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CAUSES AND EFFECTS OF COST OVERRUNS IN PUBLIC SECTOR CONSTRUCTION PROJECTS IN SOUTH AFRICA

By

LISEBO JERMINAH KHABISI

A DISSERTATION

Submitted in fulfillment of the requirements for the degree

MASTER OF TECHNOLOGY

in

QUANTITY SURVEYING

in the

FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT

At the

UNIVERSITY OF JOHANNESBURG

SUPERVISOR: PROF. C.O. AIGBAVBOA

CO-SUPERVISOR: PROF. W.D. THWALA

2013
CAUSES AND EFFECTS OF COST OVERRUNS IN PUBLIC SECTOR CONSTRUCTION PROJECTS IN SOUTH AFRICA

LISEBO JERMINAH Khabisi

SUPERVISOR: PROF. C.O. AIGBAVBOA

CO-SUPERVISOR: PROF. W.D. THWALA

A dissertation submitted to the Faculty of Engineering and the Built Environment, Department of Construction Management and Quantity Surveying, University of Johannesburg, in partial fulfillment of the requirements for the degree of Master of Technology in Quantity Surveying.
DECLARATION

I, LISEBO JERMINAH KHBISI, do hereby declare that this dissertation is the result of my own investigation and research, except to the extent indicated in the references and by comments included in the body of the report, and that it has never been presented anywhere else for a similar purpose. It is submitted to the University of Johannesburg (Department of Construction Management and Quantity Surveying), as a requirement to obtain MASTER OF TECHNOLOGY degree in QUANTITY SURVEYING.

............................................  ............................................

Signature
University of Johannesburg
Doornfontein Campus.
DEDICATION

Firstly, this dissertation is dedicated to the ALMIGHTY GOD, for granting me this opportunity, strength and health to accomplish the goals for this phase on my academic development.

Secondly, I dedicate this dissertation to my husband Dr. Moeketsi Khabisi for his support, twin sons Karabo and Kamohelo, and daughter Kananelo who felt sorry for me every time I got home late from the library while working on this dissertation.

Thirdly, I dedicate this dissertation to my mother Malebohang for spiritual support and my late father and brother, may their souls rest in peace, I know they are watching every step of my way. My surviving brother Lebohang and sisters Kabelo and Rethabile for guidance and continual support.
ACKNOWLEDGEMENT

I would like to express my sincere gratitude to my Supervisor Prof. Clinton Aigbavboa and Co-supervisor Prof. Didibhuku Thwala for their patience, supervision, guidance, expert advice and support during the accomplishment of this research. I could not have imagined having better advisors and mentors for my M.Tech Studies.

I am grateful to my family, and special friend Mpeo Mahase who have been giving me moral support during my time in the university.

Last but not least, I am very grateful to many of my colleagues and peers who supported me in distributing and collecting research questionnaires. It is also my pleasure to thank all of the professionals in consulting, contractors, public sector institutions and other firms who made this thesis possible by responding to questionnaires.
ABSTRACT

Construction is a major industry worldwide accounting for a sizeable proportion of most countries’ gross domestic product (GDP). This sector is also the largest industrial employer in most countries. The sector is, however, confronted with major delivery challenges such as late completion and excessive budget. This research was conducted in an attempt to identify the major causes and effects of cost overruns in public sector construction projects in South Africa. The study further attempts to establish the measures that can be taken to minimise the impact of cost overruns in public sector construction projects and to establish critical success factors for public sector construction projects in South Africa.

The methodology used for this study was quantitative. A structured questionnaire with the five-point Likert-type scale and open-ended questions was used to determine the participants’ responses with regard to the identified factors from the reviewed literature. Out of 120 questionnaires sent out, 119 were received, which represented a 99 per cent response rate. Findings from the survey revealed that the causes of the most severe cost overruns were variation orders, changes in scope of the project, cash flow and financial difficulties faced by contractors, and delays in decision making and adequate planning. The findings also indicated the major effects of cost overruns as time overrun, increased project cost due to extension of time, disputes between owner and contractor, bankruptcy and wastage of tax payers’ money.

Furthermore, the study also showed that the measures for minimising cost overruns in public sector construction projects were the use of experienced suppliers, proper project planning, the appointment of highly experienced committed design teams, effective strategic planning and proper project scheduling. Lastly, it was revealed that the critical success factors for public sector construction projects were the experience of the project manager, the experience of the contractor, the commitment of project team members, proper planning, awarding the bid to the right contractor, effective decision making and clear and realistic project goals. This study suggests that cost overruns in public sector construction projects could be minimised by careful management, proper planning by contractors, prompt release of funds by the employer and engagement of experienced contractors by the clients.

Key words: Cost-overruns, public sector construction projects, South Africa.
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<thead>
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<th>Description</th>
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<tbody>
<tr>
<td>AIDS</td>
<td>Acquired Immune Deficiency Syndrome</td>
</tr>
<tr>
<td>Bn</td>
<td>Billion</td>
</tr>
<tr>
<td>BOQ</td>
<td>Bill of Quantity</td>
</tr>
<tr>
<td>CAD</td>
<td>Computer Aided Design</td>
</tr>
<tr>
<td>CAGR</td>
<td>Compound Annual Growth Rate</td>
</tr>
<tr>
<td>CIDB</td>
<td>Construct Industry Development Board</td>
</tr>
<tr>
<td>CSFs</td>
<td>Critical Success Factors</td>
</tr>
<tr>
<td>DBSA</td>
<td>Development Bank of Southern Africa</td>
</tr>
<tr>
<td>DDF</td>
<td>Documentation Related Factors</td>
</tr>
<tr>
<td>DPW</td>
<td>Department of Public Works</td>
</tr>
<tr>
<td>FIFA</td>
<td>Federation Internationale de Football Association</td>
</tr>
<tr>
<td>FIN</td>
<td>Financial Related Factors</td>
</tr>
<tr>
<td>HIV</td>
<td>Human Immunodeficiency Virus</td>
</tr>
<tr>
<td>GPD</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GDFI</td>
<td>Gross Domestic Fixed Investment</td>
</tr>
<tr>
<td>MARA</td>
<td>Majlis Amanah Rakyat</td>
</tr>
<tr>
<td>MIS</td>
<td>Mean Item Score</td>
</tr>
<tr>
<td>MYR</td>
<td>Malaysian Ringgit</td>
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<tr>
<td>MMF</td>
<td>Non-human related factors</td>
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<td>NEC</td>
<td>New Engineering Contract</td>
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<td>NIC</td>
<td>Newly Industrialized Country</td>
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<tr>
<td>PCTS</td>
<td>Performance Cost Time Scope</td>
</tr>
<tr>
<td>R</td>
<td>Rand</td>
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<td>RM</td>
<td>Ringgit Malasia</td>
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SD  Standard Deviation
SPSS  Statistical package for Social Sciences
US  United States
USA  United States of America
CHAPTER ONE

INTRODUCTION
The study focuses on the causes and effects of cost overruns in public sector construction projects in South Africa. The research will establish the measures that can be taken to minimise the impact of cost overruns in public sector construction projects and the critical success factors for a public sector construction project. This chapter outlines the research introduction, problem statement, research questions, research objectives, significance of the study, research scope, research methodology and ethical issues. It concludes with an outline of the research project.

1.1 BACKGROUND
The South African construction industry was particularly hard hit when the infrastructure development highs/upturn leading up to the 2010 FIFA World Cup were/was followed by a global recession and depressed growth (Pricewaterhouse Coopers, 2013). As a prime indicator of economic activity, the construction industry is often utilised by governments, not only to stimulate growth but also to assist economic recoveries from recessions (Baloyi and Bekker, 2011). The cost-overrun problem has significantly affected construction projects in South Africa.

Construction is a unique industry that involves complex and dynamic processes. It depends on the successful coordination of multiple discrete business entities such as professionals, tradesmen, manufacturers, trade unions, investors, local authorities, specialist trade contractors and others (Keane and Caletka, 2008). Construction is a contract-centred activity, with transactional contracts or assignments defining and balancing the objectives of various participants. Coordination between organisations or crew is primarily controlled from a central plan that establishes sequence and determines when an activity will start (Howell and Ballard, 1998). According to Ramanathan, Narayanan and Idrus (2012), the construction process can be divided into three important phases, namely project completion, project design and project construction.

A construction project is considered to be a success when it applies the iron triangle constraints: time, cost, and quality. According to Atkinson (1999), the iron triangle was originally
conceived as a framework to enable project managers to evaluate and balance the competing demands of cost, time and quality of their projects. Subsequently, Shenhar and Dvir (2007) stated that it has become the *de facto* method to define and measure project success, with the general perception amongst project managers that a successful project is based upon these three criteria alone.

![The iron triangle diagram](source: Ebbesen and Hope (2013))

Centre to the concept of the iron triangle, as shown in figure 1.1, is the mutual dependency between the three constraints; thus increasing quality will increase the amount of time needed, which will also lead to increase in cost. A tight time schedule could lead to a decrease in quality and subsequent increase in cost (Morris and Sember, 2008). In addition, Modesto and Tichapondwa (2009) mentioned that a project has specific performance requirements that have to be met such as performance, a budget (cost), a definite starting and ending point (time), and a clearly defined range of work to be done (scope). The authors therefore referred to these as the PCTS (performance, cost, time and scope) targets of a project.
A graphic way of expressing it is depicted in Figure 1.2:

![Diagram showing PCTS targets of a project]

**Figure 1.2: The PCTS targets of a project**

Source: Modesto and Tichapondwa (2009)

A project is therefore a one-off scope of work, of predetermined cost, and designed to bring about a change of a defined quality performance in a given time (Modesto and Tichapondwa, 2009). Olumide (2009) mentioned that construction projects vary in size, type and fundamental structural characteristics. Regardless of the differences in scope, all projects require adequate planning (Olumide, 2009). The author further stated that thorough planning prepares stakeholders for the major risks that may be encountered during the course of a project, and enables them to meet project objectives exactly or within acceptable cost and schedule deviations from initial budgets.

A project always starts with a need or demand by the owner for the design and construction of a certain facility to provide certain service or product (Oberlender, 2000). According to Oberlender (2000), the first requirement for any civil engineering construction project is the clear definition of the owner’s needs and objectives for the project.

The construction industry plays an important role in the economy, and the activities of the industry are also vital to the achievement of the national socio-economic development goals of providing shelter, infrastructure and employment (Aje, Ogunsemi, and Oladirin, 2012). Additionally Ibrahim, Roy, Ahmed and Imtiaz (2010) stated that the construction industry also plays a major and vital role in transforming the aspirations and needs of people into reality by physically implementing various construction development projects.
Aje et al (2012) consolidated the statement of Ibrahim et al (2010) by mentioning that it is clear that construction activities affect nearly every aspect of the economy and that the industry is vital to the continued growth of the economy. Ibrahim et al (2010) also mentioned that construction projects usually cover infrastructure such as roads, dams and irrigation work. Schools, houses, hospitals, airports, railways, factories and other construction work are some of the examples of the physical foundations of some form of development efforts to improve living standards. Therefore, the construction industry is undeniably essential to the growth of a nation and a key sector in the nation’s economy (Ibrahim et al, 2010).

Memon, Rahman, and Aziz (2012), also indicated that the socio-economic growth of a country depends to a large extent on the construction industry as it provides necessary infrastructure such as roads, hospitals and schools and other enhanced facilities. Also, it contributes significantly to the county’s gross domestic product (GDP). Hence, it is crucial that construction projects are completed successfully within time, budget and expected quality constraints (Cantarelli, 2009; Olawale and Sun, 2010). However, Cantarelli (2009) and Olawale and Sun (2010) mentioned that construction, being a complex and schedule-driven industry, is always faced with chronic problems such as low quality and productivity, cost overrun, time overrun, construction waste and others. Of these, cost overrun is a severe problem because it affects the overall development of the country (Olawale and Sun, 2010).

Kaliba, Muya and Mumba (2009) emphasised that the wealth of any nation is gauged by its performance in infrastructure provision through the construction industry. The construction industry is large, volatile, and requires tremendous capital outlays (Kaliba et al, 2009). According to Ibrahim et al (2010), a country cannot grow if there is no development or infrastructure built to spur the economy. The construction industry is therefore an important factor in the process of development. Ibrahim et al (2010) further mentioned that its contributions are more than just economic. The authors stated that the products of construction mentioned contribute extensively towards the creation of wealth and the quality of life of the population.

The world, however, is full of unpredictable forces and undesirable outcomes (Gould and Joyce, 2003). The authors emphasised that creating a large facility takes a long time and usually involves a large capital investment therefore cost overruns, delays, and other problems tend to be proportionally monumental. Furthermore, Gould and Joyce (2003) expressed the view that
the process of building is complicated by the large number of components that are provided by suppliers. The nature of the products and the parties involved in building depend on time, site conditions, user needs and economic health. Moreover, a building not delivered on time usually costs more than planned, and a late delivery can have cascading effects throughout an owner's organisation (Gould and Joyce, 2003).

Morris and Hough (1987) stated that although management of projects has been studied for many years, most projects either failed or presented cost overruns. The authors also affirmed that many projects are cancelled owing to the lack of proper management which causes expenditure of significant amounts of money over the original budget. Morris and Hough (1987) suggested three different measures to recognise whether a project is successful, namely; the project functionality which means that the project should function technically and financially. Secondly, the management of the project indicates whether the project meets the budget and schedule targets. Finally, the project should be evaluated depending on the performance of the contractors which determines whether they provide services that benefit the project.

According to Edwards (2009), people tend not to spend other people's money as carefully as they spend their own. In governments, policymakers and administrators deal with large amounts of other people's money, and so wasteful spending is a significant problem. Government projects are not managed wisely because they know that taxpayers are responsible for most of the expenses. When cost overruns occur, government officials point fingers at contractors for their poor performance. No level of government takes responsibility, and taxpayers have to shoulder the financial burden (Edwards, 2009).

1.2 AIM OF THE STUDY
The aim of this study is to identify the major causes and effects of cost overruns in public sector construction projects in South Africa and to suggest remedial measures to be taken to minimise the impact of cost overruns in public sector projects as well as identifying critical success factors for public sector construction projects.
1.3 PROBLEM STATEMENT
Government construction projects are currently failing to achieve budgeted costs and have resulted in various unexpected negative effects. Normally, when the projects are delayed, they are extended and therefore incur additional cost. Cost overruns are considered as a significant problem because they hinder the project’s progress, since they decrease the contractor’s profit, leading to huge losses which pose a threat to the successful completion of the project. Without an in-depth assessment of cost overruns, implementation of cost control measures and sensible professional accountability, the problem of cost overruns would remain a threat to public sector construction projects, as has been experienced by other developing countries. Therefore, the problem to be investigated in this research project is the causes and effects of cost overruns in public sector construction projects.

1.4 RESEARCH QUESTION
Based on the definition of the research problem statement, the following research questions emerge:

- What are the causes of cost overruns in public sector construction projects?
- What are the effects of cost overruns in public sector construction projects?
- What measures can be taken to minimise the impact of cost overruns in public sector construction projects?
- What are the critical success factors for a public sector construction project?

1.5 RESEARCH OBJECTIVES
The objective of the study is to investigate the causes and effects of cost overruns in public sector construction projects in South Africa, and to provide recommendations for addressing the situation.

In the cause of such investigations, it is expected that the following specific objectives will be addressed:

- To determine the causes of cost overruns in public sector construction projects;
- To determine the effects of cost overruns in public sector construction projects;
- To establish measures that can be taken to minimise the impact of cost overruns in public sector construction projects; and
To establish the critical success factors for a public sector construction project.

1.6 SIGNIFICANCE OF THE STUDY
Cost can be described as one of the most important issues relating to a project’s success. Despite its proven significance, it is common to see construction projects failing to achieve their objectives within the specified cost. Normally, when projects are delayed, they are extended and therefore incur additional cost. Finishing a project in the absence of cost overruns is considered the most important factor of a successful project which helps to reduce problems for all the parties involved and leads to new opportunities to construct other related projects.

The public sector faces the dilemma of construction projects being completed at excess cost than budgeted for, namely the cost overrun problem. The attainment of effective remedial cost control measures for public sector construction projects will assist the socio-economic advancement of the country. Furthermore, the success of the study will contribute to revealing possible solutions to the problem of cost overruns associated with public sector construction projects.

Malholtra (2004) defined research as the systematic and objective identification, collection, analysis, dissemination, and use of information for the purpose of assisting management in decision making related to the identification and solution of problems and opportunities. The findings of this research project are expected to contribute towards the improvement of cost management in public sector construction projects and to suggest remedial cost control measures.

1.7 RESEARCH SCOPE
The study focused on the causes and effects of cost overruns in public sector construction projects in Gauteng Province. Owing to the time constraint, the study is unable to cover all nine provinces of South Africa. The study covered the identification of trends of the cost overruns and their effects in public sector projects in Gauteng, investigation of the reasons for cost overruns and the development of a set of recommendations to help the public sector to manage the problem of cost overruns.
The study was carried out/conducted by soliciting professional opinion on the ranking of the major causes of cost overruns and the most cost effective cost control measures.

Different categories of professional bodies in the construction industry were involved, namely (i) architects, (ii) quantity surveyors, (iii) project managers, (iv) construction managers, (v) civil engineers, (vi) electrical and (vii) mechanical engineers (viii) as well as construction project managers.

1.8 RESEARCH METHODOLOGY
Research methodology is a system of methods and rules to facilitate the collection and analysis of data. It provides the starting point for choosing an approach made up of theories, ideas, concepts and definitions of the topic (Rajasekar, Philominathan and Chinnathambi (2013).

1.8.1 Research approach and design
The methodology used for this study was quantitative. A descriptive survey design was adopted in the study, therefore a structured questionnaire was designed and distributed to the respondents by the researcher.

1.8.2 Research area and targeted respondents
The study area for the research was conducted in Gauteng Province of South Africa. A quantitative survey was conducted with 120 questionnaires distributed to construction professionals in the public sector such as project managers, architects, engineers, quantity surveyors, construction managers and construction project managers. The diversity of professional expertise (due to their different fields of practice) was aimed to provide different views in identifying causes and effects of cost overruns.

1.8.3 Sampling and data collection
A random sampling method was adopted; hence all the participants had an equal chance of being selected. Data was collected by means of questionnaires and analysed using statistical programmes to determine quantitative information obtained during research. Subsequently this data formed the basis of this report.
1.8.4 Limitations
Questionnaires were distributed to construction professionals in the public sector such as project managers, architects, engineers, quantity surveyors, construction managers and construction project managers who are conversant with public sector projects in the Gauteng Province. This was intended to establish the various causes of cost overruns in public sector construction projects, the effects of cost overruns, effective remedies for minimising construction cost overruns and the critical success factors for a public sector construction project.

1.8.5 Ethical considerations
Ethical issues were considered in undertaking this research. The principle of voluntary participation was upheld, thus people were not forced into participating in the research. The privacy of research participants was protected by ensuring confidentiality in not making identification information available to anyone who is not directly involved in the study. Confidentiality was further enhanced by maintaining participants’ anonymity throughout the study.

1.9 OVERVIEW OF CHAPTERS
This section gives a brief framework of how the presentation of the research report is divided into eight chapters.

CHAPTER ONE
This chapter introduces the research. It contains the introduction to the research, which includes the background, the aim of the study, the problem statement, research questions, research objectives, the significance of the study, the research scope and a brief description of the research methodology.

CHAPTER TWO
This section provides the theory required to comprehend the subject matter. The literature section covers the research findings carried out by different/various researchers on different countries’ construction industries, concepts of construction cost, cost modelling, cost planning, cost performance, construction delay, cost overrun, the causes of cost overruns in construction projects, the effects of cost overruns in construction projects, mitigation measures to improve cost performance and the critical success factors for a construction project.
CHAPTER THREE
This chapter focuses on international experiences from Malaysia and Hong Kong. It covers the introductory outline, their backgrounds, their construction industry performance, cost overruns, causes of cost overruns, the effects of cost overruns, mitigation measures to improve cost performance, lessons learnt, comparison between Malaysia and Hong Kong and the chapter conclusion.

CHAPTER FOUR
This chapter focuses on African countries such as Nigeria and Ghana. The introductory outline is followed by their backgrounds, their construction industry performance, cost overruns, causes of cost overruns, the effects of cost overruns, mitigation measures to improve cost performance, lessons learnt, comparison between Nigeria and Ghana and the chapter conclusion.

CHAPTER FIVE
This chapter focuses on the South African experience. Its introductory outline is followed by the background, construction industry performance, cost overruns, causes of cost overruns, the effects of cost overruns, mitigation measures to improve cost performance, lessons learnt, a comparison between South Africa and international countries, a comparison between South Africa and African countries and finally, the chapter conclusion.

CHAPTER SIX
This chapter contains discussions on the research methodology and the instrument to be used to conduct the study as well as a discussion of the questionnaire design.

CHAPTER SEVEN
This chapter outlines the research results and data analysis.

CHAPTER EIGHT
This chapter focuses on the discussion of findings, conclusions and recommendations.

1.10 CONCLUSION
The chapter presents the discussion of the background of the study, aim of the study, problem statement, research questions, aim of the study, problem statement, research questions, research
objectives, significance of the study and research scope. Moreover the chapter highlighted the specific performance requirements such as cost, time and quality for a successful project. The next chapter presents the literature relating to the cost overruns in construction projects.
CHAPTER TWO

LITERATURE REVIEW – CONSTRUCTION COST OVERRUN

INTRODUCTION
This chapter provides a literature review on how cost overruns are critical in construction projects. This section will also review some studies that have been carried out recently, which aimed to find the main causes and effects of cost overruns, mitigation measures and critical success factors for a construction project.

2.1 CONSTRUCTION COST
Yaman and Tas (2007) stated that the concept of cost is defined in various ways. The authors pointed out that in general, cost means the monetary value of all goods and services used in order to perform an operation. Cost can be employed as an evaluation criterion in design in two ways (Shehab and Abdalla, 2001). Shehab and Abdalla (2001) mentioned that cost can be used either in a design-to-cost or design-for-cost context. Design-for-cost is the conscious use of engineering process technology to reduce life cycle cost while design-to-cost provides a design satisfying the functional requirements for a given cost target (Shehab and Abdalla, 2001).

However, Yaman and Tas (2007) mentioned that in terms of building construction participants of the projects, the owner, the designer, the contractor, the user and society are concerned with the building cost in various ways owing to the diverse expectations and the objectives of the participants. The authors further mentioned that in building construction projects, the direct cost is often emphasised and it is underlined in the cost estimation and cost control studies as the direct cost is generally very high compared with the indirect cost within the building cost. Furthermore, Shalton and Brugh (2002) added that generally, building costs include all direct costs, such as materials, direct labour, and sub-contracts. The authors explained that indirect costs are costs necessary for the performance of the job but are difficult to identify to a specific contract.

Shalton and Brugh (2002) pointed out that indirect costs allocable to contracts include the costs of indirect labour, contract supervision, tools and equipment, supplies, quality control and inspection, insurance, repairs and maintenance, depreciation and amortisation, and, in some circumstances, support costs, such as central preparation and processing of payrolls.
According to Azhar, Farooqui and Ahmed (2008), cost has its proven importance as the prime factor for project success. Cost is a major consideration throughout the project management life cycle and can be regarded as one of the most important parameters of a project and a driving force of the success of the project (Memon, Rahman, Abdullah and Azis, 2010).

Despite its proven importance it is not uncommon to see a construction project failing to achieve its objectives within the specified cost (Azhar et al, 2008). According to Ashworth and Hogg (2002), quantity surveyors are required to advise the client on any cost implications that may arise throughout the design and construction process. Such advice will be necessary irrespective of the procurement method used for contractor selection or tendering purposes. However, Ashworth and Hogg (2002) mentioned that the advice will be especially crucial during the project’s inception. During this time major decisions are taken affecting the size of the project and the quality of the works (Ashworth and Hogg, 2002).

Ashworth and Hogg (2002) further indicated that anyone proposing to construct a building or engineering structure will need to know the probable costs involved in the works in advance. These costs include the cost of the works carried out on site by the contractor and professional fees (Ashworth and Hogg, 2002).

2.2 COST MODELLING

Construction projects are faced with serious risks in the completion of the project. One of these risks is the inaccuracy of cost estimates; the project is carried out under conditions of uncertainty as to whether the over- or underestimation of construction works (Challal and Tkiouat, 2012). The authors pointed out that this is due to inadequate knowledge of current existing costs, leading to a set of difficulties hindering the smooth progress of the project. Hence, the authors expressed the opinion that there is a need to set out a cost estimating model in line with major studies conducted locally and internationally in terms of estimating methods and common relationships between various expenses so that the cost estimate would be more realistic.

Challal and Tkiouat (2012) further mentioned that establishing an accurate estimate is a challenge. So clients must provide themselves with all resources needed to establish the estimate in the best possible conditions and avoid unintended consequences clearly seen in over- or underestimates.
According to Yaman and Tas (2007), cost is a measurement of the function and the performance of a building. Therefore, in order to appraise the design of a building, it is necessary to use a convenient cost model. Shehab and Abdalla (2001) mentioned that cost estimation is concerned with the predication of costs related to a set of activities before they have actually been executed. Shehab and Abdalla (2001) further explained that cost-estimating approaches can be broadly classified as the intuitive method, parametric techniques, variant-based models, and generative cost estimating models. However, the authors believe that the most accurate cost estimates are made using the generative approach. Among the many methods for cost estimating, at the design stage, are those based on knowledge bases, features, operations, weight, material, physical relationships and similarity laws (Shehab and Abdalla, 2001).

Ashworth and Hogg (2002) defined cost modelling as computer-based techniques that are used for forecasting the estimated costs of a proposed construction project. They mentioned that a statistical model or formula is constructed which best describes the building in terms of cost. The development of cost model building can be a lengthy process requiring the collection and analysis of large quantities of data (Ashworth and Hogg, 2002). Prior to using the model in practice, it needs to be tested against the more conventional methods. Cost modelling is a radical approach to pre-contract estimating and cost control (Ashworth and Hogg, 2002). Yaman and Tas (2007) described the process in using cost model. They mentioned that the first step in using a cost model is collecting the data required. Then, these data must be analysed and updated. In the meantime, the quality and the level of data and thus the convenience of the chosen model must be evaluated.

As soon as new data are acquired during the implementation of the model, they must be attached to the previous data (Yaman and Tas 2007). Furthermore, Yaman and Tas (2007) explained that the cost models can also be divided into two groups, namely deterministic and probabilistic models. In deterministic models, it is assumed that the values can be qualified with any kind of variables and all these are exactly known or can be estimated accurately (Yaman and Tas, 2007). The authors mentioned that in probabilistic models, it is accepted that although the values of some variables are not absolutely certain, they can be calculated. Additionally, Yaman and Tas (2007) pointed out that the cost estimation models can also be classified according to their characteristics.
The first are the traditional cost estimation models based on quantities, for example, monopriced cost estimation models used in the schematic design phase (such as unit, square, cube and building envelope models), and the resource-based models used in the construction phase, based on functional elements and building operational units. The second are the untraditional models, which are the models comprising new techniques and practices, for example, the experimental models, regression models and simulation models (Yaman and Tas, 2007).

Bylund and Magnusson (2011) mentioned that a cost estimate needs to be done in numerous stages of a project, for instance, in the conceptual stage, rough key figures are needed to determine whether a project is feasible. Then later on in the bidding and construction phase more accurate estimates are required to control budget and tendering processes (Bylund and Magnusson, 2011). They further pointed out that the accuracy of construction cost predictions is largely depending on the amount and quality of historical cost data and the experience of the estimator, among other factors.

However, in the early stage of a project a lack of information might force the estimator to make assumptions about the project design that appear to be incorrect as the project evolves (Bylund and Magnusson, 2011). Moreover, Yaman and Tas (2007) mentioned that computer-based estimating programs are good regarding the data collection, computational, and clerical aspects of estimating. They achieve and retrieve large volumes of resources, cost and productivity information, perform calculations quickly and accurately, and present results in an organised, neat, and consistent manner (Yaman and Tas, 2007). Additionally Yaman and Tas (2007) mentioned that recent developments in communication and information technologies have increased the speed, productivity and accuracy of the building cost estimation process and made the following tasks easy:

1. Processing electronic bill-of-quantities (BOQ) either directly from digital CAD files or paper-based documents through digitizers;
2. Setting up computer-aided cost databases; and
3. Setting up computer-aided cost estimation systems.

According to Yaman and Tas (2007), the building cost estimation model based on functional elements helps the user to estimate the total building cost using historical data of similar projects. The total building cost can be estimated in the feasibility or in the schematic design phase, depending on the detail level of project data available.
2.3 COST PLANNING

Cost planning arose out of the need to plan the cost of a construction project effectively from inception through design and continuing throughout the construction phase (Corbett and Rowley, 1999). Cost plans are generally prepared by cost consultants (often quantity surveyors). These plans evolve through the life of the project, developing in detail and accuracy as more information becomes available about the nature of the design, and then actual prices are provided by specialist contractors, contractors and suppliers (Designing Buildings, Wiki, 2013). Cost plans range from very early initial cost appraisals through to tender pricing documents and the final account (Designing Buildings, Wiki, 2013).

According to Bylund and Magnusson (2011), when a project is in its earliest phase, the expected cost is of the utmost importance, especially to the client since he is the one who will have to bear the cost in the end. The authors mentioned that to be able to measure the economic success or failure of an on-going or finished project, some kind of factors of measurements must exist. The project budget is the most important factor for such an evaluation (Bylund and Magnusson, 2011).

Corbett and Rowley (1999) emphasised that professional quantity surveyors’ main service to clients is to forecast likely construction costs. The authors stated that quantity surveyors are the best qualified professionals to provide this service amongst all other construction professionals. Ashworth and Hogg (2002) mentioned that cost planning is not simply a method of pretender estimating, but seeks also to offer a controlling mechanism during the design stage. Its aims in providing cost advice are to control expenditure and to offer better value for money to the client. The authors further explained that cost planning attempts to keep the designer fully informed of all the cost implications of the design.

Full cost planning will incorporate the attributes of whole life costing and value management. The cost planning process commences with the preparation of an approximate estimate and then the setting of cost targets for each element (Ashworth and Hogg, 2002). However, Corbett and Rowley (1999) emphasised that prior to cost planning, design decisions had to be taken and tenders invited, with the resultant cost only being known upon receipt of tender. Often, as a result of the tender sum being greater than the client originally contemplated, abortive and/or remedial measures would then have to be taken, which in themselves involve additional costs.
Furthermore Ashworth and Hogg (2002) stated that as the design evolves, these cost targets are checked against the developing design and details for any changes in their financial allocations. The quantity surveyor will also always be looking for ways of simplifying the details without altering the design, in an attempt to reduce the expected costs. This process should also result in fewer abortive designs, and the seeking of value for money should continue throughout the post-contract cost-control procedure (Ashworth and Hogg, 2002). According to Olawale and Sun (2010), in the construction industry the aim of project control is to ensure that the projects finish on time, within budget and achieving other project objectives. Olawale and Sun (2010) further mentioned that project control is a complex task undertaken by project managers in practice, which involves constantly measuring progress, evaluating plans and taking corrective actions when required.

There are a great number of terms that can be used for key cost planning information therefore Designing Buildings Wiki (2013) has standardised these as follows:

- **Initial cost appraisals**: They are studies of options prepared during the feasibility study stage. These all relate to the construction cost of the project (rather than wider project costs that the client might incur, which could include fees, equipment costs, furniture, the cost of moving staff, contracts outside of the main works and so on). It is important that the client makes it clear what costs should be monitored by the cost consultant and what will remain within the control of the client organisation.

- **Elemental cost plan**: This is prepared during the project brief stage and carried through to detailed design.

- **Approximate quantities cost plan**: This is from the end of detailed design through to tender.

- **Pre-tender estimate**: This is prepared alongside tender documentation.

- **Tender pricing document**: This is not a priced document, but is part of the tender documentation issued to the contractor for pricing.

- **Contract sum**: This is agreed with the contractor during the tender period and adjusted during the construction period.

- **Contract sum analysis**: This entails a break-down of the contract sum prepared by the contractor on design and build projects.

- **Final account**: This is agreed during the defects liability period.
Alshanbari (2010) stated that understanding how pre-construction planning affects project cost savings or profit can be a deciding factor for many construction firms to become involved. He further suggested that it will also pave the way to developing more effective methods or at least evolving the existing ones to obtain a higher return on investment. On the other hand, pre-construction planning can be the thin line between success and failures in some projects (Alshanbari, 2010).

2.4 COST PERFORMANCE

Cost performance is the most important indicator of project success (Frimpong, Oluwoye and Crawford, 2003; Olawale and Sun, 2010). It does not only present the firm’s profitability but also the productivity of the organisations at any point during the construction process. It is always used to measure project performance. Ali and Kamaruzzaman (2010) stated that in the construction industry, it is important to have control of the cost performance of projects to ensure the construction cost is within the budget. Therefore, project cost management is needed to keep the project within its defined budget. Ali and Kamaruzzaman (2010) further stated that in general over the years the construction industry has been facing poor cost performance which describes the inability to complete the project within budget. According to Memon and Rahman (2014), poor cost performance in construction projects is a common element resulting in huge amounts of cost overrun as faced by construction industry globally. This issue was also discussed by Aziz et al (2013) who stated that poor cost performance in construction projects is a common problem worldwide, resulting in a significant amount of cost overruns. Occurrences of poor cost performance in construction projects are due to various factors (Memon and Rahman, 2014).

There are four fundamental constraints needed to be considered when managing the construction projects: scope, cost, time, and quality. In order to manage the projects successfully, it is necessary to consider whether the project lies/falls within those four constraints (Durdyev, Ismail and Bakar, 2012). However, the authors stated that there are many problems with cost performance in many countries. One of the major problems was cost overrun in construction projects (Durdyev et al, 2012). Memon et al (2012), also stated that the construction industry in Malaysia has been regarded as an industry facing poor performance leading to failure in achieving effective time and cost performance. As a result, most of the projects in Malaysia face huge amounts of time and cost overrun (Memon et al, 2012). The authors assessed the time and cost performance of construction projects in Malaysia and the
findings of study revealed that 92 per cent of construction projects were overrun and only 8 per cent of projects could achieve completion within contract duration. They concluded that major contributors of this poor performance include design and documentation issues, financial resource management and project management, and contract administration issues.

Flyvbjerg, Holm and Buhl (2003) carried out a study on cost performance in transport infrastructure projects in the Danish construction industry. The focus of the study was on infrastructural investments in terms of actual costs, cost benefits and risks. The results from different project types, different geographical regions and different historical periods showed that substantial cost escalations were found to be the major impact. Flyvbjerg et al (2003) concluded that large cost escalations combined with large standard deviations translate into large financial risks. These risks are typically ignored or underplayed in decision-making (project planning stage), to the detriment of the social and economic welfare (Flyvbjerg et al, 2003).

In a study done by Memon et al (2010), they concluded that the fluctuation of material prices was the most dominant factor affecting construction cost performance, followed by cash flow and financial difficulties faced by contractors. Shortage of site workers and a lack of communication between parties were found to be the third major factors affecting construction cost performance. The uncertainties and the increase of stakeholders make the management of cost difficult in construction projects. These facts result in many of the time and cost overruns in the project (Doloi, 2011). Even though there have been improvements in the management of construction projects, the problems of cost and time overruns are still a critical issue in the construction industry (Reichelt and Leyneis, 1999).

2.5 CONSTRUCTION DELAY

When projects are delayed, they are either accelerated or have their duration extended beyond the scheduled completion date. These are not without some cost consequences (Aibinu and Jagboro 2002). Delay may also be defined as the time overrun, either beyond the date for completion specified by the contract or beyond the extended contract period where an extension of time has been granted (Fugar and Agyakwah-Baah, 2010). Delay and cost increase are common phenomena in projects worldwide (Le-Hoai, Young and Jun, 2008). According to Aibinu and Jagboro (2002), the conventional approach to managing the extra cost is to include a percentage of the project cost as a contingency in the pre-contract.
However, construction projects are unique, as they may have a distinctive set of objectives, requiring the application of new technology or technical approaches to achieve the required result (Aibinu and Jagboro, 2002). This uniqueness makes the contingency allowance allocation based on assumption and intuition inadequate and unrealistic (Aibinu and Jagboro, 2002).

Delays and cost overruns have significant implications from an economic as well as political point of view (Singh, 2009). The people and the economy have to wait longer than is necessary for the provisions of public goods and services when project implementation is delayed. Thus, delays limit the growth potential of the economy. Similarly, cost overruns reduce the competitiveness of the economy. Services provided by infrastructure projects serve as an input for other sectors of the economy (Singh, 2009). Fugar and Agyakwah-Baah (2010) mentioned that delay also has cost consequences for the contractor: standby costs of non-productive workers, supervisors, and equipment, expenses caused by disrupted construction and material delivery schedules and additional overhead costs.

Kaming, Olomolaiye, Holt and Frank (1997) examined factors influencing construction delays and cost escalations in Indonesian cities. They identified project cost underestimation and project complexity as the main causes of project delays and cost overruns.

Fugar and Agyakwah-Baah (2010) conducted an investigation into the causes of delays in building construction projects in Ghana. They identified the following thirty-two possible causes of delays: shortages of materials on site or market, late delivery of material, shortage of unskilled labour, shortage of skilled labour, equipment failure or breakdown, unskilled equipment operators, delay in honouring payment certificates, difficulties in assessing credit, fluctuation of prices, bad weather conditions, unfavourable site conditions, client initiated variations, necessary variations, mistakes in soil investigation, poor design, foundation conditions encountered on site, delays in obtaining permit from municipality, public holidays, discrepancy between design specification and building code, legal disputes, insufficient communication between parties, poor professional management, delay in instructions from consultants, delay by sub-contractors, poor site management, poor supervision, lack of programme of works, accidents during construction, construction methods, underestimation of costs of projects, underestimation of complexity of projects and underestimation of time of completion.
These causes of delays were further grouped into nine major areas as follows: materials, manpower, equipment, financing, environment, changes, government action, contractual relationships, and scheduling and controlling techniques. Fugar and Agyakwah-Baah (2010) concluded that the top ten influencing factors in causing delay were the following: delay in honouring certificates, underestimation of the costs of projects, underestimation of the complexity of projects, difficulty in accessing bank credit, poor supervision, underestimation of time for completion of projects by contractors, shortage of materials, poor professional management, fluctuation of prices/rising cost of materials and poor site management.

Kaliba et al (2009) conducted a case study of delays in Zambian road construction projects. In their study they identified the following major causes of project delays: delayed payments, financial processes and difficulties by the contractors and clients, contract modification, economic problems, materials’ procurement, changes in drawings, staffing problems, equipment unavailability, poor supervision, construction mistakes, poor coordination on site, changes in specifications and labour disputes and strikes.

Le-Hoai et al (2008) investigated causes of delays in Vietnamese large construction projects. From the twenty-one causes identified from the literature review, they established seven most significant causes of delays. These were poor site management and supervision, poor project management assistance, financial difficulties of owner, financial difficulties of contractor, design changes and inexperience of human resources.

Mahamid (2013) identified the following seven critical causes of delays in road construction in the West Bank, Palestine: financial status of contractor, payment delays by owner, unstable political situation, segmentation of the West Bank, poor communication between construction parties, high competition in bids and a lack of equipment efficiency.

Majid (2006) carried out a study in causes of delays in Aceh, Indonesia. From a list of fifty-seven factors identified from the literature review, ten most important causes were discovered/identified. He concluded that the most significant causes of delays were the following: insufficient equipment, inaccurate time estimate, monthly payment difficulties, change orders, inaccurate cost estimate, poor site management and supervision, inadequate modern equipment, shortage of construction materials, incompetent project team, improper project planning and scheduling, and contractors’ financial difficulties.
Delays in construction are caused by several factors. Ahmed, Azhar and Gollapudi (2003) grouped delays into two categories: internal causes and external causes. Internal causes arise from the parties to the contract (e.g. contractor, client, and consultant). External causes, on the other hand, arise from events beyond the control of the parties. These include an act of God, government action, and material suppliers (Ahmed et al, 2003). Keane and Caletka (2008) classified delays as follows:

- Non-excusable delays – these are delays caused by the contractor.
- Excusable compensable delays - these are delays caused by the project owner (client).
- Concurrent delays are those caused by both owner and the contractor.

Delay involves multiple complex issues, all of which are invariably of critical importance to the parties to the construction contract. These issues concern entitlement to recover costs of delay or the necessity to prolong the project with the consequential entitlement to recovery costs for adjustments to the contract schedules (Fugar and Agyakwah-Baah, 2010).

Time and cost are the two common concerns of construction management. Many factors relate to delay and cost overruns and vary along with types of project, locations, sizes, and scopes (Le-Hoai et al, 2008). Olawale and Sun (2010) mentioned that despite the availability of various control techniques and project control software, many construction projects still do not achieve their cost and time objectives.

Aibinu and Jagboro (2002) studied the effects of construction delays on project delivery in the Nigerian construction industry. The six identified effects of delay were time overrun, cost overrun, dispute, arbitration, total abandonment and litigation. In a study on the effects of delays by Memon, Rahman and Aziz (2011), the authors also observed that time overrun, cost overrun, arbitration, dispute, total abandonment and litigation were the six likely effects of project delays. They concluded that time overrun was the most significant effect of delay, followed by cost overrun. Majid (2006) also outlined time and cost overrun as the most significant effects of project delays in Aceh construction industry in Indonesia. However, Kaliba et al (2008) identified poor quality of end product, projects extension, litigation and cost overrun as the effects of delays in Zambian road construction projects.
2.6 COST OVERRUN
Cost overrun occurs when the final cost of the project exceeds the initial estimate or budget. Nevertheless, the estimate or initial budget is constantly changing during the execution of the project. For this reason it is important to be careful with the budget that is going to be taken into account to calculate the overrun of the project (Avots, 1983).

According to Avots (1983), cost overrun can be defined as not having achieved the project objectives within the estimated budget. The authors further mentioned that cost overrun is a major problem faced by the construction industry globally and its solution needs serious attention. Rahman et al (2012) explained cost overrun as a result of one or a combination of several causes which are very important to identify for cost-effective performance.

Cost overruns are a major problem in both developed and developing countries (Angelo and Reina, 2002). Therefore, the authors mentioned that the problem of cost overruns is critical and needs to be studied to alleviate this issue in the future. Durdyev et al (2012) stated that in developing countries the trend is more severe where the cost overruns sometimes exceed 100 per cent of the estimated cost of the project. Azhar et al (2008) also emphasised that cost overrun is a very frequent phenomenon and is associated with nearly all projects in the construction industry.

Overruns are caused by poor management of the resources such as man, material and money (Durdyev et al, 2012). According to Baloyi and Price (2003), cost overruns are also common in different types of projects and locations. In addition, cost overruns have become a norm rather than an exception in the construction industry (Baloyi and Prince, 2003). Park and Papadopoulou (2012) stated that cost overruns affect all project stakeholders. The authors mentioned that cost overruns bring about less return-on-investment for the client and extra charges for end-users. Furthermore, they mean negative publicity for the design team and a loss of client confidence (Park and Papadopoulou, 2012).

Cost overruns have plagued governments for decades, even centuries. In a study for the National Bureau for Economic Research, economists Stanley Engerman and Kenneth Sokoloff compared actual costs to originally estimated costs for a sample of large government projects in the United States dating back to the early 19th century. They found a pattern of large cost overruns, and they concluded the following: the Erie Canal (46% cost overrun), Panama Canal
(106%), Hoover Dam (12%), Louisiana Superdome (366%), and the renovation of Yankee Stadium in the 1970s (317%).

There are several factors that affect the construction cost and various studies have been conducted to address these factors. Low quality materials cause higher construction costs than expected because of the loss of materials during construction. These result from a lack of standards for materials and management systems. The lack of ability to prevent cost overruns or to control construction costs causes many Thai construction companies to fail (Memon et al, 2010).

According to Wakjira (2011), cost overrun arises primarily because of the following four factors:

i. External risk due to:
   - modifications in the scope of a project and
   - changes in the legal, economic and technologic environments.

ii. Technical complexity of the project due to:
   - size,
   - duration and
   - technical difficulty.

iii. Inadequate project management due to:
   - poor control of internal resources,
   - poor labour relations and
   - low productivity.

iv. Unrealistic estimates because of the uncertainties involved.

Construction can be considered as a dynamic industry which is constantly facing uncertainties. These uncertainties and the many stakeholders in these kinds of projects make the management of costs difficult which consequently causes cost overruns (Arcila, 2012).
2.7 CAUSES OF COST OVERRUNS IN CONSTRUCTION PROJECTS

Generally, the factors that impact on cost performance of the project and cause cost overruns are present from the estimating stage to the completion stage of the project (Baloi and Price, 2003). Morris (1990) conducted one of the first studies with a narrow focus on cost overruns in large projects. Morris (1990) argued that delays in project implementation and cost overruns have become a regular feature of public sector projects. The author then concluded that about 20 to 25 per cent of cost overruns can be attributed to price increases, and the remaining 70 to 75 per cent has to be explained in terms of real factors, such as delays in implementation. The following factors are the main causes of delays and cost overruns: poor project design and implementation, inadequate funding of projects, bureaucratic indecision, and a lack of coordination between enterprises (Morris, 1990).

Winch (2010) stated that common causes of cost overruns are as follows: a lack of clear links between the project and the organisation’s key strategic priorities, including agreed measures of success; a lack of clear senior management and ministerial ownership and leadership; a lack of effective engagement with stakeholders; a lack of skills and proven approach to project management and risk management; evaluation of proposals driven by initial price rather than long-term value for money; a lack of understanding of, and contact with the supply industry at senior levels in the organisation; and a lack of effective project team integration between clients, the supplier team and the supply chain.

Lee (2008) examined cost overruns in Korean social overhead capital projects. Based on 161 completed projects he concluded that the causes of cost overruns can be grouped into several major categories: change of scope, delays during constructions, unreasonable estimation and adjustment of project costs, and no practical use of the earned value management system. Various studies which were conducted in different developing countries (Nigeria, Saudi Arabia, Malaysia and Indonesia) confirmed that all of the projects currently undertaken in these countries suffer from significant construction cost overruns (Kaming et al, 1997).

Morris (1990), Kaming et al,(1997) and Mansfield, Ugwu and Doranl (1994), listed the following as the critical causes of cost overruns: incomplete design at the time of tender, additional work at owner’s request, changes in owner brief, a lack of cost planning/monitoring during pre-and-post contract stages, site/poor soil conditions, adjustment of prime cost and
provisional sums, re-measurement of provisional works, logistics due to site location, and a lack of cost reports during construction stage.

The authors also identified other factors which are usually ignored as follows: delays in issuing information to the contractor during construction delays; technical omissions at design stage; contractual claims such as extension of time with cost claims; improvements to standard drawings during construction stage; wrong decisions by the supervising team in dealing with the contractor’s queries; delays in costing variations and additional works: omissions and errors in the bills of quantities: ignoring items with abnormal rates during tender evaluation, especially with provisional quantities and some tendering manoeuvres by contractors, such as front-loading of rates.

The most important variables of cost overruns have been identified as unpredictable weather, inflationary material cost, inaccurate materials estimates, complexity of project, the contractor’s lack of geographical experience, the contractor’s lack of project type experience, and non-familiarity with local regulations (Kaming et al, 1997). Mahamid and Bruland (2011) conducted a study to identify the cost overrun causes in road construction projects in the West Bank in Palestine from the consultants’ perspective. Their findings revealed that the top five affecting factors are materials’ price fluctuation, insufficient time for estimate, experience in contracts, the size of contracts, and incomplete drawings.

Park and Papadoulou (2012) identified the contract being awarded to the lowest bidder, inaccurate site investigation, unforeseen site conditions, an inadequate pre-construction study and inaccurate estimates as the top five important causes of cost overruns in transport infrastructure projects in Asia. Memon et al (2012) identified that the causes of cost overrun involve thirty-five common factors which were selected through the literature. The results from their study indicated that fluctuation in materials price, cash flow and financial difficulties faced by contractors, delay in progress payment by owner, and frequent design changes were most dominant factors causing cost overrun. Azhar et al (2008) outlined the top ten cost overrun factors as fluctuation in prices of raw materials, the unstable cost of manufactured materials, the high cost of machineries, lowest bidding procurement procedures, poor project (site) management/ poor cost control, delays between design and procurement phases, incorrect/ inappropriate methods of cost estimation, additional work, improper planning and unsupportive government policies.
2.8 EFFECTS OF COST OVERRUNS ON CONSTRUCTION PROJECTS

According to Akinsiku and Akinsulire (2012), construction clients demand the timely completion of projects without delay or additional cost. However, the authors indicated that cost and time overruns and interest accumulation on capital are the most frequent effects of delay in the construction industry although the effects of delay are slightly more on time overruns than cost overruns. This could be as a result of the contractors’ inability to honour contract deadlines and using shortages of material as an excuse or the consultants’ inability to implement proper design and obtaining adequate knowledge about the usage of materials (Akinsiku and Akinsulire, 2012).

Akisiku and Akinsulire (2012) further stated that causes of delays can be categorised as financially related e.g. client not being able to meet up with the payment of interim certificates; design related e.g. delays in design and frequent change orders; improper project logistic and planning e.g. shortages of resources, late delivery of materials and organisational deficiency and resources management. Planning and scheduling issues may lead to an extension of time on the project, an accumulation of interest on the capital to finance the project and cost overruns due to inflation and fluctuations. Moreover, Akisiku and Akinsulire (2012) mentioned that other effects are wastages and under-utilisation of man-power resources due to idle workmen because of the non-availability of material to work due to poor logistic arrangements.

Akisiku and Akinsulire (2012) concluded that inadequate contractor experience, inaccurate cost estimates, poor technical performance and workmanship, and a lack of communication all lead to disputes between parties involved, as well as arbitration and litigation, including the total abandonment of project. Inclement weather, restricted access and buildability issues are factors which lead to the under-utilisation of equipment and plant meant for the project, including a reduction in employment opportunities for construction workmen (Akinsiku and Akinsulire, 2012).

Wakjira (2011) also identified the following effects of cost overrun: losses of credibility to highway organisation; bad reputation; loss of clients’ confidence in consultants; added investment risks or funding risks to professionals; the inability to deliver value to clients discouraging sponsors to invest in the construction industry; less returns on investment for clients; delay in payment, loss of profit to the contractor, abandonment of future projects, drop in construction activities; inability to secure project finance or securing it at higher costs.
preventing planned increase in road network; damage to professional relations; suspension of work; dispute among parties and a decreased rate of national growth. All these consequences undermine the viability and sustainability of the construction industry (Wakjira, 2011).

However, Akinsika and Akinsulire (2012) have a different view, stating that arbitration or litigation and the total abandonment of projects were no longer seen to be the usual effects of delay as outlined by past researchers. This could be as a result of the implementation of risk management procedure which enables the parties to the contract to terminate, treat, transfer and tolerate contractual risk; hence the number of disputes and court proceedings on construction contracts have declined significantly (Akinsiku and Akinsulire, 2012).

2.9 MITIGATION MEASURES TO IMPROVE COST PERFORMANCE

In the construction industry, the aim of project control is to ensure the projects finish in time, within budget and achieving other project objectives. It is a complex task undertaken by project managers in practice, which involves constantly measuring progress, evaluating plans and taking corrective actions when required (Olawale and Sun, 2010).

Viswanathan (2012) discussed ways to prevent the projects from having cost overruns. Firstly, much attention needs to be paid to project planning, since planning is the most essential component of project management and the biggest weapon against cost overruns and delays. The author advised project managers to think of all the major scenarios and flesh out the complete scope of the project before a single line is coded. Thereafter, once the scope is defined, sign-offs should be obtained from all the stakeholders. Secondly, Viswanathan (2012) mentioned that the vendor’s capabilities should be checked before hiring. Owing to the fact that many projects are complex, there might be a need to use outside vendors for some of the project tasks. Therefore before hiring a vendor, the following need to be considered:

- Find out their team’s capabilities and check whether that matches the requirements of the project on hand. Improper skill-sets match can cause a significant disruption to the projects;
- Find out whether their cost estimates are realistic and
- Check how good they have been at meeting deadlines in their previous projects.

Thirdly, there should be an attempt to stay within the scope that was originally planned (Viswanathan, 2012). This is simply because fighting scope creep is the biggest challenge for
a project manager. The developers want to add their favourite features, the clients start asking for things that were not originally planned and the testing team wants a change in some of the features. Drastic scope creep puts the project in danger. It is essential to exert control and convince all the stakeholders why the increased scope can harm the project.

Fourthly, Viswanathan (2012) advised on the use of good scheduling tools and charts because proper scheduling is essential in complex projects, since improper scheduling can cause wrong cost estimations and increase the idle times of some of the team members. A simple Gantt chart can be used or more advanced project scheduling tools are available for scheduling (Viswanathan, 2012).

Viswanathan (2012) also pointed out that the stakeholders in the project should be on the same page. Use of effective communication can help reduce the delays by avoiding working errors and by making the scheduling of work better (Viswanathan, 2012). The author mentioned that it is the project manager’s responsibility to keep the communication among the team members working seamlessly. Lastly, Viswanathan (2012) advised on the constant tracking and measuring of the progress. A project manager has to constantly track the progress of the various tasks and have various metrics to measure in the projects. This will provide early signals of project delays, while also offering opportunities to fix the issues before it is too late (Viswanathan, 2012).

The following mitigation measures to improve cost performance were identified by Memon, et al (2012): effective strategic planning, proper project planning and scheduling, effective site management and supervision, frequent progress meeting, proper emphasis on past experience, use of experienced sub-contractors and suppliers, use of appropriate construction methods, use of up-to-date technology, clear information and communication channels, frequent coordination between the parties, performing a preconstruction planning of project tasks and resources needs, developing human resources in the construction industry, comprehensive contract administration, systematic control mechanism, and improving contract award procedure by giving less weight to prices and more weight to the capabilities and past performance of contractors. In order to achieve efficient and effective cost performance in construction project, owners of organisations are suggested to incorporate the mentioned measures as compulsory practices and project managers are suggested to adopt particular measures to implement at planning stage to avoid the hindrances during project execution and
achieve effective cost control assuring the completion of project within budgeted cost (Aziz et al, 2013).

2.10 CRITICAL SUCCESS FACTORS FOR A CONSTRUCTION PROJECT

According to Saqib, Farooqui and Lodi (2008), a construction project is completed as a result of a combination of many events and interactions, planned or unplanned, over the life of a facility, with changing participants and processes in a constantly changing environment. Jari and Bhangale (2013) also explained a project as a complex, no-routine, one-time effort limited by time, budget and resource and performance specifications designed to meet customer needs. An assumption is made that, if a project is completed on time, within the agreed budget and set quality, referred to as the ‘golden triangle’, then the project is deemed successful. Evidence suggests that this is far from the truth. Hence, the construction industry needs to pay special attention to critical success factors, besides the ‘golden triangle’ (Garbharran, Jeevarathnam and Msani, 2013). Other important issues that have been incorporated as critical success factors are: (i) meeting the strategic goals of the client organisation, (ii) achieving satisfaction of the end users, and (iii) attaining satisfaction of all other stakeholders. Finally, in case the criteria for project success are defined in a particular setting, there are still some conditions that should be provided in order to consider a project as successful (Alexandrova and Ivanova, 2012).

The construction industry is a very competitive high-risk business. Increasing uncertainties in technology, budgets and development processes creates a dynamic construction industry (Gudiene, Ramelyte and Banaitis, 2013). Gudiene et al (2013) reinforced this issue by stating that construction companies have to consider the factors that can have a direct effect on their success in construction project performance because construction is a risky business, and the possibility of failure always exists. Saqib et al (2008) further mentioned that currently building projects are becoming much more complex and difficult, therefore the project team is facing unprecedented changes.

Jari and Bhangale (2013) and Saqib et al (2008) emphasised that the study of project success and the critical success factors (CSFs) are considered to be a means to improve the effectiveness of project. Saqib et al (2008) further mentioned that certain factors are more critical to project success than others. These factors are called critical success factors (CSFs). The term "critical success factors," in the context of projects and the management of projects, is defined as those factors predicting success on projects (Saqib et al, 2008).
2.11 PROJECT SUCCESS CRITERIA AND PROJECT SUCCESS FACTORS

According to Jari and Bhangale (2013), project success factors are the elements of a project that can be influenced to increase the likelihood of success; these are independent variables that makes success more likely. Project success criteria are the measures that judge the successful outcome of a project; these are dependent variables which measure project success (Jari and Bhangale, 2013). The authors further explained primal success criteria to be an integrated part of project management theory, given that early definitions of project management included the so called “iron triangle” success criteria such as cost, time and quality.

While success factors are those inputs to the management system that lead directly or indirectly to the success of the project or business, Jari and Bhangale (2013) stated that project success factors are not universal for all projects since different projects and different people prioritise different sets of success factors. The authors expressed the view that project success criteria also vary from project to project and what is acceptable in one project without impact on perceived success is deemed an abject failure in another project. Figure 2.1 depicts the cycle of the critical success factors for a construction project:

![Figure 2.1: Cycle of critical success factors](image)

Source: Pakseresht and Asgari (2012)
According to a study conducted by Saqib et al (2008), a number of variables influencing the success of project implementation were identified following a thorough literature review. A careful study of previous literature suggests that CSFs can be grouped under seven main categories. These include: (1) project management factors; (2) procurement-related factors; (3) client-related factors; (4) design team-related factors; (5) contractor-related factors; (6) project manager-related factors; and (7) business and work environment-related factors.

Then the authors concluded that the top ten CSFs (across the seven categories given above) are as follows: 1) decision-making effectiveness, 2) project manager’s experience, 3) contractor’s cash flow, 4) contractor’s experience, 5) timely decision by owner or owner’s representative, 6) site management, 7) supervision, 8) planning effort, 9) prior project management experience, and 10) the client’s ability to make decisions. A survey with seventy-one critical success factors by Gudiene et al (2013) was distributed among construction professionals and experts who have projects management knowledge and related experience. Among the seven critical success factors groups affecting construction projects, the project management/team members-related factors were found to be the most important group. The institutional factors were found to be the least important group. Based on the results, ten factors, including the experience of project management, project value, the experience of the project manager, the technical capabilities of the project manager, the experience of the contractor, the project size, the competence of project team members, clear and realistic goals, decision making, the effectiveness of project management and the technical capability of project management were determined to be the most important success factors for construction projects.

Alexandrova and Ivanova (2012) identified the following as the important success factors for project management: the competence of the project manager, support from the agency administering the respective operational programmes, the clarity of the project goals, top management support, the competence of project team members, the motivation of project team members, effective communication between project stakeholders, the quality of sub-contractor services, precision in documenting and archiving of project information, effective coordination of project activities, compliance with the rules and procedures established by the operational programmes, systematic control over the project execution, access to organisational resources, smart planning, and competence and adequate support from a project consultant.
Jari and Bhangale (2013) mentioned that for a project to be successful, it is essential to understand the project requirements right from the start and go for/select project planning which provides the right direction to project managers and their teams and then to execute the project accordingly. Additionally, the authors expressed the belief that project success can be attained by understanding what the end result would be, and then stating the deliverables of the project.

Furthermore, Jari and Bhangale (2013) added that the success of a project can be defined as meeting the required expectation of the stakeholders and achieving its intended purpose. Hidayat and Egbu (2011) stated that success criteria are the measures by which the success or failure of a project will be judged. Success criteria or a person's definition of success as it relates to a building often changes from project to project, depending on the participants, the scope of services, the project size, the sophistication of the owner related to the design of facilities, technological implications, and a variety of other factors (Saqib et al, 2008).

On the other hand, common threads relating to success criteria often develop, not only with an individual project, but across the industry as success is related to the perceptions and expectations of the owner, designer, or contractor. Differences in a person's definition of success are often very evident (Saqib et al, 2008). Hidayat and Egbu (2011) further identified project success criteria to include the following project results: budget, schedule, quality, appreciation by client, appreciation by project personnel, appreciation by users, appreciation by contracting partners and appreciation by stakeholders.

Gudiene et al (2013) also mentioned that there is no single answer to the question of what determines the success of construction projects. The authors stated that success factors vary depending on the country, the type of project, scope, size, complexity, use of methods, materials, project team and other factors. According to Alexandrova and Ivanova, (2012), project managers need focused efforts to gain an expanded comprehension of the potential effects of the critical success factors which in turn could assist their work on current and future projects management. The authors further added that this is the way that their chances for achieving the projected goals could substantially increase in the framework of time, resources, and budget constraints.
2.12 CONCLUSION
The literature reviewed in this chapter indicated that construction can be considered as a dynamic industry which is constantly facing uncertainties. These uncertainties make the management of costs difficult which consequently causes cost overruns. Therefore, it is of high importance to properly select project team members, identify the development needs of the project team members, and most importantly, forecast the performance level of a construction project before construction commences. Studies have shown that the size of a construction project influences the rate of cost overrun. Large projects are generally more complex, and in complex projects some items are easily missed out or may be forgotten during the planning and design stages, hence the complexity may increase the rate of cost overruns. However, since the stakes are higher on larger projects, more care may be exercised from conception of the project until completion. The next chapter presents the literature on cost overruns relating to international experience and the focus is on Malaysia and Hong Kong.
CHAPTER THREE

INTERNATIONAL EXPERIENCE – COST OVERRUNS IN MALAYSIA AND HONG KONG

INTRODUCTION

This chapter provides a literature review on the cost overruns in construction in Malaysia and Hong Kong. This section will also review the construction industry performance in Malaysia and Hong Kong, the causes and effects of cost overruns in Malaysia and Hong Kong and mitigation measures to improve construction performance in Malaysia and Hong Kong.

3.1 MALAYSIA

3.1.1 Background on Malaysia

The construction sector has been playing a significant role in the aggregate economy of the country in terms of its contribution to revenue generation, capital formation and employment creation which ultimately support the gross domestic product (GDP) and the socio-economic development of Malaysia (Khan, Liew and Ghazali, 2014).

The Federation of Malaysia was established in 1963 after gaining independence from British rule. Initially it was comprised of Malaya, Sarawak, Sabah and Singapore. In 1965 Singapore was separated from the federation and became an independent state because of internal political conflicts. Present Malaysia, known as Peninsular Malaysia, consists of an east and west part. It is regarded as one of the most successful non-western countries that achieved a smooth and gradual transition to modern economic growth by the end of 20th century. By the year 1990 Malaysia had achieved the status of Newly Industrialised Country (NIC) and now it is the 37th largest economy in the world, according to the gross domestic product (GDP) at current prices in US dollars (Khan et al, 2014).
3.1.2 Construction industry performance in Malaysia

The socio-economic growth of a country depends heavily on construction industry as it provides the necessary infrastructure such as roads, hospitals, schools and other basic and enhanced facilities. Also, it contributes significantly to the country’s gross domestic product (GDP). In Malaysia, the construction sector has been consistently contributing to the strong economic growth of 5.8 per cent in 2009 and subsequently 8.7 per cent in 2010 as against the overall GDP growth (Memon et al., 2012).

According to Malaysia report (2014), the construction industry had a growth of 10.9 per cent in 2013 with projects valued at RM124 billion, of which 30 per cent or RM38 billion were residential projects. The industry grew at the rate of 14.3 per cent in the first half of 2014 with projects worth RM69 billion carried out until the third quarter of 2014. 39 per cent of the projects valued at RM27 billion were non-residential projects, 33 per cent were residential projects (RM23 billion), 22 per cent were infrastructure projects (RM15 billion) and 6.0 per cent were social services (RM4 billion). The private sector is the biggest contributor to the construction industry, having contributed RM57 billion in the first three quarters of 2014. The industry’s growth is expected to remain strong over their forecast period of 2013 – 2018.
3.1.3 Cost overruns in Malaysia

The construction industry is a highly dynamic sector and plays an important role in the development of a country and hence in Malaysia, the construction industry has shown a rapid growth since its independence. However, the construction industry in Malaysia is facing chronic problems including poor performance of time and cost, construction waste, poor productivity and over-dependence on foreign workers. Of these challenges, poor time and cost performance is considered as a critical issue (Memon et al, 2012).

Further, a survey conducted by Rahman, Memon, Azis, Nagapan and Latif (2012) in the southern region of Peninsular Malaysia highlighted that 89 per cent of 140 respondents mentioned that most of their projects faced cost overruns. Moreover Endut, Shehu, Akintoye and Jaafar (2009) stated that both the public sector and private sector projects have similar patterns of cost overruns. The authors indicated that only 46.8 per cent and 37.2 per cent of public sector and private sector projects respectively are completed within the budget. However, they concluded that 84.3 per cent of the private sector projects are completed within the 10 per cent cost deviation compared with 76.0 per cent of the public sector projects.

Memon et al (2012), in another study on time and cost performance, revealed that 92 per cent of construction projects were overrun and only 8 per cent of projects could achieve completion within contract duration. The amount of time overrun was between 5 to 10 per cent as agreed by respondents. In terms of cost performance only 11 per cent of respondents mentioned that their projects are normally finished within the budgeted cost while 89 per cent of respondents agreed that their projects were facing the problem of cost overruns with average overrun at 5 to 10 per cent of the contract price. Thus, cost overrun is a pertinent issue in the construction industry which needs serious attention in improving project’s cost performance as the overrun is an additional burden to all parties involved in the project (Memon and Rahman, 2014).

3.1.4 Causes of cost overruns in construction projects in Malaysia

In Malaysia the problem of cost overrun is a serious issue. Aziz et al (2013) pointed out that cost overruns in construction projects can occur because of many reasons. Memon et al (2012) stated that the major contributors of this poor performance include design and documentation issues, financial resource management and project management and contract administration issues.
According to Kadir, Jaafar, Sapuan and Ali (2005), the Malaysian residential industry experiences time and cost overruns due to various project delay factors that affect construction labour productivity. The authors concluded that the most important factors are as follows: material shortage at project site, non-payment (financial problem) to suppliers causing the shortage of material delivery to site, change order by consultants, late issuance of construction drawing by consultants and inability of contractors’ site management to organise activities.

In the study by Memon et al (2012) on the cause factors of large projects’ cost overruns the findings were the following: the fluctuation in the prices of material, cash flow and financial difficulties faced by contractors, poor site management and supervision, lack of experience of contractors, schedule delay, inadequate planning and scheduling, and poor financial control on site are the major causes of cost overrun. These significant factors fall into three major groups of cost overrun i.e. non-human-related factors (MMF), financial-related factors (FIN) and design and documentation-related factors (DDF).

Memon et al (2010) also investigated large projects of Majlis Amanah Rakyat (MARA) Malaysia and found that cash flow and financial difficulties faced by contractors, contractors’ poor site management and supervision, inadequate contractor experience, shortage of site workers, incorrect planning and scheduling by contractors were the most severe factors while changes in the scope of projects and frequent design changes are factors least affecting construction cost.

Ali and Kamaruzzaman (2010) found that main factors that contribute to cost overruns include inaccurate or poor estimation of original cost, construction cost underestimation, improper planning, poor project management, lack of experience, poor contract management, inflation of project costs, high cost of machineries, fluctuation in the price of raw materials, unforeseen site conditions, insufficient funds, obsolete or unsuitable construction equipment and methods and mistake in design.

### 3.1.5 Effects of cost overruns in construction projects in Malaysia

Memon et al (2012) concluded that the major inhibiting factors in achieving successful completion of projects were frequent design changes, while the second major factor was found to be financial resource management. The delay in payment of completed works by the owner affects the cash flow of contractors significantly and it causes a delay in the procurement of
resources. Consequently time and cost performance of projects are affected. Project management and contract administrated were also rated as the second major contributors affecting time and cost performance. Changes in scope and inadequate site investigation at the planning stage led to major changes and rework in construction projects.

Kadir et al (2005) listed the following as the effects of cost overruns: 1) A lack of material causes workers to remain idle while waiting for materials. This is because the construction activities are interdependent, and the shortage of critical materials such as re-bars, ready-mixed concrete and formwork hamper the work sequence and progress. 2) The stoppage of material delivery by the suppliers due to non-payment by the contractors causes the suppliers to lose their confidence in the credibility of the contractors. 3) Change order by consultants due to design error during the planning stage is a costly problem if the work has been done. For instance, the hacking of hardened concrete is time consuming and affects the workers’ motivation. Work sequences are also disrupted due to rework. 4) Late issuance of construction drawing by consultants results in delays in the progress of the work. 5) Poor knowledge and the inexperience of the site management team in planning, scheduling and procurement hamper the work progress. 6) Late issuance of progress payment by the client to the contractor can severely hinder the work progress because a delay in progress payment affects the cash flow of contractors which, in turn, affects the payment to workers and suppliers. This causes detrimental effects on workers’ motivation and suppliers’ creditability. 7) Coordination problems between main contractors and subcontractors pose a major hindrance to work progress. The common coordination problems such as late issuance of revised construction drawings to the sub-contractor can cause rework due to construction errors.

3.1.6 Mitigation measures to improve cost performance in Malaysia

Since cost overrun is a serious problem, it is necessary to identify the measures that can be implemented by contractors to control their construction cost (Ali and Kamaruzzaman, 2010). According to Aziz et al (2013), managing construction cost is one of the important tasks in achieving successful project completion. Unfortunately effective cost management is seldom achieved and a significant amount of cost overrun is often experienced.

Memon et al (2012) mentioned that the Malaysia construction industry was faced with the poor performance of construction time and cost. Hence, the authors conducted a study to develop mitigation measures to control time and construction costs. Mitigation measures were classified
into three categories in accordance with implementation strategy as pro-active, re-active and organisational measures. They stated that these measures will be helpful in improving time and cost performance at different stages, from planning as proactive measures to construction and reactive measures. Memon et al (2012) also mentioned that some of the measures may be applicable in both the planning and execution stages.

The authors concluded that the following are the mitigation measures to improve cost performance in Malaysia: 1) Effective strategic planning, 2) Proper project planning and scheduling, 3) Effective site management and supervision, 4) Frequent progress meetings, 5) Proper emphasis on past experience, 6) Use of experienced sub-contractors and suppliers, 7) Use of appropriate construction methods, 8) Use of up-to-date technology. 9) Clear information and communication channels, 10) Frequent coordination between the parties, 11) Performing a preconstruction planning of project tasks and resources needs, 12) Developing human resources in the construction industry, 13) Comprehensive contract administration, 14) A systematic control mechanism, 15) Improving contract award procedures by giving less weight to prices and more weight to the capabilities and past performance of contractors.

Ali and Kamaruzzaman (2010) identified eleven mitigation measures which include proper project costing and financing, proper cost control, competent personnel, efficient management, risk management during project execution, realistic cost estimation, appropriate scope definition, appropriate contractual framework, establishing training programmes, increasing the supply of materials, and establishing a system in design.

3.1.7 Lessons learnt
From the studies carried out in Malaysia, it can be seen that the common major factors contributing to cost overruns in the Malaysian construction sector are the following: fluctuations in prices of materials, cash-flow and financial difficulties faced by contractors, material shortages, contractors’ poor site management and supervision, inadequate contractor experience, shortage of site workers, inadequate planning and scheduling by contractors, schedule delay and delays in progress payment by owner. In Malaysia, both the public sector and private sector projects have similar patterns of cost overruns. Only 48.8 per cent of the public sector projects are completed within the budget and 37.2 per cent of private sector projects.
Literature also revealed that the major effects of cost overruns in Malaysia were delays in the procurement of resources caused by delayed contractors’ payment, and changes in scope and inadequate site investigation at the planning stage which led to major changes and rework. Rework also led to disrupted work sequences, idling resources caused by a lack of materials, stoppage of material delivery by suppliers due to non-payment by contractors, delay in progress of the work caused by the late issuance of construction drawings by consultants, poor knowledge and the inexperience of the site management team in planning, and contractors’ cash flow problems caused by late payment by the client which hinders work progress because it affects payment to workers.

Furthermore, literature revealed the following as the mitigation measures to improve cost performance in Malaysia: effective strategic planning, effective site management and supervision, frequent progress meetings, proper emphasis on past experience, the use of experienced sub-contractors and suppliers, use of appropriate construction methods, clear information and communication channels, frequent coordination between the parties, comprehensive contract administration, improving contract award procedure by giving less weight to prices and more weight to the capabilities and past performance of contractors, proper project costing and financing, proper cost control, competent personnel, efficient management, realistic cost estimation, and appropriate scope definition. Therefore, cost overrun can be minimised or totally eliminated using a proper project performance monitoring and control system that will integrate all the key activities of each phase of the project.

3.2 HONG KONG

3.2.1 Background on Hong Kong
Hong Kong’s expertise in timely construction of quality high-rise residential and commercial buildings is internationally renowned and in great demand in overseas markets, especially on the Chinese mainland. The Middle East has emerged as a market with growing potential for Hong Kong’s construction companies. Government infrastructure plans as well as stimulus packages provide good support to construction activities in the Gulf region (Building and construction industry in Hong Kong, 2000).
Hong Kong was established as a Special Administrative Region of the People's Republic of China on 1 July 1997. It is situated at the south-eastern tip of China, and it is ideally positioned at the centre of East Asia, one of the world's most dynamic regions. With a total area of 1,104 square kilometres, it covers Hong Kong Island, the Kowloon Peninsula and the New Territories, including 262 outlying islands. Hong Kong Island lies just south of Kowloon, separated by Victoria Harbour, the New Territories lie north of Kowloon and runs up to the border with Mainland China. Hong Kong's population was approximately 7,103,700 million at the end of 2011. The population density is 6,544 people per square kilometre. The population of Chinese descent is almost 95 per cent. The foreign population comprises many nationalities, with the largest numbers from Philippines, Indonesia and the USA. Chinese and English are the official languages. English is widely used in the government, the legal system and by the professional and business sectors (Hong Kong economic and trade office Brussels, 2011).

![Figure 3.2: Map of Hong Kong](source: Geology.com (2008))

3.2.2 Construction industry performance in Hong Kong

The construction industry is one of the main pillars of Hong Kong’s economy. According to Construction for Excellence (2001), Hong Kong's economic growth contracted from an expansion of 4.9 per cent in 2011 to 1.4 per cent in 2012. Since 2010, Hong Kong's construction industry has shown strong levels of growth and posted an annual growth of 24.2 per cent in 2012. This was driven by public investment and the expansion plans of private developers to...
meet housing sector demands. PR Newswire, 2014 indicated that Hong Kong has several leading financial institutions and the largest number of corporate headquarters in Asia. It is an attractive business hub due to its low tax rates, free economic structure and connectivity to markets across the world. The nation's competitive advantage in terms of business attractiveness is expected to stimulate investment inflow into the office buildings category. Infrastructure construction is expected to benefit from several large-scale infrastructure projects.

At a cost of US$46 billion, the projects are designed to enhance connectivity across the country. The supply of industrial space is diminishing continuously with government initiatives to increase residential supply. However, there is still a sizeable demand for industrial space owing to warehousing, logistics, back office and light industrial activity (Construction for Excellence, 2001). Hong Kong's construction industry recorded robust growth during the review period, registering a compound annual growth rate (CAGR) of 12.84 per cent, predominantly driven by several large infrastructure development projects undertaken by the government to promote economic growth and an increase in the volume of high-rise residential buildings backed by population growth, low interest rates, limited land availability and buying interest from China (PR Newswire, 2014).

The construction industry is expected to register a compound annual growth rate (CAGR) of 8.25 per cent over the forecast period (2013-2017). Expansion of the industry will be aided by government measures to increase land supply for around 40,000 public housing flats every year until 2017 and moderate housing prices, which have been increasing steadily. Growth will be driven by the continuation of large-scale infrastructure projects and the attractiveness of Hong Kong as Asia's business hub (PR Newswire, 2014).

3.2.3 Cost overruns in Hong Kong

According to Sovacool (2014), the economic impact of a construction cost overrun is the possible loss of the economic justification for the project. In a study of construction cost overruns and electricity infrastructure, Sovacool, (2014) mentioned that a cost overrun can also be critical to policies for pricing electricity on the basis of economic costs because such overruns would lead to under-pricing.
Cost overrun is not an uncommon phenomenon in construction projects and in particular with civil engineering and infrastructure projects. This has been highlighted recently with large delays in high profile projects in Hong Kong. Recent surveys suggest that cost overrun for transport infrastructure projects was mostly in the range of 40 to 60 per cent for rail projects, 20 to 40 per cent for fixed link projects and 0 to 20 per cent for road projects (Maxim Recruitment, 2013).

3.2.4 Causes of cost overruns in construction projects in Hong Kong
According to Chan and Kumaraswamy (2002), project delays can lead to cost overruns as well, for example through additional overheads and potential clauses between client and contractor. Tat-fai (1999) carried out a study on major cost overrun factors for mega infrastructure projects in Hong Kong, and the study identified major causes of cost overruns at the post-contract stages as the following: 1) design changes, 2) scope changes, 3) financial claims, 4) poor client's project management, 5) unforeseen site conditions 6) poor interface between contracts, 7) inaccurate pre-tender estimates, and 8) late instructions. These findings should encourage substantial pre-tender design completion as far as possible in order to alleviate the relatively high likelihood of subsequent post-contract cost overruns.

Principal and common causes of delays in Hong Kong construction projects were identified by Chan and Kumaraswamy (1997). They identified the following as the major and common causes: 1) poor site management and supervision, 2) unforeseen ground conditions, 3) low speed of decision making by project teams, 4) client-initiated variations and 5) necessary variations of works.

Lo, Fung and Tung (2006) identified the following as the causes of cost overruns in construction projects: 1) exceptionally low bid, 2) inadequate resources due to contractor/lack of capital, 3) inexperienced contractors, 4) poor site management and supervision by consultants and 5) unforeseen ground conditions.

3.2.5 Effects of cost overruns in construction projects in Hong Kong
Chan and Kumaraswamy (1997) studied delays in the Hong Kong construction industry. They mentioned that the timely delivery of projects within budget and to the level of quality standard specified by the client is an index of successful project delivery. Failure to achieve targeted time, budgeted cost and specified quality results in various unexpected negative effects on the
projects. Owolabi et al (2014) stated that normally, when the projects are delayed, they are either extended or accelerated and therefore incur additional cost. They further pointed out that although the contract parties agreed upon the extra time and cost associated with delay, in many cases there were problems between the owner and contractor as to whether the contractor was entitled to claim the extra cost. Such situations usually involved questioning the facts, causal factors and contract interpretation.

Therefore, delays in construction projects give rise to dissatisfaction among all the parties involved and the main role of the project manager is to make sure that the projects are completed within the budgeted time and cost. Chan and Kumaraswamy (2002) also mentioned that project delays can lead to cost overruns as well, for example, through additional overheads and potential claims between client and contractor. Additionally, Lo et al (2006) also stated that construction delays are common in civil engineering projects in Hong Kong, inevitably resulting in contractual claims and increased project costs.

3.2.6 Mitigation measures to improve cost performance in Hong Kong

Chan and Kumaraswamy (2002) recommended strategies for shortening the construction durations in public housing projects. The strategies are categorised into technological and management approaches. Technological strategies are as follows: 1) Enhancing the buildability of project design by integrating early inputs of the contractor in the design phase; 2) Encouraging standardisation, modularisation and repetition in the design of building elements and construction details; 3) Maximising the mechanisation of the construction process; 4) Ensuring an efficient and simple construction sequence; 5) Increasing the number of cranes and sets of large panel steel formwork used in a single project; 6) Using hydraulic boom concrete pumps with a higher pump rate in casting all floor slab components; 7) Encouraging more symmetrical block designs so that the contractors can adopt innovative construction methods/system formwork. 8) Mandatory use of precast concrete facades panels and semi-precast concrete floor slabs in all public housing contracts, even if a project needs to erect only one single block. 9) Installing the precast facades by pre-installation, rather than post-installation (as compared to floor slab construction) in order to achieve a four-day cycle and 10) Ensuring continuous workflow for each critical resource such as tower crane, large panel formwork, pumped concrete and any other related resource, for example, site labourers to facilitate a four-day working cycle.
Chan and Kumaraswamy (1997) stated that the managerial strategies are based on communication management, for example, information flows and speeds of decision making among contracting parties. The strategies were listed as follows: 1) Improving the effectiveness of site management and supervision to ensure a co-ordinated workflow among all work trades and close liaison among all contracting parties; 2) Establishing appropriate overall organisational structures and integrated information communication network systems across professional boundaries throughout the construction process; 3) Clearly defining the roles and responsibilities of each project participant; 4) Increasing the co-ordination of the design and construction teams at the design-construction interface and 5) Providing training programmes and formed education for industry practitioners to better foster communication management skills through using integrated management information systems and advanced information processing technology for promoting faster information flows among the project team members.

### 3.2.7 Lessons learnt

The construction industry is one of the main pillars of Hong Kong’s economy. Cost overrun is a common phenomenon in construction projects and particularly with civil engineering and infrastructure projects, which have been highlighted because of considerable delays in high profile projects in Hong Kong. The major causes of cost overruns reviewed from the literature were identified by Tat-fai (1999) at the post-contract stages as the following: design changes, scope changes, financial claims, poor client’s project management, unforeseen site conditions, poor interface between contractors, inaccurate pre-tender estimates, poor site management and supervision by consultants, unforeseen ground conditions, low speed of decision making by project teams, client-initiated variations and late instructions, necessary variations of works, exceptionally low bid, inadequate resources due to contractor or lack of capital and inexperienced contractors.

Literature also revealed that most construction projects in Hong Kong are delayed, resulting in extension of time claims which incur additional costs. Furthermore, from the reviewed literature the highest ranked mitigation measures to improve cost performance in Hong Kong were: enhancing the buildability of project design, encouraging standardisation, modularisation and repetition in the design of building elements and construction details (Chan and Kumaraswamy 2002). Moreover, from the study conducted by Chan and Kumaraswamy
(1997) the top three ranked mitigation measures to improve cost performance in Hong Kong were; improving the effectiveness of site management and supervision, establishing appropriate overall organisational structures and integrated information communication network systems across professional boundaries throughout the construction process and clearly defining the roles and responsibilities of each project participant.

3.2.8 Comparison between Malaysia and Hong Kong

Literature revealed that poor time and cost performance is considered as a critical issue in Malaysia: as a result most of the projects face huge amounts of time and cost overrun. Cost overrun is also a common phenomenon in construction projects and it has been highlighted because of considerable delays in high profile projects in Hong Kong. Literature showed that Malaysia and Hong Kong experienced different factors of cost overruns. However, there were a few causes of cost overruns that were common to construction projects in both Malaysia and Hong Kong, such as design changes or change orders by consultants, a lack of experience of contractors, contractors’ poor site management and supervision and unforeseen site conditions. The results of the study conducted by Kadir et al (2006) were in agreement with those of Tat-fai (1999) where design changes or change orders were identified as the most significant factor contributing to cost overruns in Malaysia and Hong Kong. Furthermore, the results from the study conducted by Memon et al (2012) were in agreement with the findings from the study conducted by Lo et al (2006) where they identified a lack of experience as the contributing factor to cost overruns. Moreover, Memon et al (2012) and Ali and Kamaruzzaman (2010) identified contractors’ poor site management and supervision as a significant cause of cost overruns in both Malaysia and Hong Kong. Lastly, from the literature reviewed, Ali and Kamaruzzaman (2010), Tat-fai (1999), and Chan and Kumaraswamy (2002) were in agreement in identifying unforeseen site conditions as the significant factor which contributed to cost overruns in both Malaysia and Hong Kong construction projects.

The following were revealed by the following authors Kadir et al (2006), Memon et al (2012), Memon et al (2010) and Ali and Kamaruzzaman (2010) as the causes of cost overruns in Malaysia:

- Material shortage at project site,
- Non-payment (financial problem) to suppliers causing a shortage of material delivery to site,
- Change orders by consultants,
- Late issuance of construction drawing by consultants,
- Incapability of contractors’ site management to organise activities,
- Fluctuation in the prices of material,
- Cash flow and financial difficulties faced by contractors,
- Poor site management and supervision,
- Lack of experience of contractors,
- Schedule delay,
- Inadequate planning and scheduling,
- Poor financial control,
- Contractors’ poor site management and supervision,
- Shortage of site workers,
- Incorrect planning and scheduling by contractors,
- Changes in scope of project and frequent design changes,
- Inaccurate/poor estimation of original cost,
- Poor project management,
- Poor contract management,
- Inflation of project costs,
- High cost of machineries,
- Unforeseen site conditions,
- Insufficient funds,
- Obsolete or unsuitable construction equipment and methods and
- Mistakes in design.

The literature reviewed by Tat-fai (1999), Chan and Kumaraswamy (2002) and Lo, Fung and Tung (2006) revealed the following as the causes of cost overruns in Hong Kong:

- Design changes,
- Scope changes,
- Financial claims,
- Client's poor project management,
- Unforeseen site conditions,
- Poor interface between contractors,
Inaccurate pre-tender estimates,
Late instructions,
Poor site management and supervision by contractors,
Low speed of decision making by project teams,
Client-initiated variations,
Necessary variations of works,
Exceptionally low bid,
Inadequate resources due to contractor/ or lack of capital,
Inexperienced contractors and
Poor site management and supervision by consultants.

Furthermore, literature indicated one common effect of cost overrun between Malaysia and Hong Kong, namely the project delay which led to the extension of time claims, resulting in additional cost. Memon et al (2012) and Kadir et al (2006) were in agreement with Owolabi et al (2014) in identifying project delay which led to extension of time claims as the effect of cost overruns in Malaysia and Hong Kong.

From the reviewed literature, the following effects of cost overruns in Malaysia were identified by Memon et al (2012) and Kadir et al (2006):
- Delay in procurement of resources due to late payments resulting in time delays,
- Major changes and rework in construction projects,
- Workers idle while waiting for materials,
- Suppliers losing their confidence in the credibility of the contractors,
- Disrupted work sequences due to rework,
- Inexperience of the site management team in planning, scheduling and procurement hinder the work progress, and
- Late payment hindering the work progress because delay in progress payment affects cash flow of contractors which in turn affects the payment to workers and suppliers.

However, very few effects of cost overruns in Hong Kong were revealed by Owolabi et al (2014) from the literature reviewed, namely:
- Delayed projects which are either extended or accelerated incurring additional costs, and
• Additional overheads and potential claims between client and contractor.

Literature reviewed showed two common mitigation measures common to Malaysia and Hong Kong, namely the establishment of training programmes and effective site management and supervision. The findings from the study by Ali and Kamaruzzaman (2010) were in agreement with those of Chan and Kumaraswamy (2002) in identifying the establishment of training programmes as the most significant mitigation measure. Furthermore, Memon et al (2012) were in agreement with Chan and Kumaraswamy (2002) in identifying effective site management and supervision as the major mitigation measures. The following were indicated by Memon et al (2012) and Ali and Kamaruzzaman (2010) as the measures that can be taken to minimise cost overruns in Malaysia:

• Effective strategic planning,
• Proper project planning and scheduling,
• Effective site management and supervision,
• Frequent progress meeting,
• Use of experienced sub-contractors and suppliers,
• Use of appropriate construction methods,
• Use of up-to-date technology,
• Clear information and communication channels,
• Frequent coordination between the parties,
• Preconstruction planning of project tasks and resources needs,
• Developing human resources in the construction industry,
• Comprehensive contract administration,
• Systematic control mechanism,
• Improving contract award procedure by giving less weight to prices and more weight to the capabilities and past performance of contractors,
• Proper project costing and financing,
• Proper cost control,
• Competent personnel,
• Efficient management,
• Risk management during project execution,
• Appropriate scope definition,
• Appropriate contractual framework,
• Establishment of training programmes,
• Increasing supply of materials and
• Establishing a system in design.

The following were indicated by Chan and Kumaraswamy (2002; 1997) as measures that can be taken to minimise cost overruns in Hong Kong:

• Enhancing the buildability of project design by integrating early inputs of the contractor in the design phase,
• Encouraging standardisation, modularisation and repetition in the design of building elements and construction details,
• Maximising the mechanisation of the construction process,
• Establishing an efficient and simple construction sequence,
• Increasing the number of cranes and sets of large panel steel formwork used in a single project,
• Using hydrolic boom concrete pumps with a higher pump rate in casting all floor slab components,
• Encouraging more symmetrical block designs so that the contractors can adopt innovative construction methods/system formwork,
• Mandatory use of precast concrete facades panels and semi-precast concrete floor slabs in all public housing contracts, even if a project needs to erect only one single block,
• Installing the precast facades by pre-installation, rather than post-installation (as compared to floor slab construction), in order to achieve a four-day cycle,
• Ensuring continuous workflow for each critical resource such as tower cranes, large panel formwork, pumped concrete and any other related resource, for example, site labourers to facilitate a four-day working cycle,
• Improving the effectiveness of site management and supervision to ensure a coordinated workflow among all work trades and close liaison among all contracting parties,
• Establishing appropriate overall organisational structures and integrated information communication network systems across professional boundaries throughout the construction process,
• Clearly defining the roles and responsibilities of each project participant,
• Increasing the co-ordination of the design and construction teams at the design-construction interface and
• Providing training programmes and formal education for industry practitioners to better foster communication management skills through using integrated management information systems and advanced information processing technology for promoting faster information flows among the project team members (Chan and Kumaraswamy 2002; 1997)

3.3 CONCLUSION
The literature reviewed in this chapter indicated that construction plays an important role in the development of both Malaysia and Hong Kong. However, in both Malaysia and Hong Kong cost overrun is a serious issue. These findings should encourage substantial pre-tender design completion as far as possible in order to alleviate the relatively high likelihood of subsequent post-contract cost overruns. The next chapter will discuss cost overrun in Nigeria and Ghana.
CHAPTER FOUR

AFRICA EXPERIENCE – COST OVERRUNS IN NIGERIA AND GHANA

INTRODUCTION
This chapter provides a literature review on the cost overruns in Nigeria and Ghana. This section also reviews the construction industry performance in Nigeria and Ghana, the causes and effects of cost overruns in Nigeria and Ghana and mitigation measures to improve construction performance in Nigeria and Ghana

4.1 NIGERIA

4.1.1 Background on Nigeria
The major challenge facing the construction industry in developing counties such as Nigeria is the chronic problem of cost overruns (Kasimu, 2012). The Nigerian construction industry continues to occupy an important position in the nation’s economy even though it contributes less than the manufacturing or other service industries (Aibinu and Jagboro, 2002). The construction industry in south-east Nigeria has continued to undergo complex changes in recent times with the result that clients, contractors and consultants now seek to adopt several survival strategies in the face of keen competition in order to complete projects at the required time and cost (Ubani, Okorocha and Emeribe, 2013)

According to travel.nationalgeographic.com (2013), Nigeria is located in West Africa and is the population giant of Africa, with more than 130 million people. Nigeria has an area of 923,768 square kilometres. The terrain changes from the oil-rich Niger Delta in the south to a belt of rain forests inland and to high savannah-covered plateaux in the north. The population is as diverse as it is large, with some 250 ethnic groups. Nigeria’s three largest groups are the Hausa-Fulani (29 per cent of the population), the Yoruba (21 per cent) and the Igbo or Ibo (18 per cent).

Northern Nigeria is mostly Islamic and dominated by the Hausa-Fulani ethnic group. Southern Nigeria is more westernised and urbanised than the north, with the Yoruba in the south-west and the Igbo in the south-east. The languages spoken in Nigeria are English, Hausa, Yoruba, Igbo and Fulani. The nation’s capital moved from Lagos to Abuja in 1991. Since the oil boom
of the 1970s Nigeria has had an unhealthy dependence on crude oil. In 2002 oil and gas exports accounted for 98 per cent of export earnings, providing 83 per cent of the federal government’s revenue.

Agriculture suffers from years of mismanagement and corruption. The country’s poor transportation infrastructure hinders economic development (National Geographic, 2013).

4.1.2 Construction industry performance in Nigeria

Nigeria’s economy has been reportedly advancing by an average of 7 per cent a year, compared to South Africa’s average of 3 per cent. This is probably as a result of its existing fairly strong investment proposition, based on its large population, substantial natural resources and strategic position (Cameroon Tribute, 2009). The contribution of the construction industry to national economic growth necessitates improved efficiency in the industry by means of cost-effectiveness and timelines and would certainly contribute to cost savings for the country as a whole (Aibinu and Jagboro, 2002). Nigeria has the potential to be one of the world’s biggest construction markets. While the world is still struggling to emerge from the global economic collapse, Nigeria’s construction industry is growing fast and is likely to grow astronomically over the next decade (Corporate Nigeria, 2010/2011).
According to Lamodi (2015), Nigerian economy was declared the largest African economy in 2014. The construction industry is considered as a leading driver of economic development in a country. This is basically due to the fact that almost all other sectors of the economy in one way or another depend solely on the products and services of the construction industry in order to carry out their operations. Dantata, (2007) stated that Nigeria’s economy is one of the largest in Africa and has the potential to be among the strongest in the world, given the amount of natural and human resources that the country is blessed with. However, the economy is still heavily dependent on the oil sector.

The construction industry is considered by some economists as a leading driver of the economic development in a country. This is basically due to the fact that almost all other sectors of the economy in one way or another depend solely on the products and services of the construction industry in order to carry out their operations (Dantata, 2007). This industry sector is the second most important for absorbing human resources, after the food. The construction industry in Nigeria has been a major source of employment for 70 per cent of the labour force in the country, thus it controls the capital flow, as well as labour resources, which has cost implications (Amusan, 2011). Adequate management of these resources is considered an important aspect of the project works; it determines to a large extent the overall success of project works.

In the 1990s, approximately 2.5 million labourers were directly involved in construction projects. However, 88 per cent are unskilled or have low levels of skill, 11 per cent have medium to high levels and the remaining 1 per cent are at managerial level. The large range in this organisational structure is still indicated as a serious problem in Nigeria as a developing country. In other words, the construction industry is facing a serious labour skill shortage. Young people are not keen to work in this industry. This is because jobs in Nigeria tend to rely on physical work or hard manual labour and offer relatively poor pay conditions (Oyewobi Ibironke, Ganiyu, and Ola-Awo, 2011).

4.1.3 Cost overruns in Nigeria
According to Ameh, Soyingbe, and Odusami (2010), the history of the construction industry worldwide is full of projects that were completed with significant time and cost overruns. A study that was conducted in 1994 which looked at 8,000 projects showed that only 16 per cent
of the projects could satisfy the following three famous performance criteria: completing projects on time, within the budgeted cost and maintaining a high standard of quality.

Ameh et al (2010) reported that various studies which were conducted in different developing countries (Nigeria, Saudi Arabia, Malaysia and Indonesia) confirmed that all of the projects currently undertaken in these countries suffer from significant construction cost and time overruns. Ubani et al (2013) indicated that construction projects in south-eastern Nigeria have suffered serious neglect and setbacks since the Nigerian civil war. There have been many research works on cost and time overruns (Kaming et al, 1997). It was found that there were more cases of cost overruns than time overruns. This makes the problem of cost overruns to be of great significance (Kasimu, 2012).

Construction projects in Niger State suffer from many problems and complicated issues in performance such as cost, time and quality (Mamman and Omozokpia, 2014). Oyewobi et al (2011) also reinforced this statement by stating that cost and time overrun has become a cankerworm within the Nigerian construction industry today as well as the lack of good quality work of its end product which does not provide many of the clients with value for money. Over the last decade, several changes have occurred in Nigeria, which have helped all sectors of the economy, especially the building and construction sector (Oyewobi et al, 2011).

Dada and Jagboro (2007) carried out a study on an evaluation of the impact of risk on project cost overrun in the Nigerian construction industry. In the projects studied, risk factors have the greatest impact on projects executed with the project management procurement method; the cost overrun due to risk factors can be estimated to be 30 per cent of project contract sum. For the traditional method, which is the most common procurement method in Nigeria, the cost overrun due to risk factors can be estimated to be 16 per cent of project contract sum. Other risk factors include design and build (9 per cent), management contracting (25 per cent) and direct labour (13 per cent). The authors identified the risk factors inherent in different building procurement methods as physical, environmental, design, logistics, financial, legal, political, construction, operation and time schedule slippage. The study showed that, out of the numerous risk factors encountered in building project procurement, financial and political risks were the most significant of all the procurement methods investigated.
4.1.4 Causes of cost overruns in construction projects in Nigeria
The factors that cause cost overrun in building construction projects in Nigeria have been endemic and a matter for consideration in the Nigeria construction industry (Kasimu, 2012). The problem of cost overruns is more evident in the traditional and public sector type of projects in which a contract is awarded to the lowest bidder. This is the contract-awarding strategy of the majority of public projects in developing countries, including Nigeria (Ubani, Okorocha and Emeribe, 2013). Amusan (2011) also conducted a study on factors affecting construction cost performance in Nigeria. The research concluded by identifying the following major factors that result in cost overrun on construction sites: 1) inadequate planning, 2) contractors’ project inexperience, 3) inflation, 4) incessant variation order, 5) change in project design, 6) project complexity, 6) shortening of contract period and 7) fraudulent practices.

Ameh et al (2010) investigated 42 cost overrun cases and found that a lack of experience of contractors, the cost of materials, fluctuation in the prices of materials, frequent design changes, economic stability, high interest rates charged by banks on loans and mode of financing, bonds and payments as well as fraudulent practices and kickbacks were the dominant factors causing cost overruns in Nigeria. The study by Mansfield et al (1994) also considered the causes of cost overruns in Nigerian construction projects. They concluded that the major variables that lead to excessive project overruns are the financing for completed works, poor contract management, shortages of materials, price fluctuations, and inaccurate estimates. Kasimu (2012) identified the following as the major significant factors that causes cost overrun in building construction projects in Nigeria: market conditions, personal experience in contract works, insufficient time, material fluctuation and the political situation. Ubani and Ononuju (2013) concluded that factors accounting for cost overrun problems range from frequent changes in government and political power, corruption and mode of financing, the use of political undertones rather than economic advantage in siting of projects, sharing of contract sum meant for development by the contractors, ineffective project planning, poor feasibility studies and design, lack of technological capacity as well as the inability to detect failure warning signals on time.

4.1.5 Effects of cost overruns in construction projects in Nigeria
Amusan (2011) concluded that there are nine out of ten chances of the tendency to incur cost overrun on site, and this could lead to project abandonment, followed closely by the tendency for clients’ capital being tied down. In addition, there is the likelihood of an increased project
cost resulting from payments for unproductive time. There is also a seventy per cent (70\%) chance of concerned firms or contractor being declared bankrupt, insolvent or incurring bad debt.

Ubani and Ononuju (2013) pointed out that when there are changes in the government policies and political powers, especially from one political party to another, these result in inconsistencies in the agreed terms of payment, scope creep, inflation in the prices of civil engineering materials and equipment, and ineffective project design, design errors and myopic technical feasibility studies requiring frequent scope changes, modification and correction beyond the capacity of the professionals in the field. They also indicated that the failure and abandonment of public sector civil engineering projects will occur if the warning signals and modes are not remedied on time.

According to Aibunu and Jagboro (2002), loss and expense claims arising from delay and fluctuation claims during the delay period have a significant effect on cost overrun. Loss and expense claims arise from ascertained and approved delays caused by the client or his agent. Aibunu and Jagboro (2002) further emphasised that the significant effect of loss and expense claims on project cost overrun suggests that clients are a significant cause of delay in Nigerian building projects. In this regard, the continuous issue of design information or variation orders by the clients often frustrate the acceleration process. Consequently Aibunu and Jagboro (2002) identified time overrun, disputes, arbitration, litigation and total abandonment as the effects of cost overruns arising from delays.

4.1.6 Mitigation measures to improve cost performance in Nigeria

Amusan (2011) further identified the following as the important measures to improve cost performance in Nigeria: 1) Adequate planning, for example, breaking of project planning into short term achievable goals, medium term planning and long term planning; 2) Studying of project history for possible application on other similar projects; 3) Bulk purchase of material; 4) Proper design of the project during design stage so as to avoid undue on-project variation, and 5) Establishing a fraud detecting system or a system of individual accountability to discourage pilfering, stealing and other related vices.

Based on the findings from their study, Ubani and Ononuju (2013) pointed out that the following remedies could help to improve the incessant cases of failure and abandonment of
public sector civil engineering projects: 1) Appropriate legislation for the continuity of ongoing civil engineering projects at the original site irrespective of who is concerned when power changes hand from one political party or person to another; 2) Honouring of payment certificates as and when due so as to enhance contractors’ cash flow and ensure regular progress of the work with little or no delay; 3) Reappraising the capital investment periodically to determine whether the project should be continued, or terminated or divested and 4) Provision of adequate fund by the client based on the proper feasibility studies and capacity assessment for the execution of the project will help to ameliorate the problems. These include the determination and evaluation of manpower, and technical and professional capacities prior to project implementation.

Kasimu, (2012) pointed out cost overruns in Nigerian construction projects can be mitigated by the following: 1) The contractors should be aware of material fluctuation, so that they can prepare time schedules for the material delivery process to the site in order to avoid shortage or fluctuation problems. 2) The contractors should be advised to prepare method statements for each project, taking into consideration both reality and project type. 3) The consultants should avoid centralisation of decisions, especially those related to consultant work, because this may lead to project delay. 4) The government should be advised to compensate the contractors for any loss that result from the political situation.

Ubani et al (2013) concluded their study by suggesting the following cost overrun mitigation measures: 1) Contractors should be aware of the construction materials to use, so they are advised to purchase the right quantity and quality of construction materials at the right time. 2) The adoption of principles of material requirements planning is necessary to avoid shortages or a surplus of materials. 3) The stakeholders in a construction project should desist from cutting corners in relation to money meant for settling host communities before the start of work.

4.1.7 Lessons learnt
The literature reviewed indicated that Nigeria has the potential to be one of the world’s biggest construction markets (Corporate Nigeria, 2010/2011). There have been many research works on cost and time overruns and there were more cases of cost overruns than time overruns. This makes the problem of cost overruns to be of great significance. The problem of cost overruns
is more evident in the traditional and public sector type of projects in which a contract is awarded to the lowest bidder.

Furthermore, the studies conducted by Ubani and Jagboro (2013) and Aibunu and Jagboro (2002) indicated the following as the highly ranked effects of cost overruns in Nigeria: inconsistency in the agreed terms of payment due to changes in political powers, scope creep due to political instability, time overrun, disputes and arbitration. The lowest raked effects of cost overruns by the authors were; inflation of prices, inefficient project design, litigation and total abandonment of the projects.

Moreover, Amusan (2011), Ubani and Ononuju (2013) and Kasimu (2012) showed that there were numerous important measures to improve cost performance in Nigeria. The mitigation measures included: adequate planning; studying of project history for possible application on other similar projects; purchasing material in bulk and on time; proper design of the project during design stage; establishing a fraud detecting system or a system of individual accountability to discourage pilfering, stealing and other related vices; appropriate legislation for the continuity of on-going civil engineering projects at the original site irrespective of who is concerned when power changes hands from one political party or person to another; honouring of payment certificates as and when due; appraising the capital investment periodically to determine whether the project should be continued, or terminated or divested; provision of adequate fund by the client based on the proper feasibility studies and capacity assessment for the execution of the project. In addition, the contractors should be aware of the material fluctuation, and be advised to prepare method statement for each project, taking into consideration both reality and project type. Moreover, they should avoid the centralisation of decisions, especially those related to consultant work. Finally, the government should be advised to compensate the contractors for any loss that results from the political situation.
4.2 GHANA

4.2.1 Background on Ghana

According to Ofori (2012), the construction industries of developing countries, including that in Ghana, face many problems. There are three main reasons for these problems. First, the economic weakness which these countries face means that there are inadequate resources to devote to efforts to improve the industry. Moreover, the industry fails to receive any stimuli by way of job opportunities and the market forces which support innovation are not present. Second, many of the governments of these countries do not recognise the importance and needs of the construction industry, and hence do not formulate and implement programmes for upgrading the industries. Finally, the inherent underdevelopment of the construction industries in these countries means that they are unable to deal with their weaknesses, to make a strong case for help, or to contribute to the efforts which the government make to develop the industries.

According to ghanaweb.com (1994), Ghana is a country on the West Coast of Africa, and one of the most thriving democracies on the continent. It has often been referred to as an "island of peace" in one of the most chaotic regions on earth. It shares boundaries with Togo to the east, and Cote d'Ivoire to the west, Burkina Faso to the north and the Gulf of Guinea, to the south. A recent discovery of oil in the Gulf of Guinea could make Ghana an important oil producer and exporter in the next few years.

The country's economy is dominated by agriculture, which employs about 40 per cent of the working population. Ghana is one of the leading exporters of cocoa in the world. It is also a significant exporter of commodities such as gold and lumber. Ghana has an area of 238,500 square kilometres, and an estimated population of 22 million, drawn from more than one hundred ethnic groups, each with its own unique language. English, however, is the official
language. The major ethnic groups in Ghana include the Akan, Ewe, Mole-Dagbane, Guan and Ga-Adangbe (Ghana Web, 1994).

![Figure 4.2: Map of Ghana](source: Infoplease.com (2008))

### 4.2.2 Construction industry performance in Ghana

The construction industry is an important sector of the Ghanaian economy. It contributes an average of 8.5 per cent of the gross domestic product (Ghana Statistical Service, 2007). According to Ofori (2012), the performance of the construction industries on projects in developing countries, including Ghana, is poor in most respects including cost, quality and productivity. On most construction projects undertaken in the developing countries, the results fall short of the targets set by the participants themselves in terms of budgets (cost), schedules (time) and specifications (quality). The constructed items in these countries are also unsatisfactory in terms of their maintainability and durability. As constructed items involve huge investments and are expected to last for several years, this has significant economic and social consequences. Moreover, the performance of the construction industries in these developing countries compares unfavourably when viewed against those of their counterparts in industrialised nations.
Ofori (2012:16) further indicated that the roads sector was seen as being constrained by challenges which include the following:

- Considerable maintenance problems and backlog in the road network requiring attention;
- Need for effective reporting and management information systems;
- Serious management gap owing to the drift of young engineers to other organisations;
- Focus of donors on specific projects rather than the broad road programme;
- Long gestation period of donor loans;
- Need to expand the revenue base of the Road Fund;
- Perennial problem of arrears in payments to road contractors;
- Improving local consultancy and contracting capacities; and
- Decentralisation in the road sector.

The national road contractors face the following problems “regardless of their financial class”:

- Inability to secure adequate working capital,
- Inadequate management,
- Insufficient engineering capacity and
- Poor workmanship.

The problems of consultants include the following:

- Inadequate operating cash flow,
- Inadequate flow of jobs,
- Low level of fees, hindering the development of their technical support system,
- Low productivity,
- Poor quality of work and
- Lack of means and opportunities for providing training (Ofori, 2012:16).

### 4.2.3 Cost overruns in Ghana

Cost and time impacts are inevitable on construction projects in that they are inherent in all of project construction’s undertakings. Construction of projects may not perform as anticipated because the owners may have unrealistic expectations regarding the time and cost of
construction, forcing contractors into unrealistic gambles, corner-cutting or commitments that may not be realistic (Tamakloe, 2011).

According to Frimpong, Oluwoye and Crawford (2003), delay and cost overruns are common in construction projects and groundwater construction projects in Ghana are no exception. The authors indicated that there are many factors that can cause delay and cost overruns in groundwater drilling projects and these range from factors inherent in the technology and its management, to those resulting from the physical, social and financial environment.

### 4.2.4 Causes of cost overruns in construction projects in Ghana

According to Tamakloe (2011), construction delay has become endemic in Ghana. It is imperative to create awareness of the extent to which delays can adversely affect project delivery with regards to cost and time.

Frimpong and Oluwoye (2003) investigated the significant factors that cause delay and cost overruns in the construction of underground projects in Ghana. They reported that consultants, owners, and contractors agreed that project financing, economic and natural conditions and material supply were the four major categories of causes of delay and cost overrun factors. Frimpong et al (2003) concluded that the five most important cost overrun factors considered were the following: 1) monthly payment difficulties from agencies, 2) poor contract management, 3) material procurement, 4) poor technical performance and 5) escalation of material prices.

Fugar and Agyakwah-Baah (2010) concluded that causes of cost overruns in Ghana were the following: delay in honouring certificates, underestimation of the costs of projects, underestimation of the complexity of projects, difficulty in accessing bank credit, poor supervision, underestimation of time for completion of projects by contractors, shortage of materials, poor professional management, fluctuation of prices or rising cost of materials and poor site management.

Tamakloe (2011) stated that many projects experience extensive delays and thereby exceed initial time and cost estimates. In addition to impairing the economic feasibility of capital projects, extensive delays provide a fertile ground for costly disputes and claims. According to the contractors and project supervisors, monthly payment difficulties from agencies was the
most important delay and cost factor, while owners ranked poor contractor management as the most important factor. The overall results indicate that the project supervisors felt that the major factors that cause excessive project delays in developing countries are poor contractor management, monthly payment difficulties from agencies, material procurement, poor technical performances, and the escalation of material prices according to their degree of influence. Construction delay has become endemic in Ghana and it adversely affects project delivery with regards to cost and time. Other factors that emerged are bad weather and unexpected natural events.

4.2.5 Effects of cost overruns in construction projects in Ghana

According to Ansah (2011), delayed payments for work done by clients on construction projects in the Ghanaian construction industry are considered to be a factor of significant concern. It causes severe cash-flow problems to contractors and this can have a devastating effect down the contractual payment chain. The author pointed out that a contractor or sub-contractor who has not been paid what is due to him threatens to suspend work under the contract until the balance due to him is paid in full. He emphasised that the practice of efficient and timely payment in construction projects is a major factor that can contribute to the success of a project. Employers’ poor financial management, conflict among parties involved in the contract, and delay in certification are some of the potential causes of delayed payment (Ansah, 2011).

Withholding or delaying payment creates financial hardship for the construction companies and its impacts are sometimes so harsh that some companies have to close down. Delayed payment most likely cause undue cash-flow problems for the contractors and this would have a devastating knock-on effect down the contractual payment chain (Ansah, 2011). Furthermore Ansah (2011) stated that failure to receive payment in a timely manner could expose contractors to a greater risk of failing to complete construction projects on time, sub-contractors refusing to continue works on the project, suspending the construction process until payment is received, slowing down the construction work at site until payment is received and creating negative relationship between clients and contractors. Therefore the contractors seek arbitration or litigation as a disputes resolution mechanism which takes a long time.
4.2.6 Mitigation measures to improve cost performance in Ghana

Tamakloe (2011) pointed out that the following measures should be taken to mitigate cost overrun: 1) Appropriate funding levels should always be determined at the planning stage of the project so that regular payment should be paid to contractors for work done. 2) In order to improve contractors’ managerial skills there is need for continuous work-training programmes for personnel in the construction industry to update their knowledge and be familiar with project management techniques and processes. 3) Effective and efficient material procurement systems should be established within projects. 4) Material procurement has the potential to cause major delays to construction projects. Therefore, the material procurement process should be executed properly by improving the procurement process in order to avoid supply delays. 5) Effective and efficient technical performances in project construction should be developed through different types of training programmes. The training should cover project planning, scheduling, time and cost control, and the information systems. 6) There should be an adequate contingency allowance in order to cover any increase in material cost due to inflation. 7) Employers or owners of projects should allow more time and funds for the study phases of projects. 8) Contractors should regularly try to identify and to bring to the attention of the client project risks such as an unclear scope in the early stages (tender clarification meetings) of a project. 9) Project managers must agree that delays or impacts which cause extension of time and/or increase in cost are a frequent occurrence in project construction. 10) Regarding cost and time factors in project construction, if the employer intends to gain the most advantage from the programme (optimisation), the cost and time should be prepared jointly by the contractor and consultant and be accepted as the baseline programme.

Frimpong et al (2003) pointed out that appropriate funding levels should always be determined at the planning stage of the project so that regular payment should be paid to contractors for work done. In order to improve contractors’ managerial skills there is a need for continuous work-training programmes for personnel in the industry to update their knowledge and be familiar with project management techniques and processes, have effective and efficient performances (Frimpong et al, 2003). The authors further mentioned that effective and efficient material procurement systems should be established within projects. This is mainly because material procurement has the potential to cause major delays to construction projects. Therefore, the material procurement process should be executed properly by improving the procurement process in order to avoid supply delays. Additionally, Frimpong et al (2003) pointed out that developing effective and efficient technical performances in the groundwater
industry needs to be done through different types of training programmes. The training should cover project planning, scheduling, time and cost control, and the information systems (Frimpong et al, 2003).

4.2.7 Lessons learnt
It is clear that the construction industry in Ghana faces many problems which require attention. From the reviewed literature, Frimpong et al, (2003), Fugar and Agyakwah-Baah (2010) and Tamakloe (2011) indicated that there are a number of factors causing cost overruns in construction projects in Ghana. These included the following: project financing, economic and natural conditions, monthly payment difficulties from agencies, poor contract management, material procurement, poor technical performance, underestimation of the costs of projects, underestimation of the complexity of projects, difficulty in accessing bank credit, poor supervision, underestimation of time for completion of projects by contractors, shortage of materials, poor professional management, fluctuation of material prices and poor site management.

Furthermore literature revealed the following as the effects of cost overruns in construction projects in Ghana by Ansah (2011): suspended works by sub-contractors, conflicts among parties involved in the contract, companies closing down, time delays, arbitration or litigation.

Literature further revealed numerous measures that should be taken to mitigate cost overrun in Ghana by Tamakloe (2011) and Frimpong et al (2003). These measures included the following: determination of appropriate funding levels at the project planning stage so that regular payment should be paid to contractors for work done; continuous work-training programmes for personnel in the construction industry to improve contractors’ managerial skills; establishment of effective and efficient material procurement systems within projects; early procurement of material; developing effective and efficient technical performances in project construction through different types of training programmes; an adequate contingency allowance to cover for material inflation; and sufficient time and budget allowance by employers. In addition, contractors should regularly try to identify and to bring to the attention of the client project risks such as an unclear scope in the early stages (tender clarification meetings) of a project. Moreover, project managers must agree that delays or impacts which cause an extension of time and/or increase in cost are a frequent occurrence in project construction and regarding cost and time factors in project construction. Finally, if the
employer intends to gain the most advantage from the programme optimisation, the cost and
time should be prepared jointly by the contractor and consultant and be accepted as the baseline
programme.

4.2.8 Comparison between Nigeria and Ghana

Cost overrun is a chronic problem in both Nigeria and Ghana. Literature revealed the causes
of cost overrun that were common to Nigeria and Ghana as the following: escalation of material
prices, project financing, shortages of materials and inaccurate estimates. The results of the
study conducted by Ameh et al (2010), Mansfield et al (1994) and Kasimu (2012) were in
agreement with the results from the study conducted by Frimpong et al (2003), Tamakloe
(2011) and Fugar and Agyakwa-Baah (2010) which identified escalation of material prices as
the most significant cause of cost overruns in construction projects. Furthermore, Ameh et al
(2010) and Mansfield et al (1994) were in agreement with Fugar and Agyakwah-Baah (2010)
in identifying project financing as a major cost overrun factor. Literature further indicated the
results from the study conducted by Mansfield et al (1994) were in agreement with those of
Fugar and Agyakwah-Baah (2010) in identifying a shortage of material as the major cost
overrun factor. Moreover, Mansfield et al (1994) were in agreement with Fugar and Agyakwah-
Baah (2010) in identifying inaccurate estimates as a significant cost overrun factor.

The literature reviewed indicated the following as the causes of cost overruns in Nigeria by

- Inadequate planning,
- Contractors’ project inexperience,
- Incessant variation order,
- Project complexity,
- Shortening of contract period,
- Fraudulent practices and kickbacks,
- Lack of experience of contractors,
- High cost of material,
- Fluctuation in the prices of materials,
- Frequent design changes,
- Economic instability,
- High interest rates charged by banks on loans and mode of financing,
• Financing for completed works,
• Poor contract management,
• Shortages of materials,
• Inaccurate estimates,
• Market condition,
• Personal experience in contract works,
• Frequent changes in government and political power,
• Poor feasibility studies and design and
• Lack of technological capacity as well as an inability to detect failure warning signals on time.

From the reviewed literature, the studies conducted by Frimpong et al (2003), Fugar and Agyakwah-Baah (2010) and Tamakloe (2011) showed the following as the causes of cost overruns in Ghana:
• Monthly payment difficulties from agencies,
• Poor contract management,
• Material procurement,
• Poor technical performance,
• Escalation of material prices,
• Delay in honouring certificates,
• Underestimation of the costs of projects,
• Underestimation of the complexity of projects,
• Difficulty in accessing bank credit,
• Poor supervision,
• Underestimation of time for completion of projects by contractors,
• Shortage of materials
• Poor professional management,
• Fluctuation of prices of rising cost of materials,
• Poor site management and
• Material procurement.

Literature further showed that the effects of cost overruns common to both Nigeria and Ghana were time overrun, disputes, arbitration and litigation. The results of the study conducted by
Aibunu and Jagboro (2002) concur with the results of the study conducted by Ansah (2011) in identifying these three factors as the effects of cost overruns.

The reviewed literature revealed the effects of cost overruns in Nigeria as the following from the studies conducted by Ubani and Ononuju (2013) and Aibunu and Jagboro (2002):

- Inconsistency in agreement terms due to changes in political powers,
- Scope creep,
- Inflation of prices,
- Ineffective project design,
- Time overrun,
- Disputes,
- Arbitration,
- Litigation and
- Total abandonment.

The effects of cost overruns in Ghana were indicated as the following by Ansah (2011):

- Severe cash-flow problems to contractors leading to suspension of works,
- Companies having to close down,
- Devastating knock-on effect down the contractual payment chain,
- Exposing contractors to a greater risk of failing to complete construction projects on time, and sub-contractors refusing to continue works on the project,
- Slowing down the construction work at site until payment is received which creates a negative relationship between clients and contractors,
- Arbitration and
- Litigation as a disputes resolution mechanism which takes a long time.

The studies conducted by Amusan (2011), Frimpong et al (2003), Amusan (2011), Tamakloe (2011) and Ubani and Ononuju (2003) also indicated the important measures to improve cost performance that were common to Nigeria and Ghana as the following: adequate planning, effective and efficient material procurement and determination of appropriate funding levels at the project planning stage. The results from the study conducted by Amusan (2011) were in agreement with those of Frimpong et al (2003) in identifying adequate planning as a significant measure to improve cost performance in construction projects. Furthermore, the results from
the study conducted by Amusan (2011) were in agreement with results from the study conducted by Tamakloe (2011) and Frimpong et al (2003) in identifying effective and efficient material procurement as the important measure to improve cost performance. Moreover, the results of the study conducted by Ubani and Ononuju (2003) were in agreement with those of Tamakloe (2011) in identifying the determination of appropriate funding levels at the project planning stage as the important mitigation measure.

The studies conducted by Amusan (2011), Ubani and ononuju (2013), Kasimu (2012) and Ubani et al (2013) showed the following mitigation measures to improve cost performance in Nigeria:

- Adequate planning, for example, breaking of project planning into short term achievable goals, medium term planning and long term planning;
- Studying of project history for possible application on other similar projects;
- Bulk purchase of material;
- Proper design of the project during design stage so as to avoid undue on-project variation;
- Establishing fraud detecting system or system of individual accountability to discourage pilfering, stealing and other related vices;
- Appropriate legislation for the continuity of on-going civil engineering projects at the original site irrespective of who is concerned when power changes hands from one political party or person to another;
- Honouring of payment certificates as and when due so as to enhance contractors’ cash flow and ensure regular progress of the work with little or no delay;
- Reappraising capital investment periodically to determine whether the project should be continued, or terminated or divested;
- Provision of adequate fund by the client based on the proper feasibility studies and capacity assessment for the execution of the project will help to ameliorate the problems. These include the determination and evaluation of manpower, technical and professional capacities prior of project implementation; The contractors being aware of the material fluctuation, so that they can prepare the time schedule for the material delivery process to the site in order to avoid shortage or fluctuation problems;
- The contractors preparing a method statement for each project, taking into consideration both reality and project type;
- The consultants avoiding centralisation of decisions, especially those related to consultant work, because this may lead to project delay;
- The government being advised to compensate the contractors for any loss that results from the political situation,
- Contractors being aware of the construction materials to use, so they are advised to purchase right quantity and quality of construction materials at the right time;
- The necessary adoption of principles of material requirements planning to avoid shortages or surplus of materials and
- The stakeholders in construction project desisting from cutting corners in relation to money meant for settling host communities before the start of work.

Studies conducted by Tamakloe (2011) and Frimpong et al (2003) in Ghana showed the following as the mitigation measures to improve cost performance:
- Appropriate funding;
- Continuous work-training programmes to improve contractors’ managerial skills;
- Establishing effective and efficient material procurement systems within projects;
- Developing effective and efficient technical performances;
- Adequate contingency allowance in order to cover increase in material cost due to inflation;
- Employers or owners of projects allowing more time and funds for the study phases of projects;
- Contractors regularly identifying and bringing to the attention of the client project risks such as an unclear scope in the early stages (tender clarification meetings) of a project;
- Project managers agreeing that delays or impacts which cause extension of time and/or increase in cost are a frequent occurrence in project construction;
- Regarding cost and time factors in project construction, if the employer intends to gain the most advantage from the programme (optimisation), the cost and time being prepared jointly by the contractor and consultant and being accepted as the baseline programme;
- Effective and efficient performances;
- Establishing effective and efficient material procurement systems should be established within projects,
• Material procurement process being executed properly by improving the procurement process in order to avoid supply delays and
• Developing effective and efficient technical performances, training on project planning, scheduling, time and cost control, and the information systems.

4.3 CONCLUSION
The literature reviewed in this chapter indicated that construction is the most important sector for Nigeria and Ghana. However, both Nigerian and Ghanaian projects were completed with significant time and cost overruns. The next chapter will discuss cost overruns in South Africa.
CHAPTER FIVE

SOUTH AFRICA EXPERIENCE – COST OVERRUNS IN SOUTH AFRICA

INTRODUCTION
This chapter provides a theoretical review on the cost overruns in South Africa. This section further reviews the construction industry performance in South Africa, and the causes and effects of cost overruns in South Africa. Finally, it suggests mitigation measures to improve construction performance in South Africa.

5.1 BACKGROUND ON SOUTH AFRICA
According to the South African Construction Industry Status Report, 2004, the construction industry accounts for more than 10 per cent of the world’s economy (CIDB, 2004). CIDB, (2004) states that construction provides the physical infrastructure and backbone for economic activity. It is also a large-scale provider of employment. The legacy of apartheid has, however, left the South African construction industry with a number of development and transformation challenges. These include the following:

- Improving effectiveness of public sector spending on physical infrastructure development and maintenance;
- Improving labour absorption, labour relations and job stability;
- Accelerating sustainable transformation through access to opportunity, finance and training;
- Reducing the impact of HIV and AIDS in construction and
- Ensuring international competitiveness.

South Africa has a mainly urban-based population of 49.6 million and covers an area of 1.22 million square kilometres. It has a population of diverse origins, cultures and languages. The major languages include Afrikaans, English, Sesotho, Xhosa and Zulu. The executive capital of South Africa is Tshwane, also known as Pretoria and the legislative capital is Cape Town. Since the end of apartheid in 1994, South Africa experienced sustained economic growth for 16 consecutive years, entering in a recession in 2009 as a result of the global economic crisis (Global Exchange, 2011).
It is Africa’s largest and most advanced economy, with abundant natural resources and well-developed financial, legal, energy, and transport sectors. South Africa leads the continent in industrial output and mineral production. Diamonds were discovered in Kimberley in Northern Cape in the 1870s, while gold was found later in the Witwatersrand (Johannesburg) in 1886. By the start of the 20th century, Johannesburg had grown from a small rural settlement into a town boasting more than 100,000 inhabitants (Global Exchange, 2011). South Africa boasts the vast open spaces of the *platteland*, long mountain ranges, and a spider web of roads, railway lines, and air routes. Some of the rivers flow into developed ports and harbours, cutting across land routes which link the cities, towns, villages, and farming areas. Impressive bridges span the most treacherous of these rivers (Public Works White Paper, 1997).

![Figure 5.1: Map of South Africa](source: Infoplease.com (2008))

### 5.2 CONSTRUCTION INDUSTRY PERFORMANCE IN SOUTH AFRICA

The construction industry, which comprises both the building (residential and non-residential) and civil engineering sectors, plays an indispensable role in the South African economy. It provides the physical infrastructure which is fundamental to the country’s development and its activities affect the lives of all South Africans. Construction contributes about 35 per cent to gross domestic fixed investment (GDFI) and current projections of future infrastructure requirements indicate that its contribution to GDFI could double within five to ten years (Public Works White Paper, 1997).
According to the CIDB (2011), the public sector accounts for around 80 per cent of all civil works and around 20 per cent of residential and non-residential building works. Value and quality are particularly important to public sector clients. Furthermore, the public sector also has a role and responsibility towards the development and the transformation of the building and construction industry. This transformation, however, must be achieved within acceptable value and quality norms.

A large and growing percentage of infrastructure development is taking place within disadvantaged communities. Thus construction industry offers significant job and business opportunities to those formerly marginalised from economic activity. Furthermore, the sector employs more than 400 000 people, and can play a meaningful role in addressing the current unemployment crisis (Public Works White Paper, 1997). According to Baloyi and Bekker (2010), the period 1999 to 2003 produced the country’s best economic performance since the advent of democracy ten years ago. For a few years South Africa enjoyed a higher growth rate than the global average and the rate of expansion outpaced many parts of the world. The Rand strengthened and the country enjoyed high interest rates and the lowest level of inflation rate in 45 years.

The country's economic recovery has, however, not yet yielded the necessary employment growth to match the growth in population and work seekers. As a prime indicator of economic activity, the construction industry is often utilised by governments, not only to stimulate growth, but also to assist economic recoveries from recessions. Given the large capital amounts associated with construction projects, the performance in terms of cost and time are closely monitored, especially where taxpayers’ money is involved (Baloyi and Bekker, 2010).

The construction sector adds significant value to our country and its people. Stakeholders in the construction industry include employees, their families, unions representing them, the government as regulators and custodians of the tax income for the country, investors, suppliers and customers. The monetary benefit received by each of these stakeholders is often summarised by companies in their value added statements (PricewaterhouseCoopers, 2013). The South African construction industry was particularly hard hit when the infrastructure development highs leading up to the 2010 FIFA World Cup were followed by a global recession. Even though South Africa completed numerous large construction projects over the
years, the awarding of the FIFA Soccer World Cup in 2010 drew the attention to South Africa’s ability to deliver large construction projects within time and budget (Baloyi and Bekker, 2010).

Many projects are facing extensive delays and subsequently exceed initial cost and time estimates. Olatunji (2010) conducted a study on the causes of delays in project delivery in South Africa in the metropolitan cities of five provinces. The provinces are Eastern Cape, Free State, Gauteng, KwaZulu-Natal, and Western Cape while the corresponding metropolitan cities are Port Elizabeth, Bloemfontein, Johannesburg, Durban and Cape Town. The findings revealed that the factors which negatively influence project delivery time in South Africa were a lack of adequate planning, management style, the lack of reviews of designs, inadequate motivation of workers, economic policies, a lack of prompt payment to contractors, and the quality of management during design and construction.

The construction industry has not only been punished for its lacklustre financial performance in the down cycle, but also because of the public perception following the Competition Commission process, findings and settlement (PricewaterhouseCoopers, 2013). Public-sector infrastructure spending is normally a good indicator of the industry’s performance. After remaining flat from 2009 to 2011, capital expenditure by public-sector institutions has increased by 11.7 per cent since 2011, with total expenditure in 2012 amounting to R202 billion. The new construction work only increased by 3.5 per cent to R137 billion, while plant, machinery and equipment purchased increased by 55 per cent to R38 billion. The 2011 increase from 2010 was 16.1 per cent. The increase in new construction over the last three years has been real (PricewaterhouseCoopers, 2013).

5.3 COST OVERRUNS IN SOUTH AFRICA
Cost overruns in large infrastructure projects occur frequently in South Africa (Infrastrucure.ws, 2014). Cost overruns of close to R30bn at two of the government’s infrastructure projects (Transnet and Eskom) raise questions about its ability to undertake new projects and the level of oversight over the organisations managing the projects (BdLive, 2013).

According to Ramabodu and Vester (2013), South Africa has some significant projects that have experienced noteworthy cost overruns. Among these are Soccer City Stadium in Johannesburg with a 174 per cent cost overrun, Green Point Stadium in Cape Town with a 483 per cent cost overrun and Moses Mabhida Stadium in Durban with an overrun of 267 per cent.
Global Labour Column (2013) indicated that the initial cost estimate was calculated at R2.3 billion and was to be paid by the South African government, largely to fund the stadiums and related infrastructure. However, the 2010 estimated total cost (and this is likely to be much higher) for the South African government was R39.3 billion, an enormous 1709 per cent increase from the original estimate. The stadium costs increased from the initial estimate of R1.5 billion to the latest cost estimate of over R17.4 billion representing a 1008 per cent increase (Global Labour Column, 2011).

Industry experts estimate that the full cost for Medupe project, including interest during construction, will exceed R130bn and an overall delay of 48 months. That is an effective cost overrun of R77.1 billion (Infrastructure.ws, 2014). According to BdLive (2013), cost overruns for the first phase of Transnet’s new multi-product pipeline (NMPP) from Durban to Johannesburg have pushed up the capital cost 146 per cent to R23.4bn from R9.5bn at the start of the project six years ago. The cost of Eskom’s Ingula pumped storage scheme electricity project, near Van Reenen’s Pass in the Drakensberg, has risen to R23.8bn from estimates of R8.9bn six years ago (BDLive, 2013). The Competition Commission recently identified 300 collusion cases in projects worth R47 billion in the construction sector between 2000 and 2010 (Infrastructure.ws, 2014).

5.4 CAUSES OF COST OVERRUNS IN CONSTRUCTION PROJECTS IN SOUTH AFRICA
This section aims to understand the main causes of cost overrun in construction projects in South Africa. It presents some results of studies in different FIFA 2010 World Cup stadiums and a study in South African public sector mega-projects. South Africa presented its report on the massive cost overruns in relation to the 2010 FIFA World Cup stadiums which it, at the time, was suspected of bid-rigging (Global Labour Column, 2011). According to Global Labour Column (2011), five major construction companies in South Africa, namely Aveng, Murray and Roberts, Group Five, Wilson Bayly Holmes–Ovcon (WBHO) and Basil Read were principal contractors in the building of the main stadiums for the 2010 FIFA World Cup and various related infrastructure projects, from which they have made substantial profits. In 2007 they were all under investigation by the Competition Commission of South Africa for suspected collusion and anti-competitive practices with regard to these projects.
The first study was done on 10 stadiums in different parts of South Africa, and Table 5.1 below shows the budgeted cost versus indicated final cost:

<table>
<thead>
<tr>
<th>Stadium</th>
<th>Initial budgeted cost</th>
<th>Indicated final cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soccer City – Johannesburg</td>
<td>R 2.2 billion</td>
<td>R 3.7 billion</td>
</tr>
<tr>
<td>Ellis Park – Johannesburg</td>
<td>R 240 million</td>
<td>R 253 million</td>
</tr>
<tr>
<td>Moses Mabida – Durban</td>
<td>R 1.6 billion</td>
<td>R 3.1 billion</td>
</tr>
<tr>
<td>Mbombela – Nelspruit</td>
<td>R 600 million</td>
<td>R 1 billion</td>
</tr>
<tr>
<td>Green point – Cape Town</td>
<td>R 2.9 billion</td>
<td>R 4 billion</td>
</tr>
<tr>
<td>Nelson Mandela Bay – Port Elizabeth</td>
<td>R 2.1 billion</td>
<td>Not known</td>
</tr>
<tr>
<td>Peter Mokaba – Polokwane</td>
<td>R 1.3 billion</td>
<td>Not known</td>
</tr>
<tr>
<td>Royal Bafokeng – Rastenburg</td>
<td>R 360 million</td>
<td>R 483 million</td>
</tr>
<tr>
<td>Mangaung – Bloemfontein</td>
<td>R 245 million</td>
<td>R 359 million</td>
</tr>
<tr>
<td>Loftus Versfeld – Pretoria</td>
<td>R 122 million</td>
<td>R 131 million</td>
</tr>
</tbody>
</table>

Source: Baloyi and Bekker (2011)

FIFA World 2010 Soccer World Cup turned the world’s attention to South Africa’s ability to successfully complete major construction projects. With global construction projects generally late and over budget, Baloyi and Bekker (2011) investigated the factors causing cost overruns and time delay on these projects.

The factors were categorised into three categories, namely external factor-related, client-related and contractor-related. The most significant factor causing cost overrun for the FIFA World Cup stadia was material cost and price fluctuations which was ranked first, followed by inaccurate material estimates, shortage of skilled labour, the client’s late contract award, project complexity, the increase in labour cost, inaccurate quantity take-off, the difference between the selected bid and the consultants’ estimate, change orders by the client during construction and a shortage of manpower.
Table 5.2 below shows the factors causing cost overruns, their ranking and categories regarding the 2010 FIFA World Cup stadia.

**Table 5.2: Cost overrun factors**

<table>
<thead>
<tr>
<th>Cost Overrun factor</th>
<th>Rank</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase in material cost</td>
<td>1</td>
<td>External</td>
</tr>
<tr>
<td>Inaccurate material estimates</td>
<td>2</td>
<td>Client</td>
</tr>
<tr>
<td>Shortage of skilled labour</td>
<td>3</td>
<td>Contractor</td>
</tr>
<tr>
<td>Client’s late contract award</td>
<td>4</td>
<td>Client</td>
</tr>
<tr>
<td>Project complexity</td>
<td>5</td>
<td>External</td>
</tr>
<tr>
<td>Increase in labour cost</td>
<td>6</td>
<td>External</td>
</tr>
<tr>
<td>Inaccurate quantity take-off</td>
<td>7</td>
<td>Client</td>
</tr>
<tr>
<td>Difference between selected bid and the consultants’ estimate</td>
<td>8</td>
<td>Client</td>
</tr>
<tr>
<td>Change orders by client during construction</td>
<td>9</td>
<td>Client</td>
</tr>
<tr>
<td>Shortage of manpower</td>
<td>9</td>
<td>External</td>
</tr>
</tbody>
</table>

Source: Baloyi and Bekker (2011)

Another study was done by Ramabodu and Vester (2013) on the factors that influence cost overruns in public sector mega-projects. Their findings which were crucial were identified as follows: a change in the scope of work on site, incomplete design on the tender stage, contractual claim (extension of time with cost), the lack of cost plan and monitoring of funds, delays in costing variation orders, and changes in the scope. The moderately important factors were identified as follows: variation orders, the completeness of design and specifications, provisional bills of quantities and unexpected site conditions. Less important factors were ranked in the following order: clarity of drawings and documents, omission and error in bills of quantities, front end loading of rates, the revision of drawings and adjustments of prime costs and provisional sums.

Olapado (2007) stated that changes in specifications and scope, initiated mostly by project owners and their consultants, are the most prevalent sources of variation. This is mainly from
changes in owners’ income/financial ability, changes in owners’ interests/requirements, design errors and insufficient time for the preparation of contract documents (Olapado, 2007).

It is therefore necessary to identify factors that may influence construction costs and schedule overruns at the start of the project in order to ensure a decrease in cost overruns and to improve the cost performance (Ramabodu and Vester, 2013).

The CIDB (2011) report indicated that the major contributors to poor quality of construction which leads to cost overruns in South Africa are likely to be procurement-related barriers. Such procurement related barriers include the following:

- Fraud and corruption, or ‘political interference’ (including cronyism and nepotism);
- The procurement and delivery model (such as the ‘design by employer’ model);
- The use of procurement systems based on price and preference only, and not taking into account functionality (or quality); and/or,
- Insufficient information to be able to select professional services and/or contractors based on quality criteria.

Mukuka, Aigbavboa and Thwala (2014) conducted a study on construction experts’ perceptions of the causes and effects of cost overruns in Johannesburg. They concluded their study by identifying the following as the top ten causes of cost overruns in Johannesburg: contractors’ project inexperience, poor project management, inadequate planning, contractors’ inefficiency, inadequate financial provision, a shortage of skilled site workers, poor workmanship, inaccurate estimates, project complexity and site conflicts.

Nkobane (2012) conducted an investigation into the causes of delay and cost overruns in engineering, procurement, construction and management projects in South Africa. He identified thirty-nine possible causes of cost overruns which included the following: increment of material prices due to economic and political conditions, delay in construction, supply of raw material and equipment by contractors, fluctuations in the cost of building materials, project materials monopoly by some suppliers, unsettingtlement/fluctuation of the local currency in relation to dollar value, unpredictable weather conditions, delays in decision making by government, failure of specific coordinating, wrong/inappropriate choice of site, labour unrest, absence of managerial programmes that help in saving materials inside the site, bad allocation
of workers inside the site, design changes, additional work at owners’ request, change of scope or additional scope added late in the project execution phase, improvements to standard drawings during construction stage, omissions and errors in the bills of quantities, inaccurate quantity take-off, inadequate review of drawings and contract documents, a lack of coordination with engineering teams at the design phase, incomplete design at the time of tender, improvements to standard drawings during the construction stage, a lack of experience of local regulations, delay in construction, supply of raw materials and equipment by contractors, low commitment of donor to compensate any bad result that may come from the bad economic and political situation, donor policy in biding tender to the lowest priced one, resources constraint: funds and associated auxiliaries not ready, some tendering manoeuvres by contractors such as front-loading of rates, lack of cost planning/monitoring during pre- and post-contract stages, contractual claims such as extension of schedule with cost claims, lack of cost reports during construction stage, delays in issuing information to the contractor during construction stage, contractual claims such as extension of time with cost claims, delays in costing variations and additional works, inadequate project preparation, planning and implementation, a change in the scope of the project in government policies, delay in the preliminary handing over of the project and overtime work hours of supervising engineer paid by the contractor.

Nkobane (2012) concluded that the top nine factors influencing cost overruns were the following:

- Design changes,
- Contractual claims, such as extension of schedule with cost claims,
- Change of scope or additional scope added late in the project execution phase,
- Contractual claims, such as extension of time with cost claims,
- Additional work at owners’ request,
- Unsettlement/Fluctuation of the local currency in relation to dollar value,
- Donor policy in bidding tender to the lowest priced one,
- Fluctuations in the cost of building materials and
- Incomplete design at the time of tender.

Adugna (2015) conducted another study of the causes of delay and cost overruns in office construction projects in the eThekwini Municipal Area. Nine variables for cost overruns were
identified as follows: delays caused by the owner and his/her agent, design change, acceleration, quantity underestimation, price escalation, change in legislation, corruption, wastage and a lack of quality. The findings identified design change, quantity underestimation and price escalation as the most critical factors for cost overruns.

Monyane (2013) also conducted a study to identify the causes of cost overruns and effective cost control measures of public projects in the Free State Province. The various factors were identified and categorised by three phases, namely the design phase, construction phase and completion phase. The findings from the study presented the following: from the design stage respondents rated inadequate planning as the most frequent cause of cost overrun, followed by the incomplete design at the time of tender. At the construction stage additional work at the owners’ request was rated as the most frequent cause of cost overrun, which was followed by contractors’ unstable financial background. At the completion stage the most significant cause of cost overrun was late contract instruction after practical completion, which was followed by poor workmanship by the contractor.

A study conducted by Gaetsewe, Monyane and Emuze (2015) indicated the following as the major causes of cost overruns in Northern Cape public projects:

- Poor planning during the design stages as this results in an unclear scope of work, vague design brief, insufficient time for the design co-ordination, a change in the scope of works, variation orders and the fast tracking of projects;
- Late design information;
- Time overruns caused by rework due to poor workmanship, extension of time claims, loss and expense claims from the contractor and an increase in the consultation fees;
- Material escalation due to time overruns and inflation which tend to increase the contract price claims, especially where an extension of time is approved;
- Clients’ choices in appointing incapable contractors and consultants;
- Contractors’ and consultants’ lack of experience in the project in which they are appointed, as well as the lack of capacity, both human resource and finance and
- Corrupt practices by government officials during the procurement of consultants and contractors as well as a lack of client knowledge which may also be a contributing factor to the appointment of incapable consultants and contractors.
5.5 EFFECTS OF COST OVERRUNS IN CONSTRUCTION PROJECTS IN SOUTH AFRICA

Project cost overruns may reflect an inadequate original budget, a lack of adequate cost control, project delays or unforeseen extraneous factors (Treasury, 2012). For instance, the original date for production by Medupi’s first unit was January 2010; then it was changed to January 2014. Due to all the delay, Eskom lost more than four years of revenue. This loss of R43 billion in revenue could have been used to offset electricity price increases (Infrastructure.ws, 2014).

Mbahu and Nkado (2004) conducted a study of reducing building construction cost in South Africa. The authors stated that the cost overruns have the following obvious negative implications for the key stakeholders in particular, and the industry in general: 1) To the client, cost overrun implies added costs over and above those initially agreed upon at the onset, resulting in less returns on investment. 2) To the end-user, the added costs are passed on as higher rental/lease costs or prices. 3) To the professionals, cost overrun implies an inability to deliver value-for-money and could well tarnish their reputations and result in the loss of confidence in them by clients. 4) To the contractor, it implies a loss of profit through penalties for non-completion, and negative word-of-mouth that could jeopardise his/her chances of winning further jobs, if at fault. 5) To the industry as a whole, cost overruns could bring about project abandonment and a drop in building activities, a bad reputation, and an inability to secure project finance or securing it at higher costs due to added risks.

Gaetsewe et al (2015) also indicated the following as the major effects of cost overruns in Northern Cape public projects: 1) Abandonment of the site by contractors due to cash flow problems; 2) Non-payment by the client leading to legal fees in the form of litigation once the contractor has abandoned the site; 3) Audit queries, particularly in the case where there are legal implications; 4) Contractor bankruptcy which leads to the loss of work, especially among the people in the host communities and 5) The public’s negative perception of all the companies and individuals that are working on a particular project as well as a negative perception of the construction industry.

Another study conducted by Mukuka et al (2014) on the effects of cost overruns in Johannesburg revealed the following as the most significant factors: increased project cost due to extension of time, projects’ abandonment, company/firms liability to insolvency, tying down clients’ capital, under-utilisation of manpower resources, liability of companies or firms to bad debt and under-utilisation of plant and equipment purchased for the projects.
5.6 MITIGATION MEASURES TO IMPROVE COST PERFORMANCE IN SOUTH AFRICA

Nkobane (2012) stated the following as mitigation measures for cost overruns: 1) Clearly defined project scope must be established at the beginning of the project. 2) The front-end engineering and design or front-end loading must be executed according to industry guidelines. 3) Project scheduling must be done in conjunction with the input from the trade contractors, construction contractors and the owner/client and 4) capital cost estimation and project cost estimations for project control must be implemented with guidance of the basic engineering together with input from trade contractors and construction contractors.

Garbharran, Govender and Msani (2012) also stated that the needs of stakeholders have to be managed and influenced in a manner that ensures project success. It is essential that a competent project manager be appointed. Such an individual should possess both technical skills, which include being a subject matter expert and having an in-depth knowledge of structures, and ‘soft’ skills, which include team management, emotional intelligence, transformational leadership and conflict management. The authors also indicated that unexpected developments during the course of the project must be carefully managed in terms of resource planning, by ensuring that there is adequate funding throughout the project. They further suggested that a financial plan, which takes into account the project activity schedule, needs to be developed. Furthermore, there must be proper emphasis on past experience in appointing consultants and contractors. In addition, project members should be encouraged to document tacit knowledge gained from the project in order to prevent mistakes in subsequent projects.

Top management support, commitment to the project, clear objectives and scope, and political support are important objectives for success of the project (Garbharran et al, 2012). Garbharran et al (2012) emphasised that optimal performance by team members is important and having clear objectives and scope is key in providing direction to team members. Communication plays an important role in leading, integrating people, and taking decisions to make a project a success. There must be shared project vision, where the project manager identifies the interests of all relevant stakeholders and ensures that there is buy-in to the project (Garbharran et al, 2012). The authors also pointed out that progress on activities assigned to individuals or groups needs to be monitored with a view to achieving overall goals.
According to Ramabodu and Vester (2013), client involvement is very important and clients (employers) must recognise the importance of their influence on the effectiveness of cost planning and cost control. The authors also mentioned that the design team cannot budget for items that are not yet mentioned by the client and that are added to the project during the construction phase. Furthermore, the budget must be updated when external influences such as additions and variations are implemented by the employer/client and should then not be regarded as cost overruns (Ramabodu and Vester, 2013). It is necessary to identify the factors that may influence cost overruns and deal with them at the start of each project. This will decrease the occurrence of cost overruns (Ramabodu and Vester, 2013). Additionally, the authors stated that it is important to understand the conditions that result in design errors in order to reduce their occurrence in projects. Moreover, understanding and managing the factors that may cause cost overruns may enable the developer/client to control cost and reduce overruns in projects. Since design changes may be a result of insufficient planning, a further study should be done to determine the appropriate time scale during which designs and other tender documents should be produced. This will help to improve the quality of tender documents and reduce the number of changes during the construction stage (Ramabodu and Vester, 2013).

According to Adugna (2015), in order to minimise the incidences of delay and cost overrun in office construction projects, construction managers should bear the following in mind:

- Pay serious attention to the feasibility study and make sure that it is done carefully;
- Monitor risk and respond events that occur over the course of project by updating risk management plans with new information;
- Specify project objectives and strategies, including delineation of scope, budget and schedule;
- Set performance requirements for selecting project participants such as competent consultants and well performing and reliable contractors;
- Maximise the resource efficiency through the procurement of labour, materials and equipment;
- Implement various operations through proper coordination and control of planning, design, estimating, contracting and construction in the entire process;
- Develop effective mechanisms and communications for resolving conflicts that cannot be avoided;
- Use modern management systems and up to date technology such as 3D CAD and BIM (Building Information Modelling);
- Ensure all payments are made timeously and
- Make sure that sufficient contingency is available on the owner’s side to spend on acceleration costs in the event of any delay.

Monyane (2013) also identified the remedies for cost overruns and they were also categorised in three stages, namely the design phase, construction phase and completion phase. The findings from the study presented the following: From the design stage, completed designs was indicated as the most significant remedy for cost overruns, followed by adequate project preparation and planning. At the construction phase, controlled owner’s request was ranked first, followed by minimum changes in owner’s brief. At the completion phase, good workmanship was ranked first, followed by timely resolving of disputes.

5.7 LESSONS LEARNT
The South African construction industry is arguably the most advanced in sub-Saharan Africa. Therefore, cost overruns in large infrastructure projects occur frequently in South Africa. Performance-related issues such as cost overruns need to be evaluated and addressed so that spending on projects may be properly used for the good of the country. The literature reviewed revealed the following as the common causes of cost overruns in South Africa, from the studies conducted by Baloyi and Bekker (2011), Ramabodu and Vester (2013), Olapado (2007) and Nkobane (2012): difference between selected bid and the consultants’ estimate, change orders by client, the lack of a cost plan, the monitoring of funds, variation orders, and changes in specifications and scope.

Literature further indicated a number of effects overrun from the study conducted by Mbahu and Nkado (2004), as the following: fewer returns on investment to the client; added costs passed on as higher rental/lease costs or prices to the end-user; for professionals, the inability to deliver value-for-money and could well tarnish their reputations and result in the loss of confidence reposed in them by clients; loss of profit through penalties for non-completion to the contractors; negative word-of-mouth that could jeopardize his/her chances of winning further jobs; project abandonment; a drop in building activities; a bad reputation, and the inability to secure project finance or securing it at higher costs due to added risks.
Moreover, literature showed the following as the most highly ranked measures to mitigate cost overrun by Nkobane (2012), Garbharran et al (2012), Ramabodu and Vester, (2013) and Monyane, (2013): a clear definition of scope from the beginning of the project; proper project scheduling; appointment of a competent project manager; adequate funding throughout the project, and the effectiveness of cost planning and cost control.

5.8 COMPARISON BETWEEN SOUTH AFRICA AND INTERNATIONAL COUNTRIES

The construction industry plays an indispensable role in both the economy of South African and those of international countries. Construction projects in South Africa and international countries go beyond the budgeted amount, therefore cost overrun is a global phenomenon. From the reviewed literature there were a number of factors causing cost overruns which were common to both South Africa and international countries identified by Tat-fai (1999), Kadir et al (2005), Lo et al (2006), Ali and Kamaruzzaman (2010), Memon et al (2010), Baloyi and Bekker (2011), Nkobane (2012), Ramabodu and Vester (2013) and Mukuka et al (2014), these were the following: inaccurate material estimate; inaccurate financial provision; inaccurate or poor estimation of original cost; change in scope of work on site; contractor’s project inexperience; poor project management; design changes and inadequate planning or improper planning.

From the reviewed literature, the findings revealed a number of causes of cost overruns in South Africa. The top five causes of cost overrun from the study conducted by Baloyi and Bekker (2011) were as follows:

- Increase in material cost,
- Inaccurate material estimates,
- Shortage of skilled labour,
- Client’s late contract award and
- Project complexity.

Another study conducted by Ramabodu and Vester (2013) revealed the top five causes of cost overruns as follows:

- Change in scope of work on site,
- Incomplete design on tender stage,
- Contractual claim (extension of time with cost),
- Lack of cost plan and monitoring of funds and
- Delays in costing variation orders.

According to a study conducted by Mukuka et al (2014), the following were identified as the top five causes of cost overrun in South Africa:
- Contractors’ project inexperience,
- Poor project management,
- Contractors’ inefficiency,
- Inadequate financial provision and
- Shortage of skilled site workers.

A study conducted by Nkobane (2012) indicated the following as the top five causes of cost overruns:
- Design changes,
- Contractual claims, such as extension of schedule with cost claims,
- Change of scope or additional scope added late in the project execution phase,
- Contractual claims, such as extension of time with cost claims and
- Additional work at the owner’s request.

Lastly, Monyane (2014) identified the following as the top five causes of cost overruns in public sector projects:
- Inadequate planning,
- Incomplete design at time of tender,
- Additional work at owners’ request; Unstable financial background of contractors and
- Late contract instruction after practical completion.

However, a study conducted by Kadir et al (2005) on the causes of cost overrun in Malaysia revealed the following as the top five factors:
- Material shortage at project site,
- Non-payment (financial problem) to suppliers causing a shortage of material delivery to site,
- Change order by consultants,
• Late issuance of construction drawing by consultants and
• Incapability of contractors’ site management to organise activities.

Another study by Memon et al (2012) identified the top five causes of cost overruns in Malaysia as the following:
• Fluctuation in the prices of material,
• Cash flow and financial difficulties faced by contractors,
• Poor site management and supervision,
• Lack of experience of contractors and
• Schedule delay.

Memon et al (2010) had previously identified the following as the top five causes of overruns in Malaysia:
• Cash flow and financial difficulties faced by contractors,
• Contractors’ poor site management and supervision,
• Inadequate contractor experience,
• Shortage of site workers and
• Incorrect planning and scheduling by contractors.

A study conducted by Tat-fai (1999) revealed the following as the top five causes of cost overruns in Hong Kong:
• Design changes,
• Scope changes,
• Financial claims,
• Poor clients’ project management and
• Unforeseen site conditions.

Ali and Kamaruzzaman (2010) revealed the top five causes of cost overruns in Hong Kong as the following:
• Inaccurate/poor estimation of original cost,
• Construction cost underestimation,
• Improper planning,
• Poor project management and
• Lack of experience.

Lo et al (2006) revealed the following as the causes of cost overruns in Hong Kong:
• Exceptionally low bid,
• Inadequate resources due to contractor/lack of capital,
• Inexperienced contractors,
• Poor site management and supervision by consultants and
• Unforeseen ground conditions.

Ali and Kamaruzzaman (2010) were in agreement with Baloyi and Bekker (2011) and Mukuka et al., (2014 who identified inaccurate/poor cost estimation as a significant factor of cost overruns in both South Africa and Hong Kong. Ramabodu and Vester (2013), Nkobane (2012), Tat-fai (1999) and Kadir et al (2006) also identified scope changes as an important factor contributing to cost overruns in South Africa, Malaysia and Hong Kong. Nkobane (2012) and Tat-fai (1999) further identified design changes as an important factor of cost overruns in South Africa and Hong Kong. Mukuka et al (2014), Memon et al (2012), Memon et al (2010), Ali and Kamaruzzaman (2010) and Lo et al (2006) were in agreement that a lack of experience by contractors was a significant factor of cost overruns in both South Africa and international countries. Both Mukuka et al (2014) and Ali and Kamaruzzaman (2010) identified poor project management as the most important factor contributing to cost overruns in both South Africa and Hong Kong. Lastly, Monyane (2014), Memon et al (2010) and Ali and Kamaruzzaman (2010) identified improper or inadequate planning as the most significant cause of cost overruns in both South Africa and international countries.

The studies also revealed a few common effects between South Africa and international countries such as a delay in the progress of the work and additional overheads and potential claims between the client and the contractor. Memon et al (2012) identified a delay in the procurement of resources due to late payments, time delays and major changes and rework in construction as the effects of cost overruns in construction projects in Malaysia. The findings by Owolabi et al (2014) and Memon et al (2012) were in agreement with those of Mbahe and Nkado (2004) where a delay in progress of the work and added costs were the major effects of cost overruns. However, Gaetsewe et al (2015) were not in agreement as they identified the major effects of cost overruns as the following: the abandonment of the site by contractors due
to cash flow problems; non-payment by the client leading to an abandoned site; audit queries, particularly in the case where there are legal implications, and contractor bankruptcy.

Literature from the studies conducted by Ali and Kamaruzzaman (2010), Memon et al (2010), Memon et al (2012), Nkobane (2012) and Ramabodu and Vester, (2013) further showed a number of common cost overrun mitigation measures. These included the following: 1) The establishment of a clearly defined scope at the beginning of the project where Nkobane (2012) was in agreement with Ali and Kamaruzzaman (2010) in identifying this factor as an important mitigation measure. 2) Improving the contract award procedure by giving less weight to prices and more weight to the capabilities and past performance of contractors. 3) A financial plan which takes into account the project activity schedule needs to be developed: here Memon et al (2010) were in agreement with Memon et al (2012) and 4) Proper cost control which was identified by both Ramabodu and Vester, (2013) and Ali and Kamaruzzaman (2010) as a significant mitigation measure.

5.9 COMPARISON BETWEEN SOUTH AFRICA AND AFRICAN COUNTRIES

The reviewed literature indicated that the construction industry is considered a leading driver of the economic development in a country (Dantata, 2007). However, the construction industry worldwide has many examples of projects that were completed with significant time and cost overruns. Literature showed a number of causes of cost overruns which were common to South Africa and the African countries. These factors included the following: increase in material cost, a change in the scope of work, a lack of cost plan and monitoring of funds, fraudulent practices, variation orders and political interference.

Amusani (2011) identified the top five causes of cost overruns as inadequate planning, contractors’ project inexperience, incessant variation orders and change in project designs. These results were in agreement with the study by Monyane (2013) where inadequate planning was ranked first. Furthermore, Ameh et al (2010) identified the following as the top five causes of cost overruns in Nigeria: a lack of experience of contractors, the cost of material, fluctuation in the prices of materials, frequent design changes, and economic instability. The results of the study by Ameh et al (2010) were also in agreement with the results from the study conducted by Mokuka et al (2014) where a lack of experience by contractors was ranked number one. However, the results from the study conducted by Mansfield et al (1994), Kasamu (2012) and Ubani and Ononuju (2013) identified financing of completed works, market condition and
frequent changes in government and political power as the first ranked causes of cost overruns. Therefore, these results were not in agreement with the results of the studies conducted by researchers in South Africa. The studies conducted in Ghana by Frimgpong et al (2003), Fugar and Agyakwah-Baah (2010), and Tamakloe (2011) revealed monthly payment difficulties from agencies and poor contract management as the most highly ranked causes of cost overruns. Therefore, these results were also not in agreement with the results from the studies conducted in South Africa. What does this imply?

In relation to the effects of cost overrun, the factors which were common between South Africa and African counties were time overrun, arbitration and total abandonment. The results from the study by Aibunu and Jagboro (2002) were in agreement with the results from the study by Mukuka et al (2014) where time overrun, arbitration and total abandonment were identified among the most significant effects of cost overruns. However, Ansah (2011) had a different view where suspension of works and companies being closed down were ranked the highest, which was not in agreement with the studies conducted in South Africa.

Literature also presented a few cost overrun mitigation measures which were common among South Africa and African countries. These were adequate planning where a study by Amusan (2011) was in agreement with a study by Monyane (2013); the proper design of the project during design stage so as to avoid undue on-project variation which was ranked first by Nkobane (2012) and Amusan (2011); and appropriate funding which was also identified as the most significant mitigation measure by Tamakloe (2011) and Nkobane (2012).

However, the results from the study by Ubani and Ononuju (2013) on mitigation measures in Nigeria were not in agreement with studies conducted by researchers in South Africa in identifying the following as mitigation measures:

- Appropriate legislation for the continuity of on-going civil engineering projects at the original site, irrespective of who is concerned when power changes hands from one political party or person to another;
- Honouring of payment certificates as and when due so as to enhance contractors’ cash flow and ensure regular progress of the work with little or no delay; and
- The regular appraisal of capital investment to determine whether the project should be continued, or terminated or divested.
The literature further revealed that the study conducted by Fringpong et al (2003) was not in agreement with studies conducted in South Africa in identifying effective and efficient performance as a highly ranked mitigation measures in Ghana. The results from the study by Kasimu (2012) also identified different factors form the studies conducted in South Africa.

The findings from their study revealed the following mitigation measures in Nigeria:

- The contractors should be aware of the material fluctuation, so that they can prepare a time schedule for material delivery process to the site in order to avoid shortage or fluctuation problems.
- The contractors should be advised to prepare a method statement for each project, taking into consideration both reality and project type.
- The consultants should avoid centralisation of decisions, especially those related to consultant work, because this may lead to project delay.
- The government should be advised to compensate the contractors for any loss that result from the political situation.

However, a study by Fringpong et al (2003) in Ghana was in agreement with that of Adugna (2015), identifying effective and efficient material procurement systems as a significant factor.

5.10 CONCLUSION

The literature reviewed in this chapter indicated that the construction industry plays an important role in the economy, and the activities of the industry are also vital to the achievement of national socio-economic development goals. Although cost overrun may seem inherent in most construction projects, it can be minimised or totally eliminated using a proper project performance monitoring and control system that will integrate all the key activities of each phase of the project. The next chapter will discuss the research methodology employed in this study.
CHAPTER SIX

RESEARCH METHODOLOGY

6 INTRODUCTION
The literature reviewed provided a detailed description as well as a theoretical framework for this study. This chapter presents the general description of the research methodology adopted to carry out this dissertation. The key topics discussed in this chapter are the geographical area where the study was conducted, the study design and population. The chapter further explains the method for data collection. Furthermore, the methods implemented to maintain validity and reliability of the instruments are described in order to carry out the evaluation of the causes and effects of cost overrun as well as the measures to be taken to minimise cost overrun and the critical success factor for Public Sector construction project in South Africa with specific reference to Gauteng Province will also be evaluated.

6.1 RESEARCH APPROACH AND DESIGN
In quantitative research the aim is to determine the relationship between one thing (an independent variable) and another (a dependent or outcome variable) in a population (Hopkins, 2008). However, Sagepub (2010) stated that quantitative research is explaining phenomena by collecting numerical data that are analysed using mathematically based methods in particular statistics. The research approach used in this study is descriptive in nature. A quantitative approach was used to gather realistic data and to study relationships between facts and how such facts and relationships relate to theories and past observed findings.

Kothari (2004) indicated that researchers also need to understand the assumptions underlying various techniques and they need to know the criteria by which they can decide that certain techniques and procedures will be applicable to certain problems and others will not. All this means that it is necessary for the researcher to design his methodology for his problem as the same may differ from problem to problem. Moreover, Rajasekar et al (2013) indicated that research methods help to collect samples, data and find a solution to a problem.

Research design guides the researcher in planning and implementing a study in a way that is most likely to achieve the intended goal (Burns and Grove, 1993:261). The descriptive approach was used in order to meet the objectives of this study, thus establishing the causes
and effects of cost overrun, measures to mitigate their impact and the critical success factors for public sector construction projects in Gauteng Province, South Africa. Therefore this dissertation adopted the quantitative research methodology to determine the causes and effects of cost overrun, measures to mitigate their impact and the critical success factors for public sector construction projects in Gauteng Province, South Africa.

6.2 RESEARCH AREA

This study was carried out in Gauteng, in South Africa, targeting constructions professionals who are currently or have been involved with government projects. The province was convenient for the researcher because many projects were being constructed at the time of the research. According to South Africa.info (2015), Gauteng, also known as "place of gold" in Sesotho, was built on the wealth of gold found deep underground – 40 per cent of the world's reserves. The economy has since diversified, with more sophisticated sectors such as finance and manufacturing setting up shop, and gold mining is no longer the mainstay. Occupying only 1.4 per cent of South Africa's land area, the tiny province of Gauteng contributes more than 33 per cent to the national economy and a phenomenal 10 per cent to the GDP of the entire African continent. The target population of this research were architects, contractors, project managers, construction project managers, construction managers, quantity surveyors and other professionals who worked on public sector construction projects in Gauteng Province in South Africa.

![Map of Gauteng](image)

Figure 6.1: Map of Gauteng South Africa
Source: Gauteng Carnival (2013)
6.3 TARGET POPULATION
According to Burns and Grove (1993:779), a population is defined as all elements (individuals, objects and events) that meet the sample criteria for inclusion in a study. The target population of this research were architects, contractors, project managers, construction project managers, construction managers, quantity surveyors and other professionals who worked on public sector construction projects in Gauteng Province in South Africa. This was a benchmark considered significant for the study in order to obtain a clear reflection of the causes and effects of cost overruns, measures to mitigate their impact and the critical success factors for public sector construction projects in Gauteng Province, South Africa.

6.4 SAMPLE
Polit and Hungler (1996:652) mentioned that sampling refers to the process of the selection of a portion of the population to represent the entire population in a study. There are a range of methods available for determining that the sample studied accurately represents the population to which the researcher wishes to generalise. The population can serve as a sample for a study (Johnson and Christensen, 2000:150). Since the cost of a study is partially dependent on the number of subjects sampled, it is important to determine the fewest number of subjects required to yield valid results (Ingham-Broomfield, 2008).

Professionals who are currently or have been involved with public sector projects in Gauteng, South Africa were included in this study. Their views would indicate the causes and effects of cost overruns as well as the measures to be taken to minimise cost overruns and the critical success factor for public sector construction projects in South Africa with specific reference to Gauteng Province. A random sampling method was adopted; hence all the participants had an equal chance of being selected.

6.5 DATA COLLECTION
Primary data can be collected either through experiment or through survey. If the researcher conducts an experiment, he or she observes some quantitative measurements, or the data, with the help of which he or she examines the truth contained in his or her hypothesis (Kumar, 2005). In the case of this survey, data was collected in two ways, namely through emails and hand delivery.
Questionnaires were emailed to the respondents with a request to return after completing the same. Other questionnaires were hand-delivered and collected from the respondents. Follow-up emails and calls were made to remind the respondents. A questionnaire is the most extensively used method in various economic and business surveys. Before applying this method, the questionnaire was prepared very carefully so that it would prove to be effective in collecting the relevant information. After the supervisor of the current study had approved the questionnaire, a list of potential respondents was created. The dates were indicated on the questionnaire schedule to indicate when they were sent out and received by the researcher. The data was collected over a period of seven months. However, it took twenty-five minutes for willing respondents to fill in a questionnaire. From the 120 questionnaires distributed to respondents, 119 participated in the main survey, which is equal to a 99 per cent response rate.

6.6 DATA COLLECTION INSTRUMENT
Data collection is a precise, systematic method of gathering information relevant to the research purpose, or of addressing research objectives, and research questions or hypotheses (Burns and Grove, 1993). According to Kumar (2005), data are categorised as secondary and primary data. Information gathered using secondary data is said to be collected from secondary sources, whereas the sources used in primary data are called primary sources. In this study a structured data collection approach was used to collect the data. This approach was selected because it allowed for the quantification of responses, and the statistical analysis thereof.

Data was collected by means of structured questionnaires and analysed using statistical survey to determine quantitative information obtained during research. This was followed by a report on data gathered. A questionnaire is a printed self-report form designed to elicit information that can be obtained through the written responses of the subject (Burns and Grove, 1993). Anonymity was maintained because each respondent was given his or her own questionnaire and the responses could not be linked to any particular person. Questionnaires were selected because they are easy to administer and analyse, they ensured a high response rate as they were distributed to respondents to complete and were either collected personally or emailed back to the researcher and they offered anonymity because respondents’ names were not required on the completed questionnaires.
There are two types of questionnaires which are used in research, namely the closed-ended and the open-ended questionnaires. Therefore, in this study, questionnaires consisted mostly of closed-ended questions and a few open-ended questions, as these provide more details. In the open-ended questions, the respondents were required to respond in writing, whereas closed-ended questions had options which were determined by the researcher (Burns and Grove, 1993). Open-ended questions were included because they allow respondents to respond to questions in their own words and provide more detail. Closed-ended questions were included because they are easier to administer and to analyse. The questionnaire was designed in English so that everyone could understand and was divided into six sections. Section A was aimed at gaining demographic data such as sex/gender, age, ethnicity, company, experience, level of education and the like. This information could assist the researcher when interpreting the results.

Section B was aimed at project characteristics, Section C was aimed at assessing causes of cost overruns, Section D was aimed at evaluating the effects of cost overruns, Section E was aimed at determining the measures that can be taken to minimise cost overruns and Section F was aimed at assessing critical success factors for a construction project. Instruction guidelines were indicated along with the questionnaires to guide the respondents as to how to tick the chosen responses.

From the 120 questionnaires distributed to respondents, 119 participated in the main survey, which equals a 99 per cent response rate, as indicated in Table 6.1 below. The data was collected by the researcher from August 2014 to March 2015.

<table>
<thead>
<tr>
<th>Survey responses</th>
<th>Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questionnaires sent out</td>
<td>120</td>
</tr>
<tr>
<td>Questionnaires received back</td>
<td>119</td>
</tr>
<tr>
<td>Usable questionnaires</td>
<td>119</td>
</tr>
<tr>
<td>Usable response rate (%)</td>
<td>99%</td>
</tr>
</tbody>
</table>

Table 6.1: Questionnaire survey
6.7 MEAN ITEM SCORE (MIS)
Within each of the areas in Section C and Section E of the questionnaire, respondents had to respond to items by indicating to which extent they agreed or disagreed with the causes and measures to be taken to minimise cost overruns in the public sector construction projects in Gauteng, South Africa. Each item was judged using a 5-point Likert scale consisting of the following:

1. = Strongly disagree (SD)
2. = Disagree (D)
3. = Neutral (N)
4. = Agree (A)
5. = Strongly agree (SA)

Within each of the areas in Section D of the questionnaire, respondents had to determine the effects of cost overruns in public construction projects in Gauteng, South Africa. Each item was judged using a five-point Likert scale consisting of the following:

1. = Extremely unlikely (EU)
2. = Unlikely (U)
3. = Neutral (N)
4. = Likely (L)
5. = Extremely likely (EL)

Within each of the area in Section F of the questionnaire, respondents had to assess the critical success factors for public construction projects in Gauteng, South Africa. Each item was judged using a five-point Likert scale consisting of the following:

1. = Not at all important (NAI)
2. = Not important (NI)
3. = Neutral (N)
4. = Important (I)
5. = Very important (VI)
The five-point Likert type scale was used to determine the participants’ responses with regard to the identified factors from the reviewed literature. The five-point scale was transformed to a mean item score (MIS) for each of the factors of causes and effects as assessed by the respondents. The indices were then used to determine the rank of each item. These rankings made it possible to cross-compare the relative importance of the items as perceived by the respondents.

The mean item score (MIS) was calculated from the total of all weighed responses and then relating it to the total responses on a particular aspect. The index of MIS of a particular factor is the sum of the respondents’ actual scores (on the five-point scale) given by all the respondents as a proportion of the sum of all maximum possible scores on the five-point scale that all the respondents could give to the criterion. A weight was assigned to each response. The indices were then used to determine the rank of each item. The mean item score (MIS) is ranked in descending order (from highest to lowest). The mean item score (MIS) was derived from the following formula:

\[
\text{MIS} = \frac{1n_1 + 2n_2 + 3n_3 + 4n_4 + 5n_5}{\Sigma N} \quad \text{Equation 1}
\]

Where

- \(n_1\) = number of respondents for ‘strongly disagree’
- \(n_2\) = number of respondents for ‘disagree’
- \(n_3\) = number of respondents for ‘neutral’
- \(n_4\) = number of respondents for ‘agree’
- \(n_5\) = number of respondents for ‘strongly agree’
- \(N\) = Total number of respondents

Or

Where

- \(n_1\) = number of respondents for ‘extremely unlikely’
- \(n_2\) = number of respondents for ‘unlikely’
- \(n_3\) = number of respondents for ‘neutral’
- \(n_4\) = number of respondents for ‘likely’
- \(n_5\) = number of respondents for ‘extremely likely’
- \(N\) = Total number of respondents
Or

Where

\[ n_1 = \text{number of respondents for ‘not at all important’} \]
\[ n_2 = \text{number of respondents for ‘not important’} \]
\[ n_3 = \text{number of respondents for ‘neutral’} \]
\[ n_4 = \text{number of respondents for ‘important’} \]
\[ n_5 = \text{number of respondents for ‘very important’} \]
\[ N = \text{Total number of respondents} \]

Following mathematical calculations, the criteria are then ranked in descending order of their relative importance index (from the highest to the lowest).

6.8 RELIABILITY

A reliability analysis was done to determine the consistency of the questionnaire. Internal consistency of the items was measured by using Cronbach’s alpha reliability coefficient. Cronbach’s alpha is the average value of the reliability coefficient which one could obtain for all possible combinations of items (Matkar, 2012). Gliem and Gliem (2003) indicated that Cronbach’s alpha is a test reliability technique that requires only a single test administration to provide a unique estimate of the reliability for a given test. The current study adopted the Cronbach’s alpha to check internal consistency.

George and Mallery (2003) indicated that a Cronbach’s alpha of above 0.7 is acceptable. Gliem and Gliem (2003) further stated that a Cronbach’s alpha of 0.8 is a reasonable goal. Therefore the current study had Cronbach’s alpha which ranges from 0.701 to 0.880 which was within the acceptable values, meaning all items were inter-related.

6.8.1 Results from reliability

Internal consistency of the items was measured by using Cronbach’s alpha reliability coefficient. Cronbach’s alpha reliability coefficient normally ranges between 0 and 1. George and Mallery (2003) provide the following rules of thumb: “> 0.9 – excellent, > 0.8 – good, > 0.7 – acceptable, > 0.6 – Questionable, > 0.5 – Poor and < 0.5 – unacceptable”. A high value of alpha indicates good internal consistency of the items in the scale. As indicated on page 102,
reliability analysis was done to determine the reliability of the questionnaire. A reliability analysis was done to determine the reliability of the questionnaire as shown in Table 6.2.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contractor-related factors</td>
<td>0.856</td>
</tr>
<tr>
<td>Design-related factors</td>
<td>0.793</td>
</tr>
<tr>
<td>Consultant-related factors</td>
<td>0.820</td>
</tr>
<tr>
<td>Site management factors</td>
<td>0.817</td>
</tr>
<tr>
<td>Financial-related factors</td>
<td>0.843</td>
</tr>
<tr>
<td>Price-related factors</td>
<td>0.765</td>
</tr>
</tbody>
</table>

Table 6.2: Consistence test using the Cronbach’s alpha - Causes of cost overruns

The results shown in Table 6.2 indicate that all the scores of the six constructs are quite acceptable according to George and Mallery (2003). This shows good internal consistency of the items representing the above constructs. Contractor-related factors indicate a high level of internal consistency. It should be noted that a high value for Cronbach’s alpha indicates a good internal consistency of the items in the scale. The Cronbach’s alpha of contractor-related factors is 0.856; Cronbach’s alpha of consultant-related factors is 0.820; Cronbach’s alpha of site management factors is 0.817 and Cronbach’s alpha of financial-related factors is 0.843 which are good and most reliable to internal items consistency. Cronbach’s alpha of design-related factors is 0.793 and Cronbach’s alpha of price related factors is 0.765 which are acceptable.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner-related factors</td>
<td>0.880</td>
</tr>
<tr>
<td>Financial-related factors</td>
<td>0.804</td>
</tr>
</tbody>
</table>

Table 6.3: Consistence test using the Cronbach’s alpha – Effects of cost overruns
The results as shown in Table 6.3 indicate that all the scores of the two constructs are quite acceptable according to George and Mallery (2003). This shows good internal consistency of the items representing the above construct. The owners’ responsibility-related factor indicates a high level of internal consistency. It should be noted that a high value for Cronbach’s alpha indicates a good internal consistency of the items in the scale. The Cronbach’s alpha of owners’ responsibility-related factors is 0.880 and Cronbach’s Alpha of financial-related factors is 0.804 which are good and most reliable to internal items’ consistency.

Table 6.4: Consistence test using the Cronbach’s alpha – Measures of minimising cost overruns in public sector construction projects

<table>
<thead>
<tr>
<th>Construct</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management-related factor</td>
<td>0.880</td>
</tr>
<tr>
<td>Experience-related factors</td>
<td>0.830</td>
</tr>
<tr>
<td>Planning-related factors</td>
<td>0.808</td>
</tr>
<tr>
<td>Design-related factors</td>
<td>0.796</td>
</tr>
</tbody>
</table>

The results shown in Table 6.4 indicate that all the scores of the two constructs are quite acceptable according to George and Mallery (2003). This shows good internal consistency of the items representing the above constructs. Management-related factors indicate a high level of internal consistency. It should be noted that a high value for Cronbach’s alpha indicates a good internal consistency of the items in the scale. The Cronbach’s alpha of management-related factors is 0.880; Cronbach’s alpha of experience-related factors is 0.830 and Cronbach’s alpha of planning-related factors is 0.808 which are good and most reliable to internal items consistency. Cronbach’s alpha of design-related factors is 0.796 which is acceptable.
Table 6.5: Consistence test using the Cronbach’s alpha – Critical success factors for a construction project

<table>
<thead>
<tr>
<th>Construct</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management-related factors</td>
<td>0.792</td>
</tr>
<tr>
<td>Communication-related factors</td>
<td>0.828</td>
</tr>
<tr>
<td>Experience-related factors</td>
<td>0.701</td>
</tr>
</tbody>
</table>

The results shown in Table 6.5 indicate that all the scores of the two constructs are quite acceptable according to George and Mallery (2003). This shows good internal consistency of the items representing the above constructs. Communication-related factors indicate a high level of internal consistency.

It should be noted that a high value for Cronbach’s alpha indicates a good internal consistency of the items in the scale. The Cronbach’s alpha of communication-related factors is 0.828 which is good and most reliable to internal items consistency. Cronbach’s alpha of management-related factors is 0.792 and Cronbach’s alpha of experience-related factors is 0.701 which are acceptable.

6.9 DATA ANALYSIS
The raw data was organised considering the issues which the questionnaire was designed to address, then frequencies were analysed by a Statistical Package for Social Sciences (SPSS). Tables, charts and descriptive explanations have been employed to illustrate data gathered from the field to make the research findings more meaningful.

6.10 LIMITATIONS
Questionnaires were distributed to construction professionals in the public sector such as project managers, architects, engineers, quantity surveyors, construction managers and construction project managers who are conversant with public sector projects in the Gauteng Province. This was intended to establish the various causes of cost overruns in public sector construction projects, the effects of cost overruns, and effective remedies for minimising construction cost overruns as well as establishing the critical success factors for public sector construction projects.
6.11 ETHICAL ISSUES
Written permission to conduct the research study was obtained from the Department of Construction Management and Quantity Surveying, the University of Johannesburg, Doornfontein Campus which was attached to the questionnaires. Conducting research requires not only expertise and diligence, but also honesty and integrity. A researcher protects the rights of the participants of a research study and those of the institution in which the study is conducted. Prior to obtaining informed consent from the respondents, the researcher explained the nature and purpose of the study. The respondents were not obliged to participate in the study, as one of the principles of the ethical conduct in the research was that participation in studies should be voluntary (Burns and Grove, 1993: 94). Confidentiality was further enhanced by maintaining participants’ anonymity throughout the study. Ethical considerations such as providing incentives, seeking sensitive information and the possibility of causing harm to participants were avoided.

6.12 CONCLUSION
In this chapter, the design of the research was discussed and the reasons for using a questionnaire were given. The study area and sample size of this research was identified as well as the ethical considerations. The next chapter will present the data analysis and discussion.
CHAPTER SEVEN

RESEARCH RESULTS AND DATA ANALYSIS

INTRODUCTION

In this chapter, the data gathered from the questionnaire administered in the public sector in Gauteng are analysed. Respondents were construction professionals such as architects, contractors, project managers, construction project managers, construction managers, quantity surveyors and other professionals who work on public sector construction projects in Gauteng Province in South Africa. The analysis of the data and interpretation of the results are given from the questionnaire. The questionnaire serves as the main tool of this quantitative data collection. The procedure used in analysing the results was aimed at establishing various factors responsible for cost overruns in public sector construction projects.

7.1 SECTION A – BACKGROUND INFORMATION

This section discusses the respondents’ demographic data such as sex/gender, age, ethnicity, position in company, experience, level of education, work entity and company size.

7.1.1 Respondents’ background information results

Findings from 119 respondents revealed that 61 per cent of respondents were male while 39 per cent of the respondents were female. In relation to age, out of 119 respondents 8.4 per cent were 25 years or younger, 15.1 per cent were between 26 and 30 years of age, 26.9 per cent were between 30 and 35 years, 30.3 per cent were between 36 and 40 years, 13.4 per cent were between 41 and 45 years, 3.4 per cent were between 46 and 50 years and 1.7 per cent were 56 years or older.

Findings from the questionnaire revealed that 64.7 per cent of the respondents were black, 17.6 per cent were white, 2.5 per cent were coloured and 14.3 per cent were Indian or Asian. In relation to their position in the company, findings from the questionnaire revealed that 12.6 per cent of the respondents were architects, 42 per cent were quantity surveyors, 10.1 per cent were project managers, 0.8 per cent were construction managers, 14.3 per cent were construction project managers, 10.9 per cent were civil engineers and 8.4 per cent held other positions in the company. These included architects/construction project managers working in rural areas, candidate architectural technologists, chief quantity surveyors at the National Department of
Public Works, commercial managers, electrical technicians, junior quantity surveyors, lecturers, mining engineers, professional quantity surveyors, programme managers, project supervisor, at executive level, quantity surveyors, senior quantity surveyors, specialist trainers New Engineering Contracts (NEC) conditions and lastly, students.

Regarding years of experience, findings from the questionnaire further indicated that 5 per cent had less than one year; 16.8 per cent had between one and five years; 30.3 per cent had between five and ten years; 35.3 per cent had between 10 and 15 years, 8.4 per cent had between 15 and 20 years and 3.4 per cent had more than 20 years of working experience.

The results of the level of education revealed that 0.8 per cent had a post-matric certificate, 14.3 per cent had a post-matric diploma, 65.5 per cent had a bachelor’s degree and 17.6 per cent had a master’s degree. In relation to work entity, findings revealed that 51.3 per cent worked for public sector clients, 10.1 per cent worked for private sector clients, 21.8 per cent worked for consultant quantity surveying firms, 4.2 per cent worked for consultant project management firms, 1.7 per cent worked for consultant mechanical and electrical engineering firms, 2.5 per cent worked for consultant civil engineering firms, 2.5 per cent worked for main contractors and 5 per cent selected other entities such as consultant architects, Development Bank of Southern Africa (DBSA) architects, Department of Public works (DPW), facilities management firms, multi-disciplinary consultants, private companies and public sector implementing agents for other public sector departments.

Furthermore, findings related to respondents’ company size revealed that 13.4% per cent worked for a very small company, 19.3 per cent worked for a small company, 15.1% per cent worked for a medium-sized company and 49.6 per cent worked for a large company.
7.2 DATA ANALYSIS

7.2.1 Section A: Respondents’ background information

Figure 7.1 shows that out of 119 respondents, 61 per cent were male and 39 per cent were female:

![Figure 7.1 Respondents’ gender distribution](image)

In relation to age group, as shown in Figure 7.2, out of 119 respondents, 8.4 per cent were 25 years or younger, 15.1 per cent were between 26 and 30 years of age, 26.9 per cent were between 31 and 35 years, 30.3 per cent were between 36 and 40 years, 13.4 per cent were between 41 and 45 years, 3.4 per cent were between 46 and 50 years, 0.8 per cent were between 51 and 55 years while 1.7 per cent were 56 years or older.
Figure 7.2 Respondents’ age group/distribution

Figure 7.3 below shows the respondents’ ethnicity: it indicates that 64.7 per cent of the respondents were black, 17.6 per cent were white, 2.5 per cent were coloured and 14.3 per cent were Indian or Asian.
Figure 7.4 represents respondents’ position in company. Findings reveal that 12.6 per cent of the respondents were architects, 42 per cent were quantity surveyors, 10.1 per cent were project managers, 0.8 per cent were construction managers, 14.3 per cent were construction project managers, 10.9 per cent were civil engineers and 8.4 per cent held other positions in the company which included architects/construction project managers working in rural areas, candidate architectural technologists, chief quantity surveyors at the National Department of Public Works, commercial managers, electrical technicians, junior quantity surveyors, lecturers, mining engineers, professional quantity surveyors, programme managers, project supervisors at executive level, quantity surveyors, senior quantity surveyors, specialist trainers New Engineering contracts (NEC) conditions and lastly, students.

![Figure 7.4: Respondents’ position in the company](image)

Figure 7.5 shows respondents’ findings regarding years of experience. It reveals that 5 per cent had less than one year; 16.8 per cent had between one and five years; 30.3 per cent had between five and ten years; 35.3 per cent had between 10 and 15 years; 8.4 per cent had between 15 and 20 years and 3.4 per cent had more than 20 years of working experience.
Figure 7.5: Respondents’ years of experience in construction industry

Regarding educational background, the results of the respondents shown on Figure 7.6 below reveal that 0.8 per cent have a post-matric certificate, 14.3 per cent have a post-matric diploma, 65.5 per cent have a bachelor’s degree and 17.6 per cent have a master’s degree.

Figure 7.6: Respondents’ highest educational qualification
Figure 7.7 below represents respondents’ work entities. Findings revealed that 51.3 per cent worked for public sector clients, 10.1 per cent worked for private sector clients, 21.8 per cent worked for consultant quantity surveying firms, 4.2 per cent worked for consultant project management firms, 1.7 per cent worked for consultant mechanical and electrical engineering firms, 2.5 per cent worked for consultant civil engineering firms, 2.5 per cent worked for main contractors and 5 per cent were selected other entities such as consultant architects, Development Bank of Southern Africa (DBSA) architects, Department of Public Works (DPW), facilities management firms, multi-disciplinary consultants, private companies and public sector implementing agents for other public sector departments.

![Figure 7.7: Respondents’ current work entity](image)

Findings related to respondents’ company size as illustrated in Figure 7.8 reveal that 13.4 per cent worked for a very small company, 19.3 per cent worked for a small company, 15.1 per cent worked for a medium-sized company and 49.6 per cent worked for a large company.
7.2.2 Section B – Project characteristics

This section discusses the project characteristics such as the number of projects that exceeded the original contract sum in the past five years, the reasons for the project exceeding the original contract sum, original project cost, the average cost overruns, the project type where they experienced cost overruns and the facility type.

7.2.2.1 Project characteristics results

Findings from the questionnaires revealed that 20.2 per cent of the participants had no projects that exceeded the original contract sum, 16 per cent had one or two projects, 21 per cent had three to four projects, 16.8 per cent had five to six projects, 5.9 per cent had seven to eight projects and 19.3 per cent had more than eight projects that exceeded the original contract sum. Regarding the reasons for the projects exceeding the original contract sum, the findings revealed the first reason as variation orders with 10.8 per cent, followed by frequent design changes with 9.0 per cent, incomplete design at the time of tender with 7.6 per cent, cash flow and financial difficulties faced by contractors with 7.4 per cent, policy in accepting lowest tender with 7.0 per cent, delays in decision making with 6.2 per cent, unforeseen ground conditions with 5.2 per cent, contractors’ project inexperience with 5.1 per cent, lack of
communication between parties with 4.8 per cent, inaccurate quantity take-off, poor site supervision and delay in progress payment by the owner with 4.0 per cent, strikes and lack of experience of technical consultants with 3.5 per cent, poor site management and poor project management with 3.0 per cent, fraudulent practices (kickbacks, corruption) with 2.7 per cent, incompetent sub-contractors and labour disputes with 2.5 per cent, negative effects of weather with 2.4 per cent, limited funds with 1.3 per cent and lastly were respondents who selected ‘others’ with 0.6 per cent.

Findings regarding respondents’ original project cost revealed that 0.8 per cent had original project costs of up to R 650 000.00; 7.6 per cent had original projects costs between R 650 001.00 to R2m; 2.5 per cent had original project cost between R 2 000 001.00 to R4m; 5.9 per cent had original project costs between R 4 000 001.00 to R6.5m; 11.85 per cent had original project costs between R 6 500 001.00 to R13m; 21 per cent had original project costs between R 13 000 001.00 to R40m; 18.5 per cent had original project costs between R 40 000 001.00 to R13m and 10.9 per cent had original project costs above R130m. With regard to average cost overruns, findings further revealed that 5.8 per cent of respondents’ projects had a cost overrun of between R 0 to R 100 000.00; 2.5 per cent had a cost overrun of between R 100 001.00 to R 200 000.00; 1.7 per cent had a cost overrun of between R 200 001 to R 300 000.00; 12.6 per cent had a cost overrun of between R 300 001.00 to R 400 000.00; 16.8 per cent had a cost overrun of between R 400 001.00 to R 500 000.00; 15.1 per cent had a cost overrun of between R 500 001.00 to R1m and 22.7 per cent had a cost overrun of between R 1 000 001.00 and R2m.

Furthermore, in relation to project type, findings from the questionnaire revealed that respondents experienced 47 per cent cost overruns on new construction, 27 per cent on refurbishment, 24 per cent on renovations and 2 per cent on other projects. Moreover, findings from the questionnaire revealed that respondents experienced cost overruns of 17.2 per cent in school projects, 13.4 per cent in hospital projects, 12.9 per cent in clinics, 8.6 per cent in prisons, 14.5 per cent in office projects, 5.9 per cent in construction of high courts/magistrates’ courts, 9.7 per cent in construction of police stations, 2.7 per cent in construction of multipurpose community centres, 3.2 per cent in housing developments (Green Fields), 3.8 per cent in renovations of housing projects, while 8.1 per cent of cost overruns were experienced on other projects.
Figure 7.9 below shows respondents’ findings regarding the number of projects that went beyond original the contract sum in the past five years. It was found that 20.2 per cent of participants had no projects that exceeded the original contract sum, 16 per cent had one to two projects, 21 per cent had three to four projects, 16.8 per cent had five to six projects, 5.9 per cent had seven to eight projects and 19.3 per cent had more than eight projects that exceeded the original contract sum.

The findings from the reasons for the project exceeding the original contract sum were as follows: variation orders with 10.8 per cent, followed by frequent design changes with 9.0 per cent, incomplete design at the time of tender with 7.6 per cent, cash flow and financial difficulties faced by contractors with 7.4 per cent, policy in accepting lowest tender with 7.0 per cent, delays in decision making with 6.2 per cent, unforeseen ground conditions with 5.2 per cent, contractors’ project inexperience with 5.1 per cent, a lack of communication between parties with 4.8 per cent, inaccurate quantity take-off, poor site supervision and delay in progress payment by the owner with 4.0 per cent, strikes and lack of experience of technical consultants with 3.5 per cent, poor site management and poor project management with 3.0 per cent, fraudulent practices (kickbacks, corruption) with 2.7 per cent, incompetent sub-
contractors and labour disputes with 2.5 per cent, negative effects of weather with 2.4 per cent, limited funds with 1.3 per cent and other reasons with 0.6 per cent.

Findings shown on Figure 7.10 regarding respondents’ original project costs revealed that 0.8 per cent had original project costs of up to R 650 000.00; 7.6 per cent had original projects costs between R 650 001.00 to R2m; 2.5 per cent had original project costs between R 2 000 001.00 to R4m; 5.9 per cent had original project costs between R 4 000 001.00 to R6,5m; 11.85 per cent had original project costs between R 6 500 001.00 to R13m; 21 per cent had original project costs between R 13 000 001.00 to R40m; 18.5 per cent had original project costs between R 40 000 001.00 to R130m and 10.9 per cent had original project costs above R130m.

![Figure 7.10: Original project cost](image)

Regarding the original project costs, findings in Figure 7.11 show that 5.8 per cent of the projects had a cost overrun of between R 0 to R 100 000.00; 2.5 per cent had a cost overrun of between R 100 001.00 to R 200 000.00; 1.7 per cent had a cost overrun of between R 200 001 to R 300 000.00; 12.6 per cent had a cost overrun of between R 300 001.00 to R 400 000.00; 16.8 per cent had a cost overrun of between R 400 001.00 to R 500 000.00; 15.1 per cent had a cost overrun of between R 500 001.00 to R1m and 22.7 per cent had a cost overrun of between R 1 000 001.00 and R2m.
Findings from the project type shown in Figure 7.12 below reveal that respondents experienced 47 per cent of cost overruns on new construction, 27 per cent on refurbishment, 24 per cent on renovations and 2 per cent on other projects.

Figure 7.11: Average cost overrun

Figure 7.12: Project type where cost overruns were experienced

Figure 7.13 below shows findings from the facility type indicating that respondents experienced 17.2 per cent cost overruns on school projects, 13.4 per cent on hospital projects, 12.9 per cent on clinics, 8.6 per cent on prisons, 14.5 per cent on office projects, 5.9 per cent on construction of high courts/magistrates’ courts, 9.7 per cent on construction of police
stations, 2.7 per cent on construction of multipurpose community centres, 3.2 per cent on housing developments (Green Fields), 3.8 per cent on renovations of housing projects, while 8.1 per cent of cost overruns were experienced on projects other than the ones mentioned.

Figure 7.13: Facility type where cost overruns were experienced

7.2.3 Section C – Causes of cost overruns

Table 7.1 represents the factors that cause cost overruns in public sector projects in Gauteng, South Africa as ranked by respondents. The respondents ranked variation orders first (MIS = 4.26; SD = 1.070; R = 1), followed by change in scope of the project (MIS = 4.24; SD = 0.844; R = 2) and cash flow and financial difficulties faced by contractors (MIS = 4.24; SD = 1.000; R = 2), delays in decision making (MIS = 4.18; SD = 0.881; R = 3), inadequate planning (MIS = 4.05; SD = 0.950; R = 4), frequent design changes (MIS = 4.03; SD = 1.070; R = 5), lack of coordination between parties (MIS = 4.02; SD = 0.963; R = 6), policy in accepting lowest tender (MIS = 4.01; SD = 1.059; R = 7), inaccurate time and cost estimates (MIS = 3.98; SD = 0.991; R = 8), errors and omissions in design (MIS = 3.97; SD = 1.042; R = 9), inaccurate quantity take-off (MIS = 3.95; SD = 1.028; R = 10), contractors’ project inexperience (MIS = 3.95; SD = 1.007; R = 10), extension of time claims (MIS = 3.92; SD = 1.039; R = 11), change in material specification and type (MIS = 3.88; SD = 1.006; R = 12), poor contract management (MIS = 3.87; SD = 0.943; R = 13), delay in progress payment by the owner (MIS = 3.85; SD
= 1.126; R = 14), poor project management (MIS = 3.82; SD = 0.979; R = 15), fluctuations in material prices (MIS = 3.82; SD = 0.899; R = 15), poor workmanship (MIS = 3.80; SD = 1.013; R = 16), lack of communication between parties (MIS = 3.79; SD = 0.972; R = 17), mistakes and discrepancies in contract document (MIS = 3.75; SD = 0.973; R = 18), late delivery of materials (MIS = 3.72; SD = 1.060; R = 19), incomplete design at the time of tender (MIS = 3.72; SD = 1.181; R = 19), incompetent sub-contractors (MIS = 3.71; SD = 1.047; R = 20), mistakes during construction (MIS = 3.70; SD = 1.044; R = 21), slow information flow between parties (MIS = 3.70; SD = 1.009; R = 21), unforeseen ground conditions (MIS = 3.69; SD = 1.033; R = 22), delay in payment to supplier/sub-contractor (MIS = 3.68; SD = 1.127; R = 23), delay in preparation and approval of drawings (MIS = 3.68; SD = 1.027; R = 23), poor site supervision (MIS = 3.67; SD = 1.017; R = 24), strikes (MIS = 3.67; SD = 1.091; R = 24), poor site management (MIS = 3.65; SD = 1.057; R = 25), financial difficulty by owner (MIS = 3.60; SD = 1.267; R = 26), fraudulent practices (kickbacks, corruption) (MIS = 3.59; SD = 1.384; R = 27), labour disputes (MIS = 3.55; SD = 1.004; R = 28), inadequate funding of the project (MIS = 3.48; SD = 1.179; R = 29), schedule delay (MIS = 3.46; SD = 0.990; R = 30), delay in inspection and approval of completed works (MIS = 3.43; SD = 1.128; R = 31), site conflicts (MIS = 3.43; SD = 0.998; R = 31), lack of executive capacity by employer (MIS = 3.41; SD = 1.184; R = 32), negative effects of weather (MIS = 3.40; SD = 1.130; R = 33), high cost of labour (MIS = 3.37; SD = 1.126; R = 34), shortage of site workers (MIS = 3.32; SD = 1.172; R = 35) and lack of experience of technical consultants (MIS = 3.24; SD = 1.117; R = 36).
### Table 7.1: Causes of cost overruns

<table>
<thead>
<tr>
<th>Causes of cost overrun</th>
<th>σX</th>
<th>MIS</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variation orders</td>
<td>1.070</td>
<td>4.26</td>
<td>1</td>
</tr>
<tr>
<td>Change in scope of the project</td>
<td>0.844</td>
<td>4.24</td>
<td>2</td>
</tr>
<tr>
<td>Cash flow and financial difficulties faced by contractors</td>
<td>1.000</td>
<td>4.24</td>
<td>2</td>
</tr>
<tr>
<td>Delays in decision making</td>
<td>0.881</td>
<td>4.18</td>
<td>3</td>
</tr>
<tr>
<td>Inadequate planning</td>
<td>0.950</td>
<td>4.05</td>
<td>4</td>
</tr>
<tr>
<td>Frequent design changes</td>
<td>1.070</td>
<td>4.03</td>
<td>5</td>
</tr>
<tr>
<td>Lack of coordination between parties</td>
<td>0.963</td>
<td>4.02</td>
<td>6</td>
</tr>
<tr>
<td>Policy in accepting lowest tender</td>
<td>1.059</td>
<td>4.01</td>
<td>7</td>
</tr>
<tr>
<td>Inaccurate time and cost estimates</td>
<td>0.991</td>
<td>3.98</td>
<td>8</td>
</tr>
<tr>
<td>Errors and omissions in design</td>
<td>1.042</td>
<td>3.97</td>
<td>9</td>
</tr>
<tr>
<td>Inaccurate quantity take-off</td>
<td>1.028</td>
<td>3.95</td>
<td>10</td>
</tr>
<tr>
<td>Contractors’ project inexperience</td>
<td>1.007</td>
<td>3.95</td>
<td>10</td>
</tr>
<tr>
<td>Extension of time claims</td>
<td>1.039</td>
<td>3.92</td>
<td>11</td>
</tr>
<tr>
<td>Change in material specification and type</td>
<td>1.006</td>
<td>3.88</td>
<td>12</td>
</tr>
<tr>
<td>Poor contract management</td>
<td>0.943</td>
<td>3.87</td>
<td>13</td>
</tr>
<tr>
<td>Delay in progress payment by the owner</td>
<td>1.126</td>
<td>3.85</td>
<td>14</td>
</tr>
<tr>
<td>Poor project management</td>
<td>0.979</td>
<td>3.82</td>
<td>15</td>
</tr>
<tr>
<td>Fluctuations in material prices</td>
<td>0.899</td>
<td>3.82</td>
<td>15</td>
</tr>
<tr>
<td>Poor workmanship</td>
<td>1.013</td>
<td>3.80</td>
<td>16</td>
</tr>
<tr>
<td>Lack of communication between parties</td>
<td>0.972</td>
<td>3.79</td>
<td>17</td>
</tr>
<tr>
<td>Mistakes and discrepancies in contract document</td>
<td>0.973</td>
<td>3.75</td>
<td>18</td>
</tr>
<tr>
<td>Late delivery of materials</td>
<td>1.060</td>
<td>3.72</td>
<td>19</td>
</tr>
<tr>
<td>Incomplete design at the time of tender</td>
<td>1.181</td>
<td>3.72</td>
<td>19</td>
</tr>
<tr>
<td>Incompetent sub-contractors</td>
<td>1.047</td>
<td>3.71</td>
<td>20</td>
</tr>
<tr>
<td>Mistakes during construction</td>
<td>1.044</td>
<td>3.70</td>
<td>21</td>
</tr>
<tr>
<td>Slow information flow between parties</td>
<td>1.009</td>
<td>3.70</td>
<td>21</td>
</tr>
<tr>
<td>Unforeseen ground conditions</td>
<td>1.033</td>
<td>3.69</td>
<td>22</td>
</tr>
<tr>
<td>Delay in payment to supplier/sub-contractor</td>
<td>1.127</td>
<td>3.68</td>
<td>23</td>
</tr>
<tr>
<td>Delay in preparation and approval of drawings</td>
<td>1.027</td>
<td>3.68</td>
<td>23</td>
</tr>
<tr>
<td>Poor site supervision</td>
<td>1.017</td>
<td>3.68</td>
<td>23</td>
</tr>
<tr>
<td>Strikes</td>
<td>1.091</td>
<td>3.67</td>
<td>24</td>
</tr>
<tr>
<td>Poor site management</td>
<td>1.057</td>
<td>3.65</td>
<td>25</td>
</tr>
<tr>
<td>Financial difficulty by owner</td>
<td>1.267</td>
<td>3.60</td>
<td>26</td>
</tr>
<tr>
<td>Fraudulent practices (kickbacks, corruption)</td>
<td>1.384</td>
<td>3.59</td>
<td>27</td>
</tr>
<tr>
<td>Labour disputes</td>
<td>1.004</td>
<td>3.55</td>
<td>28</td>
</tr>
<tr>
<td>Inadequate funding of the project</td>
<td>1.179</td>
<td>3.48</td>
<td>29</td>
</tr>
<tr>
<td>Schedule delay</td>
<td>0.990</td>
<td>3.46</td>
<td>30</td>
</tr>
<tr>
<td>Delay in inspection and approval of completed works</td>
<td>1.128</td>
<td>3.43</td>
<td>31</td>
</tr>
<tr>
<td>Site conflicts</td>
<td>0.998</td>
<td>3.43</td>
<td>31</td>
</tr>
<tr>
<td>Lack of executive capacity by employer</td>
<td>1.184</td>
<td>3.41</td>
<td>32</td>
</tr>
<tr>
<td>Negative effects of weather</td>
<td>1.130</td>
<td>3.40</td>
<td>33</td>
</tr>
<tr>
<td>High cost of labour</td>
<td>1.126</td>
<td>3.37</td>
<td>34</td>
</tr>
<tr>
<td>Shortage of site workers</td>
<td>1.172</td>
<td>3.32</td>
<td>35</td>
</tr>
<tr>
<td>Lack of experience of technical consultants</td>
<td>1.117</td>
<td>3.24</td>
<td>36</td>
</tr>
</tbody>
</table>

$\sigma X = \text{Standard deviation, MIS = Mean item score, R = Rank}$

### 7.2.4 Section D – Effects of cost overruns

Table 7.2 represents the effects of cost overruns as ranked by the respondents. The respondents ranked time overrun first (MIS = 4.55; SD = 0.732; R = 1), followed by increased project cost due to extension of time (MIS = 4.29; SD = 0.752; R = 2), disputes between owner and contractor (MIS = 4.10; SD = 0.845; R = 3), bankruptcy (MIS = 3.98; SD = 1.147; R = 4), wastage of taxpayers’ money (MIS = 3.96; SD = 1.147; R = 5), company/firms liability to insolvency (MIS = 3.86; SD = 1.023; R = 6), reduced profit to contractor (MIS = 3.80; SD = 1.154; R = 7), arbitration (MIS = 3.64; SD = 1.151; R = 8), total project abandonment (MIS = 3.58; SD = 1.191; R = 9), idling resources (MIS = 3.56; SD = 1.004; R = 10), delaying in getting profit by the clients (MIS = 3.49; SD = 1.047; R = 11), creating stress for contractors (MIS = 3.453; SD = 1.126; R = 12), loss of confidence from the public (MIS = 3.45; SD = 1.126; R = 12), delaying by the clients to return loans (MIS = 3.44; SD = 1.094; R = 13) while
demolition and reconstruction were ranked second last (MIS = 3.27; SD = 1.196; R = 14) and litigation was ranked last (MIS = 2.97; SD = 1.175; R = 15).

Table 7.2: Effects of cost overruns

<table>
<thead>
<tr>
<th>Effects of cost overruns</th>
<th>σX</th>
<th>MIS</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time overrun</td>
<td>0.732</td>
<td>4.55</td>
<td>1</td>
</tr>
<tr>
<td>Increased project cost due to extension of time</td>
<td>0.752</td>
<td>4.29</td>
<td>2</td>
</tr>
<tr>
<td>Disputes between owner and contractor</td>
<td>0.845</td>
<td>4.10</td>
<td>3</td>
</tr>
<tr>
<td>Bankruptcy</td>
<td>1.147</td>
<td>3.98</td>
<td>4</td>
</tr>
<tr>
<td>Wastage of tax payers’ money</td>
<td>1.147</td>
<td>3.96</td>
<td>5</td>
</tr>
<tr>
<td>Company/firms liability to insolvency</td>
<td>1.023</td>
<td>3.86</td>
<td>6</td>
</tr>
<tr>
<td>Reduced profit to contractor</td>
<td>1.154</td>
<td>3.80</td>
<td>7</td>
</tr>
<tr>
<td>Arbitration</td>
<td>1.151</td>
<td>3.64</td>
<td>8</td>
</tr>
<tr>
<td>Total project abandonment</td>
<td>1.191</td>
<td>3.58</td>
<td>9</td>
</tr>
<tr>
<td>Idling resources</td>
<td>1.004</td>
<td>3.56</td>
<td>10</td>
</tr>
<tr>
<td>Delaying in getting profit by the clients</td>
<td>1.047</td>
<td>3.49</td>
<td>11</td>
</tr>
<tr>
<td>Creating stress for contractors</td>
<td>1.126</td>
<td>3.45</td>
<td>12</td>
</tr>
<tr>
<td>Loss of confidence from the public</td>
<td>1.126</td>
<td>3.45</td>
<td>12</td>
</tr>
<tr>
<td>Delaying by the clients to return loans</td>
<td>1.094</td>
<td>3.44</td>
<td>13</td>
</tr>
<tr>
<td>Demolition and reconstruction</td>
<td>1.196</td>
<td>3.27</td>
<td>14</td>
</tr>
<tr>
<td>Litigation</td>
<td>1.175</td>
<td>2.97</td>
<td>15</td>
</tr>
</tbody>
</table>

σX = Standard deviation, MIS = Mean item score, R = Rank

7.2.5 Section E – Measures for minimising cost overruns in public sector construction projects

Findings from the study indicated measures that can be taken to minimise cost overruns in the public sector with regards to construction projects in South Africa as shown in Table 7.3. The respondents ranked the use of experienced suppliers first (MIS = 4.74; SD = 0.846; R = 1), followed by proper project planning (MIS = 4.50; SD = 0.649; R = 2), appointment of highly experienced committed design teams (MIS = 4.49; SD = 0.711; R = 3), effective strategic
planning (MIS = 4.48; SD = 0.675; R = 4), proper project scheduling (MIS = 4.45; SD = 0.648; R = 5) and completed designs at the time of tender (MIS = 4.45; SD = 0.789; R = 5), decrease number of variation orders (MIS = 4.44; SD = 0.744; R = 6), adequate designs (MIS = 4.41; SD = 0.656; R = 7), timely supply of materials (MIS = 4.40; SD = 0.642; R = 8), comprehensive contract administration (MIS = 4.39; SD = 0.667; R = 9), appointment of highly experienced technical consultants (MIS = 4.38; SD = 0.725; R = 10), good workmanship (MIS = 4.37; SD = 0.649; R = 11), use of appropriate construction methods (MIS = 4.34; SD = 0.728; R = 12), effective site management (MIS = 4.33; SD = 0.705; R = 13), improving contract award procedures by giving less weight to prices and more weight to the capabilities and past performance of contractors (MIS = 4.32; SD = 0.833; R = 14), proper emphasis on past experience (MIS = 4.30; SD = 0.913; R = 15), effective site supervision (MIS = 4.28; SD = 0.715; R = 16), frequent progressive meetings (MIS = 4.19; SD = 0.902; R = 17), use of experienced sub-contractors and suppliers (MIS = 4.12; SD = 0.776; R = 18), clear information and communication channels (MIS = 3.99; SD = 0.650; R = 19), frequent coordination between the parties (MIS = 3.89; SD = 0.699; R = 20), use of up-to-date technology (MIS = 3.75; SD = 0.866; R = 21), use of experienced contractors (MIS = 2.97; SD = 0.736; R = 22), while reliable pre-contract estimates was ranked last (MIS = 2.03; SD = 0.721; R = 23).

Table 7.3: Measures for minimising cost overruns in public sector construction projects

<table>
<thead>
<tr>
<th>Measures for minimising cost overruns in public sector construction projects</th>
<th>σX</th>
<th>MIS</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of experienced suppliers</td>
<td>0.846</td>
<td>4.74</td>
<td>1</td>
</tr>
<tr>
<td>Proper project planning</td>
<td>0.649</td>
<td>4.50</td>
<td>2</td>
</tr>
<tr>
<td>Appointment of highly experienced committed design teams</td>
<td>0.711</td>
<td>4.49</td>
<td>3</td>
</tr>
<tr>
<td>Effective strategic planning</td>
<td>0.675</td>
<td>4.48</td>
<td>4</td>
</tr>
<tr>
<td>Proper project scheduling</td>
<td>0.648</td>
<td>4.45</td>
<td>5</td>
</tr>
<tr>
<td>Completed designs at the time of tender</td>
<td>0.789</td>
<td>4.45</td>
<td>5</td>
</tr>
<tr>
<td>Decrease number of variation orders</td>
<td>0.744</td>
<td>4.44</td>
<td>6</td>
</tr>
<tr>
<td>Adequate designs</td>
<td>0.656</td>
<td>4.41</td>
<td>7</td>
</tr>
<tr>
<td>Timely supply of materials</td>
<td>0.642</td>
<td>4.40</td>
<td>8</td>
</tr>
<tr>
<td>Item</td>
<td>Score</td>
<td>Rank</td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>Comprehensive contract administration</td>
<td>0.667</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Appointment of highly experienced technical consultants</td>
<td>0.725</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Good workmanship</td>
<td>0.649</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Use of appropriate construction methods</td>
<td>0.728</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Effective site management</td>
<td>0.705</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Improving contract award procedures by giving less weight to prices and more weight to the capabilities and past performance of contractors</td>
<td>0.833</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Proper emphasis on past experience</td>
<td>0.913</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Effective site supervision</td>
<td>0.715</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Frequent progress meetings</td>
<td>0.902</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Use of experienced sub-contractors and suppliers</td>
<td>0.776</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Clear information and communication channels</td>
<td>0.650</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Frequent coordination between the parties</td>
<td>0.699</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Use of up-to-date technology</td>
<td>0.866</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Use of experienced contractors</td>
<td>0.736</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>Reliable pre-contract estimates</td>
<td>0.721</td>
<td>23</td>
<td></td>
</tr>
</tbody>
</table>

$\sigma X =$ Standard deviation, $MIS =$ Mean item score, $R =$ Rank
7.2.6 Section F – Critical success factors for construction projects

Table 7.4 represents the critical success factors for construction projects. The respondents ranked the experience of the project manager first (MIS = 4.68; SD = 0.503; R = 1), followed by the experience of the contractor (MIS = 4.61; SD = 0.556; R = 2), commitment of project team members (MIS = 4.60; SD = 0.526; R = 3), proper planning (MIS = 4.60; SD = 0.642; R = 3), awarding the bid to the right contractor (MIS = 4.60; SD = 0.601; R = 3), effective decision making (MIS = 4.56; SD = 0.547; R = 4), clear and realistic goals (MIS = 4.56; SD = 0.564; R = 4), competence of project team members (MIS = 4.53; SD = 0.534; R = 5), adequacy of funding (MIS = 4.51; SD = 0.636; R = 6), learning from previous experience (MIS = 4.44; SD = 0.732; R = 7), top management experience and support (MIS = 4.39; SD = 0.678; R = 8), sufficient resources (MIS = 4.36; SD = 0.607; R = 9), good written contract (MIS = 4.32; SD = 0.700; R = 10), access to resources (MIS = 4.24; SD = 0.673; R = 11), stakeholder satisfaction (MIS = 4.19; SD = 0.833; R = 12), stable political environment (MIS = 4.13; SD = 0.907; R = 13), client experience (MIS = 3.92; SD = 0.967; R = 14), while effective communication was ranked second last (MIS = 3.03; SD = 0.607; R = 15) and project monitoring was ranked last (MIS = 2.82; SD = 0.580; R = 16).

Table 7.4: Critical success factors for construction projects

<table>
<thead>
<tr>
<th>Critical success factors for construction projects</th>
<th>σX</th>
<th>MIS</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experience of project manager</td>
<td>0.503</td>
<td>4.68</td>
<td>1</td>
</tr>
<tr>
<td>Experience of contractor</td>
<td>0.556</td>
<td>4.61</td>
<td>2</td>
</tr>
<tr>
<td>Commitment of project team members</td>
<td>0.526</td>
<td>4.60</td>
<td>3</td>
</tr>
<tr>
<td>Proper planning</td>
<td>0.642</td>
<td>4.60</td>
<td>3</td>
</tr>
<tr>
<td>Awarding bid to right contractor</td>
<td>0.601</td>
<td>4.60</td>
<td>3</td>
</tr>
<tr>
<td>Effective decision making</td>
<td>0.547</td>
<td>4.56</td>
<td>4</td>
</tr>
<tr>
<td>Clear and realistic goals</td>
<td>0.564</td>
<td>4.56</td>
<td>4</td>
</tr>
<tr>
<td>Competence of project team members</td>
<td>0.534</td>
<td>4.53</td>
<td>5</td>
</tr>
<tr>
<td>Adequacy of funding</td>
<td>0.636</td>
<td>4.51</td>
<td>6</td>
</tr>
<tr>
<td>Learning from previous experience</td>
<td>0.732</td>
<td>4.44</td>
<td>7</td>
</tr>
<tr>
<td>Top management experience and support</td>
<td>0.678</td>
<td>4.39</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>MIS</td>
<td>σX</td>
<td>R</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-------</td>
<td>------</td>
<td>----</td>
</tr>
<tr>
<td>Sufficient resources</td>
<td>0.607</td>
<td>4.36</td>
<td>9</td>
</tr>
<tr>
<td>Good written contract</td>
<td>0.700</td>
<td>4.32</td>
<td>10</td>
</tr>
<tr>
<td>Access to resources</td>
<td>0.673</td>
<td>4.24</td>
<td>11</td>
</tr>
<tr>
<td>Stakeholder satisfaction</td>
<td>0.833</td>
<td>4.19</td>
<td>12</td>
</tr>
<tr>
<td>Stable political environment</td>
<td>0.907</td>
<td>4.13</td>
<td>13</td>
</tr>
<tr>
<td>Client experience</td>
<td>0.967</td>
<td>3.92</td>
<td>14</td>
</tr>
<tr>
<td>Effective communication</td>
<td>0.607</td>
<td>3.03</td>
<td>15</td>
</tr>
<tr>
<td>Project monitoring</td>
<td>0.580</td>
<td>2.82</td>
<td>16</td>
</tr>
</tbody>
</table>

$\sigma X =$ Standard deviation, $MIS =$ Mean item score, $R =$ Rank

### 7.3 CONCLUSION

In this chapter data obtained from the structured questionnaire was presented and analysed. The respondents comprised professionals such as architects, contractors, project managers, construction project managers, construction managers, quantity surveyors and other professionals who worked on public sector construction projects in Gauteng Province in South Africa. The next chapter will focus on the discussion of the research findings in relation to the research objectives formulated in Chapter One.
CHAPTER EIGHT

DISCUSSION OF FINDINGS, CONCLUSIONS AND RECOMMENDATION

8.0 INTRODUCTION

This chapter discusses the research findings in fulfilment of the research objectives. As indicated in Chapter One, the objective of the study is to investigate the causes and effects of cost overruns in public sector construction projects in South Africa, and to provide recommendations for addressing the situation. Literatures revealed that cost overrun is a frequent phenomenon and is associated with nearly all projects in the construction industry. The trend is more severe in developing countries where these overruns sometimes exceed 100 per cent of the anticipated cost of the project. Therefore, identifying risk factors leading to cost overrun and analysing its ultimate impact is a prerequisite to minimise or avoid cost overrun so as to reduce its consequential effects.

8.1 BACKGROUND INFORMATION

This section discusses the background information regarding the respondents’ gender, age, ethnicity, position in the company, years of experience in construction industry, education background, current work entity and company size.

8.1.1 Background information data results

The findings reveal that out of 119 respondents, 61 per cent were males and 39 per cent were females. This could be because the construction industry is historically male-dominated industry. In relation to age, the majority of 30.3 per cent were within the age group of 36 to 40, followed by 26.9 per cent who were within the age group of 31 to 35; 15.1 per cent who were within the age group of 26 to 30; 13.4 per cent who were within the age group of 41 to 45; 8.4 per cent who were within the age group of 25 or younger while 3.4 per cent were above 56 years old and a minority of 0.8 per cent were within the age group of 51 to 55.

Regarding ethnicity, blacks comprised the majority (64.7%), followed by 17.6 per cent of whites, 14.3 per cent of Indian or Asian and the minority (2.5%) were coloured respondents.

In regard to position in the company, the majority (42%) were quantity surveyors, followed by 14.3 per cent who were construction project managers, 12.6 percent who were architects, 10.9 per cent who were civil engineers, 10.1 per cent who were project managers, 8 per cent who
held other positions and a minority of 0.8 per cent who were construction managers. In relation to years of experience in construction industry, the majority of respondents who had 10 to 15 years of experience was (35.3%), followed by five to ten years was 30.5 per cent, one to five years was 16.8 per cent, 15 to 20 years was 8.4 per cent, less than one year of experience was 5 per cent and a minority who had more than 20 years of experience was 3.4 per cent. This minority could be because older people have retired from their full time jobs.

Regarding educational background, the majority (65.5%) had a bachelor’s degree, followed by 17.6 per cent who had a master’s degree, 14.3 per cent who had a post-matric diploma and lastly 0.8 per cent who had a post-matric certificate. The minority indicates that more respondents had higher qualifications. In relation to respondents’ current work entity, the majority (51.3%) worked for public sector clients, followed by 21.8 per cent who worked for consultant quantity surveying firms, 10.1 per cent who worked for private sector clients, 5 per cent who worked for other sectors, 4.2 per cent who worked for consultant project management firms, 2.5 per cent who worked for both consultant civil engineering firms and construction firms and lastly, 1.7 per cent worked for consultant engineering firms (mechanical and electrical). This indicates that more respondents who participated worked in the public sector.

Regarding respondents’ company size, the majority (49.6%) worked for a large company of more than 200 employees, followed by 19.3 per cent who worked for a small company of up to 50 employees, 15.1 per cent who worked for a medium-sized company of up to 200 employees and a minority (13.4%) who worked for a very small company of up to 20 employees.

8.2 PROJECT CHARACTERISTICS
This section discusses the project characteristics such as the number of respondents’ projects that have exceeded the original contract sum in the past five years, the reasons for project exceeding the original contract sum, the original project cost, and the average cost overrun, project types where respondents experienced cost overruns and the facility type where respondents experienced cost overruns.
8.2.1 Project characteristics information data results

The findings reveal that in the case of 21 per cent of the respondents, three to four projects exceeded the original contract sum, followed by 20.2 per cent with projects within budget, 19.3 per cent who had more than eight projects exceeding the original sum, 16.8 per cent who had five or six projects, 16 per cent who had one or two projects and lastly 5.9 per cent who had between seven and nine projects that exceeded the original contract sum. In relation to the reasons for the projects exceeding the original sum, out of 22 factors the top five factors were variation orders which was ranked the highest at 10.8 per cent, followed by frequent design changes (9.0%), incomplete design at the time of tender (7.6%), cash flow and financial difficulties faces by the contractor (7.4%) and policy of accepting lowest tender (7.0%).

Regarding original project cost, the majority (21.8%) had an original project cost within R 13 000 001 to R 40 000 000, followed by 18.5 per cent of the respondents with original project costs within R 40 000 001 to R 130 000 000; 11.8 per cent with original project costs within R 6 500 001 to R 13 000 000; 10.9 per cent with original project costs above R 130 000 000; 7.6 per cent with original project costs within R 650 001-R 2 000 000; 5.9 per cent with original costs within R 4 000 001 to R 6 500 000 while 2.5 per cent met the original project cost and 0.8 per cent exceeded the original cost by R 0 to R 650 000. The majority (22.7%) of the respondents indicated that their average cost overrun was R 1 000 001 to R 2 000 000, followed by 16.8 per cent who had an average cost overrun of R 4000 001 to R 500 000; 15.1 per cent had an average cost overrun of R 500 001 to R 1000000; 12.6 per cent had an average cost overrun of R 300 001 to R 400 000; the second lowest (2.5%) had an average cost overrun of R 100 001 to R 200 000 and lowest (1.7%) had an overrun of R 200 001 to R 300 000. In relation to the project type, the majority (47%) were new constructions, followed by 27 per cent for refurbishment, 24 per cent were renovations and 2 per cent were other projects. Regarding the facility type, the majority (17.2%) experienced cost overruns on schools, followed by 14.5 per cent of overruns on office projects, 13.4 per cent were hospital projects, 12.9 per cent were clinics, 9.7 per cent were police stations, 8.6 per cent were prisons, 8.1 per cent were other projects, 5.9 per cent were high courts/magistrates’ courts, 3.8 per cent were renovations of housing projects, 3.2 per cent were housing developments (Green Fields) and lastly, 2.7 per cent were construction of multipurpose community centres. This shows that variation orders are common factors causing cost overrun, and a projects with the original contract sum of R 13 000 001 to R 40 000 000 were ranked highest and the highest average cost overrun was R 1 000 001 to R 2 000 000 which is a very significant value. The results also
reveal that new construction projects face a bigger risk of cost overrun than refurbishments and renovations, and more cost overruns were experienced in the construction of new schools.

8.3 RESEARCH QUESTION 1
What are the causes of cost overruns in public sector construction projects?

8.3.1 Findings
The respondents were asked to indicate the causes of cost overrun using the 5-point Likert scale, and Table 7.2 shows their responses based on the ranking of the weighted average from the mean item score (MIS) and the standard deviation. The respondents ranked variation orders first (MIS = 4.26; SD = 1.070; R = 1), followed by change in scope of the project (MIS = 4.24; SD = 0.844; R = 2), cash flow and financial difficulties faced by contractors (MIS = 4.24; SD = 1.000; R = 2), delays in decision making (MIS = 4.18; SD = 0.881; R = 3), inadequate planning (MIS = 4.05; SD = 0.950; R = 4), frequent design changes (MIS = 4.03; SD = 1.070; R = 5), lack of coordination between parties (MIS = 4.02; SD = 0.963; R = 6), policy of accepting the lowest tender (MIS = 4.01; SD = 1.059; R = 7), inaccurate time and cost estimates (MIS = 3.98; SD = 0.991; R = 8), errors and omissions in design (MIS = 3.97; SD = 1.042; R = 9), inaccurate quantity take-off and contractors’ project inexperience (MIS = 3.95; SD = 1.028; R = 10), extension of time claims (MIS = 3.92; SD = 1.039; R = 11), change in material specification and type (MIS = 3.88; SD = 1.006; R = 12), poor contract management (MIS = 3.87; R = 13), delay in progress payment by the owner (MIS = 3.85; R = 14), poor project management (MIS = 3.82; SD = 0.943; R = 15), fluctuations in material prices (MIS = 3.82; SD = 0.899; R = 15), poor workmanship (MIS = 3.80; SD = 1.013; R = 16), lack of communication between parties (MIS = 3.79; SD = 0.972; R = 17), mistakes and discrepancies in contract document (MIS = 3.75; SD = 0.973; R = 18), late delivery of materials (MIS = 3.72; SD = 1.060; R = 19), incomplete design at the time of tender (MIS = 3.72; SD = 1.181; R = 19), incompetent sub-contractors (MIS = 3.71; SD = 1.047; R = 20), mistakes during construction (MIS = 3.70; SD = 1.044; R = 21), slow information flow between parties (MIS = 3.70; SD = 1.009; R = 21), unforeseen ground conditions (MIS = 3.69; SD = 1.033; R = 22), delay in payment to supplier/sub-contractor (MIS = 3.68; SD = 1.127; R = 23), delay in preparation and approval of drawings (MIS = 3.68; SD = 1.027; R = 23), poor site supervision (MIS = 3.68; SD = 1.017; R = 23), strikes (MIS = 3.67; SD = 1.091; R = 24), poor site management (MIS = 3.65; SD = 1.057; R = 25), financial difficulty by owner (MIS = 3.60; SD = 1.267; R = 26), fraudulent practices (kickbacks, corruption) (MIS = 3.59; SD = 1.384; R =
27), labour disputes (MIS = 3.55; SD = 1.004; R = 28), inadequate funding of the project (MIS = 3.48; SD = 1.179; R = 29), schedule delay (MIS = 3.46; SD = 0.990; R = 30), delay in inspection and approval of completed works (MIS = 3.43; SD = 1.128; R = 31), site conflicts (MIS = 3.43; SD = 0.998; R = 31), lack of executive capacity by employer (MIS = 3.41; SD = 1.184; R = 32), negative effects of weather (MIS = 3.40; SD = 1.130; R = 33), high cost of labour (MIS = 3.37; SD = 1.126; R = 34), while shortage of workers was ranked second last (MIS = 3.32; SD = 1.172; R = 35) and a lack of experience of technical consultants was ranked last (MIS = 3.24; SD = 1.117; R = 36).

The findings from the current study were similar to the findings by Amusan (2011) and Olapado (2007), where variation orders and change in project design were revealed as the major causes of cost overruns in construction projects. However, the results of the study did not agree with those of the study by Ameh et al (2010), where a lack of experience of contractors, the cost of materials and fluctuations in the prices of materials were revealed as the major causes of cost overruns in construction projects in Nigeria. Further, the results of the current study did not agree with the study by Lo et al (2006) where the study identified an exceptionally low bid, inadequate resources due to contractor/lack of capital and inexperienced contractors as the major causes of cost overruns. Moreover, the results of the current study did not agree with the study by Mukuka et al (2014) where the study identified the contractors’ project inexperience and poor project management as the major factors of cost overruns. Causes of cost overruns share common characteristics in projects worldwide, and they are also affected by country-specific conditions (Olawale and Sun, 2010).

8.4 RESEARCH QUESTION 2
What are the effects of cost overruns in public sector construction projects?

8.4.1 Findings
The respondents were asked to indicate the effects of cost overrun using the five-point Likert scale, and Table 7.2 shows their responses. The respondents ranked time overrun first (MIS = 4.55; SD = 0.732; R = 1), followed by increased project cost due to extension of time (MIS = 4.29; SD = 0.752; R = 2), disputes between owner and contractor (MIS = 4.10; SD = 0.845; R = 3), bankruptcy (MIS = 3.98; SD = 1.147; R = 4), wastage of taxpayer’s money (MIS = 3.96; SD = 1.147; R = 5), companies’/firms’ liability to insolvency (MIS = 3.86; SD = 1.023; R = 6), reduced profit to contractor (MIS = 3.80; SD = 1.154; R = 7), arbitration (MIS = 3.64; SD
1.151; R = 8), total project abandonment (MIS = 3.58; SD = 1.191; R = 9), idling resources (MIS = 3.56; SD = 1.004; R = 10), delaying in getting profit by the clients (MIS = 3.49; SD = 1.047; R = 11), creating stress on contractors and loss of confidence from the public (MIS = 3.45; R = 1.126) while demolition and reconstruction were ranked second last (MIS = 3.27; SD =1.196; R = 14) and litigation was ranked last (MIS = 2.97; SD = 1.175; R = 15).

These results were similar to the findings from the studies by Owolabi et al (2014) and Mbahu and Nkado (2004), where time delay and additional overhead and potential claims between client and contractor were revealed as the major effects of cost overruns in construction projects. Furthermore, the results were in agreement with the study by Mukuka et al (2014), where increased project cost due to extension of time was identified as a major effect of cost overrun. However, the results of the current study were not in agreement with the study by Ubani et al (2013) where the results showed inconsistency in agreement terms due to changes in political powers and scope creep as the major effects of cost overruns in construction projects. Further, the results did not concur with the results of the study by Ansah (2011), where suspension of the works and the closing down of companies were identified as the major effects of cost overruns. Moreover, the results were not in agreement with the study conducted by Gaetsewe et al (2015) where abandonment of the site by the contractors due to cash flow problems and non-payment by the client which leads to litigation were identified as the major effects of cost overruns.

8.5 RESEARCH QUESTION 3
What measures can be taken to minimise the impact of cost overruns in public sector construction projects?

8.5.1 Findings
The respondents were asked to indicate to what extent they agree that the measures on Table 7.3 can be taken to minimise cost overruns in the public sector with regard to construction projects in South Africa. The respondents ranked the use of experienced suppliers first (MIS = 4.74; SD = 0.846; R = 1), followed by proper project planning(MIS = 4.50; SD = 0.649; R = 2), the appointment of highly experienced committed design teams (MIS = 4.49; SD = 0.711; R = 3), effective strategic planning (MIS = 4.48; SD = 0.675; R = 4), proper project scheduling (MIS = 4.45; SD = 0.648; R = 5), completed designs at the time of tender (MIS = 4.45; SD =
0.789; R = 5), a decrease in the number of variation orders (MIS = 4.44; SD = 0.744; R = 6), adequate designs (MIS = 4.41; SD = 0.656; R = 7), timely supply of materials (MIS = 4.40; SD = 0.642; R = 8), comprehensive contract administration (MIS = 4.39; SD = 0.667; R = 9), appointment of highly experienced technical consultants (MIS = 4.38; SD = 0.725; R = 10), good workmanship (MIS = 4.37; SD = 0.649; R = 11), use of appropriate construction methods (MIS = 4.34; SD = 0.728; R = 12), effective site management (MIS = 4.33; SD = 0.705; R = 13), improving contract award procedures by giving less weight to prices and more weight to the capabilities and past performance of contractors (MIS = 4.32; SD = 0.833; R = 14), proper emphasis on past experience (MIS = 4.30; SD = 0.913; R = 15), effective site supervision (MIS = 4.28; SD = 0.715; R = 16), frequent progressive meetings (MIS = 4.19; SD = 0.902; R = 17), use of experienced sub-contractors and suppliers (MIS = 4.12; SD = 0.776; R = 18), clear information and communication channels (MIS = 4.00; SD = 0.650; R = 19), frequent coordination between the parties (MIS = 3.89; SD = 0.699; R = 20), use of up-to-date technology (MIS = 3.75; SD = 0.866; R = 21), use of experienced contractors (MIS = 2.97; SD = 0.736; R = 22), while reliable pre-contract estimates was ranked last (MIS = 2.03; SD = 0.721; R = 23).

The results of this study were similar to the findings revealed by Memon et al (2012), where effective strategic planning, use of experienced sub-contractors and suppliers and proper project planning and scheduling were revealed as the major measures that can be taken to minimise the impact of cost overruns in construction projects. However, the study by Ali and Kamaruzzaman (2010) indicated different results, where proper project costing, financing, proper cost control and competent personnel were revealed as the major measures that can be taken to minimise the impact of cost overruns in construction projects. Furthermore, the study by Chan and Kammaraswamy (2002) indicated different results where enhancing the buildability of project design by integrating early inputs of the contractor in the design phase and encouraging standardisation, modularisation and repetition in the design of building elements and construction details were indicated as the major measures that can be taken to minimise the impact of cost overruns in construction projects. Moreover, the results from the study by Tamakloe (2011), were not in agreement with the results from this study since appropriate funding, continuous work-training programmes to improve contractors’ managerial skills and the establishment of effective and efficient material procurement systems were identified as the major measures that can be taken to minimise the impact of cost overruns in construction projects. Literature reviewed indicated that despite the availability of various
control techniques and project control software, many construction projects still do not achieve their cost and time objectives. In the construction industry, it is important to have control of cost performance of projects to ensure the construction cost is within the budget. So project cost management is needed to keep the project within its defined budget (Ali and Kamaruzzaman, 2010).

8.6 RESEARCH QUESTION 4
What are the critical success factors for a construction project?

8.6.1 Findings
The respondents were asked to indicate the critical success factors for construction projects and Table 7.4 show their responses. The respondents ranked the experience of the project manager first (MIS = 4.68; SD = 0.503; R = 1), followed by the experience of the contractor (MIS = 4.61; SD = 0.556; R = 2), the commitment of project team members (MIS = 4.60; SD = 0.526; R = 3), proper planning (MIS = 4.60; SD = 0.642; R = 3), awarding bid to the right contractor (MIS = 4.60; SD = 0.601; R = 3), effective decision making (MIS = 4.56; SD = 0.547; R = 4), clear and realistic goals (MIS = 4.56; SD = 0.564; R = 4), competence of project team members (MIS = 4.53; SD = 0.534; R = 5), adequacy of funding (MIS = 4.51; SD = 0.636; R = 6), learning from previous experience (MIS = 4.44; SD = 0.732; R = 7), top management experience and support (MIS = 4.39; SD = 0.678; R = 8), sufficient resources (MIS = 4.36; SD = 0.607; R = 9), good written contract (MIS = 4.32; SD = 0.700; R = 10), access to resources (MIS = 4.24; SD = 0.673; R = 11), stakeholder satisfaction (MIS = 4.19; SD = 0.833; R = 12), stable political environment (MIS = 4.13; SD = 0.907; R = 13), client experience (MIS = 3.92; SD = 0.967; R = 14), while effective communication was ranked second last (MIS = 3.03; SD = 0.607; R = 15) and project monitoring was ranked last (MIS = 2.82; SD = 0.580; R = 16).

The results for this study were in agreement with the results of a study by Gudiene et al (2013), where the experience of the project manager, the experience of the contractor, the competence of project team members and clear and realistic goals were determined as the most important success factors for construction projects. However, the results of the current study were not in agreement with the study by Alexandrova and Ivanova (2012), where compliance with the rules and procedures established by the operational programme and the quality of sub-contractor services were identified as the most important success factors. Literature reveals that a construction project is completed as a result of a combination of many events and interactions,
planned or unplanned, over the life of a facility, with changing participants and processes in a constantly changing environment (Sanvido, Grobler, Pariff, Guvents and Coyle 1992). Certain factors are more critical to project success than others. Cost, time, and quality have their proven importance as the prime factors for project success. Therefore to implement a project successfully, priorities should be selecting project team members, identifying the development needs of the project team members, and, most important, forecasting the performance level of a construction project before it commences (Muhammad et al, 2008).

8.7 CONCLUSION
The objectives of the research work have been achieved through studying the causes and effects of cost overruns in public sector construction projects in Gauteng, South Africa, as well as considering the remedial measures to minimise cost overruns and the critical success factors of a construction project.

Conclusion drawn from the discussions and research findings are presented as follows:

8.7.1 Research objective 1
The first objective was to establish the causes of cost overruns in public sector construction projects in Gauteng, South Africa.

Cost overruns are universal phenomena. The research concluded by identifying the following factors as the major common causes of cost overrun on construction sites from the literature: increase in material cost, changes in scope of work, lack of cost plan and monitoring of funds, fraudulent practices, variation orders and political interference. The findings from the questionnaire indicated the following as the major causes of cost overruns: variation orders, changes in scope of the project, cash flow and financial difficulties faced by contractors, delays in decision making, inadequate planning, frequent design changes and lack of coordination between parties.

8.7.2 Research objective 2
The second objective of the research was to investigate the effects of cost overruns in public sector construction projects in Gauteng, South Africa.
The research concluded by identifying these factors as the major common effects of cost overruns: extension of time claims, time overrun and loss of profit to the contractor through penalties for non-completion. The following effects of cost overruns were perceived by the respondents as the most significant: time overrun, additional overhead and potential claims between client and contractor.

8.7.3 Research objective 3
The third objective of the research was to establish the measures of minimising cost overruns in public sector construction projects in Gauteng, South Africa.

In order to prevent cost overruns or minimise their occurrence, the following are recommended: effective site management, proper project planning, proper project scheduling, effective site supervision, appointment of highly experienced committed design teams, appointment of highly experienced technical consultants, use of experienced contractors, use of appropriate construction methods, clear information and communication channels, frequent coordination between the parties, effective strategic planning, good workmanship, a decreased number of variation orders, completed designs in time of tender, reliable pre-contract estimates and adequate designs. The following were perceived as the most significant mitigation measures by the respondents: the experience of the project manager, the experience of the contractor, the commitment of project team members, proper planning, awarding the bid to the right contractor and effective decision making.

8.7.4 Research objective 4
The fourth objective of the research was to establish the critical success factors for a construction project in public sector construction projects in Gauteng, South Africa. To complete a project successfully is key/crucial in the construction industry. The major critical success factors indicated by the respondents are the following: sufficient resources, access to resources, a good written contract, awarding the bid to the right contractor, the commitment of the project team members, the competence of project team members, the experience of the project managers, top management experience and support, and the experience of the contractor.
8.8 GENERAL RESEARCH CONCLUSION

The data obtained from the questionnaires as completed by the respondents were presented and analysed in relation to the research questions. The findings from the research analysis were able to address the research questions. As part of the study, the method used in gathering information was the use of questionnaires. The data that were collected were analysed using computer software SPSS. The study has shown that proper planning is essential to any construction project. All projects must be properly planned with enough details so that everyone involved knows where the project is going. A good/sound plan provides the following benefits: a valid and realistic timeline, clearly documented project milestones and deliverables, details of resource requirements, accurate cost estimates, and an early warning system. These provide visibility of task slippage and keep the project team focused and aware of progress.

Furthermore, contractors and project managers should ensure that they have the right personnel with appropriate qualifications to manage their projects efficiently. It is preferable for construction project managers to have experience and qualifications in projects or construction management. The competence of project managers is the most important factor to the success of the project. Project managers should have administrative skills and be committed to the project from its inception to close out.

Contractors should draw up guidelines during construction because if they do not follow the planning and scheduling effectively due to financial problems, poor management of the site, inexperienced staff or a shortage of workers, the project will fail. Similarly, committed project team members can potentially lead to fewer disputes and conflicts that negatively affect construction activities on site. Projects are critical to the success of any organisation, therefore effective strategic planning gives confidence in project performance. More importantly, it is more satisfying to complete a project on schedule, with good quality and within budget. Moreover, it is important to meet the strategic goals of the client organisation and achieve satisfaction of the end users, and of all other stakeholders. The results of the study as indicated by the questionnaires have revealed that all the research questions have been answered and the objectives of the study have been met.
8.9 RECOMMENDATIONS

Based on the findings of the research, the following recommendations are proposed:

- The appointment of contractors should be in accordance with their capabilities and evidence of ability in knowledge and skills required to complete the project.
- Owners should prepare sufficient funds for the project and pay on time as shown in the contract agreement to the contractor.
- The personnel performing estimating duties should be provided with the right training and information by stakeholders.
- As early in the estimating process as possible. Prompt resolution to design change queries, issues and authorisation requests should be ensured and all design change should be captured on a register with corresponding cost and schedule implications for discussion during project team meetings.
- The project should be designed to great detail at the outset whenever possible.
- Enough time should be allocated during tender planning for the proper development of the project programme.
- Experienced personnel that have handled similar types of complexity in the past should be allocated to the project.
- Clear information and communication channels should be provided.
- There should be some way to manage the flow of information. The suggested methods of transferring information should include drawings, manuals, meetings and letters.
- It is essential to make sure the project is properly understood before embarking on it.
- A stringent process must be in place for selecting sub-contractors into the supply chain and properly directing the sub-contractors to ensure they know what is expected of them in relation to the project.
- Appropriate funding levels should always be determined at the planning stage of the project so that regular payment should be paid to contractors for work done.
- Adequate and realistic project duration should be ensured, allowing for potential project delays.
- There needs to be a prompt system of payment to sub-contractors for jobs that have been done and to prevent sub-contractors’ financial difficulties.
- Adequate allowance should be prepared for any emergency case in order to cover increasing in material cost and labour cost due to inflation.
• There should be an attempt to better define the scope of the project for cost estimates at an early project phase.

8.10 FURTHER RESEARCH
The study identified the significant causes and effects of cost overruns and in public sector construction projects in Gauteng, South Africa as well as the effective mitigation measures and critical success factors thereof.

There should be more studies to investigate the following:

• The degree to which companies have an impact on the cost overruns to provide awareness to professionals in the public sector regarding cost overrun problems in Gauteng Province.
• The impact of the use of inexperienced contractors in construction projects in South Africa.
• The skills level of South African construction professionals.
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[Accessed 13 June 2013].

[Accessed 20th November 2015].


APPENDIX 1: COVER LETTER

University of Johannesburg
Department of Construction Management and Quantity Surveying
Doornfontein, 2028

TO WHOM IT MAY CONCERN

Dear Sir/Madam;

LETTER OF INVITATION FOR RESEARCH SURVEY

We are inviting you to participate in this research study by completing the attached questionnaire. This research project is an M-Tech study being conducted at the Faculty of Engineering and the Built Environment, Department of Construction Management and Quantity Surveying, University of Johannesburg, Doornfontein campus, South Africa. The research topic is: “CAUSES AND EFFECTS OF COST OVERRUNS IN PUBLIC SECTOR CONSTRUCTION PROJECTS IN SOUTH AFRICA”.

As part of this research we need to test the validity of the measures in minimizing cost overruns in Public Sector construction projects. We would like you to assist us identify the causes, effects and methods of minimizing cost overruns in Public Sector construction projects in South Africa. In order to ensure that all information will remain confidential, please do not include your name. The following questionnaire will take approximately 25 minutes.

Should you wish to know the findings of the research, you are welcome to contact Khabisi L.J telephonically on: +27835172878 or email: jrapiletsa@yahoo.co.uk or Prof. C.O Aigbavboa on: +27115596398 or email: caigbavboa@uj.ac.za. The faculty will gladly send you a summary of the results if required.

Thank you for your consideration. Your help is greatly appreciated.

KHABISI L.J
APPENDIX 2: QUESTIONNAIRE

QUESTIONNAIRE

CAUSES AND EFFECTS OF COST OVERRUNS IN PUBLIC SECTOR CONSTRUCTION PROJECTS IN SOUTH AFRICA

INSTRUCTIONS:

PLEASE ANSWER THE FOLLOWING QUESTIONS BY CROSSING (X) THE RELEVANT BLOCK OR WRITING DOWN YOUR ANSWER IN THE SPACE PROVIDED.

EXAMPLE of how to complete a questionnaire:

Your gender? If you are female:

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SECTION A – BACKGROUND INFORMATION

This section covers the general information about respondents. Although we are aware of the sensitivity of the questions in this section, the information will allow us to compare groups of respondents. Once again, we assure you that your response will remain anonymous. Your cooperation is appreciated.

1. Gender

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4. What is your position in the company?

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<td>Quantity Surveyor</td>
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<td>Project Manager</td>
<td>3</td>
</tr>
<tr>
<td>Construction Manager</td>
<td>4</td>
</tr>
<tr>
<td>Construction Project Manager</td>
<td>5</td>
</tr>
<tr>
<td>Civil Engineer</td>
<td>6</td>
</tr>
<tr>
<td>Others</td>
<td>7</td>
</tr>
</tbody>
</table>

Please specify: ...........................................................................................................
........................................................................................................................................
...........................................................................................................................................

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

<table>
<thead>
<tr>
<th>Experience</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 year</td>
<td>1</td>
</tr>
<tr>
<td>1 – 5 years</td>
<td>2</td>
</tr>
<tr>
<td>5 – 10 years</td>
<td>3</td>
</tr>
<tr>
<td>10 – 15 years</td>
<td>4</td>
</tr>
<tr>
<td>15 – 20 years</td>
<td>5</td>
</tr>
<tr>
<td>More than 20 years</td>
<td>6</td>
</tr>
</tbody>
</table>

6. State your highest educational qualification?

<table>
<thead>
<tr>
<th>Qualification</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No qualification</td>
<td>1</td>
</tr>
<tr>
<td>Grade 11 or lower (std 9 or lower)</td>
<td>2</td>
</tr>
<tr>
<td>Grade 12 (Matric, std 10)</td>
<td>3</td>
</tr>
<tr>
<td>Post-Matric Certificate</td>
<td>4</td>
</tr>
<tr>
<td>Post-Matric Diploma</td>
<td>5</td>
</tr>
<tr>
<td>Bachelor’s Degree</td>
<td>6</td>
</tr>
<tr>
<td>Master’s Degree</td>
<td>7</td>
</tr>
<tr>
<td>Doctorate</td>
<td>8</td>
</tr>
</tbody>
</table>
7. For which one of the following people/entities do you currently work for/as?

<table>
<thead>
<tr>
<th>Role</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public sector Client</td>
<td>1</td>
</tr>
<tr>
<td>Private sector Client</td>
<td>2</td>
</tr>
<tr>
<td>Consultant – Quantity surveying firm</td>
<td>3</td>
</tr>
<tr>
<td>Consultant – Project management firm</td>
<td>4</td>
</tr>
<tr>
<td>Consultant – Engineering firm (Mech. &amp; Elect)</td>
<td>5</td>
</tr>
<tr>
<td>Consultant – Civil</td>
<td>6</td>
</tr>
<tr>
<td>Contractor – Main contractor</td>
<td>7</td>
</tr>
<tr>
<td>Contractor – Sub-contractor</td>
<td>9</td>
</tr>
<tr>
<td>Others</td>
<td>10</td>
</tr>
</tbody>
</table>

Please specify: …………………………………………………………………………………
………………………………………………………………………………………………

8. What is the size of the company you currently work for?

<table>
<thead>
<tr>
<th>Size</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Small (up to 20 employees)</td>
<td>1</td>
</tr>
<tr>
<td>Small (up to 50 employees)</td>
<td>2</td>
</tr>
<tr>
<td>Medium (up to 200 employees)</td>
<td>3</td>
</tr>
<tr>
<td>Large (more than 200 employees)</td>
<td>4</td>
</tr>
</tbody>
</table>

SECTION B: PROJECT CHARACTERISTICS

9. How many projects were you involved in at your current company that were beyond the original contract sum in the past five (5) years?

<table>
<thead>
<tr>
<th>Number of Projects</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td>1 – 2 projects</td>
<td>2</td>
</tr>
<tr>
<td>3 – 4 projects</td>
<td>3</td>
</tr>
<tr>
<td>5 – 6 projects</td>
<td>4</td>
</tr>
<tr>
<td>7 – 8 projects</td>
<td>5</td>
</tr>
<tr>
<td>More than 8 projects</td>
<td>6</td>
</tr>
</tbody>
</table>
Please answer the following questions; with regards to the projects you encountered that were beyond the original contract sum in the **past five years**; If your answer was none in question 9, please go to section C of the questionnaire below.

10. What were the reasons for these projects going over the original contract sum? Mark all that are applicable.

<table>
<thead>
<tr>
<th>Reason</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequent design changes</td>
<td>1</td>
</tr>
<tr>
<td>Incomplete design at the time of tender</td>
<td>2</td>
</tr>
<tr>
<td>Policy in accepting lowest tender</td>
<td>3</td>
</tr>
<tr>
<td>Fraudulent practices (kickbacks, corruption)</td>
<td>4</td>
</tr>
<tr>
<td>Poor site management</td>
<td>5</td>
</tr>
<tr>
<td>Poor site supervision</td>
<td>6</td>
</tr>
<tr>
<td>Limited funds</td>
<td>7</td>
</tr>
<tr>
<td>Contractors project inexperience</td>
<td>8</td>
</tr>
<tr>
<td>Incompetent subcontractors</td>
<td>9</td>
</tr>
<tr>
<td>Cash flow and financial difficulties faced by contractors</td>
<td>10</td>
</tr>
<tr>
<td>Delay in progress payment by the owner</td>
<td>11</td>
</tr>
<tr>
<td>Poor project management</td>
<td>12</td>
</tr>
<tr>
<td>Delays in decision making</td>
<td>13</td>
</tr>
<tr>
<td>Inaccurate quantity take-off</td>
<td>14</td>
</tr>
<tr>
<td>Lack of communication between parties</td>
<td>15</td>
</tr>
<tr>
<td>Negative Effects of weather</td>
<td>16</td>
</tr>
<tr>
<td>Unforeseen ground condition</td>
<td>17</td>
</tr>
<tr>
<td>Labour disputes</td>
<td>18</td>
</tr>
<tr>
<td>Strikes</td>
<td>19</td>
</tr>
<tr>
<td>Lack of experience of technical consultants</td>
<td>20</td>
</tr>
<tr>
<td>Variation orders</td>
<td>21</td>
</tr>
<tr>
<td>Others</td>
<td>22</td>
</tr>
</tbody>
</table>

Please specify: .........................................................................................................................................................
11. What was the original project cost?

<table>
<thead>
<tr>
<th>Cost Range</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>R 0 – R 650 000</td>
<td>1</td>
</tr>
<tr>
<td>R 650 001 – R 2 000 000</td>
<td>2</td>
</tr>
<tr>
<td>R 2 000 001 – R 4 000 000</td>
<td>3</td>
</tr>
<tr>
<td>R 4 000 001 – R 6 500 000</td>
<td>4</td>
</tr>
<tr>
<td>R 6 500 001 – R 13 000 000</td>
<td>5</td>
</tr>
<tr>
<td>R 13 000 001 – R 40 000 000</td>
<td>6</td>
</tr>
<tr>
<td>R 40 000 001 – R 130 000 000</td>
<td>7</td>
</tr>
<tr>
<td>Above R 130 000 000</td>
<td>8</td>
</tr>
</tbody>
</table>

12. On average, what was the amount of cost overruns on these projects?

<table>
<thead>
<tr>
<th>Cost Range</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>R0 – R100 000</td>
<td>2</td>
</tr>
<tr>
<td>R100 001 – R200 000</td>
<td>3</td>
</tr>
<tr>
<td>R200 001 – R300 000</td>
<td>4</td>
</tr>
<tr>
<td>R300 001 – R400 000</td>
<td>5</td>
</tr>
<tr>
<td>R400 001 – R500 000</td>
<td>6</td>
</tr>
<tr>
<td>R500 001 – R1 000 000</td>
<td>7</td>
</tr>
<tr>
<td>R1 000 001 – R2 000 000</td>
<td>8</td>
</tr>
<tr>
<td>Over R2 000 000</td>
<td>9</td>
</tr>
</tbody>
</table>

13. What were the project type/s where you experienced cost overruns? Mark all that are applicable.

<table>
<thead>
<tr>
<th>Project Type</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Construction</td>
<td>1</td>
</tr>
<tr>
<td>Refurbishment</td>
<td>2</td>
</tr>
<tr>
<td>Renovation</td>
<td>3</td>
</tr>
<tr>
<td>Others</td>
<td>4</td>
</tr>
</tbody>
</table>

Please specify: ……………………………………………………………………………………………………………………..
………………………………………………………………………………………………………………………………………..
14. What was the facility type that best describes the project? Mark all that are applicable.

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schools</td>
<td>1</td>
</tr>
<tr>
<td>Hospitals</td>
<td>2</td>
</tr>
<tr>
<td>Clinics</td>
<td>3</td>
</tr>
<tr>
<td>Prisons</td>
<td>4</td>
</tr>
<tr>
<td>Offices</td>
<td>5</td>
</tr>
<tr>
<td>High courts/Magistrates Courts</td>
<td>6</td>
</tr>
<tr>
<td>Police stations</td>
<td>7</td>
</tr>
<tr>
<td>Upgrading of Taxi Ranks</td>
<td>8</td>
</tr>
<tr>
<td>Multi-purpose community centers</td>
<td>9</td>
</tr>
<tr>
<td>Housing Developments (Green Field)</td>
<td>10</td>
</tr>
<tr>
<td>Housing Projects (Renovations)</td>
<td>11</td>
</tr>
<tr>
<td>Others</td>
<td>12</td>
</tr>
</tbody>
</table>

Please specify: ………………………………………………………………………………………………
………………………………………………………………………………………………

SECTION C: CAUSES OF COST OVERRUNS

This section of the questionnaire discusses causes leading to cost overruns in Public Sector construction projects in South Africa.

Please indicate your answer using the following 5-point scale where
1. = Strongly disagree (SD)
2. = Disagree (D)
3. = Neutral (N)
4. = Agree (A)
5. = Strongly agree (SA)

15. To what extent do you agree that the following are causes of cost overruns in the Public Sector with regards to construction projects in South Africa?

<table>
<thead>
<tr>
<th>No</th>
<th>Causes of Cost Overruns</th>
<th>SD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Frequent design changes</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Errors and omissions in design</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Lack of coordination between parties</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Incomplete design at the time of tender</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Inadequate planning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Delay in preparation and approval of drawings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Lack of executive capacity by employer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Policy in accepting lowest tender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Fraudulent practices (kickbacks, corruption)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Poor site management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Poor site supervision</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Inadequate fund of the project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Contractors project inexperience</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Incompetent subcontractors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Inaccurate time and cost estimates</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Mistakes during construction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Cash flow and financial difficulties faced by contractors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Delay in progress payment by the owner</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Delay in payment to supplier/subcontractor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Extension of time claims</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Financial difficulty by owner</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Poor workmanship</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Site conflicts</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Schedule delay</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Poor project management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Change in scope of the project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Delays in decision making</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Inaccurate quantity take-off</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Slow information flow between parties</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Lack of communication between parties</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Negative Effects of weather</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Unforeseen ground condition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Delay in inspection and approval of completed works</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Mistakes and discrepancies in contract document</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>Fluctuations in material prices</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>36</td>
<td>Change in material specification and type</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>37</td>
<td>Poor contract management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>High cost of labour</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>Labour disputes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>Strikes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>Late delivery of materials</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>Lack of experience of technical consultants</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>Shortage of site workers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>Variation orders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SECTION D: EFFECTS OF COST OVERRUNS

This section of the questionnaire assesses the effects of cost overruns in Public Sector construction projects.

Please indicate your answer using the following 5- point scale where

1.  = Extremely unlikely (EU)
2.  = Unlikely (U)
3.  = Neutral (N)
4.  = Likely (L)
5.  = Extremely likely (EL)

16. To what extent do you think the following are likely to be the effects of cost overruns in the Public Sector with regards to construction projects in South Africa?

<table>
<thead>
<tr>
<th>NO</th>
<th>EFFECTS OF COST OVERRUNS</th>
<th>EU</th>
<th>U</th>
<th>N</th>
<th>L</th>
<th>EL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Time overrun</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Disputes between owner and contractor</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Arbitration</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Bankruptcy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Idling resources</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>Create stress on contractors</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>Total project abandonment</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8</td>
<td>Demolition and reconstruction</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>Loss of confidence from the public</td>
<td>1</td>
<td>2</td>
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<tr>
<td>10</td>
<td>Increased project cost due to extension of time</td>
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<tr>
<td>11</td>
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<tr>
<td>12</td>
<td>Wastage of tax payer’s money</td>
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<td>13</td>
<td>Company/firms liability to insolvency</td>
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<tr>
<td>14</td>
<td>Reduced profit to contractor</td>
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<tr>
<td>15</td>
<td>Delaying in getting profit by the clients</td>
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</tr>
<tr>
<td>16</td>
<td>Delaying by the clients to return loans</td>
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SECTION E: MEASURES OF MINIMISING COST OVERRUNS IN PUBLIC SECTOR CONSTRUCTION PROJECTS

This section of the questionnaire assesses the measures that can be taken to minimise cost overruns in Public Sector construction projects.

Please indicate your answer using the following 5-point scale where

1. = Strongly disagree (SD)
2. = Disagree (D)
3. = Neutral (N)
4. = Agree (A)
5. = Strongly agree (SA)

17. To what extent do you agree that the following measures can be taken to minimise cost overruns in the Public Sector with regards to construction projects in South Africa?

<table>
<thead>
<tr>
<th>NO</th>
<th>MEASURES TAKEN TO MINIMISE COST OVERRUNS IN CONSTRUCTION PROJECTS</th>
<th>SD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>SA</th>
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<tr>
<td>1</td>
<td>Effective strategic planning</td>
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<td>2</td>
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<td>2</td>
<td>Proper project planning</td>
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</tr>
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<td>Proper project scheduling</td>
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<td>4</td>
<td>Effective site management</td>
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<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Effective site supervision</td>
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<td>3</td>
<td>4</td>
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</tr>
<tr>
<td>6</td>
<td>Frequent progress meetings</td>
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<td>2</td>
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<td>5</td>
</tr>
<tr>
<td>7</td>
<td>Proper emphasis on past experience</td>
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<td>2</td>
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<tr>
<td>8</td>
<td>Use of experienced subcontractors and suppliers</td>
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<td>Use of experienced suppliers</td>
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</tr>
<tr>
<td>11</td>
<td>Clear information and communication channels</td>
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<td>2</td>
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<tr>
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<td>Frequent coordination between the parties</td>
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<td>Appointment of highly experienced technical consultants</td>
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<tr>
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<td>Appointment of highly experienced committed design teams</td>
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<tr>
<td>16</td>
<td>Improving contract award procedures by giving less weight to prices and more weight to the capabilities and past performance of contractors</td>
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<tr>
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<tr>
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<td>Good workmanship</td>
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<td>Decrease number of variation orders</td>
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<td>Adequate designs</td>
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<td>24</td>
<td>Timely supply of materials</td>
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</table>
SECTION F: CRITICAL SUCCESS FACTORS FOR A CONSTRUCTION PROJECT

This section of the questionnaire assesses the critical success factors for a construction project.

Please indicate your answer using the following 5-point scale where

1. = Not at All Important (NAI)
2. = Not Important (NI)
3. = Neutral (N)
4. = Important (I)
5. = Very Important (VI)

18. How important are the following factors in achieving successful construction projects?

<table>
<thead>
<tr>
<th>NO</th>
<th>CRITICAL SUCCESS FACTORS FOR A CONSTRUCTION PROJECT</th>
<th>NAI</th>
<th>NI</th>
<th>N</th>
<th>I</th>
<th>VI</th>
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<tbody>
<tr>
<td>1</td>
<td>Top management experience and support</td>
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<td>2</td>
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<td>2</td>
<td>Experience of project manager</td>
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</tr>
<tr>
<td>3</td>
<td>Experience of contractor</td>
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<td>Clear and realistic goals</td>
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<tr>
<td>5</td>
<td>Competence of project team members</td>
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<tr>
<td>6</td>
<td>Commitment of project team members</td>
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<td>Effective communication</td>
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<tr>
<td>14</td>
<td>Adequacy of funding</td>
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<tr>
<td>15</td>
<td>Awarding bid to right contractor</td>
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<td>Stable political environment</td>
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<td>2</td>
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</tr>
</tbody>
</table>

Thank you for your co-operation in completing this questionnaire. This will go a long way in solving the cost overrun problem in Public Sector construction projects.