots\dots \text{Equation (3)}$$

Adopted from Frankfort-Nachmias and Nachmias (1994).

To explore the important techniques that needs to be used in running projects of SMEs

Table 4.3.11 Important project management techniques for projects undertaken by SMEs.

	<i>Not at all important</i>	<i>Slightly not important</i>	<i>Neutral</i>	<i>Slightly important</i>	<i>Extremely important</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Rank</i>
Techniques								
Inspection of work (quality control)	0.0%	0.0%	0.0%	0.0%	100.0%	5.00	0.00	1
Organizational breakdown structure	0.0%	0.0%	6.7%	0.0%	93.3%	4.87	0.52	2
Specifications and standards	0.0%	6.7%	0.0%	0.0%	93.3%	4.80	0.77	3
Bar chart / Gantt chart	6.7%	0.0%	0.0%	6.7%	86.7%	4.67	1.05	4
Reporting procedures	0.0%	6.7%	6.7%	0.0%	86.7%	4.67	0.90	4
Monitoring project progress against baseline plan	0.0%	6.7%	0.0%	13.3%	80.0%	4.67	0.82	4
Communicating the project status	0.0%	6.7%	6.7%	0.0%	86.7%	4.67	0.90	4
Monitoring and tracking	0.0%	6.7%	6.7%	0.0%	86.7%	4.67	0.90	4
Performance measurement	0.0%	6.7%	6.7%	0.0%	86.7%	4.67	0.90	4
Project initiation plan	0.0%	6.7%	0.0%	20.0%	73.3%	4.60	0.69	10
Expert judgment	0.0%	6.7%	6.7%	6.7%	80.0%	4.60	0.91	10
Work breakdown structure	6.7%	0.0%	6.7%	0.0%	86.7%	4.60	1.12	10
Project standards and procedure	0.0%	6.7%	0.0%	20.0%	73.3%	4.60	0.69	10

Continuation Table 4.3.11 Important project management techniques for projects undertaken by SMEs.

	<i>Not at all important</i>	<i>Slightly not important</i>	<i>Neutral</i>	<i>Slightly important</i>	<i>Extremely important</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Rank</i>
Techniques								
Cost breakdown structure	0.0%	6.7%	6.7%	6.7%	80.0%	4.60	0.91	10
Conducting post project review	0.0%	6.7%	6.7%	6.7%	80.0%	4.60	0.91	10
Closing the clients contract	0.0%	6.7%	0.0%	20.0%	73.3%	4.60	0.83	10
Budget/ cost analysis	6.7%	6.7%	0.0%	0.0%	86.7%	4.53	1.25	17
Critical path network	0.0%	0.0%	6.7%	33.3%	60.0%	4.53	0.64	17
Status review meeting	0.0%	13.3%	0.0%	6.7%	80.0%	4.53	1.06	17
Closing down the project	0.0%	6.7%	0.0%	26.7%	66.7%	4.53	0.83	17
Resource plan	13.3%	0.0%	0.0%	0.0%	86.7%	4.47	1.41	21
Baseline project plan	0.0%	6.7%	6.7%	20.0%	66.7%	4.47	0.92	21
Project planning methodology	0.0%	6.7%	0.0%	33.3%	60.0%	4.47	0.74	21
Project selection method	0.0%	6.7%	6.7%	26.7%	60.0%	4.40	0.91	24
Management procedures	0.0%	6.7%	6.7%	33.3%	53.3%	4.33	0.90	25
Project management & environment workbook	0.0%	0.0%	0.0%	73.3%	26.7%	4.27	0.46	26
Managing the project workbook	0.0%	6.7%	20.0%	20.0%	53.3%	4.20	1.01	27
Project administration meeting	0.0%	13.3%	6.7%	33.3%	46.7%	4.13	1.06	28

Continuation Table 4.3.11 Important project management techniques for projects undertaken by SMEs.

	<i>Not at all important</i>	<i>Slightly not important</i>	<i>Neutral</i>	<i>Slightly important</i>	<i>Extremely important</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Rank</i>
Techniques								
Brainstorming	0.0%	0.0%	26.7%	33.3%	40.0%	4.13	0.83	28
Project scope and feasibility	6.7%	0.0%	26.7%	13.3%	53.3%	4.07	1.22	30
Preliminary schedule	33.3%	0.0%	0.0%	6.7%	60.0%	3.60	1.92	31
Statement of work	13.3%	20.0%	0.0%	26.7%	40.0%	3.60	1.55	31
Earned value analysis	20.0%	13.3%	13.3%	0.0%	53.3%	3.53	1.73	33
Control charts	20.0%	20.0%	6.7%	0.0%	53.3%	3.47	1.77	34

From the result in Table 4.3.11, it shows the ranking of the importance of project management techniques (PMTs) using the mean rates of the techniques. The cut off margin is pegged at a mid point value of 3.0. Thirty of the techniques had a (mean = 4.07 and above), which indicates that majority of the techniques were considered to be important and majority of the techniques had a dispersion rate of less than 1.00. Techniques that had a (mean = 5.0), were considered to be highly important in managing projects.

Inspection of work (quality control) was ranked first (1st) with a (mean = 5.0), which indicates that the respondents agreed that the technique is extremely important. Twenty of the techniques fell in the band between 4.50 and 5.00, which indicates that these techniques are considered to be extremely important. The other techniques are; organizational breakdown structure, specifications and standards, expert judgment, WBS, budgets/cost analysis, bar chart, CBS, reporting procedures, monitoring project progress against baseline plan, communicating the project progress, monitoring and tracking, performance measurement, status review meeting and conducting post project review. Thirteen of techniques fell in band between 3.50 and 4.50 hence indicating that these techniques are considered to be slightly important.

The project management environment and workbook was not used, it was not considered necessary and not considered important. This might be caused by the availability of other techniques, which might be easier to use and still achieve the results. Project scope and feasibility should have been used and considered important but that was not the case. It should have been carried out by the respondents, so as to know the extent of the work to be done and know the cost of work to be embarked on. The low ranking and response for this technique, either as being used or its' importance may have been caused by misunderstanding of the meaning of this technique.

The preliminary schedule was not used and not considered to be necessary by the majority of SMEs. Krone (1996), argues that this technique is mostly used on complex projects due to the level of details required. The Project administration meeting is not considered important but is considered necessary and is also used by majority of the respondents. This is a technique that should have been considered to be important, as without a meeting there will be little communication among the parties regarding the project progress. For contractors not to have considered this technique as being important was possibly an oversight by the respondents when answering the questionnaire.

Management procedure was not considered to be important but was used by majority of the respondents. The respondents might not have considered this technique to be of importance due to the fact that other techniques overlap in terms of their use. Techniques such as project initiation plan will allow participants to discuss the issues of the project as the project is initiated. Statement of work is not considered as important as it seems majority of contractors might not understand its use and importance. This should be an important technique as it reflects what is entailed in the project, despite being client oriented.

The techniques considered not to be important but which are used frequently are; project administration meeting and establishing management procedures, whereas project management and environment workbook, project scope and feasibility, control charts, statement of work and brainstorming are not used by majority of the SMEs' and are not considered to be important.

12. How adequately do you implement the following project management techniques? (1=extremely inadequate; 2=somewhat inadequately; 3=neither adequately nor inadequately; 4=somewhat adequately and 5= extremely adequate)

To explore if the techniques used, are used adequately in managing projects.

Equation 1 and 2 were used to analyze these data. The weighted score of each technique were then added and divided by the number of respondents in order to obtain the mean score. The mean scores were then ranked to attain the required position of each project management technique.

$$Wt. Sc. = Sc./Y.....Equation (1)$$

$$MS = \frac{\sum Wt.Sc}{TR}Equation (2)$$

Adopted from Frankfort-Nachmias and Nachmias (1994).

Calculation for the standard deviation

$$s^2 = 1/n-1[\sum fixi^2 - \frac{(\sum fixi)^2}{\sum fi}]Equation (3)$$

Adopted from Frankfort-Nachmias and Nachmias (1994).

Table 4.3.12 Project management techniques adequately used by SMEs.

	<i>Extremely inadequate</i>	<i>Inadequately</i>	<i>Neutral</i>	<i>Adequately</i>	<i>Extremely adequate</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Rank</i>
Techniques								
Inspection of work (quality control)	0.0%	0.0%	6.7%	13.3%	80.0%	4.73	0.59	1
Budget/ cost analysis	0.0%	0.0%	13.3%	13.3%	73.3%	4.60	0.74	2
Bar chart / Gantt chart	0.0%	6.7%	13.3%	0.0%	80.0%	4.53	0.99	3

Continuation Table 4.3.12 Project management techniques adequately used by SMEs.

	<i>Extremely inadequate</i>	<i>Inadequately</i>	<i>Neutral</i>	<i>Adequately</i>	<i>Extremely adequate</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Rank</i>
Techniques								
Specifications and standards	0.0%	6.7%	0.0%	26.7%	66.7%	4.53	0.83	3
Monitoring and tracking	0.0%	6.7%	6.7%	13.3%	73.3%	4.53	0.92	3
Status review meeting	0.0%	6.7%	0.0%	33.3%	60.0%	4.47	0.83	6
Work breakdown structure	0.0%	6.7%	6.7%	26.7%	60.0%	4.40	0.91	7
Baseline project plan	0.0%	6.7%	6.7%	26.7%	60.0%	4.40	0.91	7
Performance measurement	0.0%	6.7%	13.3%	13.3%	66.7%	4.40	0.99	7
Communicating the project status	0.0%	6.7%	6.7%	33.3%	53.3%	4.33	0.90	10
Project -standards and procedure	0.0%	13.3%	13.3%	6.7%	66.7%	4.27	1.98	11
Monitoring project progress against baseline plan	0.0%	13.3%	13.3%	6.7%	66.7%	4.27	1.16	11
Expert judgment	0.0%	13.3%	0.0%	40.0%	46.7%	4.20	1.01	13
Project scope and feasibility	0.0%	20.0%	0.0%	20.0%	60.0%	4.20	1.21	13
Cost breakdown structure	6.7%	13.3%	6.7%	0.0%	73.3%	4.20	1.42	13
Reporting procedures	0.0%	6.7%	6.7%	46.7%	40.0%	4.20	0.86	13
Organizational breakdown structure	0.0%	13.3%	13.3%	20.0%	53.3%	4.13	1.13	17
Project initiation plan	6.7%	6.7%	6.7%	33.3%	46.7%	4.07	1.22	18
Brainstorming	6.7%	6.7%	6.7%	33.3%	46.7%	4.07	1.22	18
Project planning methodology	0.0%	20.0%	6.7%	20.0%	53.3%	4.07	1.22	18
Closing down the project	0.0%	13.3%	13.3%	26.7%	46.7%	4.07	1.10	18

Continuation Table 4.3.12 Project management techniques adequately used by SMEs.

	<i>Extremely inadequate</i>	<i>Inadequately</i>	<i>Neutral</i>	<i>Adequately</i>	<i>Extremely adequate</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Rank</i>
Techniques								
Conducting post project review	6.7%	13.3%	13.3%	6.7%	60.0%	4.00	1.41	22
Closing the clients contract	0.0%	13.3%	20.0%	20.0%	46.7%	4.00	1.13	22
Project administration meeting	13.3%	6.7%	6.7%	20.0%	53.3%	3.93	1.49	24
Project selection method	0.0%	20.0%	13.3%	20.0%	46.7%	3.93	1.22	24
Resource plan	0.0%	6.7%	20.0%	13.3%	60.0%	3.87	1.03	26
Critical path network	0.0%	13.3%	13.3%	46.7%	26.7%	3.87	0.83	27
Preliminary schedule	0.0%	20.0%	13.3%	20.0%	40.0%	3.60	1.55	28
Managing the project workbook	20.0%	6.7%	13.3%	20.0%	40.0%	3.53	1.60	29
Management procedures	20.0%	6.7%	13.3%	26.7%	33.3%	3.47	1.55	30
Project management & environment workbook	20.0%	13.3%	13.3%	20.0%	33.3%	3.33	1.59	31
Statement of work	33.3%	6.7%	6.7%	20.0%	33.3%	3.13	1.77	32
Earned value analysis	26.7%	13.3%	20.0%	0.0%	40.0%	3.13	1.73	32
Control charts	40.0%	6.7%	13.3%	6.7%	33.3%	2.87	1.81	34

From the result in Table 4.3.12, it shows the ranking of the adequacy of use of project management techniques (PMTs). The mean rates of the techniques were used to rank the techniques. The cut off margin is pegged at a mid point value of 3.0. Twenty-three of the techniques had (mean > 4.00) but with a high dispersion rate greater than 1.00. The dispersion indicates that majority of the techniques were not considered to be adequately used. The project management techniques with (mean = 5.0) are considered extremely adequately used in managing projects undertaken by SMEs.

Of the thirty-four (34) techniques summarized in Table 4.3.12 above, four (4) of the techniques fell between the band of 4.5 to 5.00, and thus considered to be highly adequately used, these techniques are inspection of work, budget/ cost analysis, bar chart / gantt chart, specifications and standards, and monitoring and tracking

Inspection of work (quality control) was highly ranked at first (1st) with a (mean = 4.73). Jenkins (1999) agrees with this result. This verifies the importance of inspecting work as the construction proceeds in order to keep track of all that is taking place in terms of quality of work. It is also considered to be necessary and important. This result verifies that construction projects have to be inspected whether undertaken by small or medium contractors. It's a technique that will ensure better delivery of projects, as discussed in the literature review. Bar chart was also considered to be adequately used as the (mean > 4.53), and was ranked third (3rd). Faniran (1999) agrees with this result as this technique is used for planning, scheduling and controlling of the project activities. If not adequately used it may not achieve the correct result.

Finances of a small project undertaken by SMEs are vital as reflected in the literature review. Small and medium contractors are most likely to be liquidated after their first 3 years in business according to the DPW (1999), and Van Wyk (2003). The need to adequately use budget/cost analysis and cost breakdown structure is vital to enable the companies to ensure a good cash flow as these techniques were also adequately used. In terms of earned value analysis, which was not frequently used by the respondents as indicated in Table 4.3.8, was ranked thirty-second (32nd) in terms of adequacy of use with (mean = 3.13), and a standard deviation of 1.73. The underlying factor for this might have been due to the use of a budget and cost breakdown structure as indicated in Table 4.3.12.

The result also indicates that the control charts were not adequately used as it attained (mean = 2.87), which was less than the midpoint of 3.00. Four techniques fell in the band between 3.00 and 3.50 and these were management procedures, project management and environment workbook, statement of work and earned value analysis. These techniques were considered to be neutral by the respondents.

Critical path method was not adequately used as the bar chart. This might have been prompted by the use of bar chart/Gantt chart, as it is easier to program than a critical path network. Bates *et al.* (1999), and Faniran (1999), concurs with this result. Network preparation needs computer programs, which are expensive to install and use. The critical path network had (mean = 3.87) as compared to 4.53 mean score of the bar chart.

From the analysis, majority of the techniques were not used adequately as they had a high mean score but a poor dispersion of response. This result addresses research question *objective two (2)* formulated in chapter one.

SECTION C

4.4 Open-ended interview questionnaire analysis

This was a follow-up questionnaire interview to section B to explore the adequate use and effectiveness of project management techniques in delivering projects in terms of time, cost and quality and hence explore the factors that hinder the implementation of project management techniques. This data has been analyzed using content analysis method.

Question 1

To explore the project management techniques used by SMEs' in managing their projects' time and their effectiveness and adequate use of these techniques in their projects.

Table 4.4.1 Project management techniques for managing time.

Respondents	Technique(s) or tool(s) used by respondents	Performance measurement of the technique	Deviation test & incase experience deviation	Decision and reaction process	Effectiveness of the technique(s) as assessed by respondents
Respondent 1	Bar chart	Measure actual vs. project completion time	When the days work has not been finished	In case of a delay communicate with the client suppliers	Ineffective
Respondent 2	Ms project, critical path method, bar chart	Actual time vs. time budgeted progress report	In case late delivery of material, information from the professionals. Days work not completed	Increase labour resource	Effective as one will know if they are lagging behind or not
Respondent 3	Bar charts, CPM to plan the projects	Controls the work, scheduling the activities	Progress for the week is checked to ensure that work on the short term plan is achieved	Increase labour force or work overtime on the project	Delays are minimal hence catered for in the program. Very effective.
Respondent 4	None	Experience	None	Working over time	Not effective
Respondent 5	Bar chart, CPM	Planning, controlling and scheduling the project	Ensure activities in the program are stack with	Update the program and work overtime	Experience delays hence needs improvement
Respondent 6	None	Experience	None	Negotiate with the client & review time	Effective.
Respondent 7	Program bar chart	Actual vs. programmed time compared	Stick to the program	Working overtime	Effective as they do not experience enormous delay

Continuation: Table 4.4.1 Project management techniques for managing time.

Respondents	Technique(s) or tool(s) used by respondents	Performance measurement of the technique	Deviation test & incase experience deviation	Decision and reaction process	Effectiveness of the technique(s) as assessed by respondents
Respondent 8	Bar chart	Daily co-ordination of activities on site	Weekly meetings with the supervisors to check the program	In case of deviation of time work overtime or increase the labour	The technique is effective
Respondent 9	Bar chart	Actual work done v/s programmed work	Ensures enough float time for every activity	Work overtime or addition of labour	Needs to be improved, but effective
Respondent 10	Method statement, ms project	Check actual time v/s programmed	Days work not completed	None no time delay	Effective
Respondent 11	Bar chart/ CPN	Check actual v/s anticipated time	Ensure adequate analysis of the project	In case of delay of work. Over time & analyze the cause of the delay	Effective in planning controlling and scheduling the projects.
Respondent 12	Meetings to prepare the program	Check weekly program v/s master program	None	Bring in extra resources incase of delay	Same as above
Respondent 13	Time determined at tender stage hence prepare a bar chart, CPM to cater for the clients time	Check actual v/s anticipated time in the program	None	In case of delay, which is seldom, increase the resources.	Very effective as they can anticipate any problems
Respondent 14	Program	Check master program on a weekly basis with weekly program	Incise resources have not been delivered make follow up	Apply for extension of time	Needs improvement, but effective
Respondent 15	Program in the form of a bar chart	Counter actual v/s programmed work and scheduled delivery	None	In case delay caused by client given extension	Quite effective as one is able to track down the project effectively.

The cut off margin for analysing the repetitive usage and effectiveness of time management techniques among the respondents in Table 4.4.1, were nine respondents as these techniques, were not pre-determined.

From the result indicated in Table 4.4.1, majority of the respondents used a technique to manage their projects in terms of time. It can be seen that of the fifteen (15) contractors interviewed, only two (2) did not prepare any form of technique to manage their project time. The two (2) respondents based their time management on “intuition” i.e. experience rather than the use of quantitative techniques to guide them in decision-making. It can be seen that majority of the contractors are familiar with the PMTs used for managing time. As a follow up question to questions in section B, bar charts featured prominently amongst thirteen (13) contractors whereas CPM is seen as probably not being embraced fully by the SMEs in managing their time as only five (5) contractors attested to it. This result concurs with Faniran (1999), and Bates et al, (1999). In the analysis of the structured questionnaire the bar chart, was used by majority of the SMEs, it is also considered to be necessary and important and used adequately, as analysed in Tables, 4.3.7, 4.3.10, 4.3.11 and 4.3.12 respectively.

The contractors who used these techniques were so articulate in their response. When using the bar chart or CPM, ten (10) contractors were satisfied with their outcome but three (3) of them felt there is need for improving the use of their technique. This result addresses the research question *objective three (3)* formulated in chapter one. The result signifies that the use of project management technique to manage time is effective and enables one to meet the clients’ targeted time. The three contractors who did not meet the time aspect of their projects might not have been implementing the method in the right way possibly due to lack of skilled personnel in the industry as stated by the Minister of Education Pandor (2004), as the need to prepare a construction program needs skill and knowledge. Two of these contractors were small contractors whereas the other was a medium contractor. The need to share responsibilities should be the key aspect instead of the managing director trying to manage all the parameters of a project i.e. time, cost and quality of their projects individually. The need to review the time by one contractor might

have been stipulated in his contract condition whereas the other contractor worked overtime hence his contract might have been without an extension of time clause.

The other two contractors who used “intuition” i.e. experience were not considered to have used a project management technique for managing time. The characteristic of the two contractors who did not achieve the result are both small contractors and they both undertake home improvement type of projects. The two contractors had no point of reference in order to update their project time. The personnel in question had more than ten (10) years of experience in the construction industry and in their current positions, which might have made it ideal for them to be able to manage their projects time without difficulties. Of these two SMEs one of the respondents never attained the required time, which could have been caused by lack of not using a time management technique, or the nature of the project in relation to lack of personnel. The other contractor attained the time set for the project.

As per the results, lack of education does not seem to affect the ineffectiveness of using the technique or the result at the end of the project as thirteen (13) of the contractors had attained a tertiary education qualification. Only two (2) of the contractors had matric qualification and below as seen in Table 4.2.10 and the two contractors agreed to have attained the required time set for their projects. Respondent (5) in Table 4.4.1 had a tertiary qualification and more than ten (10) years of experience in the industry as shown in Table 4.2.10 and 4.2.11 respectively but still experienced delays. This might have been caused by interference by clients’ due to time constraints and lack of information from the professionals. Despite these factors, majority of the respondents who used these techniques achieved the required results, hence verifies that the use of time management techniques improves projects delivery time.

Question 2

To explore the project management techniques used by SMEs in managing their projects' cost and their effectiveness and adequate use of these techniques in their projects.

Table 4.4.2 Project management techniques for managing cost.

Respondents	Technique(s) or tool(s) used by the respondents	Performance measurement	Deviation test	Decision and reaction process	Effectiveness of the technique(s) as assessed by respondent
Respondent 1	Lump sum contract	None	Different activities broken down to reflect expenses	In case high budget some items are removed	Effective no cost overrun experienced
Respondent 2	Bills of quantity (BOQ)	Physical measurement of work to ensure within budget	Check monthly valuation with projected cost	In case of deviation inform client or professional quantity surveyor	Effective for the nature of the projects
Respondent 3	Budget as in bills of quantity	Cost reporting is used to check work done v/s budgeted	Ensure what is being claimed for is the right amount. Stick to the budget	Investigate the cause of any deviation	Effective for planning and controlling the project cost
Respondent 4	Prepare a quotation	Work with clients cost hence paid in stages as per the agreement	Check work done and needs payment	Do not experience cost overrun	Need improvement because no proper management
Respondent 5	Use bills of quantity to plan	Actual cost of work v/s budgeted	Check for work that need payment	None	Need updating to be more efficient
Respondent 6	Client gives rates to each work	Submit an invoice for payment	None	In case of cost overrun use own money	Happy with the system
Respondent 7	Budgets	Prepare interim payments, cost breakdown	None	Do not experience cost overrun	Effective

Continuation: Table 4.4.2 Project management techniques for managing cost.

Respondents	Technique(s) or tool(s) used by respondents	Performance measurement of the technique	Deviation test & incase experience deviation	Decision and reaction process	Effectiveness of the technique(s) as assessed by respondents
Respondent 8	Prepare good tenders good BOQ	Check actual v/s budgeted. Cash flow & cost report	Experience cost overrun	Adjust trades that are causing overrun in the same project or next	Effective as one can establish the cost overrun
Respondent 9	Cash flow and cost breakdown of the BOQ	Progress of cost, interim payments, check actual v/s budgeted cost	Try to reconcile the books, by checking the resources cost codes	Adjust with next project in case they experience cash flow problems	Not very effective needs to be improved
Respondent 10	Tender prepared with allowable	Progress of work for payment. Cost report of work done & work budgeted for	Always spot on with their cost	None	Effective
Respondent 11	Negotiated contracts. Hence the tenders are considered to be ideal	Cost reporting using CPM to anticipated the cost to date	Check the activity broken down and the cost allocation	No cost overrun	Effective
Respondent 12	Tenders are adequately prepared	Monitor cost on a weekly basis. Cost report	Weekly planning, controlling and scheduling resources	Experience cost overrun. Go to their coffers and get money	Needs updating and improvement as it's not very effective
Respondent 13	Accurate bills of quantity	Measure work on site and compare to the program to know the cost of payment to date	Ensure program is strictly followed and no major revisions in the project	Ensure enough work for quantity surveyor. Experience cost overrun	Effective in establishing cost problems

Continuation: Table 4.4.2 Project management techniques for managing cost.

Respondents	Technique(s) or tool(s) used by respondents	Performance measurement of the technique	Deviation test & incase experience deviation	Decision and reaction process	Effectiveness of the technique(s) as assessed by respondents
Respondent 14	Negotiated contracts. Hence the tenders are considered to be ideal	Check work done v/s budgeted	Monthly meetings and valuations	Track down cost overrun before proceeding	Need to be improved to current situations
Respondent 15	Put up a budget	Claim on a fortnight basis and counter with the program	Breaking down the budget appropriate trades and check deviation on monthly basis	In case of cost overrun establish the cause and rectify in the next project	The method is not adequate as cost overrun is experienced

The cut off margin for analysing the repetitive usage and effectiveness of cost management techniques among the respondents, were nine respondents as these techniques, were not pre-determined.

From the result in Table 4.4.2, all the fifteen (15) respondents interviewed prepared a form of cost plan to enable them budget for their construction projects. As analyzed in the structured questionnaire the cost management techniques i.e. cost breakdown structure and budget/cost analysis were used by majority of the respondents, and were considered to be necessary, were considered important and used adequately as analysed in Tables 4.3.7, 4.3.10, 4.3.11 and 4.3.12 respectively. The results in the aforementioned tables concur with the result in Table 4.4.2. Cost breakdown structure that was frequently used was in the form of bills of quantities, which was articulated by the SMEs. The provision of a cost report to enable the contractor to control his finances was evident amongst the respondents. The cost report enables the respondents to trace their finances, and is vital to ensure proper

cost reconciliation of the contractor resources. Weisswange (1998) agrees with this result that majority of SMEs use PMTs to manage their projects cost.

In respect of using these techniques, nine (9) of the contractors achieved the results i.e. they never experienced any cost overrun hence the techniques were seen to be effective. This result addresses the research question i.e. research *objective three (3)* formulated in chapter one, i.e. effectiveness of using PMTs. Whereas five (5) of the contractors felt that their companies need to update their techniques so as to be more efficient and effective to bring more success. They never experienced cost overrun but they felt the need to update their techniques of managing their project cost. This might have been caused by, lack of personnel to use the available techniques adequately which might have been cumbersome for the contractors. As stated in Table 4.2.1 majority of SMEs are managed single handed hence this might have caused the need to improve their cost management technique. Respondent four (4) in Table 4.4.2 prepared a quotation, which he/she felt needs to be improved. This quotation might not have been adequately prepared to enable the contractor to trace his project cost despite not experiencing any cost overrun. Inadequate preparation of the cost breakdown document might have also created difficulties in managing the cost of this respondents' project.

Question 3

To explore the project management techniques used by SMEs in managing their projects' quality effectiveness and adequate use of these techniques in their projects.

Table 4.4.3 Project management techniques for managing quality.

Respondent	Technique(s) or tool(s) used by the respondents	Performance measurement of the technique	Deviation test & deviations in the project	Decision & reaction due to deviation	Effectiveness of the technique(s) as assessed by the respondents
<i>Respondent 1</i>	Set quality standards that need to be achieved.	Check actual work done to the set standard of the company	In case of disputes involve inspectors from GMBA	Penalize workers for poor workmanship re-do the work	Effective in the projects

Continuation: Table 4.4.3 Project management techniques for managing quality.

Respondent	Technique(s) or tool(s) used by the respondents	Performance measurement of the technique	Deviation test & deviations in the project	Decision & reaction due to deviation	Effectiveness of the technique(s) as assessed by the respondents
Respondent 2	Inspection, of standards and specification	Check standards set for work and material. Sample of work to the actual	Contracts manager ensures defective work is re-done.	Make good any defective work or in case of material order	Not 100% effective
Respondent 3	Inspection standards and specification	Check standards set for work and material. Sample of work to the actual	Consultants inspect work in case not happy issues a checklist for defects	Make good any defective work or in case of material order	Quality is achieved hence effective
Respondent 4	Specification and standards form the client	Observation and thorough inspection	Countercheck with sample of workmanship and material	Re-do the work or order material where necessary	Need for improvement as they experience dispute
Respondent 5	Good specification and standards	Thorough supervision & inspection undertaken	Check material sample & work sample	Re-do the work	Effective as one will detect a problem on time
Respondent 6	Specifications Quality control	Use a checklist for inspecting work done and material being delivered	In case of major defects like honey-combs involve a consultant.	Rectify any defective work	Quite effective as no much defects are experienced
Respondent 7	Standards set & specification given	Inspection done quality control, client involved	Check specifications and standards to verify quality	Work is rectified	Improvement is required

Continuation: Table 4.4.3 Project management techniques for managing quality.

<i>Respondent</i>	Technique(s) or tool(s) used by the respondents	Performance measurement of the technique	Deviation & test & deviations in the project	Decision & reaction due to deviation	Effectiveness of the technique(s) as assessed by the respondents
<i>Respondent 8</i>	Specifications from client or architect	Thorough supervision of work and proper check list is used, ensure proper material is ordered	Check work done with the consultants, in case of defects, defect list is issued	Making good all the defects	Effective in tracking good workmanship and good material being ordered
<i>Respondent 9</i>	Procedures, standards and specifications	Quality control of material, plumbness of work, good concrete mix	Check for defects, carry out tests e.g. cube test. Get results from engineers	Redo the work that is not appropriate	Effective method of managing quality
<i>Respondent 10</i>	Check for standards and specifications	Work done as per the specification and standards. Thorough inspection	Involve engineers and clients representative in dispute or poor quality material	Re-do the work if possible or return the material	Achieve good results
<i>Respondent 11</i>	Good specifications and inspection	Ensure the standard has been achieved good workmanship	Principal agent verifies the work after inspection by the contracts manager	In case of poor workmanship or material re-do the work or re-order the material	Effective
<i>Respondent 12</i>	Good specifications and inspection	Ensures sample of work is followed to the actual work.	Client and the principal agent compliments if good work. Experience counts	In case of poor workmanship or material redo the work or re-order the material	Effective method of planning & controlling quality on site

Continuation: Table 4.4.3 Project management techniques for managing quality.

Respondent	Technique(s) or tool(s) used by the respondents	Performance measurement of the technique	Deviation test & deviations in the project	Decision & reaction due to deviation	Effectiveness of the technique(s) as assessed by the respondents
Respondent 13	Inspection of work, standards & specification set	Quality control of material supplied and, works done.	Ensure good work first time. Thorough supervision on LOSC	Work is re-done	Not very effective as there are disputes
Respondent 14	Set specifications & standards	Thorough inspection of the work by NHBRC inspectors	Involve NHBRC inspectors and stringent with the subcontractor	If not satisfied they order rework	Not 100% happy with the procedure
Respondent 15	NHBRC have set standards & specifications	Ensure appropriate supply of material & thorough work inspection	Material is the problem as this lies entirely with the client due to the nature of contract	If the contracts manager is not satisfied with the workmanship orders making good	Effective

The cut off margin for analysing the repetitive usage and effectiveness of quality management techniques among the respondents in Table 4.4.3, were nine respondents as these techniques, were not pre-determined, hence, might have taken time for the respondents to think about a variety of techniques they use to manage quality.

From the result in, Table 4.4.3, all the fifteen (15) respondents interviewed agreed to have been using a quality management technique to manage their projects. Jenkins (1999), agrees with this result. All the respondents in managing their projects used

specifications and standards; this is due to the fact that, specification is drafted by an architect on behalf of the client as part of the tender document. On any project, especially in construction projects they will have a specification and standard set to manage the project, as this is a benchmark for ordering of the required material and the workmanship of the activities. According to the respondents the specification and standards were specified to them and in case of any changes they were informed. The use of quality management technique is evident, as the contractor would have to meet the client's needs in terms of good quality product. Bell *et al.* (1997), concurs with this result.

All the respondents used inspection of work as a quality control technique, to enable them achieve good quality of work. Five (5) of the contractors felt they need to improve their techniques of managing quality. This might have been caused by poorly prepared specifications and standards, which create conflict in the project they are handling. The specifications should be in line with the project the respondents are undertaking, if not carried out to the specification at hand the contractors have to correct the mistake if caused by them. If materials ordered are not to the required specification the contractor has to reorder the material to meet the requirements of the project.

It can also be verified that from the summary in Table 4.4.3 using specification and standards, and inspecting the work is effective in achieving the results of the small and medium contractors projects as ten (10) of the SMEs agreed that the techniques were effective. Inspection and specifications are used for any kind of project not necessarily new buildings but is of equal importance to the contractors who are carrying out projects of refurbishment and renovations i.e. home improvement as some of the small contractors were involved in these projects. One of the contractor penalized workers for not appropriately achieving good quality work. This might have been associated with the constraints the small contractors are subjected to i.e. insufficient finances; hence they don't have room for laxity. The workers should do it right the first time. If not carried out correctly the first time, then the work is redone at the contractors' expenses. All the contractors rectified their work in case there was a defect. The defects were detected during inspection of work by the respondents, it is therefore of paramount importance that the work is properly

inspected in order for the contractors to be able to detect any defects in the work they are carrying out.

The involvement of building inspectors from either GMBA or NHBRC is of paramount importance especially on projects that are under their jurisdiction. Quality is one of the pre-requisite elements that have been stated by the chief executive officer of NHBRC Phetola Makgathe (S.A Builder/Bouer 2004). This can be evident by the need of the NHBRC inspectors getting involved in their client's projects. One of the respondent number fifteen (15) had a problem with the client pertaining to supply materials, as the client was the one supplying the materials and wanted to cut on cost where he felt necessary. The NHBRC as a statutory body protects its clients from poor quality of houses that might be delivered by the contractors, hence setting standards to be achieved in terms of quality of work and the specifications to be used in the various projects. One of the respondent number thirteen (13) in Table 4.4.3 used the quality management techniques but could not achieve the required result, as he was involved in disputes. The nature of his project involved a subcontractor who was a labour only subcontractor who might not have been thoroughly supervised by the main contractor in the project. Negligence or complacencies might have crept in hence poor inspection of work on the side of the main contractor.

From the results in Table 4.4.3, fifteen (15) of the contractors used quality management techniques i.e. specifications and standards set and inspection of work. This result is in line with the results analyzed in the structured questionnaire that these quality management techniques were used by majority of the respondents, and were considered to be necessary, important and used adequately by the respondents as analyzed in Tables, 4.3.7, 4.3.10, 4.3.11 and 4.3.12 respectively. It can also be verified that ten (10) of the contractors agreed that using these techniques, they achieved a good result i.e. the techniques were effective. The researchers' opinion is that using PMTs to manage quality improves delivery of projects in terms of quality. Hence this addresses research question, *objective three (3)* formulated in chapter one.

Question 4

To outline what hinders the implementation of project management techniques among small and medium contractors, thus exploring the internal and external factors that cause the hindrance.

Table 4.4.4 Factors hindering the implementation of project management techniques.

Respondents	Internal factors	External factors
Respondent 1	The company is understaffed Financial constraints Time constraints	Client interference in the project (change of mind)
Respondent 2	None	Financial constraints Government policies e.g. Black Economic Empowerment (BEE) Competitive tenders
Respondent 3	The company is understaffed Financial constraints Time constraints	Magnitude of the projects
Respondent 4	Lack of skill in the construction industry i.e. professionals as well as tradesmen Financial constraints to buy the packages Contractors don't see the importance (slow in accepting change)	Time constraints for project deadlines Lack of information from the professionals
Respondent 5	Skills dearth Time constraints project dead lines	Time constraints Educate clients on their projects (client interference) Lack of information from the professionals
Respondent 6	The nature of work done	None
Respondent 7	Lack of skill in the construction industry i.e. professionals as well as tradesmen	Clients demand (interference) Lack of information from professionals
Respondent 8	Financial constraints Flow of communication in the company Lack of good training Lack of management skills	Size of project being handled
Respondent 9	None	None
Respondent 10	Time constraints Financial constraints to have packages e.g. cost reporting	Shortage of right skill in construction industry especially tradesmen, i.e. bricklayers Lack of information from professionals.

Continuation: Table 4.4.4 Factors hindering the implementation of project management techniques.

Respondents	Internal factors	External factors
Respondent 11	Project handling from inside of the company Time & financial constraints to manage the techniques	Lack of skill in the construction industry i.e. professionals as well as tradesmen Lack of information flow from the professionals
Respondent 12	Time constraints in the project	Lack of information from professionals. Skills dearth in the construction industry
Respondent 13	None	Lack of skill in the construction industry i.e. professionals as well as tradesmen
Respondent 14	Financial constraints to buy the package Good expertise not employed Construction industry slow in accepting change	Lack of information flow from the professionals is a problem
Respondent 15	Lack of skill in the construction industry i.e. professionals as well as tradesmen Constraints of finance and time	Lack of information from the professionals as it derails the implementation of the techniques

The cut off margin for analysing the factors that hinder the implementation of project management techniques was eight respondents as these factors were not pre-determined, hence might have taken time for the respondents to think about a variety of hindering factors.

From the results in Table 4.4.4, indicates that there are internal and external factors that hinder the implementation of project management techniques (PMTs) in small and medium construction enterprises. This result answers the research question *objective four* formulated in chapter one. Alshawi and Ingirige (2003), concurs with this result, they state the challenges facing project management, which might have an effect on project management techniques.

The *internal factors*, which have been identified, are: financial constraints, time constraints, lack of skill, lack of management skills, industry is slow in accepting change and understaffing. Whereas the *external factors* identified are clients' interference, magnitude of the project, lack of information from the professional team, time constraints, governments' policies and skills dearth.

The factors that featured prominently as hindrances internally were financial and time constraints. This might have been caused by the contractor being under pressure to deliver his project to the client hence not being able to implement the project management techniques outlined in Tables 4.3.6 to 4.3.12 and hence not using them adequately. Eight (8) contractors agreed that financial constraints created a problem in implementing the project management techniques. DPW (1999) agrees with this result. Time constraint is also evident. This might have been caused by the clients' demand of project delivery of the project at the right time. This aspect might drive the respondent to try and fast track the project, hence tend to use experience and decide not to use the project management techniques available.

The other factors, i.e. understaffing, lack of skill, attitude towards the use of the techniques, nature of work, lack of good training, lack of management skills, "managing projects with the old school of thought" i.e. not adapting to the modern ways of managing projects were mentioned by less than four (4) contractors. It can therefore, be stated that they do not have a major impact internally towards the implementation of PMTs. According to the Minister of Education Pandor (2004), lack of skill is a major factor in the construction industry, hence the results partially fulfils her sentiment. This result suggests that personnel, as a resource needs to be involved to enable better usage of the project management techniques.

From the summary on Table 4.4.4 the results reveal that there are external factors that hinder the implementation of PMTs, these are client interference, magnitude of the project, professional interference due to lack of information in the project, time constraints, government policies and skills dearth.

From the result the major factor that hinders the implementation of PMTs externally is lack of information from the professional team, as eight of the contractors attested to this factor. Lack of information is due to the professionals not producing complete drawings or specifications on their projects, which later creates a problem between the contractor and the project team. It can therefore be viewed that the contractors will not have a continuous flowing project as they encounter stoppages and hence time interference of the project. It can be verified that without proper

information the project will be derailed and it will not flow as per the contracts program. Lack of information creates interference by the professionals and hence repercussions on the side of the SMEs (contractor) by complicating the usage of the techniques.

Lack of skill was also viewed both as an internal and external factor that hinders the implementation of PMTs, but not to a larger scale as only four (4) contractors felt that it has an effect. The other factors mentioned above are not seen as major factors despite being detrimental to the implementation of PMTs.

The result suggests that time and financial constraints were evident as internal factors and lack of information from the professional team was seen as an external factor. It can therefore be indicated that there are internal and external factors that hinder implementation of project management techniques. The factors outlined are not homogenous across all the contractors that were interviewed. It could have been homogeneous if the interviewer had set pre-meditated factors to be selected from by the respondents.

CHAPTER 5

5. INTERPRETATION OF THE ANALYZED DATA

Introduction

The interpretation of the data was dealt with by addressing each objective formulated in chapter one bearing in mind the data tabulated and described in chapter four, which addressed the characteristics and background of the contractor and its' personnel. The adequacy of use and effectiveness of the various project management techniques in delivering infrastructure in terms of time, cost and quality and lastly factors that hinder the implementation of project management techniques.

5.1 Characteristics and background of the contractors

The research reveals that small and medium construction enterprise projects are managed and planned by managing directors or contract managers who are experienced and educated, as more than ten (10) of the interviewed respondents had over ten (10) years of experience in the construction industry as well as in their current positions. In terms of their educational qualifications thirteen (13) of the respondents had diplomas to post-graduate qualifications. The result also indicates that most SMEs are involved in building construction projects as ten (10) of them alluded to this. None of the contractors were involved in the field of Civil Engineering.

Due to purposive selection of the contractors the result indicates that the amount of turnover stipulated by various contractors was quite similar to the definition given in chapter one apart from one of the medium-sized contractors who had a turnover of over R50 million, and one of the small contractors who had a turnover of over R10 million. Despite attaining turnovers that are not of their categories the two respondents achieved their results in terms of time, cost and quality.

In terms of permanent employees the definition of small contractors concurs with the definition of DTI (1995), and National Small Business Act (1996), all the ten (10) small contractors had between five (5) and fifty (50) permanent employees, of the five (5) medium contractors only three (3) fell in the category of their appropriate definition. The other two (2) had either less than twenty (20) permanent employees or exceeded two hundred (200) permanent employees. These contractors are still medium contractors as their turnovers were appropriately categorized. This might have been attributed by the amount of work being undertaken by the contractors currently as the two medium contractors had different volume of work, which they were undertaking at present.

The study also indicates that SMEs interviewed are currently busy with different number of projects, from one (1) to ten (10). In the last three years before 2003 most of the contractors had completed an average of six (6) projects varying in cost as indicated in Table 4.2.5a and 4.2.5b respectively. These suggests that the contractors have been busy, and hence fulfilling the government policy of empowering SMEs in the main stream of the economy. The results also indicate that most of the respondents do not attend refresher courses in management as summarized in Table 4.2.12. This latter result indicates that majority of the personnel interviewed are not keen on refreshing their knowledge in management aspects as they might be contented with the knowledge they had previously acquired. These results addresses research question *objective one*.

5.2 Use of project management techniques by SMEs on construction projects

The research reveals that project management and project management techniques are considered to be necessary as indicated in Tables 4.3.1 and Table 4.3.2 respectively. As described in the literature review, construction projects need to be managed in phases, 100% of the respondents agreed that they manage their projects in phases as indicated in Table 4.3.4. These phases are initiation, design/planning, construction and handover/closeout. 100% of the respondents interviewed agreed that project management techniques should be used during the various phases of construction project as indicated in Table 4.3.5.

From the results in Tables' 4.3.6, 4.3.7, 4.3.8 and 4.3.9, of the thirty-four (34) techniques investigated in the various phases of project management life cycle, seventeen (17) of the techniques were used infrequently by most of the respondents i.e. less than 80% of the respondents. This result suggests that some of the techniques were not useful for managing projects undertaken by small and medium contractors. During the handover phase the result indicates that the techniques were not frequently used, hence the respondents not wanting to re-check their projects success and failures. It is quite interesting to note that earned value analysis, which is regarded as a "hardcore" method of analyzing financial cost in a project is used frequently by the contractors. It can be inferred that SMEs in the construction industry use majority of the project management techniques they perceive to be essential in managing their projects.

The respondents felt that majority of the techniques are necessary in managing their projects as of the thirty-four techniques stipulated only four (4) of the techniques were not considered necessary as they fell in the band between 2.00 and 2.50 and had high dispersion rate. These techniques are statement of work, preliminary schedule, control charts and earned value analysis as indicated in Table 4.3.10. The techniques that had a mean falling in the band between 2.50 and 3.00 were perceived to be necessary in managing projects managed by SMEs. The important techniques that can be used to manage projects undertaken by SMEs, are ranked between first (1st) and twentieth (20th). These techniques are twenty (20) as indicated in Table 4.3.11 they fell in the band between 4.50 and 5.00 with majority of them with a standard deviation of less than 1.00. Highly ranked technique in terms of importance was inspection of work (quality control) and the lowest ranked technique was control chart.

The adequacy of using the techniques does not compliment the results in Tables 4.3.6 to 4.3.9, which indicated the usage of the techniques, and Tables 4.3.10 and 4.3.11, which indicated the necessity of the techniques and the importance of the techniques respectively. There is a high dispersion of response as the result indicates a high standard deviation greater than 1.00 for the various techniques stipulated. The result in Table 4.3.7 indicates that over 80% of the contractors agreed they were using bar chart and agreed that it is necessary as well as important, as indicated in

Tables 4.3.10 and 4.3.11 respectively. It was also ranked high in terms of adequacy of use. It was also used in managing projects time as more than twelve (12) of the respondents used a bar chart, this result indicates that managing time of projects is essential. Two contractors used “intuition” experience to manage and plan for their projects, which was not considered to be a formal project management technique.

The techniques of managing cost were used by the contractors as indicated in Tables 4.3.7, 4.3.8 and 4.4.2, i.e. budget/cost analysis and cost breakdown structure. A budget was put in place in the form of bills of quantity to enable the contractor to manage his cost well from inception of the project till the completion. Experience and education seem to have had a positive impact on managing cost despite the fact that some contractors experienced cost mismanagement, which were minimal.

Quality management technique was in place to enable the contractors to achieve sufficient quality of work. In relation to Table 4.4.3 all the respondents used a specified standard and specification given to them by the architects or the engineers and thus managed quality of their projects by inspecting their work. The specification is seen as a benchmark to measure quality standards of projects.

In conclusion the results in Table 4.3.6 to 4.3.9 and Table 4.4.1 to 4.4.3 indicate that formal project management techniques were used during the phases of project management apart from the handover phase where the techniques were infrequently used. Time management technique that was frequently used was a bar chart as analysed in Table 4.3.7 and 4.4.1. Cost management techniques that were frequently used by the contractors are; budgets, cost breakdown structure, cost analysis and bills of quantities as indicated in Table 4.3.7 and 4.4.2. Quality management techniques frequently used are; specifications and standards, monitoring the project progress against baseline plan and inspection of work (quality control) as indicated in Table 4.3.7, 4.3.8 and 4.4.3 respectively. In terms of adequacy of use majority of the techniques are not adequately used, hence addressing research question *objective two*.

5.3 Effectiveness of project management techniques in delivering projects among SME construction companies.

This objective was analyzed on the basis of the project success achieved by the use of project management techniques. The techniques and tools indicated in Tables 4.3.6 to 4.3.9 and also those in Tables 4.4.1, 4.4.2 and 4.4.3 indicated that most of the contractors used the various techniques. The result indicates that project management techniques were used frequently at the different phases of project management apart from the handover phase. The techniques were also addressed to be necessary despite the fact that some were seen to be more appropriate than others.

The results indicated in Table 4.4.1, 4.4.2 and 4.4.3 suggests that the contractors used the techniques and tools to manage time, cost and quality respectively. As analyzed in Table 4.4.1, thirteen (13) of the respondents used a quantitative technique i.e. a bar chart and four (4) backed it by using critical path network to manage their projects. This verifies that the respondents used time management techniques to check the actual time versus the anticipated time in the program, hence scheduling their resources. Two (2) of the respondents used “intuition” experience, one of the respondents who claimed to have used experience never achieved the desired outcome whereas the other contractor achieved the desired results. Nine (9) of the respondents were satisfied with the technique used as they were mostly on time and could identify aspects that were going to create delays. It was easy for them to manage their projects time and hence update their programs to the current situation. It can therefore be concluded that the usage and adequate usage of the techniques improved the management of the projects in terms of time.

All the fifteen (15) respondents had a project management technique in place to manage their project costs, nine (9) of the respondents achieved the desired results of their project costs, as they were able to track any misdemeanor in terms of the cost of the project and thus agreed that the technique was effective. Four (4) of the contractors achieved the desired results of the project but still felt that their techniques need to be improved to concur with the current methods and nature of

their projects. The result indicates that using cost management techniques and using them adequately improves the delivery of the projects in terms of its budget.

Quality of work was another important parameter to all the respondents as all of them used the stipulated technique (plan) i.e. standards and specifications given to them. Of the fifteen (15) respondents interviewed ten (10) of them were satisfied with the quality of work they remitted to their clients. To achieve this they ensured thorough supervision and inspection of work by checking the specifications and standards of work being executed. Checking for plumb-ness of the walls, plasterwork well cured and have no hair cracks or defects. The respondents also inspected the delivered material before signing the delivery note to verify the cost, quality and quantity delivered. Work that had not been properly executed was re-done in the contractors account before moving to the next stage. From this result quality was attained when using the techniques, hence delivery of good quality project to the client. The need for improving quality management may have arisen due to lack of skills among their personnel, time constraint of the project, lack of information from the professional team and nature of the project/ magnitude of the project summarized in Table 4.4.4 might have led to inadequate use of the quality management techniques.

The attainment of time, cost and quality can also be attributed to experience and level of education of the respondents as eleven (11) of them had more than ten (10) years of experience in their current positions and in the construction industry and thirteen (13) of the respondents had a tertiary qualification in construction field, hence putting them in a position to be able to judge whether they have achieved the time, cost and quality of their project. The result indicates that the contractors used the project management techniques and that the techniques are effective in delivering projects in terms of time, cost and quality as more than nine (9) of the fifteen (15) respondents interviewed achieved the desired results. Thus it can be concluded that the techniques play a vital role in terms of improving the management of time, cost and quality in small and medium firm projects, hence addressing research question *objective three*.

5.4 Internal and external factors hindering implementation of project management techniques.

This objective was to find out if there are any factors that hinder the implementation of project management techniques. It is evident that there are internal and external factors that hinder the implementation of project management techniques. The factors that featured prominently as hindrances internally were financial and time constraints. These factors might have caused the contractor to be under pressure to deliver his project to the client hence not being able to implement the project management techniques outlined in Table 4.3.6 to 4.3.12 and Table 4.4.1 to 4.4.3 adequately. The result in Table 4.4.4 indicates that financial and time constraints hindered the respondents from implementing the project management techniques. These factors can drive the contractor to try and fast track the project hence tend to use “intuition” experience and decide not to use project management techniques that are appropriate for a given phase of project management.

Lack of information from the professional team is viewed as an external factor that hinders the implementation of PMTs. This is due to the professionals not producing complete drawings or specifications in their projects, which later creates a problem between the contractor and the project team. It can therefore be stated that contractors will not have a continuous flowing project as they encounter stoppages and hence time interference. This suggests that without proper information the project will be derailed and it will not flow as per the contracts program, thus complicating the usage of the techniques. The other factors, i.e. understaffing, lack of skill, attitude towards the use of the techniques, nature of work, lack of good training, lack of management skills, not adapting the modern ways of managing projects were mentioned by less than four (4) respondents, which indicates that they do not have major impact internally towards the implementation of PMTs.

In conclusion the result indicates that time and financial constraints are internal factors that hinder the implementation of project management techniques while professional interference due to lack of information is seen as an external factor. This result therefore suggests that there are internal and external factors that hinder the implementation of PMTs, hence addressing research question *objective four*.

CHAPTER 6

6. FINDINGS AND RECOMMENDATIONS

The implications arising from this research project are discussed below reflecting the characteristics of SMEs and its' personnel, the use, necessity, importance and adequate use of the project management techniques. The improvement in the delivery of infrastructure by using project management techniques is discussed, and the factors that hinder the implementation of project management techniques are identified. Lastly areas for further research are recommended.

6.1 Findings

From the findings of this research small and medium contractors are managed by experienced and educated personnel, they are also involved in diverse types of construction activities but mostly in the building construction. The study verifies that small contractors employ between five (5) and fifty (50) permanent employees and they have a turnover of less than R10 million, whereas medium contractors employ between fifty (50) and two hundred (200) permanent employees and have a turn over of between R10 million and R50 million. The results also suggest that SMEs are in the mainstream of the economy as they are managing various projects and hence creating employment. The need for respondents updating their management skills is not in place. There is also an indication that SMEs in the South Africa construction industry use the various project management techniques at the different phases of project management to manage their projects in terms of time, cost and quality. The project management techniques are also considered to be important and necessary in managing projects undertaken by the SMEs, and are also adequately used.

The techniques used frequently are project administration meeting, work breakdown structure, budget/cost analysis, bar chart, Cost Breakdown Structure (CBS), specifications and standards, monitoring project progress against baseline plan, monitoring and tracking, inspection of work and performance measurement. They are also considered to be necessary. Of the eleven (11) techniques considered to be

highly used and necessary, only three (3) of them were regarded as highly important these were inspection of work (quality control), specifications and standards, and organizational breakdown structure.

As per adequacy of using these techniques inspection of work (quality control) was highly ranked technique at first (1st), whereas, budget/cost analysis was second (2nd), whereas CBS, specifications and standards, monitoring and tracking were ranked third (3rd), with mean score between 4.50 and 5.00 band with a standard deviation of less than 1.00. The result indicates that most small and medium contractors do not adequately use majority of the techniques. Bar chart and inspection of work are highly rated in all sections i.e. in terms of use, necessity, importance and adequacy of use, also in managing of time and quality. These techniques can be regarded as vital in managing projects undertaken by small and medium contractors.

The study also indicates that managing the projects time, cost and quality was undertaken as most of the contractors used a project management technique to manage these parameters, which assisted them in achieving their project time, cost of the project and quality of work done by the contractors, as the contractors felt that the clients and professional team were happy with the kind of work they had delivered. This indicates that the project management techniques are effective in improving the delivery of projects in terms of time, cost and quality when used in managing construction projects.

Despite achieving the parameters of time, cost and quality there were hindering factors that deterred the respondents to fully implement these techniques. Lack of project information from the professional team was viewed as an external factor. This factor hinders the contractor from carrying out the work as per the program, budget or even the required specification, thus creating misunderstanding between the client and contractor. Time and financial constraints also exacerbates the inadequacy of using project management techniques from within the company, the latter factor prevents the SMEs not to be able to afford buying the current programs for managing their projects.

In conclusion the delivery of infrastructure projects may be improved when experienced and educated personnel manage their projects using project management techniques adequately, as they assist the contractor to trace faults in their projects. Inadequate use of some of the techniques should be alleviated and the factors that hinder the implementation of project management techniques should be taken into account. The hindering factors to be overcome are: lack of information from the professional team as an external factor and financial and time constraints among SMEs as an internal factor. The need to alleviate these hindering factors should enhance the adequate usage of, project management techniques and thus improve the project delivery. Therefore the construction industry is challenged to reflect on the findings of the research, as this will influence the desired change within the industry among small and medium contractors involved in infrastructure delivery.

6.2 Areas recommended for further research

The following areas need further research:

- The need to compare, project management techniques in use by the small and medium firms and the large construction companies;
- The need to research the informal sector of contractors, especially small and micro contractors; and
- There is need to carry out this type of research from the conception of the project till the completion of the project cooperating the following role players

The client and the professionals i.e. (consultant quantity surveyor, the architect and the consultant engineers) who were part of the various projects that the contractor was involved in, need to be interviewed.

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Appendix A

Letter of Introduction

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TO WHOM IT MAY CONCERN

Dear Sir/Madame;

LETTER OF INTRODUCTION – Mr. JN Agumba (Student No. 2012377)

I am writing to introduce Mr. Justus Agumba to you. Justus is a postgraduate student in the faculty of engineering at Technikon Witwatersrand, where he is registered for a Masters of Technology in Construction Management. His research, which is being conducted under the supervision of Professor F. Otieno and myself, is on the topic “*Evaluating project management techniques among small and medium contractors delivering infrastructure in the South African construction industry*”.

As part of his research, Justus requires information on project management techniques used in the construction industry. Thus, he has approached you to try and obtain some of this information. We would appreciate it if you kindly oblige and assist him in any way possible. By doing so, you will be adding valuable contribution towards the expansion of knowledge in an area which is both timely and very important in the South African construction environment and the economy as a whole.

The interviews will be approximately 30minutes and if need be he will require two interviews on separate dates of which he will inform you. The faculty and I would kindly like to request you to participate in this study by giving the required information.

You and your company are assured of complete confidentiality and should you wish to know the findings of the research, the faculty will gladly send you a summary of the results.

Thank you

IO Adegoke, Pr.Eng.
Faculty Research Manager: Engineering

Appendix B

Questionnaire interview for pilot survey

QUESTIONNAIRE TO EVALUATE PROJECT MANAGEMENT TECHNIQUES, IN SMALL AND MEDIUM FIRMS DELIVERING INFRASTRUCTURE IN SOUTH AFRICAN CONSTRUCTION INDUSTRY

Please note that this questionnaire consists of three sections, namely sections A through to C

Section A:

To outline the characteristic of the type of contractor and his personnel

Semi-structured questionnaire

Question 1.

Who in your company is responsible for project planning on given projects?

Question 2

What field of business does your company specialize in?

Home improvement	
Building construction	
Civil engineering construction	
Other	

Question 3

What is your company's estimated annual turnover?

Less than R1m	
Between R1m-R 10m	
Between R10m-R50m	
Above R50m	

Question 4

How many permanent employees does your company have?

Less than 20	
Between 20-200	
More than 200	

Question 5

What is the number of completed projects in the last 3 years and the approximate value of the largest?

Number of projects completed in the last 3 years	
Approximate value of the largest project	

Question 6

What is the average size of your current projects?

Less than R1m	
Between R1m-R10m	
Between R10m-R40m	
More than R40m	

Question 7

How many projects do you have running at this point in time?

Between 0-2	
Between 3-10	
Between 11-20	
More than 20	

Question 8

What is your current position in the company?

Construction manager	
Project manager	
Managing director/partner	
Other	

Question 9

How long have you been in this position?

Less than 3years	
Between 3-10 years	
More than 10years	

Question 10

What is your highest educational qualification?

Grade 11 or standard nine and below	
Matric	
Certificate	
Diploma	
Bachelor's degree	
Post-graduate degree or diploma	
Other	

Question 11

How many years of experience do you have in your current position?

Less than 2 years	
2-8 years	
8 years and above	

Question 12

How often do you attend refresher courses of management?

After 6 months	
After 1 year	
After 1 ½ years	

Section B:

To outline various project management techniques that are used by the contractor for different activities within the project

Open-ended interview

Question 1

Describe in detail how you (or site supervisor/staff) manage your project(s) to attain a good level of success in terms of time of completion of your project(s), bearing in mind the following questions.

- 1.1 What type of technique(s) do you use to measure time?
- 1.2 How do you measure your progress using the technique(s) mentioned above?
- 1.3 How do you know if you are ahead of time set or lagging behind?
- 1.4 How do ensure that you are in control of the required time set?
- 1.5 What is your opinion about the technique(s) you are using?

Question 2

Describe in detail how you (or site supervisor/staff) manage your project(s) to attain an acceptable level of success in terms of attaining the required cost of your project(s), bearing in mind the following questions.

- 2.1 What type of technique(s) do you use to measure cost?
- 2.2 How do you measure your cost or budget using the technique(s) mentioned above?
- 2.3 How do you know if you are within the anticipated budget of the client?
- 2.4 How do you ensure that you are within the required budget of the client?
- 2.5 What is your opinion about the technique(s) you are using?

Question 3

Describe in detail how you (or site supervisor/ staff) manage your project(s) to attain an acceptable level of success in terms of quality, bearing in mind the following questions.

- 3.1 What type of technique(s) do you use to measure quality?
- 3.2 How do measure quality with the technique(s) mentioned above?
- 3.3 How do you know if the quality is the required one?
- 3.4 How do you ensure that the quality standard is maintained or rectified?
- 3.5 What is your opinion about the technique(s) being used?

Section C:

Open-ended interview

To outline the hindrance of project management techniques implementation

Question 4

What are the internal factors that hinder the implementation of project management techniques within your company?

Question 5

What are the external factors that hinder the implementation of project management techniques within your company?

Thank you for your contribution towards improving infrastructure delivery in South African construction industry.

ANALYSIS OF PILOT SURVEY DATA

Introduction

The data gathered during the pilot survey from the interviews were analyzed using the techniques described previously and the results are presented below.

The first section was designed to establish whether the firm fell within the definitions given. Furthermore the education background, expertise, experience of the senior managers interviewed was explored.

Semi-structured questionnaire

Question 1

What field of business does your company specialize in?

	Small construction firm	Medium construction firm	Total
Home improvement	1	0	1
Building construction	1	0	1
Civil engineering construction	0	0	0
Other	0	0	0
Total	2	0	2

Question 2

What is your company's estimated annual turnover?

	Small construction firm	Medium construction firm	Total
Less than R1m	0	0	0
Between R1m-R 5m	1	0	1
Between R5m-R10m	1	0	1
Between R10m- R50m	0	0	0
Above R50m	0	0	0
Total	2	0	2

This table confirms that the definition of small and medium construction firms has been verified bearing in mind the category.

Question 3

How many permanent employees does your company have?

	Small construction firm	Medium construction firm	Total
Less than 20	2	0	2
Between 20-50	0	0	0
Between 50-200	0	0	0
More than 200	0	0	0
Total	2	0	2

This table confirms that the firms interviewed do fall within the category of small and medium as previously defined.

Question 4

What is the number of completed projects in the last 3 years and the approximate value of the largest?

	Small construction firm	Medium construction firm	Total
Number of projects			
0-20	1	0	1
20-50	0	0	0
50-100	0	0	0
100-150	1	0	1
150-200	0	0	0
200 and above	0	0	0
Total	2	0	2
Approximate value of the largest project			
0-0.5m	0	0	0
0.5m-1.0m	0	0	0
1m-5.0m	2	0	2
5m-10m	0	0	0
10m-20m	0	0	0
20m-40m	0	0	0
40m and above	0	0	0
Total	2	0	2

Question 5

What is the average size of your current projects?

	Small construction firm	Medium construction firm	Total
Less than R1m	2	0	2
Between R1m-R5m	0	0	0
Between R5m-R10m	0	0	0
Between R10m-R20m	0	0	0
Between R20m-R40m	0	0	0
More than R40m	0	0	0
Total	2	0	2

Question 6

How many projects do you have running at this point in time?

	Small construction firm	Medium construction firm	Total
Between 0-5	1	0	1
Between 5-10	1	0	1
Between 10-20	0	0	0
More than 20	0	0	0
Total	2	0	2

Question 7

What is your current position in the company?

	Small construction firm	Medium construction firm	Total
Construction manager	1	0	1
Project manager	0		0
Managing director/partner	1	0	1
Other	0	0	0
Total	2	0	2

Question 8

How many years of experience do you have in your current position?

	Small construction firm	Medium construction firm	Total
Less than 2years	0	0	0
Between 2-5years	2	0	2
Between 5-10years	0	0	0
More than 10years	0	0	0
Total	2	0	2

Question 9

What is your highest educational qualification?

	Small construction firm	Medium construction firm	Total
Grade 11 or standard 9 and below	1	0	1
Matric	0	0	0
Certificate	0	0	0
Diploma	1	0	1
Bachelor's degree	0	0	0
Post-graduate degree or diploma	0	0	0
Other	0	0	0
Total	2	0	2

Question 10

How many years of experience do you have in the construction industry?

	Small construction firm	Medium construction firm	Total
Less than 2 years	0	0	0
Between 2-5 years	2	0	2
Between 5-10 years	0	0	0
Above 10 years	0	0	0
Total	2	0	2

Question 11

How often do you attend refresher courses of management?

	Small construction firm	Medium construction firm	Total
After 6 months	0	0	0
After 1 year	0	0	0
After 1 ½ years	0	0	0
Doesn't at all	2	0	2
Total	2	0	2

Open-ended interview

To explore the usage of project management techniques and their effectiveness in a project with regard to time management.

Respondent	Plan	Performance measurement	Deviation test	Decision and reaction process	Effectiveness of the control system
1	Program	Measure actual versus project completion time	When the days work has not been finished	In case of delay, communicate with the client, suppliers	Ineffective
2	End date is known no formal plan	Judge by the days work	Experience from the proprietor	Additional resources especially labour	Ineffective

To explore the usage of project management techniques and their effectiveness in a project with regard to cost management

Respondent	Budget	Performance measurement	Deviation test	Decision and reaction process	Effectiveness of the control system
1	Lump sum contract	None	Different activities are broken down to reflect expenses	In case budget is high some items are removed	Effective
2	Negotiate with the client	None	None	In case of any cost misunderstanding settle it with the client	Effective

To explore the usage of project management techniques and their effectiveness in a project with regard to quality management.

Respondent	Specifications	Performance measurement	Deviation test	Decision and reaction process	Effectiveness of the control system
1	Set quality standards that need to be achieved by the company and ensures thorough supervision	Check actual work done to the standards set by the company	In case of dispute involve inspectors from GMBA.	Penalize works for poor workmanship Re-do the work	Effective
2	Tests/inspection	Thorough inspection is undertaken by the foreman to ensure right quality has been attained	Bring work to the required standard	In case of poor workmanship re-do the work	Not very effective

The other section on open-ended questions was to establish the factors that hinder the implementation of project management techniques in these firms. The results were taken as those that were stipulated by the respondents and were in varying degree.

INTERPRETATION OF THE PILOT SURVEY DATA

Introduction

This section of the research contains the data interpretation obtained from the two contractors interviewed. The data will be dealt with by tackling each objective in turn.

Objective one

Project management techniques will be seen to be inadequate among most small and medium enterprises.

Introduction

The literature review revealed that the three most important project performance criteria are schedule (or time management), cost and quality. These performance criteria are seen as the key factors for infrastructure delivery. The results tabulated above are discussed in the framework of these three, project performance elements.

Time management

The management of time is concerned with the planning, scheduling and controlling of the work over the anticipated duration, taking full cognizance of the resources needed versus the resources available.

The time schedule or the plan

Of the two companies interviewed, they both do not prepare any formal time plan adequately in form of bar charts, critical path network or even a work breakdown structure to monitor their construction projects in terms of time. The results outlined, portrayed a very vague way of managing time.

From these results it is evident that SMEs do not adequately prepare formal time schedule or may prepare them under compulsion from the client. Since this first step forms the basis of evaluation of project management techniques, without which other elements such as performance measurement, deviation testing and corrective action cannot take place. This phenomenon partly fulfills the objective that SMEs in the construction industry do not use formal project management technique for time management.

Performance measurement

Having a plan in place or claimed to be in place should be used to measure the actual performance of the firm in terms of that plan. In this instance the company must measure its actual progress in completing the particular project. This can be achieved through a detailed basis where the actual quantity of concrete cast or the number of bricks laid in a period is measured and documented or it could be done

by means of a holistic measure such as the value of the work completed in that period.

Of the two companies interviewed, one did not measure the actual performance of the project in terms of the project schedule. The argument was that the foreman used his “intuition” experience to judge the progress of the project. This did not seem effective at all and was not recorded as a formal performance measure in their projects. Without this performance measurement a company cannot claim to have an effective time control system in place. The second company did compare the actual progress of work from the projected schedule.

Deviation test

Without formal time schedule or programme in place and no measurement of the actual progress on site from one firm, it is not surprising that the, objective was not met by this company. The other company that compared its actual versus projected time never achieved its’ goal hence it can be verified that the program was not adequately prepared.

The decision and reaction process

It is important that once a deviation from the anticipated programme is noted, necessary corrective action needs to be taken to prevent the project from an overrun on the agreed project completion date. The two companies interviewed briefly confirmed that, they would increase the resources on a site to complete their project on time. The issue raised was that a penalty is given to an artisan who does not complete his work satisfactorily. This will make the workers’ to fear and hence make a lot of mistakes.

Cost management

Introduction

The costs management involves the development of a financial budget against which cost variances may be considered to enable corrective action to be taken.

The financial budget

This aspect of project performance is well covered by the SMEs interviewed. Of the two companies interviewed both of them had a formal way of a financial plan, well documented and detailed. These budgets have well been derived from the quotation and tender submitted, based on the allowable, which have been used therein.

The performance measurement

With the two companies interviewed having detailed project budgets, it was not surprising to find that these companies also made an effort to use these effectively by allocating costs to the specific projects activity. The balance of the company did not measure or allocate their costs on a project basis and would therefore not be able to report on the profitability or success of a particular project.

The deviation test

Of the two companies interviewed they measured their actual costs with the budgeted cost and hence they were happy with the results achieved, whereas the other company did not measure his work ideally but at the end of the today they were positive with the cost outcome.

The decision and reaction process

The critical impact of cost management on the survival of the SMEs was again highlighted by the fact that the one of the respondents interviewed was using his cost control effectively to facilitate corrective action in case of cost overrun. The time and effort that was spent on the inputs to the cost planning and control was, in the end, generally well used in either checking actual cost and the projected cost. The other contractor interviewed, never really used formal techniques but was happy with his results at the end of the project.

Quality management

Introduction

Quality control is an aggregate of the functions designed to insure adequate quality in manufactured products. This is accomplished by an initial critical study of engineering design, materials, processes, equipment and workmanship followed by periodic inspection. Furthermore an analysis of the results of inspection is used to determine causes of defects and by removal of such causes.

The interview conducted amongst the two contractors verifies that quality control is one of the most essential issues in the organization and management of building contracts. While quality is seen as the supervisory personnel's function, the failure to achieve the desired quality standard can be ascribed to a number of reasons.

The definition of the required quality standard

Of the two companies interviewed, they relied on the client or the professionals to define the required standard. Where this was not done explicitly, the contractors totally ignored the formal concept of quality control and only relied on their experience on what was regarded as an acceptable quality. According to the respondents, this invariably led to arguments since what constituted quality differed according to how you viewed the outcome of the project.

The performance measurement

Where these observations came to late, e.g. un-plumbed wall, the contractors were generally not prepared to rectify what they thought was not their mistake. In most case the depended on visual inspection based on the foremen or supervisors experience. This occurred despite the fact of taking physical measurements to verify the level of conformance with defined standards of quality.

The deviation test

With a defined standard and a measure of the attribute of that standard it is obviously possible to test whether non-conformance has occurred. As per the interview it seems that these two companies do compare actual quality standards with those defined. One of respondents is quite happy with the quality of work that is achieved from his projects, whereas the other contractor has a lot of uncertainty with the quality, which is normally not very consistent.

The decision and reaction process

As might be expected, corrective action to defective workmanship was in most cases only undertaken under compulsion from the client or the professional. This situation often ended up in unpleasant arguments, which created a poor reputation for the building industry as a whole. That is why one of the respondents involves Guateng Master Builders Association (GMBA) during these kinds of disputes

Conclusion

The data collected from the two contractors verifies the proposition that SMEs do not use formal project management techniques to manage their operations. The cost management technique and quality management technique seems to be used by the respondents. Time management technique doesn't seem to be a priority amongst the two contractors interviewed. The former concept seemed to be more easily visualized and therefore more easily understood while the latter concept seemed to be foreign to the respondents in this pilot survey.

Objective two

The adequate use of project management technique will improve infrastructure delivery among small and medium size companies.

Introduction

This objective was researched on the basis of the level of success achieved by the project management techniques, which were used. Ideally these questions should have been directed to the architects who would verify that the specifications put down were followed. On the other hand a quantity surveyor should have verified if the project achieved its goal in terms of the anticipated budget of the client, and the quality achieved should have been inquired either through the architect, client, professional quantity surveyor or even a consulting project management firm. The questions were however directed to the respective contractors.

Due to the above raised issues it was difficult to verify whether success was truly achieved or not. As per the interview conducted via telephone there was little bit of hesitation in answering the question but eventually the answer given was positive in that success was achieved.

As per the analyzed results it shows clearly that the respondents interviewed have tried to use the formal project management techniques to achieve time, cost and

quality in their respective companies. It does reflect that if the techniques of project management are adequately used all the three variables will be achieved. This is due to the fact that were the techniques were used there was at least a positive result.

The analysis of the data gathered therefore supports the objective that the use of formal project management technique will improve the delivery of infrastructure.

Objective three

There are internal and external factors that hinder the implementation of project management techniques.

Introduction

This objective was to find out if there are any factors that hinder the implementation of project management techniques. The respondents interviewed were to comment on the factors that make them not to implement project management technique.

It has been clearly defined by the respondents that there is definitely factors that hinder the implementation of project management techniques.

The internal factor that hinders the implementation of this technique is:

- Lack of personnel to assist in implementing these techniques

External factors that hinder the implementation of this technique are:

- Client interfering with the contractor when the contractor is busy, by implementing changes at his own will.

Appendix C

Questionnaire interview for the research project

QUESTIONNAIRE TO EVALUATE PROJECT MANAGEMENT TECHNIQUES, IN SMALL AND MEDIUM FIRMS DELIVERING INFRASTRUCTURE IN SOUTH AFRICAN CONSTRUCTION INDUSTRY

Please note that this questionnaire consists of three sections, namely sections A, B and C

SECTION A:

To outline the characteristic of the type of contractor and his personnel

Semi-structured questionnaire

Question 1.

Who in your company is responsible for project planning on given projects?

Question 2

What field of business does your company specialize in?

Home improvement	
Building construction	
Civil engineering construction	

Question 3

What is your company's estimated annual turnover?

Less than R1m	
Between R1m-R 5m	
Between R5m-R25m	
Between R25- R50m	

Question 4

How many permanent employees does your company have?

Less than 20	
Between 20-200	
More than 200	

Question 5

What is the number of completed projects in the last 3 years and the approximate value of the largest?

Number of projects completed in the last 3 years	
Approximate value of the largest project	

Question 6

What is the average size of your current projects?

Less than R1m	
Between R1m-R5m	
Between R5m-R10m	
Between R10m-R20m	
Between R20m-R40m	
More than R40m	

Question 7

How many projects do you have running at this point in time?

Between 0-2	
Between 3-10	
Between 11-20	
More than 20	

Question 8

What is your current position in the company?

Construction manager	
Project manager	
Managing director/partner	
Other	

Question 9

How many years of experience do you have in your current position?

Less than 3years	
Between 3-6years	
Between 6-10years	
More than 10years	

Question 10

What is your highest educational qualification?

Grade 11 or standard 9 and below	
Matric	
Certificate	
Diploma	
Bachelor's degree	
Post-graduate degree or diploma	
Other	

Question 11

How many years of experience do you have in the construction industry?

Less than 3 years	
Between 3-6 years	
Between 6-10 years	
Above 10 years	

Question 12

How often do you attend refresher courses of management?

After 6 months	
After 1 year	
After 1 ½ years	

SECTION B

This section outlines various project management techniques that are used by the contractors for different activities within the project. Two sets of questionnaire have been formulated a structured questionnaire and open-ended questionnaire

Structured interview

1. How necessary is it to have project management in your projects in your opinion?

1= Totally unnecessary; 2=unnecessary; 3=neutral; 4=necessary; 5=totally necessary

2. How necessary do you consider project management techniques?

1=totally necessary; 2=unnecessary; 3=neutral; 4=necessary; 5=totally necessary

3. Should construction projects be managed in stages?

Yes	No	Don't know

4. If 'yes' tick the project management life cycle that you use in your projects?

Phases of project management	Yes	No
Initiation phase		
Initiation and planning phase		
Initiation, planning, & construction phases		
Initiation, planning, construction & handover phases		

5. In your opinion should project management techniques be used during the project management phases?

Yes	No	Don't know

6. If "yes" which project management techniques do you use during the initiation stage?

Technique	Yes	No
Project administration meeting		
Establish project initiation plan		
Establish management procedures		
Establish the project management environment and workbook		
Project selection method		
Expert judgment		

7. Which of the following project management techniques do you use during the design phase?

Technique	Yes	No	Don't know
Project scope, feasibility			
Work breakdown structure			
Resource plan			
Preliminary schedule			
Project standards and procedures			
Budget/ cost analysis			
Statement of work			
Baseline project plan			
Bar chart/Gantt chart			
Critical path method			
Organizational breakdown structure			
Cost breakdown structure			
Brainstorming			
Specifications and standards			
Project planning methodology			

8. Which of the following project management techniques do you use during the construction phase?

Techniques	Yes	No	Don't know
Establishing reporting procedures			
Monitoring project progress against baseline plan.			
Managing the project workbook			
Communicating the project status			
Monitoring and tracking			
Earned value analysis			
Inspection of work (quality control)			
Control charts			
Performance measurement			
Status review meeting			

9. Which of the following project management techniques do you use during the handover or closeout phase?

Techniques	Yes	No	Don't know
Conducting post project review/post mortem			
Closing the clients contract			
Closing down the project			

10. In your own opinion which of the following techniques should a small or medium construction company use for running their projects?

(1=unnecessary, 2=unsure, 3=necessary)

Techniques	Necessary	Unsure	Unnecessary
Project administration meeting			
Project initiation plan			
Management procedures			
Project management & environment workbook			
Project selection method			
Expert judgment			
Project scope and feasibility			
Work breakdown structure			
Resource plan			
Preliminary schedule			
Project standards and procedure			
Budget/ cost analysis			
Statement of work			
Baseline project plan			
Bar chart / Gantt chart			
Critical path network			
Organizational breakdown structure			
Cost breakdown structure			
Brainstorming			
Specifications and standards			
Project planning methodology			
Reporting procedures			
Monitoring project progress against baseline plan			
Managing the project workbook			
Communicating the project status			
Monitoring and tracking			
Earned value analysis			
Inspection of work (quality control)			
Control charts			
Performance measurement			
Status review meeting			
Conducting post project review			
Closing the clients contract			
Closing down the project			

11. In your own opinion how important on a scale of 1 to 5 are the following project management techniques important to small and medium construction companies? (1=not at all important; 2=slightly not important; 3=neutral; 4=slightly important; 5=extremely important)

Techniques	1	2	3	4	5
Project administration meeting					
Project initiation plan					
Management procedures					
Project management & environment workbook					
Project selection method					
Expert judgment					
Project scope and feasibility					
Work breakdown structure					
Resource plan					
Preliminary schedule					
Project standards and procedure					
Budget/ cost analysis					
Statement of work					
Baseline project plan					
Bar chart / Gantt chart					
Critical path network					
Organizational breakdown structure					
Cost breakdown structure					
Brainstorming					
Specifications and standards					
Project planning methodology					
Reporting procedures					
Monitoring project progress against baseline plan					
Managing the project workbook					
Communicating the project status					
Monitoring and tracking					
Earned value analysis					
Inspection of work (quality control)					
Control charts					
Performance measurement					
Status review meeting					
Conducting post project review					
Closing the clients contract					
Closing down the project					

12. How adequately do you implement the following project management techniques? (1=extremely inadequate; 2=somewhat inadequately; 3=neither adequately nor inadequately; 4=somewhat adequate and 5= extremely adequate)

Techniques	1	2	3	4	5
Project administration meeting					
Project initiation plan					
Management procedures					
Project management & environment workbook					
Project selection method					
Expert judgment					
Project scope and feasibility					
Work breakdown structure					
Resource plan					
Preliminary schedule					
Project standards and procedure					
Budget/ cost analysis					
Statement of work					
Baseline project plan					
Bar chart / Gantt chart					
Critical path network					
Organizational breakdown structure					
Cost breakdown structure					
Brainstorming					
Specifications and standards					
Project planning methodology					
Reporting procedures					
Monitoring project progress against baseline plan					
Managing the project workbook					
Communicating the project status					
Monitoring and tracking					
Earned value analysis					
Inspection of work (quality control)					
Control charts					
Performance measurement					
Status review meeting					
Conducting post project review					
Closing the clients contract					
Closing down the project					

SECTION C

Open-ended interviews

To explore effective usage of project management techniques in section, in terms of time, cost and quality

Question 1

Describe in detail how you (or site supervisor/staff) manage your project(s) to attain a good level of success in terms of time of completion of your project(s), bearing in mind the following questions.

1.1 What type of technique(s) do you use to manage time?

1.2 How do you measure your progress using the technique(s) mentioned above?

- 1.3 How do you know if you are a head of the time set or lagging behind?
- 1.4 How do you ensure that you do not deviate from the required time set?
- 1.5 What is your opinion about the technique(s) you are using to measure time?

Question 2

Describe in detail how you (or site supervisor/staff) manage your project(s) to attain an acceptable level of success in terms of attaining the required cost of your project(s), bearing in mind the following questions.

- 2.1 What type of technique(s) do you use to manage your project cost?
- 2.2 How do you measure your cost or budget using the technique(s) mentioned above?
- 2.3 How do you know if you are within the anticipated budget of the client?
- 2.4 How do you ensure that you are within the required budget of the client?
- 2.5 What is your opinion about the technique(s) you are using to measure cost?

Question 3

Describe in detail how you (or site supervisor/ staff) manage your project(s) to attain an acceptable level of success in terms of quality, bearing in mind the following questions.

- 3.1 What type of technique(s) do you use to manage the quality of your project(s)?
- 3.2 How do measure quality with the technique(s) mentioned above?
- 3.3 How do you know if the quality is the required one?
- 3.4 How do you ensure that the quality standard is maintained or rectified?
- 3.5 What is your opinion about the technique(s) being used to measure quality?

To outline what hinders the implementation of project management techniques among small and medium contractors

Question 4

What are the internal factors that hinder the implementation of project management techniques within your company?

Question 5

What are the external factors that hinder the implementation of project management techniques within your company?

Thank you for your contribution towards improving infrastructure delivery in South African construction industry.

Raw data for semi-structured interview responses

Question 1.

Who in your company is responsible for project planning on given projects?

Respondent	Planning responsibility	Size of company
1	Managing director	Small contractor
2	Construction manager	Small contractor
3	Director	Medium contractor
4	Construction manager	Small contractor
5	Contracts manager	Medium contractor
6	Director	Small contractor
7	Contracts manager	Small contractor
8	Contract manager	Small contractor
9	Contracts manager	Small contractor
10	Managing director	Small contractor
11	Managing director	Medium contractor
12	Director	Small contractor
13	Contracts manager	Medium contractor
14	Contracts manager	Medium contractor
15	Managing director	Small contractor

Question 2

What field of business does your company specialize in?

Respondent	Company size		Type of business			
	Small	Medium	Home improvement	Building construction	Civil construction	Others
1	X		X			
2	X			X		
3		X				Commercial properties
4	X		X			
5		X		X		
6	X		X			
7	X			X		
8	X			X		
9	X			X		
10	X			X		
11		X		X		
12	X			X		
13		X		X		
14		X		X		
15	X			X		

Question 3

What is your company's estimated annual turnover?

Respondent	Size of company		Annual turnover				
	Small	Medium	> R1m	Between 1m-R5m	Between R5m-R10	Between R10m-50m	<R50m
1	X			X			
2	X				X		
3		X				X	
4	X			X			
5		X					X
6	X		X				
7	X			X			
8	X			X			
9	X		X				
10	X			X			
11		X				X	
12	X					X	
13		X				X	
14		X				X	
15	X			X			

Question 4

How many permanent employees does your company have?

Respondent	Company size		Permanent employees			
	Small	Medium	>20	Between 20-50	Between 50-200	Over 200
1	X		X			
2	X		X			
3		X			X	
4	X		X			
5		X				X
6	X		X			
7	X		X			
8	X			X		
9	X		X			
10	X		X			
11		X			X	
12	X		X			
13		X			X	
14		X			X	
15	X			X		

Question 5

What is the number of completed projects in the last 3 years and the approximate value of the largest?

Number of projects the contractors have completed in the last 3years

Respondent	Company size		Number of completed projects in last three years			
	Small	Medium	>20	Between 20-50	Between 50-100	Over 100
1	X					X
2	X				X	
3		X	X			
4	X			X		
5		X		X		
6	X		X			
7	X		X			
8	X		X			
9	X		X			
10	X		X			
11		X	X			
12	X			X		
13		X	X			
14		X	X			
15	X			X		

Value of the largest project completed within the last 3years

Respondent	Size of company		Value of the largest project					
	Small	Medium	>R1m	R1m-R5m	R5m-R10m	R10m-R20m	R20m-R40m	Over R40
1	X			X				
2	X					X		
3		X				X		
4	X		X					
5		X				X		
6	X		X					
7	X			X				
8	X				X			
9	X		X					
10	X				X			
11		X		X				
12	X				X			
13		X					X	
14		X					X	
15	X			X				

Question 6

What is the average size of your current projects?

Respondent	Size of company		Value of current project					
	Small	Medium	>R1m	R1m-R5m	R5m-R10m	R10m-R20m	R20m-R40m	Over R40
1	X		X					
2	X			X				
3		X			X			
4	X		X					
5		X			X			
6	X		X					
7	X			X				
8	X				X			
9	X		X					
10	X			X				
11		X		X				
12	X				X			
13		X					X	
14		X					X	
15	X			X				

Question 7

How many projects do you have running at this point in time?

Respondent	Company size		Number of projects at present			
	Small	Medium	>2	Between 2-10	Between10-20	Over 20
1	X			X		
2	X			X		
3		X		X		
4	X			X		
5		X		X		
6	X		X			
7	X		X			
8	X			X		
9	X		X			
10	X		X			
11		X	X			
12	X			X		
13		X	X			
14		X		X		
15	X		X			

Question 8

What is your current position in the company?

Respondent	Company size		Current position in the company			
	Small	Medium	Construction manager	Project manger	Managing director	Other
1	X				X	
2	X				X	
3		X			X	
4	X		X			
5		X				Quantity surveyor
6	X				X	
7	X		X			
8	X		X			
9	X				X	
10	X				X	
11		X			X	
12	X				X	
13		X			X	
14		X	X			
15	X				X	

Question 9

How many years of experience do you have in your current position?

Respondent	Company size		Years of experience in the current position			
	Small	Medium	>3years	3years-6years	6years-10years	Over 10years
1	X			X		
2	X				X	
3		X	X			
4	X					X
5		X				X
6	X					X
7	X					X
8	X					X
9	X					X
10	X					X
11		X				X
12	X					X
13		X				X
14		X		X		
15	X		X			

Question 10

What is your highest educational qualification?

Respondent	Size of company		Highest education qualification				
	Small	Medium	Grade 9 or std. 10	Matric	Tertiary qualification	Post graduate	Other qualifications
1	X				X		ICIOB
2	X				X		
3		X				X	
4	X				X		
5		X			X		
6	X			X			
7	X				X		
8	X				X		
9	X		X				
10	X				X		
11		X			X		
12	X				X		
13		X			X		
14		X			X		
15	X				X		

Question 11

How many years of experience do you have in the construction industry?

Respondent	Company size		Years of experience in the construction industry			
	Small	Medium	>3years	3years-6years	6years-10years	Over 10years
1	X			X		
2	X					X
3		X				X
4	X					X
5		X			X	
6	X					X
7	X					X
8	X					X
9	X					X
10	X		X			
11		X				X
12	X		X			X
13		X				X
14		X		X		
15	X			X		

Question 12

How often do you attend refresher courses of management?

Respondent	Company size		Attendance of refresher courses			
	Small	Medium	After 6 months	After 1year	After 1.5years	Not at all
1	X					X
2	X					X
3		X				X
4	X					X
5		X				X
6	X		X			
7	X					X
8	X				X	
9	X		X			
10	X			X		
11		X				X
12	X					X
13		X				X
14		X				X
15	X		X			