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IDENTIFYING CAUSES AND REMEDIES FOR COST OVERRUNS IN BOTSWANA'S PUBLIC CONSTRUCTION PROJECTS

Pelontle Dibonwa

IDENTIFYING CAUSES AND REMEDIES FOR COST OVERRUNS IN BOTSWANA'S PUBLIC CONSTRUCTION PROJECTS

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

Johannesburg, 2008

DECLARATION

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

_____

(Signature of Candidate)

_____ Day of _____ 2008

ABSTRACT

This research survey was carried out to investigate three areas of concern which are commonly associated with the implementation of government development projects: namely: (i) cost overrun causal factors, (ii) effective remedial cost control measures and (iii) apportionment of professional responsibility for either cost overrun causal factors or costs control remedial measures' implementation. The ultimate aim was to identify major causes of cost overruns, generate and recommend possible solutions to the problem of cost overruns in the Botswana public construction industry.

The research strategy adopted, involved the circulation of questionnaires and subsequent statistical data analysis. Initially, an expert group questionnaire test survey was conducted among ten (10) professionals (expert group), in order to solicit professional opinion and contributory input on the research. The purpose of the expert group questionnaire test survey was to refine the research questionnaires, make necessary questionnaire structure amendments, eliminate possible ambiguities, and finally, to make data collection an easy exercise. Through the expert group questionnaire test survey, the research questionnaires were assessed for validity and reliability. Thus, the *questionnaire content validity* (Saunders et al. 2003) was established by soliciting comments from the expert group, on the representativeness and suitability of the research questionnaires. Lists of causes of cost overruns factors and effective cost control measures were, developed for each of the three major project development cycle phases; namely: the conception/planning/designing, implementation, and completion/commissioning phases. The research questionnaires which were formulated through expert group questionnaire test survey lists of cost overruns causal factors and cost control remedial measures were circulated to a wide range of practicing professionals. In addition, a representative number of case study projects, with specific reference to cost overruns and cost control, were selected for detailed investigation.

Three statistical data analytical methods; the respondents 's cost overrun factor/cost control measures ranking order, the Kendell's Correlation Coefficient and the case study analysis, were simultaneously (triangulation analysis), employed in order to draw conclusive results of the research findings. Hence, the result of the survey identified: i) the most frequent cost overrun causal factors; as inadequate project brief, insufficient/inadequate project design, lack of project coordination and contractual claims

and ii) the most effective cost control measures; as appointment of competent project personnel, improved project monitoring, awarding contracts to reputable/competent contractors and monitoring teams and providing time and financial management facilities. The third objective, which was to identify and apportion professional personnel responsibility for causal factors and remedial cost control implementation measures; within each of the three-project development cycle phases; yielded the following results: Clients and project managers were found to play a major contributory role in activities that lead to project cost overruns at conception/planning/designing phase. The project implementation phase allocated blame to contractors, architects and quantity surveyors for cost overruns, while quantity surveyors and contractors were found to be responsible for cost overruns at the completion/commissioning phase. On the implementation of effective remedial cost control measures, the professional responsibility scenario was found to be as follows: clients and project managers play a major role at conception/planning/designing phase, whereas quantity surveyors are key players at implementation phase and project managers; at completion /commissioning phase.

Keywords: Cost Overruns, Botswana, Causal Factors, Cost Control, Professionals

DEDICATION

With heartily joy, I dedicate this thesis to my mother Elizabeth Motimedi who gave up everything to see that I get the best education accorded to any son. She was a source of encouraging support throughout my endeavour.

She is a rare God sent!

PREFACE AND ACKNOWLEDGEMENTS

In 1995, I qualified as a Quantity Surveyor (QS) and have been working for the Botswana government's Department of Buildings and Engineering Services (DBES), since then. During my years of practice, which span from 1995 to 2003 (I registered for full-time MSc in Project Management with University of the Witwatersrand, Johannesburg, in 2004); I have handled government development projects as a project team member, with professional colleagues of various expertise. The issues concerning projects' late completion, abandonment by contractors, determination of contracts, along side exorbitant costs (cost overruns), have been of my personal interest; hence, the undertaking of this research assessment. There has been accusations and counter-accusation about project managers' poor financial handling of projects; during implementation, leading to high costs. There has been minimal assessment of the actual causes of project's cost overrun; leaving behind a dilemma among professionals (project teams and managers), pondering the best answers they can give to project financiers about exorbitant project costs. This research survey and data analysis is the outcome of my professional qualification (approximately eight (8) years of work experience), concern and passion for the Botswana construction industry. It is aimed at revealing the basic causes of cost overrun in government projects, the most effective remedial cost control measures that can be adopted by project managers and to point out professional responsibilities on either causes of cost overruns or cost control measures implementation. This approach is deliberately adopted so as to minimize room for self-defense and 'after-the-fact justification for cost overruns' (i.e. playing safe and non-accountability by project professional teams) (Lewis et al. 2003), when problems are encountered during projects implementation.

The major sources of information for the purpose of this research; are the Botswana government ministries, departments (especially DBES), practicing professionals and contractors, in the country. DBES is the major organ of the government project's delivery, hence, some of the case study projects cited, has been implemented though the same department. Confidentiality has been maintained by not mentioning interviewed project team members (professionals) by name in the report. Photographic

details of projects have been given, since these are permanent and immovable structures, currently serving their intended purpose.

The author's point of view with regard to the problem of this research is that though Botswana is viewed as the fastest and most stable economy in Africa and the third world countries, the construction industry which constitutes 6% of the GDP, continually suffers financial set-backs due to cost overruns. Given the fact that the industry (construction) constitutes a remarkable portion of the country's economy; an in-depth assessment of possible loopholes that may lead to the industry's collapse in the long run, is inevitable. This investigative report, therefore, focuses on the period between 1999 and 2004, while taking into account the work done on the subject, in other countries for reference purposes.

In conclusion the author would like to thank government officials (professionals at DBES), practicing professionals in the country and contractors for their support in providing access to information and response to interview questionnaires. In addition, I extend my greatest appreciation to my supervisor for this research, Mr. O A Akindele, for the support and guidance he provided in the research.

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LIST OF SYMBOLS

K – kappa: total number of respondents

n – number of variables

s – sum of squares of standard deviation

(χ^2) (chi) - Chi-square

τ (tau) = Kendell's coefficient of rank correlation

$\sum$ - summation

NOMENCLATURE AND DEFINITIONS

Abbreviations

DBES - Department of Buildings and Engineering Services

"Government" - shall refer to government of Botswana

PEEPA:- The Public Enterprise Evaluation and Privatisation Agency

"Project Development Cycle" shall generally mean the three phases:

(i) conception/planning/designing, (ii) implementation,

(iii) completion/commissioning.

"Pula" (P) - shall denote the Botswana currency.

QS - Quantity Surveyor

SADC - Southern African Development Community

CHAPTER ONE:

INTRODUCTION

1.1 BACKGROUND

The Botswana construction industry, like that of other developing and or developed countries, constitutes a significant portion (sector) of the Gross Domestic Product (GDP). The industry has thrived on the country's expanding economy and now accounts for 6% of the GDP, while manufacturing (though affected by several failures such as the closure of the Hyundai car assembly plant by the year 2000), accounts for 5% (see Figures A1 and A2). On the other hand the mining production and earnings though rising, has had its share of the GDP shrinking from 53% in the early 1980s to 33% to date. In the same period the total national GDP has grown threefold from P5bn to P15bn (PEEPA 2004). The Department of Building and Engineering Services (DBES), whose mission is to provide public building and engineering infrastructure, and related services in partnership with stakeholders; to Clients, Ministries and Departments; consistent with the National Development Plans and other Government Policy pronouncements (DBES Mission Statement, 2004), plays a central role in the delivery of national development plan projects through its outlet depots (refer Figures A3 and A4).

1.1.1 Government's Services Delivery

The Botswana government boosted by the stable political and economic environment; dispenses its development services through three major ministerial institutions and their respective services departments, which are: (i) Ministry of Finance and Development Planning (ii) Ministry of Works and Transport (iii) Ministry of Local Governments and Lands.

1.1.2 Ministry of Finance and Development Planning

This ministry is responsible for annual budget planning and allocations for all government sectors. It is also responsible for negotiating and finalizing agreements with donor agencies for the whole development infrastructure. It regulates the volume of development projects through interim financial annual plans within long-term development plan periods.

1.1.3 Ministry of Works and Transport

This ministry port folio involve the dispensation of government development projects through several departments, including, Department of Building and Engineering Services (DBES), Roads Department, Meteorological Services Department, etc. A large contingent of professional experts, project managers and technical staff etc is employed in various services departments and plays the key role of advising planning officials in formulating annual projects budget estimates. The departmental professional workforce is responsible for the procurement and implementation of all government services facilities ranging from office blocks, health facilities, schools, houses, communication networks etc. They then report to Planning officials, on a quarterly basis, the projects progress and expenditure, thus, government development plan projects are closely monitored.

1.1.4 Ministry of Local Governments and Lands

This ministry implements government development projects through Local Authorities (District Councils). It is also responsible for allocating land for development for various purposes like commercial, residential and farming. Like the ministry of Works and Transport it employs a large professional workforce, which reports to planning officials on project budget expenditure and forecasts.

These three government ministries form the anchor upon which the success and or failures of Botswana current sound economy rest. Botswana's economic success is the result of inflation control, budgetary surpluses for the past two decades and massive foreign exchange reserves. Cost overruns are one side of construction industry shortcomings, which are worth investigating, hence, the need for an objective research in the area.

1.2 NEED FOR THE RESEARCH

A research, as defined by Malhotra (2004), is 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. The Botswana public construction projects' cost overrun problem, as outlined in the subsequent discussions, merits the necessity of an objective research, whose goal would be to pinpoint causal factors to a pending problem; on one hand, and highlight possible solutions usable by project implementers.

The public construction industry has been experiencing exorbitant budget cost expenditure (cost overruns), where in extreme cases some development projects have had to be put on hold, deferred to future development plan periods due to insufficient funds caused by money being diverted to complete long delayed running projects; and thus; distracting the whole long term government development plans (refer Tables B1, B2, B3 and B4). The latest project implementation report by the **Department of Buildings and Engineering Services (DBES)** show a record of forty-one percent (**41%**) projects which were ear-marked for the financial year 2004/2005 being deferred to the next financial year (2005/2006) or beyond, specifically, due to ministerial budget constraints (refer Tables B1, B2, B3 and B4, Figure B1 and Figure B2). While the reasons may not be blamed exclusively on cost overruns of currently or previously executed projects, the survey analysis, together with information gathered on specific case study projects reveal notable effects of cost overruns on annual project budgets. Tabulated information for planned ministerial projects deferred to financial year 2005/2006 is given in tables B1, B2, B3 and B4.

The previous financial year (2004/2005) had seen three ministries; Health, Works and Transport and Trade and Industry deferring virtually all their financial year development projects to 2005/2006 (Figure B1). Not withstanding the HIV/AIDS epidemic as a reason, especially with regard to the ministry of Health, the effects of cost overruns in previous completed or on-going projects cannot be underestimated. Figure B2 shows a total gross of 59% completed projects from an approximate budget of P2.560 Billion budget. Since development projects are delivered through short term financial year plans and long term development plan periods (five to ten year), this leaves the effects of cost overruns on completed or on going projects unnoticed or

technically excused. Nevertheless, it is an undeniable fact that cost overruns in public development projects impose budgetary constraints which undermine the government's delivery targets. In certain instances the methods of preparing budget estimates themselves are unreliable, resulting in unplanned expenditure during project execution. This study explores some of the shortcomings and resultant uncertainties associated with preparing budget estimates for long-term development projects.

1.2.1 Work previously done on the subject

There has been limited studies, surveys or researches on this particular subject matter in Botswana, apart from the one conducted by Chimwaso (2000). Chimwaso (2000) reported the main five causes of cost overruns on public projects as (i) incomplete design at time of tender, (ii) additional work at the client's request, (iii) technical omissions at design stage, (iv) adjustments of prime costs and provisional sums and (v) contractual claim, that is, extension of time with cost claims. The survey findings were exclusively based on responses from forty-six practicing professionals and final account reports from ten completed projects. Notably, the Chimwaso (2000) survey focused on the final phase of the project development cycle, whereas, cost overrun factors affect the whole project development cycle beginning with the conception/planning phase to the completion /commissioning phase. There are causal factors which would span the whole project development cycle, unless some control mitigation steps are implemented, for example, incompetent project team selection. The survey, did not address the aspect of possible remedies and professional accountability apportionment, which will be extensively addressed here. The effects of cost overruns in the public construction sector have seemed negligible, since the country is still enjoying a stable and fast growing economy. But the literature review, however, alludes that problems of projects' cost overruns affects the construction industry globally, hence, it would be a gamble to ignore its long term effects on the Botswana public construction industry. It has lead to the downfall of multi-billion institutions and stalled government development plans (Honshu 2001). A brief mention of work done on the subject is provided in this section; followed by a more detailed exposition of the same in the literature review part of this report. There have been prominent surveys carried out in Africa, the Middle East, Europe, USA and Asia, for a variety of projects; like dam building, ship building; highway construction; sport and entertainment facilities; to underline the global nature of the cost overrun problem.

The contribution of these surveys is of vital importance, since their findings are very relevant to the propositions of this research. They provide a strong basis for the formulation of the research problem and relevance of the survey. The present survey will identify cost overrun causal factors and possible cost control remedial measures applicable at the three phases of the project development cycle: planning/design, implementation and completion/commissioning; areas which were not addressed in the Chimwaso (2000) survey.

1.3 THE REASEARCH GOAL

This research can be classified as a two-prong purpose survey study. It serves as an exploratory study on one hand and as an descriptive study on the other. As an exploratory study, the research attempts to acquire new sights into the domain phenomenon (dilemma of construction projects being completed at excess costs than budgeted for, which is, the cost overrun problem). In-depth information gathered in this research could be used as a basis for a more structured study on the trend of public development projects in relation to cost constraints. On the other hand the explanatory/descriptive aspect of the research evolves from the intention of the researcher to identify cost overrun causal factors (in this case cost is an independent factor), and the most effective tools usable for the completion of the construction project within budget, a dependent factor. The apportionment of professional accountability aims at ascertaining whether the remedial measures are viable tools for achieving maximum cost control at all the stages of project implementation.

The descriptive aspect of the research is also directly related to the predictive and evaluative features of the research. If it could be possible (at present) to develop a model for 'within budget cost project implementation'; it would the be possible to identify factors causing cost overruns, develop strategies, and set up procedures to alleviate possible problems, and to make precise predictions (in principle) for projects' success. The necessity to solicit reasons for cost overrun from project professionals involved with 'case study projects', signifies the evaluative/investigative character of this research, which provides a critical evaluation of the cost control remedial measures that can be explored by project implementers.

1.5 BENEFITS FOR RESEARCH FINDINGS

On the basis of the previously discussed background, this research therefore aims at: *identifying the major cost overrun causal factors and effective costs control remedial measures.* Project managers could avoid the cost overrun factors and implement the cost control measures in order to successfully implement government projects within achievable budget cost constraints. Specific reference is made to *cost overrun* and *cost control remedial measures*, which are at the epicenter of the general failure or success of development projects' delivery. A further step is taken in apportioning responsibility (accountability) among project teams, which pint points the parties' contribution; either beneficially (i.e. cost control implementation) or negligently (cost overruns).

The attainment of effective remedial cost control measures for government development projects is a prerequisite to the successful completion of development projects, which are vital for the country's socio-economic advancement. On the other hand the success of the study will contribute to the body of knowledge in the field of Project Management, by revealing possible solutions to the problem of cost overruns associated with public development projects.

1.6 STATEMENT OF THE PROBLEM

The Botswana public construction industry is currently falling short of delivering the intended development Services in accordance with the development plans. The previous financial year (2004/2005) ended with a shortfall of fourty-one percent (41%) non-completion of development projects, valued at 1.0496 billion pula (Figure B2). Crucial services in the health, works and transport, and trade and industry have not been delivered, since these sectors have had to defer virtually all their development projects due to budget constraints (Figure B2). The HIV/AIDS epidemic, whose tackling has led to development funds diversion, has been used as an excuse by project managers for failure in projects delivery. This scenario has provided camouflage for professional negligence, leading to delayed and costly projects completion. Without an in-depth assessment of cost overrun causal factors identification, cost control measures implementation, and prudent professional accountability, the problem of cost overruns would remain a threat to the Botswana public construction industry as has been experienced by other developing countries.

1.7 THE REASEARCH OBJECTIVES

1.7.1 Primary objective:

In the light of a significant number of cost overrun cases and the strain on the annual budget, excessive costs have put on government development plans, this study seeks to:

- Identify major cost overrun causal factors and cost control measures through a critical literature review.
- Ranking of causal factors and cost control measures by practitioners.
- Validation of practitioner's perceptions against real life case studies.
- Developing recommendations for implementing the most effective cost control measures by practitioners.

1.7.2 Secondary objective:

The human resource management aspect of development project implementation will be investigated, by allocating contributory responsibility to different professional personnel, which play a central role in development projects' delivery success. The contributory party (professional personnel) responsibility apportionment indicates the possibility of eliminating accusations and counter-accusations in which project implementation professional personnel occasionally engage into; order to avoid professional accountability at the expense of project financiers (in this case government).

1.8 PROPOSITIONS

The research aims at establishing the following propositions:

1. Cost overruns in current government development projects could impose budgetary constraints which would undermine the government's delivery targets (development plan goals).
2. Effective cost control measures can be successfully implemented to achieve speedy and within cost project delivery.
3. Professional negligence is to be blamed for project cost escalations and the attendant delays.

1.9 SCOPE AND LIMITATIONS

1.9.1 Scope

The study was carried out by soliciting professional opinion; on the ranking of major causes of costs overruns and most effective cost control measures. Six categories of professional bodies in the construction industry were involved, which are: (i) project managers, (ii) architects, (iii) engineers, (iv) quantity surveyors, (v) financial managers or project financial (budget) planners, and (vi) construction manager/contractors. These professionals, all with a wide variety of work experience in the construction field, were a source of reliable information used in formulating the research approach and methodology. The research findings can therefore, be applicable across the wider spectra of the Botswana construction industry.

1.9.2 Limitation

The research confines its study to the Botswana government building development projects which are implemented though the central government department (DBES), under the Ministry of Works and Transport, for the sake of simplicity and focus. The level of the research and the time allowed to complete the report have dictated this approach, and determined the scope/size of the study area. Civil construction related works have not been exclusively covered, though most building projects include minimum civil services like sewerage and water reticulation, road-works and parking lots, electrical and mechanical services. The limited depth of the data, however, does not undermine the reliability and validity of the findings. They can be generalized to both building and civil works in the Botswana construction industry.

1.10 REASONS FOR CHOICE OF RESPONDENT PROFESSIONALS

1.10.1 Respondent Professionals

The study involved the use of two types of data collection, addressed to six groups of professionals in the construction field. These are project mangers, architects, engineers, quantity surveyors, financial managers and construction manager/contractors. First a pilot survey (expert group) questionnaire was distributed to ten selected professionals, with an average work experience of sixteen years. Their input was to provide objective comments for the formulation of the research questionnaire, its reliability and necessity. These provided reliable insights for the research survey due to their vast knowledge of the Botswana construction industry and professional expertise acquired over many years of practice.

The diversity of professional expertise (due to different fields of practice) provided room for disagreement in identifying causes of cost overrun and cost control measures. The use of correlation statistical data analysis was necessary for ranking cost overrun causal factors and cost control remedial measures in order of importance.

1.11 STRUCTURE OF THE RESEARCH REPORT

The research study is divided into six chapters. **Chapter One** gives an introductory outline, which defines the background, need for study, benefits of the research findings, statement of the research problem, research objectives, goals, propositions, the scope and limits of the study.

The **Literature Survey** in **Chapter Two**, of this research report; provides the theory required to comprehend the subject matter. The literature section covers the research findings carried out by different researchers on different countries' construction industries, concepts of project budgets cost estimates, sources of budget data information, budgets costs inherent risks, limitations and budget cost allowances.

The **Research Methodology**, in **Chapter Three** of the report deal with the exposition of the **research methodology** and **data collection** for the research. "The term "methodology" shall refer to the way in which research data are collected and

analysed in an objective and scientific manner, in order to arrive at solutions to the research problem (that is, to achieve the research objectives). The approach towards the solution to the research problem necessitates the rejection or acceptance of the problem statement. This implies that the method(s) (or methodologies) implemented shall relate to the research problem, sub-problems, and propositions as outlined in the problem development of this report.

Chapter Four of this report focuses on the '**Data Presentation and Analysis of Results'.** The section focuses the interpretation of the results on the basis of the prevalent scenario, that is, the problem of cost overrun.

Chapter Five, exclusively, discusses the research findings results**.**

Chapter Six of the report focuses on drawing conclusions of the research findings and further research recommendations.

1.12 SUMMARY OF REASEARCH OBJECTIVE

The research aims at identifying major cost overrun causal factors and effective remedial cost control measures, usable by project team personnel in the industry. A further step will be taken to allocate contributory responsibilities to professional personnel, who play a central role at different phases of the projects development cycle, whose actions result in, either, cost overruns or effective cost control.

Further more, the research survey will provide the project management body with useable knowledge for sustainable development project implementation criteria. The research findings, would be regionally and globally applicable, given the fact that construction cost overruns affects both developing and developed countries; a point that is revealed in the next chapter.

CHAPTER TWO: LITERATURE SURVEY

2.0 Introduction

This chapter explores several research findings, which have been recorded in literature; with relevance to the subject under discussion. Recorded findings on issues concerning project planning, feasibility study, budgeting, cost estimation, cost control, professional accountability, disastrous project management approaches, lessons learnt and pitfalls to avoid in order to achieve project completion and commissioning within time and the intended budget, will provide the necessary background for relevant conclusions on the Botswana construction industry cost overrun problem.

The literature survey section of this report will reveal theoretical findings and researched outcomes (conclusions) that other researchers and writers have penned down in the subject matter. The theory covers concepts on the use of budget cost and cost control measures for development projects. Statistical formulae which were used by other researchers will provide a basis upon which this survey will be tested for reliability.

2.1 Fundamental Causes of Construction Cost Overruns

The construction industry is one of the largest industries worldwide, and it involves contracts being signed everyday for a variety of construction works like civil, building, refurbishment and maintenance. Whatever size and nature, construction projects are both unique and complex; and this provides fertile ground 'for something to always go wrong'. Construction projects are finance driven, hence, prone to disagreements between contracting parties for fear of financial loss due to the other party's actions. Predicted costs are often exceeded and cost-cutting exercises adopted to control exorbitant costs (though it is hard for most projects to recover through a cost-cutting exercise). Employers have had to accept less for money; while the professional consultants are blamed for misleading the clients; and the contractor benefiting for having built to a cheaper specification for very high financial remunerations. The construction industry is fundamentally a people (human resource dependent) industry, where the project is designed by people, built by people and in the majority of cases built to serve or accommodate people (Sawczuk 1996).

One of the client's main requirements in respect of any construction project is the assessment of its expected costs (Ashworth 1994). Once the project's cost estimate has been determined, it becomes imperative to implement rigorous cost control measures in order to limit the client's expenditure to within the amount agreed. This is easier said than done due, to contrasting forces of inflation, economic uncertainties and the error prone human input, to which construction projects are subjected.

The problem of projects' cost overruns has become an incurable ailment that the industry is learning daily to live with. The problem spans across the globe with no exclusion of either super-powers or developing (third world) countries. To some degree the uniqueness and complexity of construction projects provides an escape route to failures in curbing cost escalations. Professionals in the field do not have an immediate answer, since the human input does not create masterpieces only, but also makes mistakes. Professionals have learnt to solve costly problems by recommending approval for expenditure on so-called additional works (contract variations), some of which emanate from their negligence (Lewis et al. 2003).

2.1.1 Cases of Construction Cost Overrun Findings

Arditi et al. (1985), carried a study on projects undertaken in Turkey in the decade, 1970-1980, and found cost overrun factors peculiar that countries' economy. The study identified (1) inflationary pressures, (2) increase in materials prices and workmen's wages, (3) difficulties in sourcing materials (i.e shortages) and turbulent official prices, (4) construction delays and errors in first estimates, as the most important sources for cost overruns. The effects of the construction cost overruns were found not to be confined solely to the construction industry, but reflected in the overall economy of the country (Arditi et al. 1985). This argument was found to be undisputable in the Turkish economy; were construction investments account for almost half of all investments. Though the Botswana economy is almost wholly driven by the diamond mining production, the construction industry still accounts for six (6) percent of the GDP. This portion seem insignificant, but it is magnified by other peculiar factors that directly affects Botswana; like the 1.7 million population, AIDs/HIV epidemic, landlocked geographic location, and dependence on imports. It goes without saying, that a combination of construction cost overrun effects and the peculiar socio/geographical factors affects the country's economy, hence, validating a similar study in Botswana, as that of Turkey.

Jahren et al. (1990), studed the influence of (i) Project size, (ii) construction type, (iii) number of bidders, and the percentage difference between the government project estimate and tender award amount. The cost overrun rate was found to change with change of project size. Cost overruns were found to occur more frequently for larger projects, as was the case with the Flybjerg et al. (2004), study. In addition, Jahren et al. (1990), found that the cost overrun rate was also influenced by the percentage difference between the government cost estimate and the award (contract) amount. Cost overruns were more likely when the award amount was less than the government estimate.

A study on the Nigerian construction industry projects which was carried by Elinwa et al. (1993), identified variables that could lead to cost overruns and project delays. The study revealed that high costs could be minimized by minimizing lapses in the management of human and material resources. Four major reasons for high construction costs were identified: (1) shortage of construction materials; (2) methods of financing and payment for completed works; (3) poor contract management; and (4) price fluctuations. It is logical to infer that all the major causes of cost overruns identified in this study, could have been minimized or eliminated by implementing an advanced human input either at the project inception phase, implementation phase and completion phase. Shortages of materials could have been avoided if designers disregarded their preconceived ideas, paid maximum attention to the social environment and the local people's needs in developing project's materials specifications (Elinwa et al. 1993). Elinwa et al. (1993), argues that construction costs can be greatly controlled by (1) detailed project specification, and (2) agreement by all parties concerned; on the intent of the specification. Emphasis is also laid on the importance of adequate communication channels between parties in a given project.

Semple et al. (1994), examined causes of claims, delays and cost overruns on twenty-four projects in Western Canada. The study identified the following as critical factors that lead to cost overruns: (1) contract variations and extras, (2) disputes, (3) soil and sites conditions, and (4) delays. The author stressed the need by the industry practitioners (clients, contractors, professionals) to pay maximum attention to the critical factors in order to minimize cost overrun risks.

Assaf et al. (1995), carried an investigation on causes of delay in large building construction projects in Saudi Arabia. The most important delay factors were found to be due to (i) inadequate designs, (ii) slow work progress on site, (iii) late payment for completed works and (iv) design changes by owners. These factors are by all means results of lapses in the human input factor.

Al-Momani (1996), found stunning cost overrun results of up to 30% of original contract prices in the Jordanian construction projects, resulting from variation orders. Variation orders will be indispensable at the project implementation stage, due to inadequate project brief, specification and design. The effects of these factors will be examined with reference to Botswana case.

Kaming et al. (1997), examined factors influencing constriction delays (time overrun) and cost escalations, in Indonesian cities. They identified project cost underestimation and project complexity as the main causes of project delays and cost overruns.

Principal and common causes of delays were studied by Chan et al. (1997), in Hong Kong Construction projects. The results identified; (i) poor site management and supervision, (ii) unforeseen ground conditions, (iii) low speed of decision making by project teams, (iv) client-initiated variations and (v) necessary variations of works, as the major and common causes of delay. The notably observation is that, there were differences in perceptions as to the principal causes of delays and cost overruns; in Hong Kong, Saudi Arabia and Turkey construction industries. This observation suggests a phenomenon; that time and cost overrun factors could be directly influenced by the national and regional economic trends. The study on the Botswana case will, nevertheless, not explore that trend.

Elinwa et al. (2001), studied the relative contributions of human personnel parties to construction time-overruns and cost overruns; in the Nigerian Construction Industry. The findings on time-overrun factors were that the respective relative contributions of clients, contractors and others were 62%, 32% and 6%. Delays were found to be more pronounced on government/public sector projects; at 89%; and it was noted on all projects, irrespective of size. The study identified (i) mode of financing (financial

constraints), (ii) payment delays for completed works, (iii) improper planning, and project time and cost underestimation, as important factors. It is worth noting that these factors were identified as cost overrun factors by other researchers, including Okpala et al.(1986), Flyvbjerg et al. (2004) and Jahren et al. (1990).

Xiao et al. (2002), carried a study on the construction time performance; by evaluating contractors from Japan, the UK and the US. The study is of notably importance because it focused exclusively on the human input aspect of project implementation methods. Japanese contractors were found to achieve shorter construction times and higher levels of time certainty than their UK and US counterparts. Furthermore, anticipated delays were far shorter in Japan and levels of client satisfaction were significantly higher than in the UK and US. The superior performance of Japanese' contractors, according to Xiao et al. (2002), would be attributed to their working practices which were characterized by (i) the use of a larger workforce on site (human personnel), (ii) detailed planning (adequate design), (iii) close working relationships with their subcontractors (project coordination), and an overriding focus on time certainty.

Cost performance in transport infrastructure projects were carried out by Flybjerg et al. (2003) in the Danish construction industry. The study focused on infrastructural investments in terms of actual costs, cost benefits and risks. Transport infrastructure projects were found not to perform as envisaged in terms of costs. Tested for different projects types, different geographical regions and different historical periods, substantial costs escalations were found to be the rule rather than the exception. The same study when conducted across twenty (20) nations, on five continents, proved that costs escalations were a global phenomenon. Flybjerg et.al. (2003), pointed out to cost estimates as highly, systematically and significantly misleading. Large costs 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 social and economic welfare (Flybjerg et.al. 2003). The effects of accurate/inaccurate cost estimates are discussed later in this study; with reference to the Botswana development project implementation policy.

Flybjerg et.al. (2004), carried out another study which focused on the dependence of cost escalation on: (1) the length of the project – implementation phase, (2) the size of the project and (3) the type of project ownership. Cost escalations were found to be strongly dependent on the length of the implementation phase; of the project development cycle. In that study, Flybjerg et.al (2004), highlighted the importance of the human input (professionals accountability) in the problem of cost overruns. The policy implications are clear: decision-makers and planners should be highly concerned about delays and long implementation phases because they translate into risks of substantial cost escalations (Flybjerg et al. 2004). The same study revealed that larger projects have larger percentage cost escalations. Flybjerg et al. (2004), went on to compare the cost escalation for three types of project ownership-private, state owned enterprise and other public ownership. The study showed that the often believed notion that public ownership is problematic and private ownership effective in curbing cost escalation is far from reality. The Flybjerg et al. (2004), study found that the type of accountability mattered more to cost escalation; than the type of ownership. This finding and others provides sufficient reason; as to the relevance of addressing the role of professional accountability, in soliciting possible solutions to the Botswana cost overrun case.

Several researchers on the subject of construction cost overruns have come out with significant findings that factors that lead to construction delays (time overruns), will eventually result in cost overruns. Therefore, factors leading to delays have been always studied alongside those leading to cost overruns. Though this research (Bostwana case) will not dwell much on project delays factors, the factors are worth noting; due to the human contributory factor; which this research addresses.

2.1.2 Comparisons on cost overrun factors from different researcher's findings

The literature review findings on cost overrun factors instigated by various economic environments in different countries; raises the question of global comparisons of those factors. Chan et al. (1997) observed differing perceptions as to the principal (major) causes of project delays in Hong Kong, Saudi Arabia and Nigeria. In adopting a similar approach, this research analyses seven research findings by (1) Arditi et al. (1985)-Turkey, (2) Elinwa et al (1993)-Nigeria, (3) Semple et al. (1994)-West Canada, (4) Assaf et al. (1995)-Saudi Arabia, (5) (Chan et al. (1997)-Hong Kong (6) Kaming

et al. (1997)-Indonasia, and (7) Flybjerg et al. (2004)-Denmark, for the purpose of global economic factor's comparisons; on the issue of cost overrun causal factors. The comparison will be used in the case of the Botswana findings, to prove whether each country's cost overrun causal factors are unique to the economic environment or universally adoptable.

Table 2A : Comparisons on cost overrun factors from different researcher's findings

Cost Overruns Researcher	Cost Overruns Causal Factors Identified	Regional Economic Area of Study (Country)	Similar Factors Occurring in Other Regional Economic Areas (Countries)	Remarks on Findings
(1) Arditi et al. (1985)	**(i)** inflationary pressures **(ii)** increase in materials prices and workmen's wages **(iii)** difficulties in sourcing materials (i.e shortages) **(iv)** turbulent official prices **(v)** construction delays **(vi)** errors in first estimates	**Turkey-Middle East**	**(i), (ii), (iii), (iv), (v) & (vi):** Nigeria, Canada and Indonesia	☞Factors peculiar to North America, Middle East and Asian (Far East) Economies ☞**Globally** widespread factors
(2) Elinwa et al (1993)	**(i)** Shortage of construction materials **(ii)** Methods of financing and payment for completed works **(iii)** Poor contract management **(iv)** Price fluctuations	**Nigeria-West Africa**	**(i), (ii), (iii)** & **(iv):** Turkey, Saudi Arabia and Hong Kong	☞Factors peculiar to West Africa, Middle East and Asian Economies ☞**Globally** widespread factors
(3) Semple et al. (1994)	**(i)** contract variations **(ii)** disputes **(iii)** soil and sites conditions **(iv)** delays	**Canada-North America**	**(i):** Saudi Arabia and Hong Kong	☞Factor peculiar to North America, Middle East and Asian Economies ☞**Globally** widespread factors
(4) Assaf et al. (1995)	**(i)** inadequate designs **(ii)** slow work progress on site **(iii)** late payment for completed works **(iv)** design changes by owners	**Saudi Arabia-Middle East**	**(iii), (iv) & (v):** Nigeria and Hong Kong	☞Factors peculiar to Middle East, West African and Asian Economies ☞**Globally** widespread factors
(5) Chan et al. (1997)	**(i)** poor site management and supervision **(ii)** unforeseen ground conditions **(iii)** low speed of decision making by project teams **(iv)** client-initiated variations **(v)** necessary variations of works	**Hong Kong-Asian**	**(i), (ii), (iv) & (v):** Nigeria, Canada and Saudi Arabia	☞Factors peculiar to North America, West African, Middle East and Asian Economies ☞**Globally** widespread factors
(6) Kaming et al. (1997)	**(i)** project cost underestimation **(ii)** project complexity	**Indonesia-Far East**	**(i) & (ii):** Turkey Denmark	☞Factors peculiar to European, Middle East and Asian (Far East) Economies ☞**Globally** widespread factors
(7) Flybjerg et al. (2004)	**(i)** the length of the project – implementation phase **(ii)** the size of the project **(iii)** the type of project ownership	**Denmark-Europe**	**(ii):** Indonesia	☞Factor peculiar to European and Asian (Far East) Economies ☞**Sparsely** spread factor

The analytical comparison of previous researcher's findings on the most prevalent causes of construction cost overruns reveals the global nature of those factors. Only one survey out of the seven compared; showed a sparsely occurrence of factors in the European and the Far East economic blocks. The rest of the six research findings; representing approximately 86% probability, attests to cost overrun causal factors occurring across global economies. This literature comparative finding will be tested against the Botswana's major construction cost overruns causal factors in the conclusions of this research. It is therefore, imperative to look into other researcher's overview of this global phenomenon on construction cost overruns, prior to the focus on the Botswana public construction industry.

2.1.3 Researchers Overview on Cost Overruns

The researcher's global overview on causes of cost overruns attests to the fact that construction cost overruns are a daily experience in both the developing world as well as the technologically advanced nations. Large cost overruns are common place in governments' construction projects. One of the reasons for this episode is that government officials routinely low-ball costs of project proposals in order to secure preliminary spending approvals. When programs exceed budgets and expected delivery unachievable, politicians focus blame on blunders by bureaucracy or private contractors (Edwards 2003). The undisputable truth; is that cost overruns and projects' failures are systematic and widespread across international governments. According to the findings followings a study by Danish economists which were published in the 'Journal of the American Planning Assin', in 2002, on government projects in the U.S and abroad; cost overruns stem from government deceit, not honest errors (Edwards 2003). The study further concluded that intentional deception by public officials was the source of the problem. "Project promoters routinely ignored, conceal or otherwise leave out important project costs and risks in order to make the total costs appear low. Politicians on the other hand used "salami tactics" whereby costs were revealed to taxpayers one slice at a time in the hope that the project is too far along to turn back when true costs are revealed" (Edwards 2003). In another dimension, in the US, it was found that different state competed with each other to secure federal funding. This "lion stake share", competitive approach for limited financial resources, led to officials exaggerating projects benefits and minimizing costs. The repercussions of costs

overruns were then avoided by covering up poor contract's performance, in order to conceal state official's bad oversight (Edwards 2003).

The professional approach to this problem should, therefore, be the implementation of effective diagnostic tests, effective remedial cost control measures and prudent accountability in government project implementation. "Cost control of a construction project, or indeed any type of project, should start at the inception stage and not finished until the project is handed over to the client. Even when the final cost is still likely to be agreed, and there is need for cost control of the recurring costs in use throughout the life of the building" (Ashworth 1983).

2.2. Focus on the Botswana Construction Industry

The Botswana economy has been described as comparatively stable and steadily growing which makes it conducive for long-tern investment and productive financial planning (PEEPA 2004). It is, therefore, imperative to look at the mechanisms used in Botswana construction industry, with respect to development projects planning, budgeting, implementation and cost control. The approach would be diagnostic; to determine the cost overrun causal factors, curative; determining the effective cost control measures and juridical; apportioning accountability among construction professional personnel.

2.2.1 Botswana's Short and Long Term Development Plans

The government services delivery is based on short tern; annual plans and mid-term; five year plans, and long-term; nine year development plans. The Ministry of Finance and Development Planning is charged with the responsibility of implementing all development plans. Budgetary planning forms the hub for the success or failure of the government projects and the services delivery machinery. By definition; "Cost budgeting is the process of establishing budgets (allowable costs) against which the actual costs can be measured and managed; and a budget is an intelligent evaluation based on the maximum of knowledge" (Oosthuizen et al. 1998). Budgeting dates back to time immemorial, to the extent that no nation can operate in a competitive economic environment without effective budgeting (Scofield 1945). It would be undisputable truth to say; 'failure in budget planning, is retrospectively, planning to fail'. Though

budgets are indispensable, they are not infallible. This is specifically due to the human input element which is fundamental in budget preparation. The human input can not only create masterpieces but also makes mistakes (Sawczuk 1996). Cost overruns would always be the by-project of unrealistic budgets. In Botswana, development project's budget cost estimates, are delivered through the annual budget speech, presented by the finance minister, which allocates government expenditure plans for every financial year. The construction industry has occasionally put the reliability of these annual budgets to a tasking test. The phenomenon of project deferments finds reasonable explanation in the shortfalls of budget estimates, as stated by Kozel (2000). He observed that the consistent underestimation of project costs and construction cost overruns on currently running projects, results in underestimated development plans. Therefore, development plans may be running on inadequate funds. According to Al-Bahar et al. (1990), construction, like many other industries in a free-enterprise system, has sizable risk built into its profit structure. From the beginning to end, the construction process is complex and characterized by many uncertainties.

This explanation cannot convince all; therefore, critical accusations will always have to be born by the frontline players in project's implementations, in this case construction project personnel. This further explains why project managers (professionals) would always cover-up the bad effects of unrealistic cost estimates, should they manifest through cost overruns (Edwards 2003). The starting point in producing reliable budget cost estimates is the availability of the source of information used, accuracy of the information used and the professional competence of the cost estimator. Immediately, following after this, is the implementation of effective cost control measures, lest the whole budget cost estimating exercise is a futile effort.

2.2.2 Sources of Budget Data Information

According to Borthwick (1991), budget cost estimating is the process of gathering information and predicting the cost of a development project. A budget serves as a critical control function, because it becomes the reference point by which an organization's performance and activity is measured. It is a process of establishing budgets (allowable costs) against which the actual costs can be measured and managed (controlled) (Oosthuizen et al. 1998). Reliable sources of budget cost estimates (data banks), with respect to Botswana, are very scarce, if not that they are totally non-

existent; despite the volume of construction projects implemented annually. This has resulted in projects being planned on speculative cost estimate figures, well far below or in some cases above the ultimate final costs. Project managers have had to depend on their professional expertise, acquired over years of practice, in battling to convince the generally non-convincible clients on the true cost estimates of the various construction projects. This is a battle, which is never easy to win, until up at the final stages when the projects themselves dictate the amount of financial resources it would take to complete them.

2.2.3 Accuracy of budget cost estimates

Cost estimates are an indispensable tool for most, if not all government development budget planning. If decisions are made on the basis of misleading information (erroneous cost estimates), the social and economic welfare of the nation would be negatively undermined. The study on Botswana construction cost overruns will explore the reliability of methods used for computing development budget plans.

Carr (1989) describes an estimate as a prediction-an approximation-that provides information for decisions and is surrogate or substitute for actual measurement that is not economical or possible. An estimate is considered accurate if it is sufficiently close to the actual performance that decisions taken based on it yield the expected results. Carr (1989) further states that though the guiding concept of an estimator is accuracy, by its nature an estimate is uncertain. An estimator must therefore live with uncertainty, though not as a friend. In fact the estimator must not only live with uncertainty, but must control uncertainty, because uncertainty contained in an estimate is as important information as the estimated value itself (Carr 1989).

Construction budget cost estimates are mostly calculated to some degree of forecasting and professional judgment by experienced project managers/ or planners. Frequently, insufficient time is allowed for cost estimates simply because those who ask for them do not appreciate the extent of work which is necessary for their preparation (Nisbet 1961). Construction projects, being unique in terms of time and location, make all cost predictions and estimates based on historical data (of similar or near similar

circumstances) subject to an element of uncertainty risk. Carr (1989) stated that an estimate must be an accurate reflection of reality, in order to ensure the accuracy of information provided; for useful decision making. According to Diekmann et al. (1998) a formal approach to identifying, classifying, and incorporating uncertainty into standard cost estimating procedures is needed to quantify the risk of large-scale cost growth (cost overruns) prior to project commencement. Cost estimates are therefore, provided on the basis of probabilistic professional judgments. The elicitation of expert knowledge is critical in the risk analysis associated with providing more accurate probability assessments of uncertain environmental variables. According to Beattie (2002), a greater awareness and the use of relatively simple quantitative risk analysis techniques, it is possible to increase out-turn cost certainty and obtain a better defined cost estimate that will allow investors and decision makers to assess the viability of a project, using reliable information. Beattie (2002), further states that, "risk in projects exists and must be managed; to leave them to chance is an abdication of responsibility". The general acceptable estimating principles (GAEP) should include (i) reality; that is an accurate reflection of reality, ii) relevancy; that is within acceptable level of uncertainty, iii) completeness; that is inclusive of all items, iv) documented; that is it could be used as evidence in dispute resolutions, v) inclusive of direct and indirect cost; that is overhead costs, vi) inclusive of variable and fixed cost, that is project related cost and general running costs and vii) contingency costs; that is unanticipated unknown costs (Carr 1989).

Cost estimators (project managers/planners) always reach final figures for various projects with several probable outcomes of the final cost at completion of the projects. Therefore budget estimates, which are used by project managers/planners, need a contingency provision to cover for undue cost escalations. These provisions are occasionally exceeded, due to the volatile forces associated with the construction industry like inflation, taxation, material price hicks, economic recession etc. Historical data, past professional expertise and previous records are vital for justification of development projects budget cost estimates, only when soliciting for funds. In times of recession government officials and consultants have turned exaggerating projects benefits and minimizing costs, in order to achieve project's approval (Edwards 2003). This approach has always yielded the unmistakable repercussions of costs overruns and delays.

The uniqueness of various construction projects has proved the insufficiency of cost estimates since most practical completion is achieved at exorbitantly excess costs than ever anticipated (PEEPA 2004). Budget cost estimates being vital indicators to guide project managers/planners in making decisions with regard to future long-term government development projects, have to be produced with the highest degree of accuracy. Ashworth (1983), suggested four vital steps that can be taken to ensure the reliability of preliminary estimates, as (1) improvement in the quality and type of preliminary design data supplied by the architect and client, (2) better ways of quantifying the data available at design stage, and correlating this with cost, (3) examination of operational estimating, cost modeling and computerized systems, and (4) enhancing the quality of cost information available, like, using data bank stored records. The implementation of project cost control measures at pre and post contract stages is indispensable in minimizing and eliminating the effects of inherent cost estimates' inaccuracies.

2.2.4 Implementation of Cost Control Measures

Oosthuizen et al. (1998), describes project cost control as a process of gathering, analyzing, comparing and monitoring the costs of a project and reporting the results continuously during the development cycle of a project.

Construction is often considered to be a high-risk industry (Pilcher 1994). The risk does not only arise from financial activities, but also from physical activities in the field. Many construction activities are very much concerned with the future. Project budgets cost estimate at the design and tendering stages, involve a degree of uncertainty because they are almost always prepared on incomplete information and the actual outcome being subject to inconclusive speculation. Construction related decisions are, therefore, normally made subject to conditions of risk and uncertainty, a principle not fully understood by all stakeholders. This provides a fertile ground for sharp and scornful criticism between expert professionals and political figures, should there be delays, total delivery failure and or unjustifiable cost overrun on development projects.

Construction budget cost estimates form the basis for investment decisions, the outcome of which is to satisfy the client's needs. It is imperative that the budgeted

expenditure costs are controlled during conception/planning/designing, implementation/construction and completion/commissioning stages. The estimated budget cost becomes the standard against which accumulated costs of design and construction are measured. Once the construction of a project starts there is nothing that can be done to reduce costs and its effects on the estimated budget. Pilcher (1994), stated that it is important at construction stage that unnecessary cost expenditure is avoided and that control rather than monitoring of expenditure is undertaken. He further suggests that should the capital cost of a facility escalate during design and / or construction beyond that level where the asset being provided ceases to be financially viable, work can be stopped.

According to Pilcher (1994), at the design stage, with probably almost no direct financial commitment to the physical construction, the relative penalty of costs are not too severe. On the other hand, if construction is underway, with a major part of the facility already constructed, the choices between alternatives at that stage are not attractive. It is a scenario where there is a partially completed facility incapable performing any useful function and the difficulty associated with disposing it. Occasionally, governments have constructed facilities which later become *' white elephants';* that is to say, projects where the prospects of final project expenditure is in excess of that originally envisaged, and the financial recoupment no longer achievable. These unfavorable outcomes add fuel to the volatile political environment under which government projects are implemented. Project mangers and planners always endeavor to minimize the effects of construction cost overruns and its associated risks, but their efforts may at times fail where other factors than the human element are responsible (Spork 1998).

Costs are the catalyst in many inherent contractual disputes during and after the construction period; resulting in one party to the contract suffering financial loss. Sawczuk (1996), states that in turn one of the main reasons for disputes arising during or after the construction period revolves around the potential for one party to the contract suffering a financial loss.

Projects cost estimates which are prepared for budgetary purposes, can be grossly affected by the project scope, quality, site conditions, project complexity and the prevailing state of the construction industry. The accuracy of the cost estimates used for budgetary purposes at the inception and feasibility stages, as already stated, is

limited by the scarcity of information about the project. There are numerous situations, which would normally result in uncontrollable cost escalations, occurring during construction stage. These include; design under-specifications, designs failing to meet client's brief and having to be modified at additional costs, designs that are not compliant with building regulations; resulting in specification modifications to the design required, and enhancement of project in order to achieve planning permission. Other factors, which would increase the cost, may include new building regulations and or insurer's requests of which the designers are advised too late.

The other cost associated risk in construction projects is the activity below the ground. Site history and findings during site investigations provide some degree of realities with respect to substructure design requirements. This uncertain construction activity is, however, renowned as the biggest risk element in most construction projects. Lansford (2003), outlined various reasons for project cost overruns as unforeseen situations in the field, design revisions and additional works after work commences. He specifically pointed out that buried utilities services lines like sewerage, telephone, water services and power line, which require reallocations have proved to be one of the most frustrating aspects of highway constriction. The irony of utilities reallocation dilemma is that they may not be clearly marked in design drawings, resulting, and frequent disruptions to work progress.

2.2.5 Project Evaluation Reports

The primary objective of cost control mechanisms is to ensure the cost-effectiveness for the client (Ashworth 1994). The probable economic outcomes of the proposed construction project should be identified and evaluated. Ashworth (1994), further outlines that effective cost control mechanisms should be designed along the following goals: (i) to achieve maximum profitability, (ii) to minimize construction costs, (ii) to maximize all social benefits, (iii) to minimize risk and uncertainty, (iv) to maximize safety, quality and public image. Project managers make use of evaluation reports, monthly cost reports and project review meetings as cost control tools (DBES, 2004). Evaluation reports provide quantitative information, which is communicated, to the relevant stakeholders, during monthly or project progress review meetings. The establishment of clear communication channels are necessary so that corrective cost control measures can be implemented by the parties in charge (Oosthuizen et al. 1998).

The volume of criticisms, claims, disputes, arbitration and litigation cases commonly associated with the construction industry attest to the fact that each project should be approached as a learning curve (Li 2000). An awareness of cost risks by all parties at the early stages is necessary to achieve project cost control.

2.2.6 Contingency budget provisions

According to Carr (1989) a contingency is a possible or unforeseen occurrence. The word contingency denotes two types of estimates. The first is the expected value of a possible identified event. The second is the possible cost of unforeseen events: that cannot be identified because of scarcity of reliable information.

Construction projects' investment decisions are normally made subject to conditions of *certainty, risk* and *uncertainty* (Pilcher 1994), hence the necessity of contingency budget provisions. Employers, through experience or the expertise of consultants make provisions for unforeseeable eventualities that are common with construction projects. There are many factors, which influence the final cost of construction projects, including:

- The project size/scope
- The project specification quality
- The location
- Site related problems
- Inflation and the state of the construction industry
- Sophistication of the project
- The impact of CDM (Construction Design and Management) regulations

In summary; "the basis of any cost estimate or project programme is the project scope, design drawings and specifications" (Beattie 2002). The problem that the consultant or project manager have when asked for a budget price early in the inception or feasibility stage is that not enough is known about the project to give an accurate budget price (Sawczuk 1996). Project managers would, therefore, prefer to be non-committed in presenting future budget cost estimates with any degree of accuracy, due to the already discussed risk factors and uncertainties that dodge the construction industry. The difficulty in making reasonable estimates with high degree of precision is exacerbated by the long time duration that projects take to complete, and the fast

changing industrial economic environment. Given that construction related decisions are made under risk and conditions of uncertainty. This phenomenon is not conceivable by all parties of interest in development projects. However, it cannot be conclusively agreed that the use of precise and logical mathematical techniques to access anticipated project costs is a futile endeavour. Many successful governments (an example of which is Botswana) dispense their services through long-term development plans. Methodical and analytical appraisals (feasibility analysis) should be used specifically to lay facts of unique situations open to thorough examination and creating awareness about the detail of the circumstances under examination. This approach makes it possible to gain a reliable idea of the critical areas in which there is likely to be more risk or uncertainty than others, and to highlight what further information or investigation may be justified in order to eliminate as many uncertainties as possible. Areas which are factual and therefore those which will have a predictable, or near predictable, outcome are separated from those which are at risk or are uncertain.

The use of budgetary provisions to cover cost escalations, price fluctuations and inflation has become a common practice. These have also received sharp criticism from the unwilling-to-spend clients, resulting in excessive costs due to limited budget provisions. However, project managers, should base their cost proposals on precise measurements of a degree of risk and uncertainty. The research findings explore possible scenarios where remedial cost control measures have been employed with success. Failures (including disastrous incidents) are also assessed in order to draw lessons for future planning purposes.

CHAPTER THREE: RESEARCH METHODOLGY

3.1 Introduction

The methodology adopted in this research, provides a framework or blueprint that detail the procedures that were necessary for obtaining the information needed to structure the research questionnaire and also to achieve convincing and reliable results. The research design spells out the nature of the enquiry, whether it is exploratory, descriptive or explanatory (Malhotra 2004). The chapter briefly outlines the research methodology adopted in this enquiry and justifies the reasons for using it.

3.2 Formulation of the Research Methodology

The literature review explored, provided a basis for formulating reliable methods for the data collection, analysis, interpretation and drawing a conclusive report on the data findings, with respect to the primary and secondary objectives of the research. According to Malhotra (2004), research should be based on objective evidence and supported by theory. Malhotra (2004), gives these descriptions for a *theory* and objective *evidence*: "a theory is a conceptual scheme based on foundational statements called axioms, which are assumed to be true". "Objective evidence (evidence that is unbiased and supported by empirical findings) is gathered by compiling relevant findings from secondary sources". The literature review achieved through the study of the relevant subject matter in academic books, journals, and the internet, has provided an appropriated theoretical guidance of this research. Malotra (2004), states that the researcher should rely on theory to determine which variables should be investigated. Further, Malotra (2004) reveals that theoretical considerations provide information on how the variables should be operationalised and measured, as well as how the research design and sample should be selected. The theoretical applications adopted in this research have been used to serve as a foundation for the organisation (analysis) and interpretation of the findings.

As stated in chapter one of this study report, the subject of cost overruns has not been substantially investigated in Botswana, with respect to the construction industry. Notwithstanding, this fact, the literature review pointed out to the fact that construction cost overruns are a phenomenal worldwide subject of concern. There have been some studies on this subject by several researchers in different construction

environments. These research findings have been adopted in the case of the Botswana construction industry, as a guide for the research procedure. Hence they have served as a foundation for developing the appropriate analytical model. This research will adopt the methods used by other researcher for data collection, analysis and interpretation.

3.2.1 Data Collection and Analysis Method

Chan et al. 1996, used the 'relative importance index' (RII) method to determine the relative importance of attributes of clients' organisations, which may influence projects' consultants' performance. Data was collected through a questionnaire survey, within various groups classified according to the role of the participants involved in the Hong Kong construction industry (i.e. whether clients, consultants or contractors), as well as according to the project category (i.e. whether building works or civil engineering works). A five-point scale (i.e. 1 to 5) was used to assess the effect of each factor on the project delay, where '1' represented the 'lowest' level of effect and '5' the 'highest' level of effect. The respondents were asked to identify the causes of construction time overruns and then rank the individual delay factors in order of importance, according to their local working experience in construction. The rankings made it possible to cross-compare the relative importance of the factors as perceived by the three groups of respondents.

3.2.1.1 Analysis Formulae One

The 'relative importance index' (RII) expression is given as follows:

Relative importance index = (Σw)/A x N, ($0 \leq$ index ≤ 1)

Where w = weighting given to each factor by the respondents and ranges from 1 to 5 where '1' is 'not significant' and '5' is extremely significant', A = highest weight (i.e. 5 in this case), and N = total number of respondents.

In order to quantitatively measure the agreement in ranking between different groups of participants, Chan et al. (1997) adopted the Okpala et al. (1988) rank agreement factor analysis for any two groups.

3.2.1.2 Analysis Formulae Two

The '**Rank Agreement Factor'** expression:

$RAF = (\Sigma\ R_{i1} - R_{i2})/N$, with a maximum **$RAF_{max} = (\Sigma\ R_{i1} - R_{j2})/N$**

This shows the average absolute difference in rank of the factors. For any two groups, let the rank of the ith items in Group 1 be $\mathbf{R_{i1}}$ and in Group 2 be $\mathbf{R_{i2}}$, *N* be the number of items and

$j = N - I + 1$.

The '**Percentage Disagreement'** is defined as:

$PD = [(\Sigma\ R_{i1} - R_{i2})/(\Sigma\ R_{i1} - R_{j2})] \times 100$

The '**Percentage Agreement'** is then given as:

$PA = 100 - PD$

A higher value of *RAF* suggests a lesser agreement between the two groups. A rank agreement factor of zero means perfect agreement.

In yet another study, Chan et al. (1997) carried a survey in Saudi Arabia, and stated that the problem of construction cost overruns had not even been alleviated by the introduction of advanced construction technologies and more effective management techniques. The main causes of delays in large building construction projects in the Eastern Province of Saudi Arabia, was found to be postulated by owners, architectural/engineering firms and contractors

The survey incorporated Fifty-six (56) causes of delays, which were categorised into nine major groups. They included materials, equipment, manpower, financing, environment, changes, and government relations, contractual relationships, together with scheduling and controlling techniques. The effects of the individual factors and major groups on project delays were measured and ranked by their importance indices for owners, architects/engineers and contractors. The survey data was analysed using the above-mentioned indicators, i.e. the 'importance index' which is similar to the 'relative importance index', and the 'rank correlation coefficient' which is similar to the 'rank agreement factor'.

Okpala et al. (1988) carried an investigation into the high costs of construction in Nigeria in 1988, and subsequently another survey was carried out in 1993 by Elinwa (Elinwa et al.1993). The two survey result was used for comparable analysis of the industry trend.

The 1988 survey involved an exploratory (pilot) survey, which was initially conducted to identify the major factors that could cause delay and cost overruns. The exploratory survey involved twenty (20) people; five (5) architects, five (5) civil engineers, five (5) builders (contractors), and five (5) quantity surveyors, who were interviewed. Twenty (20) variables that could cause delays and cost overruns and seven (7) other variables that could result in the escalation of construction costs without necessarily causing delay were selected. In the variable selection process, some variables that could influence others were given priority.

The Okpala et al. (1988) investigation data analysis method, adopted the 'relative importance index', on the various attributes responsible for delay and cost overruns. The study adopted a formula were a questionnaire had two opportunities for making a factor to be considered as making, an important contribution or otherwise. There were either two responses: "very important" and "important". For each question, the percentage of respondents giving those responses was called the severity index (Baldwin et al. 1971). In general, the severity indices for the different groups examined were not the same and therefore could not be compared directly. The severity index was, therefore, used to rank the items for each group. These rankings made it possible to cross-compare the relative importance of the variables as seen by different groups, by using analytical formulae.

3.2.1.3 Analysis Formulae Three

Two methods (formulae) were used to test (cross-compare) the group ordered rankings. These are: (1) The Kendall's Coefficient **(τ);** and (2) the Chi-square **(χ^2)** test of significance.

(i) Severity Index (F):

$F = F_5 + F_4 + F_3$; where F = severity index; F_5 = number of respondents that ranked the factor as excellent factor (EF); F_4 = number of respondents that ranked the factors very good factor (VGF); and F_3 = number of respondents that ranked the factors very good factor (GF).

(ii) Percentage Severity (P_3):

$P_5 = F/N_r x100$; where P_5 = Percentage Severity; F = severity index; and N_r = number of respondents per professional group.

(iii) Kendall's Coefficient of Rank Correlation (τ)

$\boldsymbol{\tau} = (\mathbf{S})/\{\mathbf{K}^2\}(n^{-1})[n^3-n]$; where; $\boldsymbol{\tau}$ = Kendell's coefficient of rank correlation; **S =** sum of squares of standard deviation; **K** = total number of professionals that ranked the variable factors; and
n = number of listed variable factors.

(iv) Chi-square (χ^2)

$\boldsymbol{\chi^2} = \mathbf{K}(n-1)\boldsymbol{\tau}$; where (n-1) = degree of freedom with n, k; τ is as defined above.

Values of Kendell's rank correlation in the range $0 \leq \boldsymbol{\tau} \leq 1.0$ indicate good agreement, and values near –1 or in the range $0 > \boldsymbol{\tau} \leq -1.0$ implies disagreement on the factors ranked by professionals. The value of Chi-square is tested at the 0.05 and 0.01 levels of significance (Okpala et al. 1988, and Elinwa et al.1993).

The data collection and analysis methods explored in the literature review, will be used to provide appropriate formulae upon which to test the Botswana research findings. The three formulae: (1) the Relative Importance Index, (2) the Kendall's Coefficient **(τ);** and (3) the Chi-square **(χ^2)** test of significance, will play a significant role in producing ordered ranking lists, for most frequent cost overrun causal factors, effective cost control remedial measures, and the most appropriate apportionment of professional accountability.

3.3 Classification of Research

The research adopted both the exploratory and descriptive research approach methods.

An exploratory research; in contrast with the descriptive one, is a research used to explore or search through a problem or a situation to provide insights and understanding (Malhotra 2004). Saunders et al. (2003) and Malhotra (2004) both state that an exploratory research is a useful tool in formulating a problem and precisely defining it. Malhotra (2004) goes further to mention that an exploratory research is characterized by flexibility and versatility with respect to the methods, because formal research protocols and procedures are not employed. The information requirements for an exploratory research is loosely defined, the process is unstructured and is characterized by small and non representative sample. The results from an exploratory research are analysed utilizing qualitative techniques; therefore, they are tentative and not conclusive. Malhotra (2004) describes qualitative research as an unstructured exploratory research methodology, based on small samples that provide insights and understanding of the problem setting. The goal of a qualitative research is to develop an initial understanding.

Saunders et al. (2003) and Malhotra (2004) describe an descriptive research as a type of research that has as its major objective the description of something, or aims at portraying an accurate profile of persons, events or situations. The approach was adopted in order to accomplish the objectives of the research through an observatory research technique. The approach was chosen because the data analysis is ordinal (sequential list) in nature. Malhotra (2004) states that an ordinal scale is a ranking scale in which numbers are assigned to objects to indicate the relative extent to which some characteristic is possessed. It is, therefore, possible to determine whether an object has more or less of a characteristic than some, as is detailed in tables in appendix C, tables C4 to C65. The research data should originate from respondents' opinions, rather than from empirical sources or experiments (Leedy 2005; Saunders et al. 2003).

According to Robson (2002:59) as quoted by Saunders et al. (2003) the object of descriptive research is 'to portray an accurate profile of persons, events or situations'. The descriptive research method adopted in this study portrays an accurate picture of the respondents (professionals) opinion with respect to cost overruns causal factors and effective remedial cost control measures, during the project development cycle.

In further observations, Malhotra (2004) and Saunders et al. (2003) state that descriptive research is characterized by prior formulation of specific hypotheses. It is used as a testing tool and examines certain factors' relationships. The hypotheses to be tested in this enquiry were formulated from the literature survey review findings.

Malhotra (2004) goes on to say that a descriptive research has specific information requirements; and is characterized by a formal and structured research process, and a relatively large representative sample. The data analysis would adopt a quantitative statistical technique, described by Malhotra (2004) as a research methodology that seeks to quantify the data and, typically applies some form of statistical analysis.

Malhotra (2004) explains that a research project may adopt several types of research designs approaches, especially where deeper understanding of the topic is required. Adams and Schvaneveldt (1999) as quoted by Saunders et al. (2003) argue that the flexibility inherent in exploratory research does not mean absence of direction to the enquiry. What it means is that the focus is initially broad and becomes progressively narrow as the research progresses. The results of an exploratory research determine the feasibility or non-feasibility of further research on the problem question.
If it points out to further research feasibility, then a descriptive or causal research is pursued. On the basis of this observation, this research utilized the an exploratory research approach technique, through the expert group questionnaire content validity survey, which was subsequently followed by a descriptive research approach.

3.4 The Research Strategy

Saunders et al. (2003) describes a research strategy as a general plan of action that a researcher sets up in order to answer the research question (the importance of clearly defining the research question can, therefore, not be overemphasized). The research approach and strategies employed in this study combined both qualitative and quantitative methods. The employment of this multi-methods approach served different purposes for the study. First, the exploratory research was conducted initially in order to clarify keys issues for incorporation in the wide scope survey questionnaires i.e the *research questionnaire content validity*. The second advantage of using the multi-method approach was to utilize the triangulation tool. Saunders et al. (2003) refers to triangulation as the usage of different data collection methods within one study in order to ensure that the data are telling you what you think they are telling you. This technique was achieved by comparing the survey questionnaire findings with that of the case study.

The research also took into consideration the issue of credibility of the research findings. Raimond (1993) as quoted by Saunders et al. (2003), neatly expressed credibility as, "when he subjects the findings to the 'how do I know?' test: ….will the evidence and my conclusions stand up to the closest scrutiny?". Credibility is to do with all efforts employed in order to reduce the possibility of getting the answer wrong by paying attention to two particular research design emphases: reliability and validity (Saunders et al. (2003).

Easterby-Smith et al. (2002) as quoted by Saunders et al. (2003), described reliability as assessed by posing three questions: 1) will the measures yield the same results on other occasion?, 2) will similar observations be reached by other observers?, and 3) is there transparency in how sense was made from the raw data.

Validity, on the other hand, is concerned with whether the findings are really about what they appear to be about (Saunders et al. (2003).

3.5 Research Approach

A two-stage research approach was adopted for this study. The first stage was dedicated to the establishment of the *questionnaire content validity* test survey, through an expert group questionnaire assessment. The *questionnaire content validity* test survey produced structured questionnaire which were distributed for the major research survey. The research questionnaires were refined from the literature review which was undertaken with respect to the topic in question.

The literature review focused on similar past research studies carried out by different researchers in different construction environments. The theoretical concepts derived from the literature survey were then used as a guide for the research and to develop a conceptual framework for the research design. These theoretical concepts were also used to formulate the basis for data analysis and interpretation of the research findings. Adopting previous research methodologies, different data analysis formulae and assessment methods were applied in the Botswana case.

3.6 Sources of Information

The sources of background information on this topic and related issues included library books, journal publications, previous dissertations, theses, company brochures internet sites, and other publications. The information obtained was used for the design of research questionnaires.

The first stage of the research approach utilized an exploratory research method, which uses a *qualitative* method of data gathering. Initial interviews were carried out though unstructured personal questionnaire which were distributed to selected industry expert group. Individuals (expert group) who are knowledgeable about the national construction industry and beyond were involved. The purpose of interviewing experts was to help verify the questionnaire content validity in order to ensure the reliability of the research findings, hence, drawing conclusive resolutions to the cost overrun problem (Malhotra 2004). The approach method explored in-depth insights and comprehensive understanding of the subject matter. These insights from expert group recommendations were incorporated in the questionnaire design **(Appendix D)**. The approach was resourceful in the collection of quantitative data as recommended by

Zikmund (1997). Thus, the exploratory survey by making use of an expert group survey input, was a preliminary; non-standardized, non-structured questionnaire circulated through selected sample (representative) expert respondents, as suggested by Zikmund (1997).

The second stage of the research utilized a descriptive research approach, which employed the *quantitative* method of data gathering. It made use of structured questionnaires that have been developed from the *questionnaire content validity* test survey experts' contributions. The questionnaires were hand delivered to offices of respondents in the target groups. Malhotra (2004) describes a quantitative research as a research methodology that seeks to quantify the data and, typically, applies some form of statistical analysis.

This quantitative research method was employed for two specific reasons. The first, being to quantify the data obtained in order to produce precise descriptive results. The results were useable in describing and portraying and accurate picture of the perceptions of respondents in relation to the topic in question as recommended by Saunders et al. (2003). Secondly, the method produced accurate statistical findings, used to draw conclusions about the correlation of opinions of all groups of respondents with respect to the objectives of the research topic. This was done through the Kendell's coefficient of Rank correlation test illustrated in tabulated data, **Appendix C.**

3.7 The Expert Group Survey: Planning and Implementation

3.7.1 Overview

In order to achieve the intended research goal, an exploratory research method executed through a pilot survey was carried out, aimed at soliciting and probing vital information from a limited number of experienced professional personnel (expert group) in the field. The expert group survey was conducted between 6 and 15 September 2004. It provided direction, focus, and eliminated chances for irrelevance of the major survey findings. Recommendations from the expert survey were incorporated into the major research survey questionnaire, which was dispatched to a larger group of professional personnel in the Botswana construction industry.

3.7.2 The expert group survey scope

The expert survey was conducted within the capital city, Gaborone. The survey group comprised four groups of professional disciplines, namely, quantity surveyors, architects, project managers and project manager/engineers; all of whom were from both government and private firm personnel.

3.7.3 The expert group survey strategy

Malhotra (2004), states that an expert group exploratory survey research approach, which involves the use of unstructured personal interviews (in this case non-formal questionnaire circulation), flexibility in capturing expert insights and focus on knowledgeable individuals; would provide vital information in critical areas of a research survey. This method also provided some measure of control and could be achieved within a short time limit (Saunders et al. 2003).

Information regarding the most frequent cost overrun causal factors and effective cost control measures was sourced. The literature review also provided some view points which were presented for consideration to the industry expert personnel.

3.7.4 The Sampling Frame

The industry expert survey group comprised of professionals in government ministries, departments, parastatals and the private sector.

Table C1 and Figure C2 show the expert group respondents who were drawn form the capital city Gaborone. The choice of the sampling group exclusively based in Gaborone was due to the following factors:

1. Gaborone provided conducive environment for the study to be carried out within a reasonable time and cost limit.
2. All ministerial offices, government departments, parastatals and most private sector firms have offices in Gaborone.

3.7.5 Sampling Technique

The sampling technique used was the non-probability sampling type. For non-probability samples, the probability of each case being selected from the total population is not known and it is impossible to answer research questions or to address objectives that require one to make statistical inferences about the characteristics of a population (Saunders et al. 2003)

3.7.6 Interview Planning

Questionnaires were delivered by hand and also e-mail, to the selected industry expert individuals during working hours. The questionnaires were distributed, along with the university (Witwatersrand in South Africa) covering letter specifying the reasons for the research and urging the individuals to provide his opinion on the research, add some vital recommendation for inclusion in the final research survey.

3.7.7 Sampling Method

The non-probability sampling method, involving a 'convenience' sampling techniques was adopted in the selection of the industry expert group in accordance with the recommendation by Leedy et al. (2005). The researcher used his own discretion, based on the ten years work experience on Botswana government projects, to select the respondents for the expert group survey. This was necessitated by the need for the respondents to provide in-depth information regarding key issues on the subject matter.

3.7.8 The Sample Size

Saunders et al. (2003) mentions that, in non-probability sampling approach, there are no restricting rules as far as the sample size is concerned, but that rather, the actual size depends, among other things, on availability of resources and the logic behind the sample selection, as opposed to quota and probability samples. Zikmund (1997) supports this argument, by maintaining that the validity and understanding that the researcher gains from data in non-probability sampling has more to do with the method of data collection and the skills of analysis than the size of the sample.

This expert group survey, however, involved ten respondents. The survey satisfactorily met the requirements of suitable sample size at the *quantitative* data gathering stage.

The research took into consideration the approach adopted by others researchers on the same subject in other parts of the world (refer literature review). The expert group (exploratory) survey requested the selected industry expert to identify the major (highly frequent) causes of cost overruns, and also the highly effective cost control remedial measures. It comprised of a total of ten (10) professional personnel, based in the city, Gaborone, seven (7) quantity surveyors, one (1) architect, one (1) project manager and quantity surveyor and one (1) project manager and engineer, in the construction industry (refer **Table C1 and Figure C2**). The ten professionals were also requested to make recommendations, contributions and suggestions key areas of interest for incorporation in the research survey.

In summary, the expert group survey achieved two goals, viz (i) to solicit professional opinion, comments, qualification (questionnaire validity content) and recommendations with respect to the whole survey initiative and (ii) to amend survey questionnaires by incorporating the professional recommendations into a broader scale survey which would be issued to professionals/personnel in the construction industry i.e., **Project Managers, Architects, Engineers, Quantity Surveyors, Project Financial Planning Officials and Construction Managers**. The expert group survey respondents had an average work experience of fifteen (15) years in the industry. Consequently, they provided highly reliable information; acquired from their long term work experience (approximately fifteen years), which was used in structuring the research questionnaires. The respondents were requested to peruse through lists of suggested survey questionnaires, involving possible cost overrun causal factors and the corresponding remedial cost control measures during the three-phase project development cycle, i.e. conception/planning/designing phase, implementation phase and the completion/commissioning phase. Incomprehensive lists of factors were listed for each development phase and the respondents had to comment on the items, make recommendations and add other factors or remedial control measures which they regarded very essential (refer **Appendix D –Expert Group Survey Questionnaire Sample)**.

3.7.9 The Expert Group Survey Respondents' Comments and recommendations

There was a unanimous approval of the survey initiative, along with vital comments and recommendations for incorporation in the broader view survey. Classical comments and professional advice from the expert group survey, included the one captioned below:

"Excellent initiative". "I think it addresses many issues bedevilling the department professionals during the project stage. I think it will go a long way to highlight some of the weaknesses currently being experienced in our work places and will contribute greatly in creating cost consciousness/awareness in the minds of the design team" (Respondent No 1).

The final survey questionnaire was prepared on the basis of the industry experts professional group survey comments and recommendations (refer **Appendix C** and **D** – Survey Questionnaire Sample).

3.8 THE RESEARCH QUESTIONAIRE

3.8.1 Questionnaire Design

The questionnaire design utilised the information that was sourced from the industry expert interviewees and the literature review ideas. The global nature of the construction industry cost overrun problem meant that most of ideas from other researchers' findings would be relevant to the Botswana context. Extremity, in whatever form was, however, disregarded.

3.8.2 Questionnaire Format and Sections

(a) Main Survey Questionnaires

The questionnaires were designed to extract two categories of information from the respondents: all professionals in the construction industry; comprising six professional fields: i) Project Managers, ii) Architects, iii) Engineering, iv) Quantity Surveyors, v) Project Financial Planners/Managers and vi) Construction Managers/Contractors. Each questionnaire contained two major sections: the demographic and the main data. The demographic section of the questionnaire was designed to obtain information about the respondent professional's field of expertise, their professional status in the organisation and duration of professional work experience. The main data section focused on soliciting cognitive phenomena, that is to say, opinions.

(b) Selected Case study Projects Questionnaires

The case study questionnaires were aimed at finding detailed information on specific identified projects which that have attracted both bad and good reports on cost overruns. The selection of the specific projects, was based on the researchers' industry work knowledge, given the time and cost constraints. The questionnaires were addressed to the relevant project team members, who had first hand account knowledge about the projects.

3.8.3 Index measures

Measures of cognitive phenomena (i.e. opinions) are often comprised of composite indices of a set of variable (Zikmund 1997). Zikmund (1997) further states that combining several items or attributes underlying a phenomenon or concept, or otherwise measuring a concept by a variety of techniques or by a combination of several attributes underlying the concept is "one method of increasing precision and accuracy".

The questionnaires were designed on Zikmund's observation principles. The Kendell's coefficient correlation analysis assesses the different phenomenon addressed by the study; as presented in the tables in Chapter five.

3.8.4 Questionnaire Administration

The research survey was conducted between 20 September and 6 December 2004.
The research survey was carried out after the incorporation of professional views gathered from the expert group survey. Sixty (60) questionnaires were distributed country-wide by hand and by e-mail, to professional personnel which included Project Managers, Architects, Engineers, Quantity Surveyors, Project Financial Planners or Construction Managers, (**refer Appendix D - Survey Questionnaire Sample)**. There was a total response of Fourty-Three (43) respondents which included: Nine (9) Project Managers, Four (4) Architects, Six (6) Engineering, Seventeen (17) Quantity Surveyors, Three (3) Project Financial Planners/Managers and Four (4) Construction Managers/Contractors. This represents 71.7% response (refer **Table C2**). In addition seven completed/or on-going projects were selected for detailed case study interview assessment. Direct personal oral interviews and notes recordings were carried out with specific project personnel involved with the projects in question (refer **Appendix D – Case Study Projects Questionnaire Sample)**.

3.9 Case Study Projects' Survey: Data Collection

The Case Study Projects' research survey was also conducted between 20 September and 6 December 2004, along with the main research survey, already described. There have been extreme incidences involving certain government projects executed in the period from 1999 to 2004, by the Department of Buildings and Engineering Services (DBES), in which cases of cost overruns were of unprecedented proportions, alongside extra-ordinary cost saving projects. Seven (7) of these special-case; development projects: namely (i) the Executive House Project, (ii) Botswana Radio and TV Station, (iii) Botswana Police College, (iv) Molepolole Sports Facility, (v) Serowe Sports Facility, (vi) Department of Wildlife Trophy Storage Facility, (vii) Makgadikgadi Game Proof Fence, were selected for a 'case study assessment, with respect to the effects of cost overruns and effective cost control measures, as viewed by the project teams; during the projects' execution. Interviews were conducted with specific project team members (professionals) who had first hand information on these projects. Their comments have been documented, in order to appreciate the realistic nature of the problem of cost overruns in the Botswana construction industry. More insights were revealed on the effectiveness of cost control measures, if implemented by competent project teams.

3.9.1 Questionnaires Delivery Format

Both the main survey and case study project's questionnaires were hand delivered to the respondents' offices, and e-mails were only used on the respondents' preference request to handle the survey electronically. Respondents' telephones and e-mails were collected at time of questionnaire delivery to serve as means of communication before the collection date. Both questionnaires included the following:

- On the University of the Witwatersrand letter head, and addressed to the respondent in three broad professional fields; consultants, planning officers and construction contractors.
- Survey title in brief and verbal communication or sticker notification of likely date of collection.

- Brief summary of the purpose for the research and assurance of anonymity. Samples of both main survey and case study questionnaires are presented in Appendices C and D.

Both the main research survey and case study questionnaires were delivered and collected between 20 September and 6 December 2004, from the respondent groups.

3.9.2 Reminders and 'please disregard' notes

Reminder e-mails were sent to the respondents a week to the final date of collection along with an electronic copy of the questionnaire. The respondents were asked to disregard the notification e-mails if they had already responded to the questionnaires.

3.10 Bias

Leedy et al. (2005) defines bias as an influence, or set of conditions that singly or together distort the data from what may have been obtained under the conditions of pure chance. Malhotra (2004) states that interviewers can bias the results of a survey by the manner in which they (1) select respondents (interviewing somebody else when required to interview the male head household), (2) ask research questions (omitting questions), and (3) record answers (recording an answer incorrectly or incompletely).

3.10.1 Other bias scenarios:

(i) A potential source of bias in the study, especially in respect to eliciting information on the underlying programmed objectives is the selection of the service provider itself. There is a possibility that the study objectives had been concealed. Leedy et al. (2005), states that motivational methods involving the use of projective techniques could be used in gathering sensitive information. These include the posing of indirect questions on sensitive or classified information. The respondent is free to make generic comments without fear or releasing secretes. Concealment of other objectives would be reduced.

(ii) Malhotra (2004) identifies non-response as another potential source of bias. Non-response could be minimized by the layout and the questionnaire brevity, the composition of the covering letter and the administration of the questionnaire;

including the assurance of anonymity. In this study, constant e-mail and telephone reminders, and personalized communications were vital steps taken in order to enhance responsiveness. Respondents were also assured of optimum confidentiality to be exercised in handling the information and also that the research survey was for the purpose of writing and academic thesis conferred with the University of the Witwatersrand in South Africa. They were further assured that the research findings would be vital for the purpose of effective project planning and implementation procedures.

(iii) The research findings are limited for application within the general Botswana construction industry economic environment. As pointed out in Chapter One and the literature review, the findings would be inappropriate if adopted in various international construction industries because of the divergence in economic environments.

3.11 METHODS EMPLOYED IN THE DATA ANALYSES

3.11.1 Quantitative Data Analysis

Malhotra (2004), states that the quality of the research results depends on the care exercised in the data preparation stages. In this study the questionnaires used for data collection, were formulated and edited for errors at the pilot research stage. The method for data analysis adopted followed the examples that were used by other researchers as revealed in the literature review. The opinions and recommendations of the industry expert were vastly used to edit and protect the questionnaires from errors. These measures were undertaken in order to ensure a thorough check for completeness, clarity effectiveness, reliability and robustness as recommended by Leedy et al. (2005) and Malhotra (2004). After the collection of all survey questionnaires, the data was edited for errors and inconsistencies.

3.12 DATA ANALYSIS PROCEDURES ADOPTED

Three data analysis methods: (1) the relative importance index, (2) the rank agreement factor and (3) the Kendall's coefficient of correlation. The first two methods are a build up to the Kendall's coefficient of correlation, which provides a conclusive summary of ordinal ranked cost overrun causal factors and effective cost control measures.

3.12.1 Respondents Opinion Factors Ranking

First the respondents were requested to rank construction costs overruns causal factors and effective cost control measures in a non-parametric opinion based order or magnitude of subject's responses, i.e perceptions of respondents on a ten point rating scale of 1-10, where 10 is the highest measure and 1 is the lowest measure, see chapter five. By this method the respondents were requested to rate the contribution of the factors to the problem or to the remedy on a ten point rating scales 1-10. The ten point rating scale was adopted due to the number of item factors concerned, contrary to the five point scale used by other researchers like Chan et al. (1997), Okpala et al. (1988) and Elinwa et al.(1993). The choice of scale was based purely an own discretion. This means that the factors and remedial measures were ranked according to their level of contribution to the problem of cost overruns or cost control remedial measures, on professional opinion basis.

The second data analysis adopted a similar approach but using the *relative Severity index* or *frequency distribution*. Malhotra (2004), describes frequency distribution as a mathematical distribution whose objective is to obtain a count of the number of responses associated with different values of one variable and to express these counts in percentage terms. The relative occurrence, or frequency, of different values of the variable is expressed in percentages.

3.12.2 Kendall's Coefficient of Rank Correlation (τ)

(i) Severity Index (F):

$F = F_3 + F_2 + F_1$; where F = severity index; F_3 = number of respondents that ranked the cost overrun causal factor as Highly frequent or the remedial cost control measure as Highly Effective; F_2 = number of respondents that ranked the cost overrun causal factor as Moderately frequent or the remedial cost control measure as Moderately Effective; and F_1 = number of respondents that ranked the cost overrun causal factor as Least Frequent or the remedial cost control measure as Least Effective. F_1 has not be used in computing the severity index since conclusive results can be drawn from the two sets of highest and moderately ranking factors (researcher's own discretion) (see chapter five). Severity Index (F) is computed using the percentage of respondents giving responses to particular costs overrun causal factor or a cost control remedial measure item.

(ii) Percentage Severity (P_3):

$P_3 = F/N_r x100$; where P_3 = Percentage Severity; F = severity index; and N_r = number of respondents per professional group.

The relative severity index analysis method is a multivariate method used to derive two index measures, firstly the significance index (i), which is a weighting or ordinal measure of each factor under consideration, given a ten point scale 1-10. 10 is the highest and 1 the lowest measure. Secondly the percentage severity (ii), expresses the relative severity as a percentage. The methods prioritise each factor according to its weighting relative to other factors (refer tables in Appendix 'C').

The third method is the Rank Agreement Factor Analysis or Kendell's Coefficient of Rank Correlation used by Okpala et al. (1988), and Elinwa et al. (1993). The Kendell's coefficient of rank correlation analysis method is a multivariate method that uses the results obtained from the relative severity index ranking orders, to cross rank of causal factors and cost control measures.

The Rank Agreement Factors for each cost overrun causal factor are computed from the each professional group severity rankings. The rank agreement factor combines all the severity ranking orders by the different groups and a quasi agreeable factor is used to rank the causal factors. This method eliminates possible disagreement degrees by the parties over the actual ranking of factors through the severity index order. Cost Overrun Causal Factors Rank Agreements and Effective Cost Control Remedial Measures are given in table in chapter five, for all the three project development cycle phases.

(iii) Kendall's Coefficient of Rank Correlation (τ)

$\tau = (\mathbf{S})/\{\mathbf{K}^2\}(n^{-1})[n^3-n]$; where; τ = Kendell's coefficient of rank correlation; **S =** sum of squares of standard deviation; **K** = total number of professionals that ranked the variable factors; and n = number of listed variable factors.

(iv) Chi-square (χ^2)

$\chi^2 = \mathbf{K}(n-1)\tau$; where (n-1) = degree of freedom with n, k; τ is as defined above.

Values of Kendell's rank correlation in the range $0 \leq \tau \leq 1.0$ indicate good agreement, and values near –1 or in the range $0 > \tau \leq -1.0$ implies disagreement on the factors ranked by professionals. The value of Chi-square is tested at the 0.05 and 0.01 levels of significance (Okpala et al. 1988, and Elinwa et al. 1993).

3.13 Assumptions

The following assumptions were made in the pilot surveys, questionnaire surveys and case study projects surveys:

1. The respondents involved in the data gathering were unbiased, well informed on the subjects of construction cost overruns and cost control in the Botswana construction industry to give reliable information.
2. The information obtained from the data gathering process was derived from respondents with relevant long-term work experience in construction cost overruns and cost control and will be relevant to the study.

3. The responses were carefully thought out and genuinely made, given the time taken between questionnaires delivery and collection dates.
4. The research assumed that the ten industry experts' group individuals are high caliber competent professional representative personnel, who are practicing in Botswana, and have been involved in a good number of government projects.
5. It was assumed that the selected case study projects are representative of the construction project which was implemented during the period in question.

3.14 RELIABILITY AND VALIDITY OF THE MEASUREMENT PROCEDURES

According to Zikmund (1997) reliability is the degree to which measures are free from error, and therefore yield constant results. It is the degree of accuracy and precision of a measurement procedure.

Zikmund (1997) defines validity as the ability of a scale or measuring instrument to measure what is intended to be measured.

3.14.1 Triangulation

The concept of triangulation has been utilized in order to enhance the reliability and validity of the research findings. Leedy et al. (2005) defines triangulation as an approach where multiple sources of data are collected with the hope that they will all converge to support a particular hypothesis or theory. It is common in both qualitative research and mixed-method designs, in which both quantitative and qualitative data are collected to answer a single research question.

The main methodologies utilized in this research included the review of literature findings, exploratory (expert group) survey, descriptive research and case study analysis. The data analysis method employed is the relative severity index and relative rank agreement factor or Kendells' correlation coefficient test.

In addition to triangulation the study adopted other forms of validity and reliability. Leedy et al. (2005) describes the two forms of validity: external and internal validity.

3.14.2 External Validity

Leedy et al. (2005) refers to external validity of a research study as the extent to which its results apply to situations beyond the study itself - in other words, the extent to which the conclusions drawn can be generalized to other contexts.

Leedy et al. (2005) further illustrates that where the study is cross-sectional and the respondents were interviewed only once, the research findings cannot claim validity across time, as the data collected are ephemeral (short lived) and are likely to change in future. However, the developed methodologies in this study could be used to up-date the findings in future enquiries (Elinwa et al. 1993).

3.14.3 Internal Validity

Leedy et al. (2005) defines internal validity of a research as the extent to which its design and the data it yields allow the researcher to draw accurate conclusions about cause-and-effect and other relationships within the data. This study ensured internal validity through the following measures:

- A wide coverage of the problem under study, by exorbitantly observing both construction cost overrun causal factors, effective cost control measures and apportioning of professional responsibility to causal factors or control measures.
- The study broke down the research into manageable research sub-problems, through the use of the expert group survey, main research questionnaires and the case study questionnaires.
- The expert group survey was employed in order to identify the relevant variables appropriate for the study.

3.14.4 Reliability

Reliability is defined by Leedy et al. (2005) as the consistence with which a measuring instrument yields a certain result when the entity being measured has not changed. Data reliability is related to data source and the identification of the position held by the person who completed the questionnaire (2002). Love (2002), goes on to state it is important that the personnel who had detailed knowledge about the procurement process associated with a project answered the questionnaire. This view was specifically upheld in all the three forms of questionnaires distributed: the pilot survey, the main research and the case study projects' questionnaires. The research ensured reliability by minimizing external sources of divergence and variations during the distribution of questionnaires. Respondents were all assured high degree of anonymity, the purpose of the research was made known to all and uniform time was allocated for responses, alongside persuasive response reminders to all.

3.15 Summary

On a conclusive note, the research employed the descriptive survey method, which combined both qualitative and quantitative research approach methods for data gathering. This was made imperative due to the descriptive research requirements, where much is not known about the problem. Being descriptive the research was characterized by indispensable information needs, a formal and structured research process, and a prior formulation of specific propositions, which were tested with the aim of examining certain relationships. The information which was gathered during the expert group qualitative research stage provided guidance for a detailed research design and aided the development of several propositions about the study question. It was also a recipe for designing questionnaires that were used for the quantitative data gathering. Guidelines were also drawn from previous researchers and authors for the same subject matter.

CHAPTER FOUR: DATA PRESENTATION AND ANALYSIS

4.1 Introduction

The results and analysis of the survey responses which were obtained with the view of realizing the objectives of the study have been presented in both text and tabulation formats.

4.2 Demographic Profile of Expert Group (Exploratory) Survey Respondents

The demographic profile of the expert group survey includes a 70% representation of the quantity surveying profession, and 10% each; for the project management and architecture professions (**Table C1** and **Figure C2**). That was in cognisant with the fact that; that the quantity surveying profession is more directly involved with project's financial management during construction than others. The quantity surveyor ensures that the resources of the construction industry are utilised to the best advantage of the society by providing, among other things, the financial management for projects and a cost consultancy service to client and designer during the construction process (Seeley 1983).

4.3 MAIN RESEARCH SURVEY RESPONSES

Shown in Table C2, are the main survey questionnaire response from six professional groups used in the research; Project Managers, Architects, Engineers, Quantity Surveyors, Project Financial Planners or Construction Managers. The tabulated presentation shows: the sampling frame, number of questionnaires sent out, the number of questionnaires received and the number not received from the survey respondents. The questionnaire distribution ratio was formulated from the findings of the pilot survey results; in which three professional group participatory ratios are: Project Managers (10%), Architects (10%), Engineers (10%) and Quantity Surveyors (70%). The same distribution ratio was applied to the sixty questionnaires for the main research survey giving: - Project Managers: (10 questionnaires), Architects: (10 questionnaires), Engineers: (10 questionnaires), Quantity Surveyors: (20 questionnaires, Project Financial Planners: (5 questionnaires) and Construction Managers :(5 questionnaires) (refer Table C2 and Figure C3).

Sixty (60) questionnaires were distributed country-wide by hand and by e-mail, to professional personnel which included Project Managers, Architects, Engineers, Quantity Surveyors, Project Financial Planners or Construction Managers, (refer **Appendix C - Survey Questionnaire Sample)**. There was a total response of Fourty-Three (43) respondents which included: Nine (9) Project Managers, Four (4) Architects, Six (6) Engineering, Seventeen (17) Quantity Surveyors, Three (3) Project Financial Planners/Managers and Four (4) Construction Managers/Contractors. This represents 71.7% response (refer **Table C2**).

4.3.1 Survey Respondents' Participatory Responsiveness

Details for the Fourty-three (43) survey questionnaire respondents are as shown in **Figure C3.** The participatory analysis of the survey indicates a larger representation of the quantity surveying profession; with up to 40%, followed by project management with 21%, engineers with 14%, and architects and Construction managers/contractors with 9% each and last financial managers with 7%.

4.3.2 Survey Respondents' Work Experience

The results show that the respondents have been in the industry for an average period of sixteen (16) years. This signifies the fact that the information obtained from the survey can be classified as reasonably reliable, due to the construction work experience of the survey participants. There were more responses of up to 40% of the total respondents, from the quantity-surveying group, but the architects group was the most responsive at group participation level, with a 90% useable responses. The most work-experienced personnel represented the architectural group, of up to 27 years on average, followed by the project management and financial managers, at 18 years and 17 years, respectively. Illustration for respondents' acquired work experience is as shown in table C3 and Figure C4.

4.4 THE RESPONDENTS RANKING OPINION FOR COST OVERRUN CAUSAL FACTORS AND EFFECTIVE COST CONTROL MEASURES

The results of the study are presented and analysed in relation to the study objectives outlined in chapter one. The primary objective of the study is to identify construction cost overruns causal factors and the effective remedial cost control measures. The data analysis findings is directly dependent on the respondents' opinion, and attracts their interest; according to Malhotra (2004).

The secondary objective is to apportion professional accountability in the construction cost overruns and or effective implementation of cost control measures. The apportionment is done in accordance with the traditional standard professional practice of project teams, and the two Joint Contracts Tribunal (JCT) contracts: Management Contracting and Construction Management (Ramus, 1993). These two building procurement methods are commonly practiced in the Botswana construction industry.

Several construction cost overrun causal factors and effective remedial cost control measures were listed from the exploratory (expert group) survey recommendations. The respondents' perceptive opinions regarding the frequency of cost overrun causal factors and effectiveness of cost control measures were solicited from the six professional groups of respondents, ordinal listed on a ten point rating scale, 1-10, where 10 is the highest measure and 1 the lowest.

4.4.1 Construction Cost Overrun Causal Factors

The contributory factors which lead to project cost overruns, during three major phases of the Construction Project's Life Cycle i.e. Conception / Planning / Designing Phase *(ending with signing of Certificate for Readiness to Tender)*, Implementation Phase *(ending with issuing of Certificate for Practical Completion)*, and Completion and Commissioning Phase *(ending with issuing of Certificate of Making Good Defects)*, **(refer Figure C1)**; all to a different degree were listed. The respondents were asked to tick [√] the appropriate box, in order to reflect their professional opinion with regard to the degree to which they would apportion the effects of the respective causal factor, and also to rank score it on a ten (10) point basis (i.e. for Highly Frequent Causes: [Seven to Ten Points], Moderately Frequent Causes: [Five to Six Points], and Least Frequent Causes: [Zero to Four points]). The average ranking for each respondent group for each causal factor are presented in tables C4 to C9.

4.4.2 Conception / Planning / Designing Phase

The ordinal presentation of cost overrun causal factors with an average group score of five points and above (i.e. highest scoring causal factors), as rank scored by the survey respondents, is shown in Table C4 (with ranking score 1 representing the highly frequent factor). It is important to note that these cost overrun causal factors are either highly or moderately frequent factors, according to the respondents score ranking.

4.4.3 Implementation Phase

Table C7 shows an ordinal presentation of cost overrun causal factors with an average group score of five points and above (i.e. highest scoring causal factors), as rank scored by the survey respondents (with ranking score 1 representing the highly frequent factor). Like in the previous phase, the cost overrun causal factors are either highly or moderately frequent factors, according to the respondents score ranking.

4.4.4 Completion and Commissioning Phase

Similarly to the other two processes, an ordinal presentation of cost overrun causal factors with an average group score of five points and above (i.e. highest scoring causal factors), as rank scored by the survey respondents, is shown in Table C9 (with ranking score 1 representing the highly frequent factor). The cost overrun causal factors, fall under the highly and moderately frequent factors category as has been the phenomenon at the first two stages of Conception / Planning / Designing and Implementation Phases.

4.4.5 Cost Overrun Remedial Control Measures

The remedial cost control measures that could be employed to counteract unreasonable cost overruns, during the three major phases of Construction Project's Life Cycle i.e. Conception / Planning / Designing Phase *(ending with signing of Certificate for Readiness to Tender)*, Implementation Phase *(ending with issuing of Certificate for Practical Completion)*, and Completion and Commissioning Phase *(ending with issuing of Certificate of Making Good Defects),* were listed in accordance with the exploratory survey recommendations ***(*Refer Figure C1);*** all to a different degree of effectiveness. The respondents were asked to tick [√] the appropriate box, in order to reflect their professional opinion with regard to the degree of effectiveness which they would apportion the respective remedial process, and also to rank score it on a ten (10) point basis (i.e. for Highly Frequent Causes: [Seven to Ten Points], Moderately Frequent Causes: [Five to Six Points], and Least Frequent Causes: [Zero to Four points]). The average ranking for each respondent group for each remedial cost control measure are presented in tables C10 to C15. The professional personnel liability is allocated in accordance with the JCT type of contract, on which the government development projects are based, though with the exception of the civil works projects like roads, bridges, dams etc (Ramus, 1993).

4.4.6 Conception / Planning / Designing Phase

An ordinal presentation of the effective remedial cost control measures with an average group score of five points and above, as rank scored by the survey respondents is shown in Table C11 (with ranking score 1 representing the highly effective remedial cost control measure). The remedial cost control measures were found to be either **highly or moderately effective measures**, according to the respondents score ranking.

4.4.7 Implementation Phase

A similar ordinal presentation, as the one for the previous phase, of the effective remedial cost control measures (average group score of five points and above, rank scored by the survey respondents), is shown in Table C13. The first ten remedial cost control measures are **all highly effective measures**, according to the respondents score ranking.

4.4.8 Completion and Commissioning Phase

The ordinal presentation of the effective remedial cost control measures, was carried out for the final phase (refer Table C15). The finding identified remedial cost control measures that are **either highly or moderately effective measures**, according to the respondents score ranking.

4.5 Summary of Findings on Respondents' Score Ranking

4.5.1 Construction Cost Overrun Causal Factors

There were ten either moderately or highly frequent cost overrun causal factors identified at each of the conception/planning/designing and implementation phases, which the respondent ranked scored between 5 to 8 points, Five factors of similar ranking score were associated with the completion/commissioning phase. Therefore, there are more cost overrun causal factors encountered at the first two project development phases than the later.

4.5.2 Remedial Cost Control Measures

From all the fifteen remedial cost control measures listed for the conception/planning/designing phase, none was found least effective. At the implementation phases, only one out of thirty-two cost control measures was rank scored least effective. At completion/commissioning phase, two out of thirteen cost control measures were rank scored least effective. Therefore, effective cost control measures can be implemented by the responsible professional parties at each project development phase, yielding optimum results.

In addition, the respondents ranking scores points out to the human resource input factor as playing a key role in either causing or controlling exorbitant construction cost overruns (Sawczuk 1996).

The respondents' ranking score results can be used to draw conclusive inferences and recommendations, because of the diversity (disagreement factor) between the respondents ranking opinion. Therefore, two other data analysis formulae; the percentage severity index and the Kendell's Correlation Coefficient have been employed in order to minimize disagreement factor. The application of triangulation methods in the data analysis is aimed at achieving conclusive and reliable findings from the research (Leedy et al. 2005).

4.6 RELATIVE SEVERITY INDEX

The relative severity index analysis method is a multivariate method used to compute the percentage severity of items. The methods priorities each factor according to its weighting relative to other factors (tables in chapter five). $P_3 = F/N_r x100$; where P_3 = Percentage Severity; F = severity index; and N_r = number of respondents per professional group. The Severity Index has been calculated from the total of highly and moderately frequent cost overrun causal factor and effective cost control measures responses, for the sake of conformity with ten point respondents' rank score analysis findings, already discussed. On the same token, the researcher's own discretion has been used to classify causal factors with percentage severity index of above 80% **(i.e. 80%≤ S ≥100%)** as 'Extremely Highly Frequent Factors' (**EHFF).** Effective remedial cost control measures with percentage severity index of above 80% **(i.e. 80%≤ S ≥100%)** have been classified as 'Extremely Highly Effective Measures' (**EHEM).** These factors would score from 5 points and above, under the ten point ranking score system. The EHFF factors would be used for comparisons of the data analysis results of the relative severity index and that of the respondents ranking score, already discussed (Elinwa et al. 2001).

4.6.1 Tabulation of respondents' results

The data was tabulated for each professional group's response for all the project development cycle phases; i.e. (i) conception/planning/designing, (ii) implementation and (iii) completion/commissioning phases, with respect to cost overrun causal factors (refer tables C16 to C33), and effective cost control measures (refer tables C34 to C51)

4.7 Cost Overrun Causal Factors Rank Agreement Table for all Professional Groups Combined

The Rank Agreement Factors for each cost overrun causal factor are computed from the each professional group severity rankings. The rank agreement factor combines all the severity ranking orders by the different groups and a quasi agreeable factor is used to rank the causal factors. This method eliminates possible disagreement degrees by the parties over the actual ranking of factors through the severity index order. Cost Overrun Causal Factors Rank Agreements are given in **Tables C52 to C57**, for all the three project development cycle phases.

4.8 Remedial Cost Control Measures Rank Agreement Table for all Professionals Combined

A similar method of professional group severity ranking was applied for Effective Remedial Cost Control Measures (refer **Tables C58 to C63**).

4.9 SUMMARY ON DATA ANALYSIS FINDINGS

There is a close agreement in the findings resulting from the three data analysis methods used: 1) the respondents' ten point score ranking method; 2) the relative severity index method, and 3) the Kendell's Correlation Coefficient. These three data analysis methods classified the construction cost overruns causal factors, remedial cost control measures and liable professional personnel for the three project development cycle phases in a similar manner.

The highly frequent construction cost overruns causal factors and liable professional personnel have been similarly identified at each of the three project development cycle phases, by all the three methods:

1) The respondents' ten point score ranking: Refer Tables C4 – C8 and C5-C11.
2) Relative Severity Index: Refer Tables C16 – C33.
3) Kendell's Correllation Coefficient: Refer Tables C52 – C56 and Figure C20.

The highly effective remedial cost control measures and liable professional personnel have been similarly diagnosed at each of the three project development cycle phases by all the three methods:

4) The respondents' ten point score ranking: Refer Tables C10 – C14 and C11-C15.
5) Relative Severity Index: Refer Tables C34 – C51.
6) Kendell's Correllation Coefficient: Refer Tables C58 – C62 and Figure C35.

The use of the three methods (triangulation) helps to draw a conclusive confirmation of the research hypothesis (Leedy et al. 2005). The case study findings which follow will give another dimension to these findings.

4.10 CASE STUDY PROJECTS RESEARCH SURVEY: DATA ANALYSIS

The case study survey research focused on assessing seven (7), special-case development projects which were constructed by the Department of Buildings and Engineering Services (DBES), in the past six (6) years; 1999 to 2005. The average percentage cost and time overrun was found to be 33.8% and 1.1 year delay (Refer Table 4A). The findings have been used for comparison with the other three methods' results.

Table 4A: Summary of Case Study Projects Findings

Case Study Project	Original Contract Value (Million Pula)	Original Contract Completion Date	Final Contract value (Million Pula)	Percentage Cost Overrun	Duration Increase
(1) The Executive House	P 3.0 M (Year 1999)	2002	P 5.5 M (Year 2003)	73.3%	(1 year delay)
(2) The Botswana radio and TV Station	P 155.0 M (Year 1999)	2001	P 289.0 M (Year 2002)	86.5%	(1 year delay)
(3) The Trophy Storage Facility	P 10.5 M (Year 2002)	2003	P 12.0 M (Year 2005)	14.3%	(2 year delay)
(4) The Makgadikgadi Game Fence	P 12.6 M (Year 2003)	2004	P 13.5 M (Year 2005)	7.1%	(1 year delay)
(5) The Serowe Sports Facility	P 27.0 M (Year 2000)	2002	P 42.0 M (Year 2003)	55.6%	(1 year delay)
(6) TheMolepolole Sports Facility	P 12.0 M (Year 2000)	2001	P 0.2 M (Year 2002)	1.7%	(1 year delay)
(7) The Botswana Police College	P 191.0 M (Year 1999)	2000	P 187.0 M (Year 2001)	-2.1%	(1 year delay)
AVERAGE % COST & DURATION OVERRUN				33.8%	1.1 year delay

4.10.1 Triangulation Agreement Analysis

The **Triangulation Agreement Analysis** Method brings into comparison, the results of the findings on major cost overrun causal factors and effective cost control measures identified using all the three methods (Refer tables C64 and C65). From these three methods of analysis; the respondents' factor ranking method, the Kendell's correlation coefficient and the case study project investigation findings, a conclusive ordinal list of major cost overrun causal factors and the effective cost control measures; has been drawn (i.e. a triangulation agreement analysis list) (Leedy et al. 2005).

4.10.2 Summary of the Three-Method Comparative Analysis (Triangulation) on Cost Overrun Causal Factors and Effective Cost Control Measures

The comparison between the three methods of analysis used to identify the major cost overrun causal factors and the effective remedial cost control measures indicate an average of at least 67% agreement (refer tables C64 and C65). The main reasons project cost overruns and project delivery delays were found to be similar when using all the three different methods. In the same vein, where there was success, the cost control measures had been efficiently implemented by the liable professional personnel.

CHAPTER FIVE: DISCUSSION OF THE RESULTS

5.1 Results discussion

The length of time that the respondents in this research have been in the industry ranged from four (4) to forty-eight years. The results show that the respondents who participated in the research survey have been in practice for a mean period of sixteen (16) years. On that basis, the information obtained, especially that concerned with the assessment of the significance of cost overrun causal factors, effective cost control remedial measures and insights on causes of cost overruns and the effective application of cost control remedial measures, on special case selected projects, is regarded as reasonably reliable due to the construction work experience of the survey participants.

5.1.1 Tabulated results

Tables C16 to C33 show each respondent group's severity index ranking order of the highly frequent cost overrun causal factors as postulated by the project managers, architects, engineers, quantity surveyors, financial managers and construction mangers (contractors), for the three phase project development cycle
(i.e. (i) conception/planning/designing, (ii) implementation and
(iii) completion/commissioning).

Tables C34 to C51 show each respondent group's severity index ranking order of the highly effective cost control remedial measures as postulated by the project managers, architects, engineers, quantity surveyors, financial managers and construction mangers (contractors), for the three phase project development cycle (i.e. (i) conception/planning/designing, (ii) implementation and (iii) completion/commissioning).

5.1.2 Cost overruns causal factors discussion

Tables C52, C54 and C56 are cross-comparison tables for each respondent group's severity index ranking order. They show the combined and cross-compared (correlated) rank agreement factors and the rank orders of highly frequent cost overrun causal factors as postulated by the project managers, architects, engineers, quantity surveyors, financial managers and construction managers (contractors), for the three phase project development cycle (i.e. (i) conception/planning/designing, (ii) implementation and (iii) completion/commissioning).

At **conception/planning/designing phase**, tables C52 and C53, it was observed that the two (2) extremely highly frequent (**80%≤ PAR ≥100%)** cost overruns causal factors; as perceived by all the professional groups are: (1) incomplete design and (2) additional work required by client at the end of design period. The kendell's coefficient of rank correlation (τ) and chi-square (χ^2) are 0.005 and 4.74, respectively; indicating a perfect agreement between the professional groups. Table C53, and Figures C5 to C9, show that Clients (44%), Project Managers (34%) and Architects (12%) play a major contributory role in perpetrating the overall cost overrun causal factors; during the conception/planning/designing phase of the projects development cycle.

At **implementation phase**, tables C54 and C55, it was observed that the two (2) extremely highly frequent (**80%≤ PAR ≥100%)** cost overruns causal factors; as perceived by all the professional groups are: (1) failure to determinate non-performing contractors and (2) delay in resolving contractual claims. The kendell's coefficient of rank correlation (τ) and chi-square (χ^2) are 0.007 and 12.94, respectively; indicating a perfect agreement between the professional groups. Table C55, and Figures C10 to C14, show that Contractors (28%), Architects (27%), Project Managers (19%) and Quantity Surveyors (19%) play a major contributory role in perpetrating the overall cost overrun causal factors; during the implementation phase of the projects development cycle.

At **completion/commissioning phase**, tables C56 and C57, it was observed that only one (1) extremely highly frequent (**80%≤ PAR ≥100%)** cost overruns causal factor; as perceived by all the professional groups is: (1) delay in resolving contractual claims. The kendell's coefficient of rank correlation (τ) and chi-square (χ^2) are 0.007 and 13.70, respectively; indicating a perfect agreement between the professional groups. Table C57 and Figures C15 to C19 show that Quantity Surveyors (34%), Contractors (25%) and, Project Managers (14%) play a major contributory role in perpetrating the overall cost overrun causal factors; during the completion / commissioning phase of the projects development cycle.

5.1.3 Cost overrun causal factors summary

Figure C20**:** Summarises the cost overrun causal factors contributory parties as follows:

- Clients, Project Managers, Architects and Quantity Surveyors are major cost overrun causal factors contributors at conception/planning/designing phase.
- Contractors, Architects, Quantity Surveyors and Projects Managers play a major role during implementation phase.
- Quantity Surveyors, Contractors and Project Managers and dominate the completion and commissioning phase.

5.1.4 Remedial cost control measures discussion

Tables C58 to C62 are cross-comparison tables for each respondent group's severity index ranking order. They show the combined and cross-compared (correlated) rank agreement factors and the rank orders of highly effective remedial cost control measures as postulated by the project managers, architects, engineers, quantity surveyors, financial managers and construction managers (contractors), for the three phase project development cycle (i.e. (i) conception/planning/designing, (ii) implementation and (iii) completion/commissioning).

The **Conception/planning/designing phase**, as illustrated in tables C58 and C59, observes that the eight (8) extremely highly effective (**80%≤ PAR ≥100%)** remedial cost control measures; as perceived by all the professional groups are: (1) adequate project design specification, (2) reliable project cost estimates, (3) comprehensive project planning; (4) adequate pre-contract project coordination; (5) comprehensive client's project brief development; (6) comprehensive tendering procedures, (7) improved cost data collection and (8) setting up effective communication channels. The kendell's coefficient of rank correlation (τ) and chi-square (χ^2) are 0.021 and 12.64, respectively; indicating a perfect agreement between the professional groups. Table C59, and Figures C21 to C25, show that Clients (43%), Project Managers (27%) and Architects (10%) can play a major contributory role in implementing effective overall remedial cost control measures; during the conception/planning/designing phase of the projects development cycle.

At **implementation phase**, tables C60 and C61, it was observed that the two (2) extremely highly effective (**80%≤ PAR ≥100%)** remedial cost control measures; as perceived by all the professional groups are: (1) Complete Project Designs and (2) Timely issuing of architect's instructions. The kendell's coefficient of rank correlation (τ) and chi-square (χ^2) are 0.006 and 8.00, respectively; indicating a perfect agreement between the professional groups. Table C61, and Figures C26 to C29, show that quantity Surveyors and Architects (13%) can play a major contributory role in implementing effective overall remedial cost control measures; during the implementation phase of the projects development cycle.

The final phase, the **completion/commissioning phase**, illustrated in tables C62 and C63, show that one (1) extremely highly frequent (**80%≤ PAR ≥100%**) cost overruns causal factor; as perceived by all the professional groups is: (1) timely issuing of architect's instructions. The kendell's coefficient of rank correlation (τ) and chi-square (χ^2) are 0.006 and 3.10, respectively; indicating a perfect agreement between the professional groups. From Table C63, and Figures C30 to C34, it is shown that Project Managers (54%), Architects (18%) and Quantity Surveyors (13%) play a major contributory role in implementing effective overall remedial cost control measures; during the completion / commissioning phase of the projects development cycle.

5.1.5 Remedial cost control measures summary

Figure C35; summarises the cost overrun remedial control measures' implementation responsibility trend as follows:

- Clients, Project Managers, Architects and Quantity Surveyors can play a major cost control remedial implementation role at conception / planning / designing phase.
- Quantity Surveyors, Projects Mangers and Architects play a major role during implementation phase.
- Project Managers, Architects, Quantity Surveyors and Contractors and dominate the completion and commissioning phase.

5.1.6 Comparisons of results with literature findings

The research employed three test techniques: (1) the case study project analysis, (2) the respondents' ranking scores, and the Kendell's correlation coefficient, for cross comparison of all factors (triangulation agreement percentage) at either phase of the project development cycle (refer Table C64). Four major causal factors for cost overruns; which scored 100%, were identified as: (i) Insufficient/Inadequate design, (ii) lack of project coordination, (iii) contractual claims, and (iv) inadequate project brief. It is worth noting that these major cost overruns causal factors were earlier identified in Chimwaso (2000) study, which focused on projects completed before 2000. This observation supports the reliability and validity of the findings (Leedy 205); suggesting that the problem of cost overruns is continuing unabated in the Botswana Construction industry. There were seven other factors scoring up to 67%, on this study analysis were identified as follows: (i) additional works, (ii) poor workmanship, (iii) poor site management, (iv) contract variations, (v) design errors, (vi) poor performance by nominated subcontractors, and (vii) delayed tender adjudication and award.

On comparison with others research findings beyond the region (i.e. SADCC), the cost overrun causal factors were found to vary, apparently, due to regional economic influential factors. There was, however, an exception with regard to those causal factors which emanate from human resources input short comings, negligence and inefficiencies. There were three factors found by several researchers, which result from shortcomings in the human resources input, namley: (1) inadequate designs, (2) contract variations, and (3) contractual claims. These factors were identified in the following studies: Arditi et al. (1985), in Turkey, Elinwa et al. (1993), in the Nigerian construction industry, Semple et al. (1994), studying projects in Western Canada, Assaf et al. (1995), studying Saudi Arabian projects and Al-Momami (1996) in Jordan. The authors also identified erroneous (incorrect) project budget cost estimates, as one of the major cause of cost overruns. This factor has not been singled out in the list of causal factors for the Botswana case, because it is also caused by the first factor identified, which is; inadequate project brief and design. The effects of inaccurate cost estimates will eventually trigger other factors like; contract variations and contract claims. The subject of cost estimates was, therefore, extensively addressed in the literature review, for the sole reason that it leads to other factors whose effects are easily recognised.

Table 5A : Comparisons on Botswana Construction Cost Overrun Factors with those of different researcher's findings

Cost Overruns Researcher	Cost Overruns Causal Factors Identified	Regional Economic Area of Study (Country)	Similar Factors Occurring in Other Regional Economic Areas (Countries)	Remarks on Findings
Dibonwa P (2008)	**(i)** Insufficient/Inadequate design **(ii)** Lack of project coordination **(iii)** Contractual claims **(iv)** Inadequate project brief	**Botswana-Southern Africa**	**(i), (ii), (iii) & (iv):** Nigeria, Canada, Saudi Arabia and Hong Kong	☞Factors peculiar to West Africa, North America, Middle East and Asian Economies
(1) Arditi et al. (1985)	**(i)** inflationary pressures **(ii)** increase in materials prices and workmen's wages **(iii)** difficulties in sourcing materials (i.e shortages) **(iv)** turbulent official prices **(v)** construction delays **(vi)** errors in first estimates	**Turkey-Middle East**	**(i), (ii), (iii), (iv), (v) & (vi):** Nigeria, Canada and Indonesia	☞Factors peculiar to North America, Middle East and Asian (Far East) Economies ☞**Globally** widespread factors
(2) Elinwa et al (1993)	**(i)** Shortage of construction materials **(ii)** Methods of financing and payment for completed works **(iii)** Poor contract management **(iv)** Price fluctuations	**Nigeria-West Africa**	**(i), (ii), (iii) & (iv):** Turkey, Saudi Arabia and Hong Kong	☞Factors peculiar to West Africa, Middle East and Asian Economies ☞**Globally** widespread factors
(3) Semple et al. (1994)	**(i)** contract variations **(ii)** disputes **(iii)** soil and sites conditions **(iv)** delays	**Canada-North America**	**(i):** Saudi Arabia and Hong Kong	☞Factor peculiar to North America, Middle East and Asian Economies ☞**Globally** widespread factors
(4) Assaf et al. (1995)	**(i)** inadequate designs **(ii)** slow work progress on site **(iii)** late payment for completed works **(iv)** design changes by owners	**Saudi Arabia-Middle East**	**(iii), (iv) & (v):** Nigeria and Hong Kong	☞Factors peculiar to Middle East, West African and Asian Economies ☞**Globally** widespread factors
(5) Chan et al. (1997)	**(i)** poor site management and supervision **(ii)** unforeseen ground conditions **(iii)** low speed of decision making by project teams **(iv)** client-initiated variations **(v)** necessary variations of works	**Hong Kong-Asian**	**(i), (ii), (iv) & (v):** Nigeria, Canada and Saudi Arabia	☞Factors peculiar to North America, West African, Middle East and Asian Economies ☞**Globally** widespread factors
(6) Kaming et al. (1997)	**(i)** project cost underestimation **(ii)** project complexity	**Indonesia-Far East**	**(i) & (ii):** Turkey Denmark	☞Factors peculiar to European, Middle East and Asian (Far East) Economies ☞**Globally** widespread factors
(7) Flybjerg et al. (2004)	**(i)** the length of the project – implementation phase **(ii)** the size of the project **(iii)** the type of project ownership	**Denmark-Europe**	**(ii):** Indonesia	☞Factor peculiar to European and Asian (Far East) Economies ☞**Sparsely** spread factor

The findings in the Botswana study and that from other countries, lead, arguably, to the fact that the human resource input short comings, negligence and inefficiencies, would result in cost overruns in any construction project, being executed elsewhere in the world.

On the Botswana scenario, the findings, notably showed that *force majeure* (acts of God); or natural catastrophes were the least; if not that they are non-existent causal factors of cost overruns in the construction industry (refer Tables C54 and C56).

The analysis used for cost overrun causal factors was similarly applied in the identification of cost control measures, an area which was not addressed by the Chimwaso (2000) study. The study identified the most effective cost control measures; scoring 100% (refer Table C65) as: (i) competent project team personnel, (ii) improved project monitoring, and (iii) good time and financial management. Five more effective cost control measures, scoring 67% were identified as: (i) effective communication, (ii) resolution of contractual claims, (iii) determination of non-performing nominated subcontractors, (iv) improved project coordination, (v) timely issuing contract variations.

It is evident from the listed effective cost control measures, that success and failure, depend entirely on the competence of the project personnel (human resource input) (Elinwa et al. 1993). On the professional accountability, project personnel parties' contributory percentages to cost overruns (refer Figure C20), were identified as follows:

(1) At the conception/planning/design phase, clients were found to account for over 40%, while project managers contributed over 30%.

(2) At the implementation phase, architects were found to account for over 25%, while project managers contributed over 15%.

(3) At the completion/commissioning phase, quantity surveyors were found to account for over 30%, while contractors contributed over 20%.

The accountability roles on implementing effective cost control measures were apportioned as follows (refer Figure C35): (1) At the conception/planning/design phase, clients could contribute over 40%, while project managers could contribute over 25%. (2) At the implementation phase, quantity surveyors could contribute over 60%, while project managers could contribute over 10%. (3) At the completion/commissioning phase, project managers could contribute over 50%, while architects could contribute over 10%.

The professional contributory percentages shown on figures C20 and C35, is an over-emphasis of the necessity for improvement in the professional competence. Negligence and incompetence would easily lead to exorbitant cost overruns, whereas the appointment of competent project teams, can effectively implement projects cost control measures.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.0 Conclusions on the Research Findings

The primary objective; of the research which was to identify major cost overrun factors and the most effective cost control measures was achieved by soliciting professional opinion from the Botswana construction industry expert group. Their input was used in the research questionnaire development and validation. The research questionnaire was circulated to a larger group of practicing personnel, who were requested to rank in ordinal sequence, both major cost overrun factors and costs control measures (Refer Tables C52, C54, C56, C58, C60 and C62). The three test technique of (1) case study project analysis, (2) respondents' rank scoring and the Kendell's correlation coefficient, was used for factor comparison (triangulation) (refer table C64). The four major cost overrun causal factors peculiar to Botswana were identified as (i) Insufficient/Inadequate design, (ii) lack of project coordination, (iii) contractual claims, and, (iv) inadequate project brief. There were three most effective cost control measures identified (refer Table C65): (i) competent project team personnel, (ii) improved project monitoring, and (iii) good time and financial management.

The case study projects assessment was based on seven selected projects, aimed at validating the professionals divergent perceptions, through real life situations. The average percentage cost overrun for the seven projects whose duration spanned over a five year development plan period was 33.3% (refer table 4A). They also recorded a 1.1 year average completion delay. Effective costs control was achieved in one of the selected project, and the reasons pointed out to the competent team involved. The comparisons which were carried on cost overrun factors identified in the Botswana Construction industry and those of other regional economies, confirmed that the factors were not unique to Botswana or the SADC region but were global (refer Table 5A). Due to the global nature of both the major cost overruns and effective cost control measures, the findings can be useful tools by practitioners in different construction industries.

The validation of the three propositions is as follows:

1) The case study projects assessment showing an average of 33.3% cost overrun, is vital in validating the first proposition that the deferment of development plan projects would remain unabated without the implementation of effective cost control measures (refer Table 4A).

2) The results on Table 4A (case study project assessment), also validated the second proposition due to the fact that, one out of the seven projects, resulted in cost savings

amounting to 2.1%. The cost savings resulted from the effort of the competent project team involved.

3) The case study projects assessment played a key role in demonstrating the effect of a competent human input in achieving total cost control at all phases of the project development cycle.

The findings also reveal that the apparent bias between respondents, which usually manifest itself due to their divers vantage points of view (resulting from different experience conditioning), from which each group view the industry was not very significant. Therefore, a fair degree of "objectivity" and "validity" can be ascribed to the findings, especially in view of the substantial average work experience of the respondents; which is sixteen years. The research observations and subsequent conclusions could be useful guidelines in minimising cost overrun in the Botswana construction industry and beyond.

6.2 Conclusions regarding the implications

The research findings are a useful tool that points out the sources of costs overrun problems and also proposes possible solutions to the problem. It is important to note that the failures and success in minimising or eliminating cost overrun problems rests on human resources management efficiency (professional competence) or inefficiency (professional incompetence). The professional competence of both clients and project teams play a vital role in successful project delivery. Willis et al. (1994), observes that a professional person is one who offers competence and integrity of service, coupled with a skilled intellectual technique. Good professional management strategies would certainly yield positive results, whereas management inefficiencies yield poor results. Professionals (project managers and project teams) need to pay maximum attention to clients' objectives (project briefs) for every project proposals. The literature and the current research findings, reveal that most projects' worse scenario cases (exorbitant costs), are a result of professional negligence. The principal objectives of any client (could be government development), is have the project completed on time, within budget and to an appropriate standard of design specification (Thomas 1993). Failure to satisfy these three key areas means that the end-user (the client's) objective are betrayed at no value for monetary expenditure. The research has satisfied the validity and reliability tests, in that it agrees with previous research findings that were done four years earlier (Chimwaso 2000). It also agrees with other international research findings, especially on factors that are influenced by human resource input. The literature findings reveal the regional economic influences, like fuel prices, inflation rates, as determinants to project cost

performances. The Botswana construction industry, seem not to be affected, grossly by non-human factors, like material prices or inflation rates. It is possible that these factors would become significant overtime (a trend left for future reviews).

6.3 Regarding further research

The research did not cover the extent of the cost overrun problem, with respect to the country's construction industry as a whole; i.e. building projects as well as civil works undertaken by various government departments. Civil works are usually executed over longer contract duration, and at higher costs that most building works. Flybjerg et al. (2004), Jahren et al. (1990) and Kaming et al. (1997), found that cost escalations and project completion delays were influenced by (i) project type, (ii) contract duration, (iii) project size and (iv) type of project ownership. A study on the Botswana construction industry, which is presently, rapidly growing would be appropriate to investigate the impact of these factors.

The issue of time overrun, which cannot be easily disassociated from cost overrun, as seen in the literature review and case study projects assessment, should be incorporated in the further researches.

Another possible approach to the subject could be totally based on specifically selected projects; so as to explore the effects of cost overruns in depth, for a data bank compilation. Since projects are unique, the implications of the human resource efficiencies and inefficiencies would be worth an investigation.

REFERENCES

1 Al-Bahar, J. F., and Crandal, K. C. (1990). Systematic Risk Management Approach for Construction Projects, Journal of Construction Engineering and Management, ASCE 1852, vol. 116, 533-552.

2 Al-Momani, A. (1996). Construction cost prediction for public school buildings in Jordan. Vol. 14. 311-317.

3 Arditi, D., Tarim, A.G., and Gurdamar, S. (1994). Cost overruns in public projects. Project Management. Vol3, 218-224.

4 Armstrong, G., and Kotler, P. (2003). Marketing. An Introduction, Sixth Edition, Pearson Education Inc., Upper Saddle River. New Jersey.

5 Ashworth, A. (1994). Cost Studies of Buildings, Second Edition, Longman Group Limited.

6 Assaf, S.A., Al-Khalil, M., and Al-Hazmi, M. (1995). Causes of delay in large building construction projects. Journal of Management in Engineering. Vol. 11. 45-50

7 Beatie, N. (2002). Using risk management techniques in capital works construction projects. Paper presented at New Zealand society for Risk Management Inaugural Conference, October 202

4 Borthwick, J. A. S. (1991). Cost Control – Zero Base Budgeting and Cost Drivers. University of the Witwatersrand, M. Comm. Thesis.

5 Cartlidge, D. P. (1973). Cost Planning and Building Economics, Hutchinson Educational Ltd, London.

6 Carr, R. I. (1989). Cost Estimating Principles, Journal of Construction Engineering and Management, ASCE 1852, 545-551.

7 Chan, D. W. M., and Kumaraswamy, M. M. (1997). A Comparative Study of Cause of Time Overruns in Hong Kong Construction Projects, International Journal of Project Management, Pergamon, 55-63.

8 Chimwaso, D. K. (2000). An Evaluation of Cost Performance of Public Projects: Case of Botswana : (Publication Journal-Unknown), 81 – 90. (refer: dchimwaso@hotmail.com).

9 DBES (Department of Building and Engineering Services)(September, 2004), Quarterly Project Status Report. Ministry of Works and Transport. Botswana.

10 Duncan, W. R. (1996). A Guide to the Project Management Body of Knowledge, PMI, 130 South State Road, Upper Darby, PA 19082 USA

11 Elinwa, A. U., and Buba, S. A. (1993). Construction Costs Factors in Nigeria, Journal of Construction Engineering and Management, ASCE 1852, 698-713.

12 Elinwa, A. U., and Joshua, M. (2001). Time-Overrun Factors in Nigerian Construction Industry, Journal of Construction Engineering and Management, ASCE 1852, 419-425.

13 Flyvberg, B., Skamris Holm, M.K., and Buhl, S. (2004). What Causes Cost Overruns in Transport Infrastructure Projects?. Transport Reviews. Vol. 24. 3-18.

14 Flyvberg, B., Skamris Holm, M.K., and Buhl,S. (2003). How Common and How Large are Cost Overruns in Transport Infrastructure Projects?. Transport Reviews. Vol. 23. 71-88.

15 Gobourne, J. (1982). Site cost control in the construction industry, London, Butterworth Scientific

16 Hufsschmidt, M.M., and Gerin, J. (1970). Systematic errors in cost estimates for public investment projects in the analysis of public output. Building and Environment. 268-315.

17 Jahren, C. T., and Ashe, A. M. (1990). Predictors of Costs Overrun Rates, Journal of Construction Engineering and Management, ASCE 1852, 548-552.

18 Kaming, P. F., Olomolaiye, P.O., Holt, G.D., and Harris, F.C. (1997). Factors influencing construction time and cost overruns on high-rise projects in Indonesia, Construction Management and Economics, 1997. vol. 15, 83-94.

19 Knowles, R. (2000). One hundred contractual problems and their solutions, Oxford, Blackwell.

20 Leedy, P. D., and Ormrod, J. E. (2001). Practical Research. Planning and Design. Eigth Edition. Pearson Education, Inc., Upper Saddle River, New Jersey. Columbus, Ohio

21 Lekota, E. L. (2000). Cost and time overrun in development projects— identification and analysis of causal factors.... University of the Witwatersrand, MSc Thesis.

22 Leresche, A. P. (1983). An investigation in the factors affecting cost control,

(Unpublished discourse), University of Witwatersrand, Johannesburg.

23 Love, P.E.D. (2002). Influence of project type and procurement method on rework cost in building construction projects, Journal of Construction Engineering and Management, ASCE 1852, 18-29.

24 Malhotra, N.K. (2004). Marketing Research, An Applied Orientation, Fouth Edition. Pearson Education Upper River, New Jersey.

25 Nebiker, J. H. (1993). Construction Costs Factors in Nigeria, Journal of Construction Engineering and Management, ASCE 1852, 154.

26 Nisbet, J. (1961). Estimating and Cost Control, B T Batsford Ltd, London.

27 Okpala, D. C., and Aniekwu, A. N. (1988). Causes of High Costs of Construction in Nigeria, Journal of Construction Engineering and Management, ASCE 1852, 233-244.

28 Oosthuizen, P., Koster, M., and De La Rey, P. (1998). Goodbye MBA, A Paradigm shift towards project management, ITP (Pty) Ltd

29 PEEPA, (2004).(The Public Enterprise Evaluation and Privatisation Agency), Investor's Guide to Botswana, structure of the economy-Construction Market Research 2004:***http://www.discover-botswana.com/articles/structure_economy.php***; (**16/12/2004**).

30 Pilcher, R. (1994). Project cost control in construction, Oxford, Blackwelll, UK.

31 RICS, Project Management Faculty (2003). The management of risk-yours, mine and ours, **http//www.rics.org.uk/**

32 Ramus, J.W. (1993). Contract Practice for Quantity Surveyors, Second Edition. NEWNES. Great Britain.

33 Saunders, M., Lewis, P., and Thornhill, A. (2003). Research Methods for Buisness Students, Third Edition. Prentice Hall. Tottenham Court Road, London.

34 Sawczuk, B. (1996). Risk avoidance for the Building Team, E & FN Spon, London.

35 Scofield Rev. C.I. (1945). The Holy Bible. New York. Oxford University Press

36 Semple, C., Hartman, F.T., and Jergeas, G. (1994). Construction Claims and Disputes: Causes and Cost/Time Overruns, Journal of Construction Engineering and Management, 1994. vol. 120, 785-795.

37 Thomas, R. (1993). Construction Contract Claims, The Macmillan Press Ltd, London.

38 Willis, C. J., Ashworth. A., and Willis, J. A. (1994). Practice and Procedure for the Quantity Surveyor, Tenth Edition published by Blackwell Scientific Publication, Oxford

39 Xiao, H., and Proverbs, D. (2002). Construction time performance: an evaluation of contractors from Japan, the UK and the US. Engineering Construction and Architectural Management, vol 9, 81.

40 Zikmund, W. (1997). Business research Methods. Fifth Edition. The Dryden Press. Oklahoma State University. USA.

A P P E N D I X ‘A’

The GDP Proportional Share is as shown on Figures A1 & A2

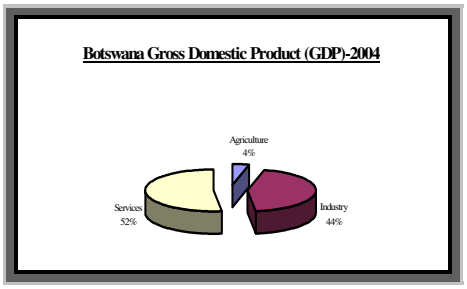


Figure A1: GDP proportional share

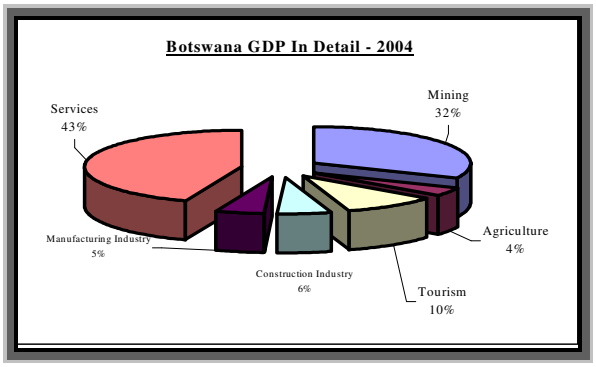


Figure A2: GDP proportional share in detail

DBES National Project Delivery Depots

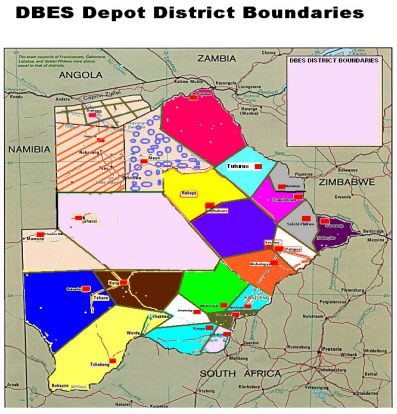


Figure A3: DBES Depot District Boundaries

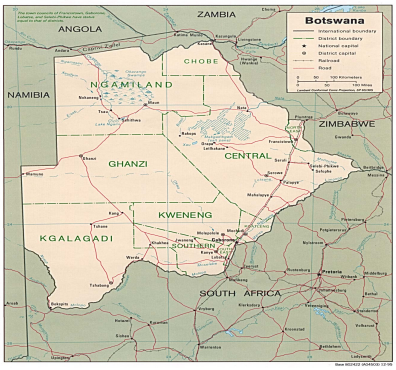


Figure A4 DBES Depot District Boundaries

A P P E N D I X ‘B’

Ministerial Projects' Budget Estimate (2004/2005)

Table B1 Ministerial project's budget estimates

Pre-Contract Project Number	Ministry	Budget Cost Estimate (Pula)	Deferred Project Cost Estimate (Pula)	Percentage Deferred Budget
1	Education	140,000,000.00		
2	Education	31,000,000.00		
3	Education	11,000,000.00		
4	Education	130,000,000.00	130,000,000.00	
5	Education	12,000,000.00	12,000,000.00	
6	Education	9,500,000.00		
7	Education	10,000,000.00	10,000,000.00	
8	Education	10,000,000.00	10,000,000.00	
9	Education	10,000,000.00	10,000,000.00	
10	Education	10,000,000.00	10,000,000.00	
11	Education	16,000,000.00	16,000,000.00	
12	Education	12,000,000.00		
13	Education	161,000,000.00		
14	Education	170,000,000.00		
15	Education	158,000,000.00		
16	Education	92,000,000.00		
17	Education	20,000,000.00		
	Total Budget Cost Estimate	**1,002,500,000.00**	**198,000,000.00**	**20%**
1	State President	7,800,000.00		
2	State President	17,000,000.00		
3	State President	42,000,000.00		
4	State President	42,000,000.00		
5	State President	22,000,000.00		
6	State President	2,900,000.00		
7	State President	20,000,000.00		
8	State President	5,000,000.00		
	Total Budget Cost Estimate	**158,700,000.00**	**-**	**0%**
1	Communication & Science Technology	150,000.00		
	Total Budget Cost Estimate	**150,000.00**		**0%**
1	Trade & Industry	10,500,000.00	10,500,000.00	
	Total Budget Cost Estimate	**10,500,000.00**	**10,500,000.00**	**100%**
	Grand Total Budget Cost Estimate	**1,171,850,000.00**	**208,500,000**	**18%**

Source: DBES Summary Project Status Report, September 2004

Ministerial Projects' Budget Estimate (2004/2005)

Table B2 Ministerial project's budget estimates

Pre-Contract Project Number	Ministry	Budget Cost Estimate (Pula)	Deferred Project Cost Estimate (Pula)	Percentage Deferred Budget
1	Labour & Home Affairs	15,700,000.00	15,700,000.00	
2	Labour & Home Affairs	8,600,000.00	8,600,000.00	
3	Labour & Home Affairs	2,400,000.00	2,400,000.00	
4	Labour & Home Affairs	140,000,000.00	140,000,000.00	
5	Labour & Home Affairs	5,900,000.00	5,900,000.00	
6	Labour & Home Affairs	1,400,000.00		
7	Labour & Home Affairs	124,000.00	124,000.00	
8	Labour & Home Affairs	350,000.00		
9	Labour & Home Affairs	170,000,000.00		
10	Labour & Home Affairs	18,500,000.00		
11	Labour & Home Affairs	3,800,000.00		
12	Labour & Home Affairs	6,900,000.00		
13	Labour & Home Affairs	6,000,000.00		
14	Labour & Home Affairs	6,500,000.00		
15	Labour & Home Affairs	2,200,000.00		
16	Labour & Home Affairs	915,000.00		
17	Labour & Home Affairs	153,000,000.00		
18	Labour & Home Affairs	205000		
19	Labour & Home Affairs	1,500,000.00		
20	Labour & Home Affairs	2,900,000.00	2,900,000	
21	Labour & Home Affairs	45,000,000.00	45,000,000.00	
22	Labour & Home Affairs	24,000,000.00	24,000,000.00	
	Total Budget Cost Estimate	**615,894,000.00**	**244,624,000.00**	**40%**
1	Health	24,000,000.00	24,000,000.00	
2	Health	3,200,000.00	3,200,000.00	
3	Health	114,000,000.00	114,000,000.00	
4	Health	155,000,000.00	155,000,000.00	
5	Health	2,300,000.00	2,300,000.00	
6	Health	1,300,000.00		
7	Health	538,000.00		
	Total Budget Cost Estimate	**300,338,000.00**	**298,500,000.00**	**99%**
1	Agriculture	175,000.00	175,000.00	
2	Agriculture	3,600,000.00	3,600,000.00	
3	Agriculture	7,600,000.00		
4	Agriculture	1,700,000.00	1,700,000.00	
5	Agriculture	3,800,000.00		
6	Agriculture	1,400,000.00	1,400,000.00	
7	Agriculture	939,000.00	939,000.00	
8	Agriculture	15,000,000.00	15,000,000.00	
9	Agriculture	13,000,000.00		
10	Agriculture	180,000.00	180,000.00	
11	Agriculture	6,200,000.00	6,200,000.00	
12	Agriculture	3,600,000.00		
13	Agriculture	7,000,000.00		
14	Agriculture	9,800,000.00		
15	Agriculture	41,000,000.00		
16	Agriculture	192,000.00		
17	Agriculture	735,000.00		
18	Agriculture	1,100,000.00		
19	Agriculture	11,000,000.00		
20	Agriculture	3,600,000.00		
21	Agriculture	3,000,000.00	3,000,000.00	
22	Agriculture	2,700,000.00	2,700,000.00	
23	Agriculture	4,200,000.00		
24	Agriculture	4,300,000.00		
25	Agriculture	645,000.00	645,000.00	
	Total Budget Cost Estimate	**146,466,000.00**	**35,539,000.00**	**24%**
	Grand Total Budget Cost Estimate	**1,062,698,000.00**	**578,663,000.00**	**54%**

Source: DBES Summary Project Status Report, September 2004

Ministerial Projects' Budget Estimate (2004/2005)

Table B3 Ministerial project's budget estimates

Pre-Contract Project Number	Ministry	Budget Cost Estimate (Pula)	Deferred Project Cost Estimate (Pula)	Percentage Deferred Budget
1	Finance & Development Planning	15,700,000.00		
	Total Budget Cost Estimate	**15,700,000.00**		**0%**
1	Mineral Energy & Water Affairs	219,000.00		
	Total Budget Cost Estimate	**219,000.00**		**0%**
1	Foreign Affairs & International Cooperation	500,000.00		
	Total Budget Cost Estimate	**500,000.00**		**0%**
1	Environment, Wildlife & Tourism	12,000,000.00		
2	Environment, Wildlife & Tourism	10,000,000.00		
3	Environment, Wildlife & Tourism	10,000,000.00		
4	Environment, Wildlife & Tourism	1,000,000.00	1,000,000.00	
5	Environment, Wildlife & Tourism	2,300,000.00	2,300,000.00	
6	Environment, Wildlife & Tourism	3,700,000.00	3,700,000.00	
7	Environment, Wildlife & Tourism	2,230,000.00	2,230,000.00	
8	Environment, Wildlife & Tourism	5,000,000.00	5,000,000.00	
9	Environment, Wildlife & Tourism	4,400,000.00		
10	Environment, Wildlife & Tourism	3,000,000.00		
	Total Budget Cost Estimate	**53,630,000.00**	**14,230,000.00**	**27%**
1	Local Government			
	Total Budget Cost Estimate	**-**	**-**	**0%**
1	Works & Transport	201,000.00		
2	Works & Transport	39,000.00		
3	Works & Transport	45,000.00		
4	Works & Transport	57,000.00		
5	Works & Transport	58,000.00		
6	Works & Transport	31,000,000.00	31,000,000.00	
7	Works & Transport	173,000,000.00	173,000,000.00	
8	Works & Transport	56,000.00	56,000.00	
9	Works & Transport	56,000.00	56,000.00	
10	Works & Transport	400,000.00	400,000.00	
11	Works & Transport	56,000.00	56,000.00	
12	Works & Transport	60,000.00	60,000.00	
13	Works & Transport	8,000.00	8,000.00	
14	Works & Transport	245,000.00		
15	Works & Transport	16,350,000.00	16,350,000.00	
16	Works & Transport	395,000.00		
17	Works & Transport	1,800,000.00		
18	Works & Transport	531,000.00		
19	Works & Transport	11,800,000.00		
20	Works & Transport	7,000,000.00	7,000,000.00	
21	Works & Transport	548,000.00	548,000.00	
22	Works & Transport	5,000,000.00	5,000,000.00	
23	Works & Transport	5,000,000.00	5,000,000.00	
24	Works & Transport	5,500,000.00	5,500,000.00	
25	Works & Transport	9,000.00	9,000.00	
	Total Budget Cost Estimate	**259,214,000.00**	**244,043,000.00**	**94%**
1	Lands & Housing	174,000.00	174,000.00	
2	Lands & Housing	197,000.00	197,000.00	
3	Lands & Housing	1,280,000.00		
	Total Budget Cost Estimate	**1,651,000.00**	**371,000.00**	**22%**
	Grand Total Budget Cost Estimate	**330,914,000.00**	**258,644,000.00**	**78%**

Source: DBES Summary Project Status Report, September 2004

Summary of Ministerial Projects' Budgets (2004/2005) (Tables B1, B2 & B3)

Table B4 Ministerial project's budget estimates

Ministerial Number	Ministry	Total Annual Budget Cost Estimate (Pula)	Total Annual Deferred Project Cost Estimate (Pula)	Percentage Deferred Budget	Percentage Deferred Budget of the Gross Annual Budget
1	Education	1,002,500,000.00	198,000,000.00	20%	7.72%
2	State President	158,000,000.00		0%	0.00%
3	Labour & Home Affairs	615,894,000.00	244,624,000.00	40%	9.54%
4	Health	300,338,000.00	298,500,000.00	99.39%	11.64%
5	Agriculture	146,466,000.00	35,539,000.00	24.26%	1.39%
6	Finance & Development Planning	15,700,000.00		0.00%	0.00%
7	Mineral, Energy & Water Affairs	219,000.00		0.00%	0.00%
8	Foreign Affairs & International Coorperation	500,000.00		0.00%	0.00%
9	Environment, Wildlife & Tourism	53,630,000.00	14,230,000.00	26.53%	0.55%
10	Local Government				0.00%
11	Works & Transport	259,214,000.00	244,043,000.00	94.15%	9.52%
12	Lands & Housing	1,651,000.00	371,000.00	22.47%	0.01%
13	Communications, Science & Technology	150,000.00		0.00%	0.00%
14	Trade & Industry	10,500,000.00	10,500,000.00	100.00%	0.41%
	GROSS ANNUAL BUDGET ESTIMATE	2,564,762,000.00	1,045,807,000.00		41%

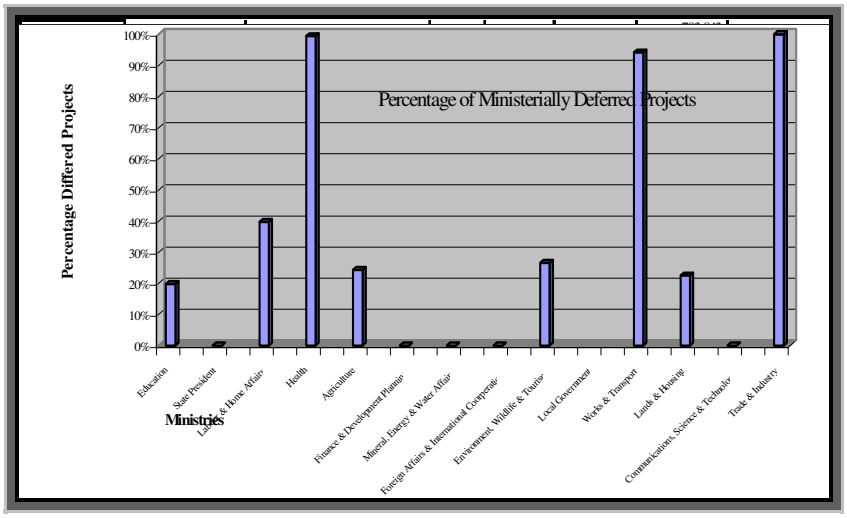


Figure B1: Percentage of Ministries deferred projects

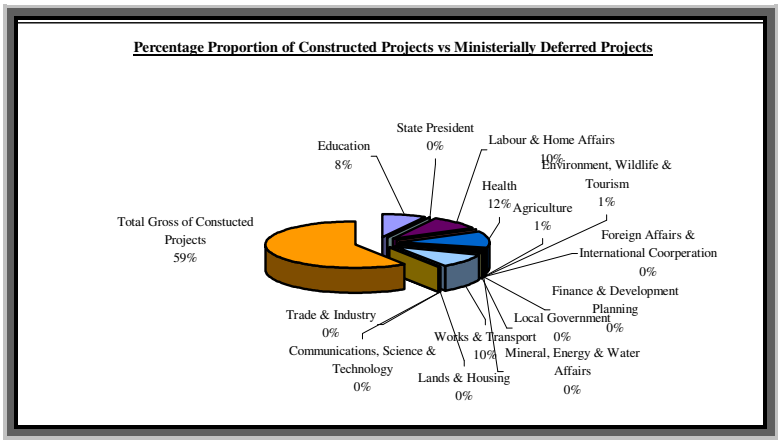


Figure B2: Deferred projects in 2005/2006 financial year

A P P E N D I X ‘C’

The three major Phases of a Construction Project's Life Cycle i.e. Conception / Planning / Designing Phase, Implementation Phase and Completion and Commissioning Phase; showing resource utilization (see Figure C1).

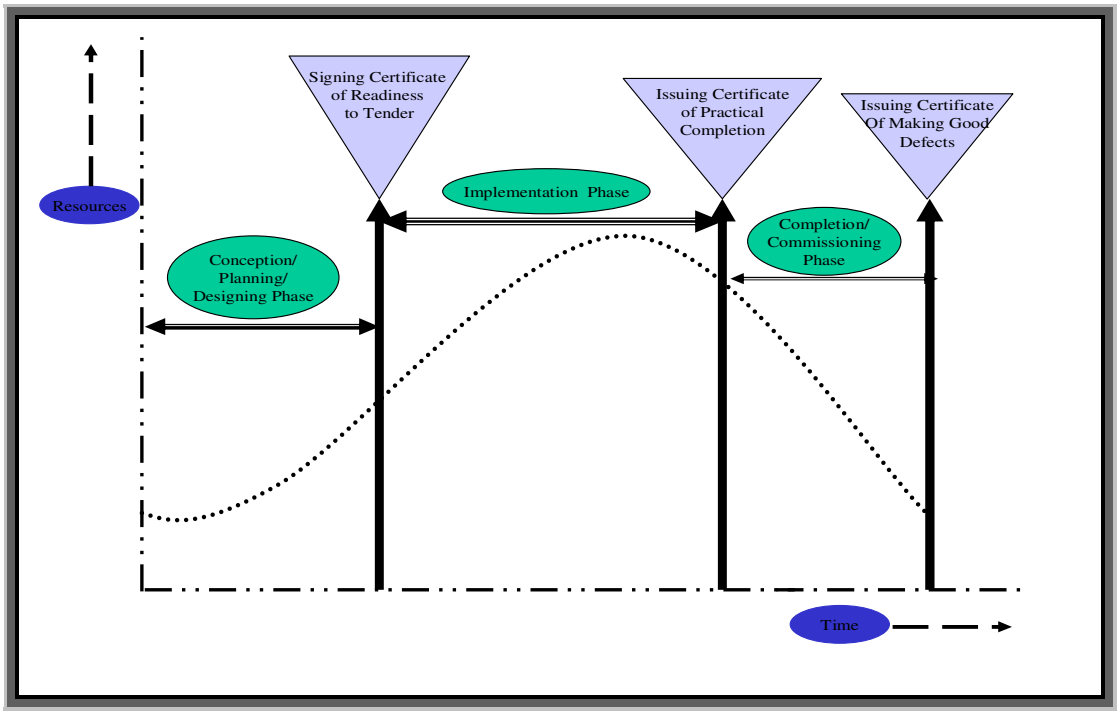


Figure C1: Construction Project's Life Cycle Phases

Details for the ten (10) industry Expert Group Survey respondents:

Table C1 Expert Group Survey Respondents

Expert Group Survey Respondents	Field of Professional Expertise	Work Experience Duration	Professional Post
1	Quantity Surveying	15 Years	Principal Quantity Surveyor in Government Office
2	Quantity Surveying	7 Years	Senior Quantity Surveyor in Government Office
3	Quantity Surveying	16 Years	Private Consultant Firm Quantity Surveyor
4	Project Management & Quantity Surveying	15 Years	Partner in Private Consultant Firm
5	Quantity Surveying	4 Years	Quantity Surveyor in Government Office
6	Quantity Surveying	16 Years	Principal Quantity Surveyor in Government Office
7	Architecture	34 Years	Principal Architect
8	Project Management & Engineering	18 Years	Chief Project Coordinator in Government Office
9	Quantity Surveying	13 Years	Private Consultant Firm Quantity Surveyor
10	Quantity Surveying	11 Years	Senior Quantity Surveyor in Government Office

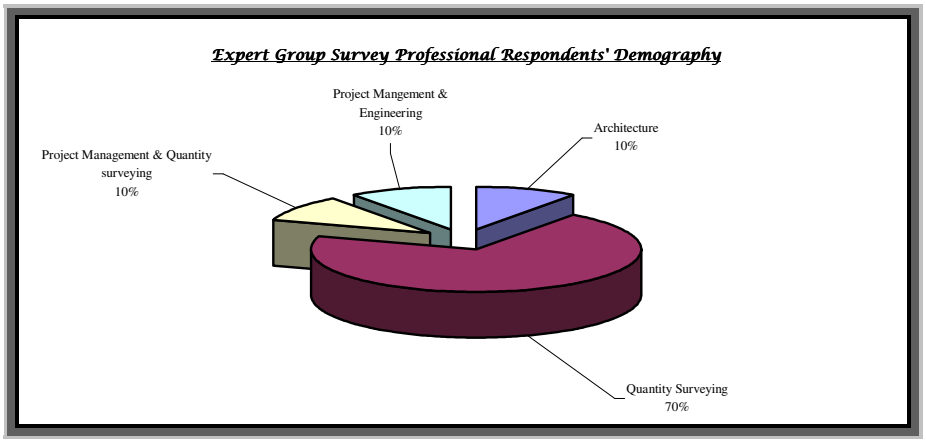


Figure C2 Expert Group Survey Respondents

4.3.1 ☞Useable Response Rate of the Survey Respondents

Table C2 Survey Questionnaire Responses

Survey Response	Project Managers	Architects	Engineers	Quantity Surveyors	Financial Managers.	Construction Managers
Sampling Frame	10	10	10	20	5	5
Questionnaires Sent (Census)	10	10	10	20	5	5
Not Received	1	6	4	3	2	1
Received & Useable	9	4	6	17	3	4
% Usable Response Rate	**90**	**40**	**60**	**85**	**60**	**80**

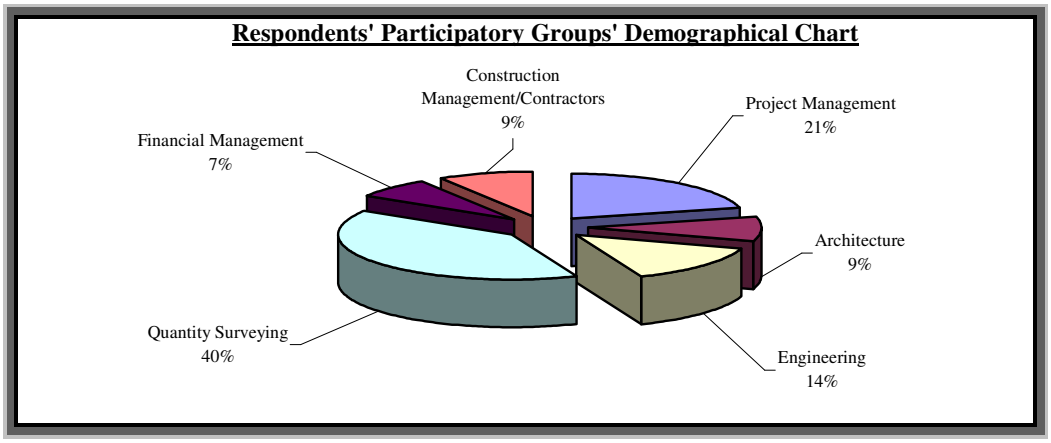


Figure C3: Survey questionnaire respondents

☞ Two responses from Quantity Surveyors not usable for the ten point score ranking only, otherwise useable for the rest of the data analysis

Table C3 Survey questionnaire respondents

Field of Professional Expertise	Number of Respondents	Average Work Experience Duration
Project Management	9	18 Years
Architecture	4	27 Years
Engineering	6	14 Years
Quantity Surveying	17	10 Years
Financial Management	3	17 Years
Construction Management	4	11 Years
OVERRAL AVERAGE WORK EXPERINCE		**16 Years**

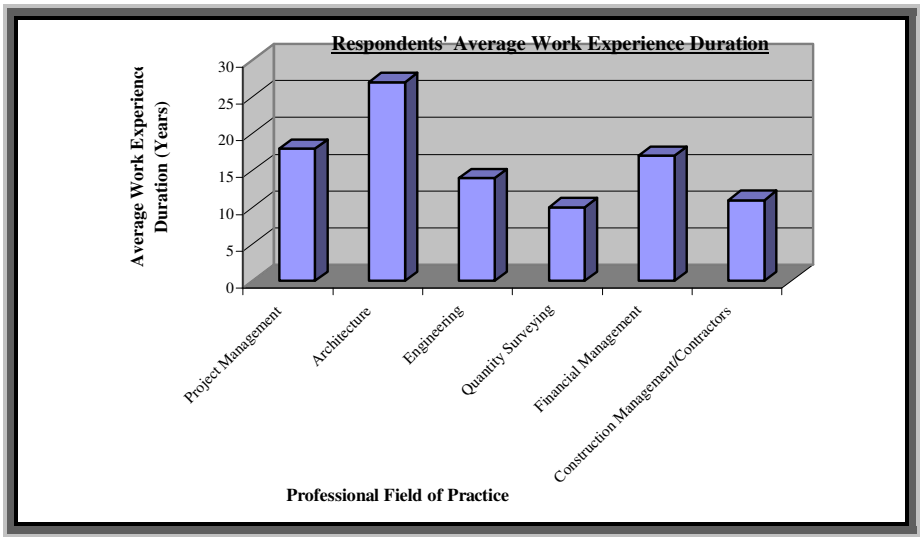


Figure C4: Survey respondents' average work experience

The most work-experienced personnel represented the architecture group; while the quantity surveying group had the least work-experienced personnel representation, on average.

Table C4: Conception / Planning / Designing Phase: ☞Ten Point Causal Factor Score Ranking

Causes of Cost Overrun	Project Managers	Architects	Engineers	Quantity Surveyors	Financial Managers	Construction Managers	Average Respondent Groups Score	Item Rank
1.0 Ambiguous/Inadequate Client's Project Brief.	8	10	9	6	5	7	**7.50**	**1**
2.0 Inadequate Project Planning	7	9	7	6	5	7	**6.83**	**3**
3.0 Lack of Pre-contract Project Coordination	6	7	8	6	5	7	**6.50**	**5**
4.0 Ineffective Communication Channels	6	7	5	6	5	6	**5.83**	**6**
5.0 Inexperienced/Incompetent Project Team Personnel	4	7	5	5	5	6	**5.33**	**9**
6.0 Incomplete Designs	7	8	8	8	4	8	**7.17**	**2**
7.0 Unreliable Project Cost Estimates	5	8	8	6	9	5	**6.83**	**3**
8.0 Inadequate Geotechnical Reports.	4	7	5	5	4	6	**5.17**	**10**
9.0 Limited information on Site location and conditions	5	6	5	5	3	6	**5.00**	**11**
10.0 Pre-Contract Budget Constraints	6	6	6	6	8	7	**6.50**	**5**
11.0 Pressure from third Parties (e.g. Incompetent & Forceful Client, Political Agents)	5	7	6	5	4	6	**5.50**	**8**
12.0 Lack of Consistent Project Cost Reporting	5	6	7	5	6	5	**5.67**	**7**
13.0 Delayed planning permission by Local Authorities/Land Boards	4	5	4	4	2	4	**3.83**	**12**
14.0 Unavailability of reliable cost database/sources/bulletins for cost estimates	7	5	5	6	5	7	**5.83**	**6**
15.0 Extensions to tender validity period	6	6	5	4	4	8	**5.50**	**8**
16.0 Incompetent client representatives	5	8	6	5	5	5	**5.67**	**7**
17.0 Government bureaucracy	6	8	6	6	7	6	**6.50**	**5**
18.0 Un-coordinated legislation (e.g. Advance Payment to citizen contractors)	6	6	4	5	6	4	**5.17**	**10**
19.0 Late release of project funds	5	6	6	5	5	6	**5.50**	**8**
20.0 Lack of Serviced Land	5	7	5	4	2	6	**4.83**	
21.0 Additional work requests from client at the end of the design period	7	8	6	7	6	7	**6.83**	**3**
22.0 Poor project management skills by Client Representatives	6	6	5	5	4	6	**5.33**	**9**
23.0 Lack of prompt decision making by Project Mangers	6	6	8	7	5	8	**6.67**	**4**

☞ Two responses from Quantity Surveyors not usable for the ten point score ranking only, otherwise useable for the rest of the data analysis.

Table C5: Highest Ranking Score Causal Factors

Factor Number	Cost Overrun Causal Factor	Factor Ranking Score	Factor Classification	Most Liable Professional Personnel
1	➢ Ambiguous/Inadequate Client's Project Brief.	1	Highly Frequent	Client, Project Managers & Architects
2	➢ Incomplete Designs	2	Highly Frequent	Architects & Engineers
3	➢ Inadequate Project Planning	3	Moderately Frequent	Financial planning officers, Clients, Project Managers & Quantity Surveyors
4	➢ Unreliable Project Cost Estimates	3		
5	➢ Additional work requests from client at the end of the design period	3		
6	➢ Lack of prompt decision making by Project Mangers	4	Moderately Frequent	Project Mangers
7	➢ Lack of Pre-contract Project Coordination	5	Moderately Frequent	Client, Project Managers & Financial planning officers
8	➢ Pre-Contract Budget Constraints	5		
9	➢ Government bureaucracy	5		
10	➢ Ineffective Communication Channels	6		Project Managers

Table C6: Implementation Phase: ☞Ten Point Causal Factor Score Ranking

Causes of Cost Overrun	Project Managers	Architects	Engineers	Quantity Surveyors	Financial Managers	Construction Managers	Average Respondent Groups Score	Item Rank
1.0 Ineffective Communication Channels	6	7	5	5	4	8	**5.83**	**9**
2.0 Inexperienced/Incompetent Project Team Personnel	5	7	6	5	5	8	**6.00**	**8**
3.0 Incomplete Designs	6	8	8	6	5	8	**6.83**	**4**
4.0 Unreliable Project Cost Estimates	5	7	6	5	2	7	**5.33**	**12**
5.0 Prolonged tendering procedures	6	6	6	5	4	8	**5.83**	**9**
6.0 In-exhaustive tender adjudication	4	6	5	5	3	7	**5.00**	**14**
7.0 Post Contract Variations	8	8	8	7	4	6	**6.83**	**4**
8.0 Late Architect's Instructions	7	6	7	7	5	7	**6.50**	**6**
9.0 Contract Document (drawings/BoQs) Errors	4	5	7	5	3	7	**5.17**	**13**
10.0 Design Failures	4	4	6	4	2	9	**4.83**	**15**
11.0 Clients requests for specification changes	5	6	6	5	3	6	**5.17**	**13**
12.0 Extension of time claims	7	6	8	7	6	7	**6.83**	**4**
13.0 Re-measurement of provisional quantities	5	7	6	5	3	7	**5.50**	**11**
14.0 Poor workmanship	6	8	5	5	7	4	**5.83**	**9**
15.0 Inadequate Geotechnical Reports.	3	5	4	5	3	4	**4.00**	**20**
16.0 Adverse Site Conditions	4	5	4	5	4	7	**4.83**	**15**
17.0 Continuous Client's interference	4	6	3	4	1	8	**4.33**	**18**
18.0 Scarcity of Specified Building Materials	4	5	4	4	3	5	**4.17**	**19**
19.0 Statutory labour escalations	4	5	4	4	2	5	**4.00**	**20**
20.0 Materials price escalations	5	6	5	5	3	6	**5.00**	**14**
21.0 Pressure from third Parties (e.g. Incompetent & Forceful Client, Political Agents)	4	6	4	4	3	6	**4.50**	**17**
22.0 Statutory Regulations & Government Policies (e.g. VAT, Labour costs, inflation)	4	6	4	5	4	8	**5.17**	**13**
23.0 Failure to Determinate No-Performing Contractors	7	9	9	8	7	8	**8.00**	**1**
24.0 Delay in Resolving Contractual Claims	7	7	8	7	7	7	**7.17**	**2**
25.0 Delayed Payments for completed Work	5	5	6	6	5	7	**5.67**	**10**
26.0 Lack of consistent Project Cost Reporting	5	6	5	5	4	5	**5.00**	
27.0 Inadequate Project Monitoring	6	6	6	5	4	4	**5.17**	**13**
28.0 Adjustment to Provisional & PC Sums (Mechanical/Electrical/Specialist Services)	6	5	6	6	7	6	**6.00**	**8**
29.0 *Force majeure* (acts of God)	3	4	3	3	2	4	**3.17**	**22**
30.0 Pressure from international market conditions (eg fuel price fluctuations)	4	4	3	4	4	4	**3.83**	**21**
31.0 Lack of control of mechanical & electrical contract by architect & team	5	6	5	6	7	6	**5.83**	**9**
32.0 Numerous provisional items in BoQ	4	7	5	5	4	6	**5.17**	**13**
33.0 Non performance by main contractor or nominated sub-contractors	8	8	7	7	6	4	**6.67**	**5**
34.0 Late extension of time claims	6	6	6	5	6	7	**6.00**	**8**
35.0 Late payments leading to increased claims	5	5	6	5	6	7	**5.67**	**10**
36.0 Lack of Pre-Qualification bidding system	7	5	7	5	7	6	**6.17**	**7**
37.0 Late provision of services (power, water, telephone etc)	5	5	7	5	6	7	**5.83**	**9**
38.0 Poor financial management by contractors	8	7	7	7	7	6	**7.00**	**3**
39.0 Poor performance of consultants	5	7	6	5	4	6	**5.50**	**11**
40.0 Insufficient project funds	5	6	4	5	3	6	**4.83**	**15**
41.0 Cumbersome payment procedures leading to contractual claims	4	5	4	5	5	6	**4.83**	**15**
42.0 Drastic change of scope of work during construction stage	5	5	4	6	3	7	**5.00**	**14**
43.0 Personnel turnover (skilled/competent)	4	5	4	5	5	5	**4.67**	**16**
44.0 Lack of adequate funds due to budget restrictions	4	5	4	5	3	7	**4.67**	**16**

☞ Two responses from Quantity Surveyors not usable for the ten point score ranking only, otherwise useable for the rest of the data analysis.

Table C7: Highest Ranking Score Causal Factors

Factor Number	Cost Overrun Causal Factor	Factor Ranking Score	Factor Classification	Most Liable Professional Personnel
1	➢ Failure to Determinate No-Performing Contractors	1	Highly Frequent	Project Managers & Architects
2	➢ Delay in Resolving Contractual Claims	2	Highly Frequent	Quantity Surveyors
3	➢ Poor financial management by contractors	3	Highly Frequent	Construction Managers
4 **5** **6**	➢ Incomplete Designs ➢ Post Contract Variations ➢ Extension of time claims	4 4 4	Moderately Frequent	Architects, Engineers & Construction Managers
6	➢ Non performance by main contractor or nominated sub-contractors	5	Moderately Frequent	Construction Managers
7	➢ Late Architect's Instructions	6	Moderately Frequent	Architects
8	➢ Lack of Pre-Qualification bidding system	7	Moderately Frequent	Clients & Project Managers
9 **10** **11**	➢ Inexperienced/Incompetent Project Team Personnel ➢ Adjustment to Provisional & PC Sums (Mechanical/Electrical/Specialist Services) ➢ Late extension of time claims	8 8 8	Moderately Frequent	Project Managers & Construction Managers

Table C8: Completion and Commissioning Phase: ☞Ten Point Causal Factor Score Ranking

Causes of Cost Overrun	Project Managers	Architects	Engineers	Quantity Surveyors	Financial Managers	Construction Managers	Average Respondent Groups Score	Item Rank
1.0 Inexperience/Incompetent Project Team Personnel	¼	⅕	¼	5	3	7	**4.67**	**8**
2.0 Post Contract Variations	⅐	⅐	⅐	6	3	7	**6.17**	**4**
3.0 Late Architect's Instructions	⅐	⅕	⅐	6	7	7	**6.67**	**2**
4.0 Bills of Quantities Errors	¼	⅙	⅕	4	4	5	**4.67**	**8**
5.0 Design Failures	⅓	⅕	⅕	4	3	7	**4.50**	**9**
6.0 Clients requests for specification changes	⅕	⅙	⅙	5	4	5	**5.17**	**6**
7.0 Extension of time claims	⅙	⅙	⅐	6	6	7	**6.33**	**3**
8.0 Poor workmanship	⅙	⅛	⅙	5	5	4	**5.67**	**5**
9.0 Delay in Resolving Contractual Claims	⅙	⅐	⅐	6	6	6	**6.33**	**3**
10.0 *Force majeure* (acts of God)	½	⅕	⅓	4	2	5	**3.50**	**11**
11.0 Slow process for appointing new contractors to rectify abortive works after contract determinations	⅐	⅛	⅛	6	8	5	**7.00**	**1**
12.0 Late provision of services (power/water/ telephone etc)	⅕	⅕	⅕	5	5	5	**5.00**	**7**
13.0 Late appointment of specialist sub-contractors	⅙	⅕	⅕	4	5	5	**5.00**	**7**
14.0 Cumbersome payment procedures leading to contractual claims	⅓	⅕	⅕	4	3	6	**4.33**	**10**

☞ Two responses from Quantity Surveyors not usable for the ten point score ranking only, otherwise useable for the rest of the data analysis.

Table C9: Highest Ranking Score Causal Factors

Factor Number	Cost Overrun Causal Factor	Factor Ranking Score	Factor Classification	Most Liable Professional Personnel
1	➢ Slow process for appointing new contractors to rectify abortive works after contract determinations	**1**	Highly Frequent	Project Managers & Architects
2	➢ Late Architect's Instructions	**2**	Moderately Frequent	Architects
3	➢ Extension of time claims	**3**	Moderately Frequent	Constructio n Managers & Quantity Surveyors
4	➢ Delay in Resolving Contractual Claims	**3**		
5	➢ Post Contract Variations	**4**	Moderately Frequent	Architects

Table C10: Conception / Planning / Designing Phase: ☞Ten Point Cost Control Measures Score Ranking

Remedial Cost Control Measures	Project Managers	Architects	Engineers	Quantity Surveyors	Financial Managers	Construction Managers	Average Respondent Groups Score	Item Rank
1.0 Comprehensive Client's Project Brief Development.	9	10	10	9	6	6	**8.33**	**1**
2.0 Comprehensive Project Planning	8	10	10	8	7	7	**8.33**	**1**
3.0 Adequate Pre-Contract Project Coordination	8	9	9	8	7	8	**8.17**	**2**
4.0 Setting up reliable communication channels	6	9	6	6	6	7	**6.67**	**6**
5.0 Appointment of reputable and experienced Project Team Managers	7	9	8	6	8	7	**7.50**	**4**
6.0 Adequate Project Design Specification	7	9	10	8	6	8	**8.00**	**3**
7.0 Reliable Pre-Contract Cost Estimates	7	9	9	8	9	8	**8.33**	**1**
8.0 Comprehensive tendering procedures	7	8	7	7	6	7	**7.00**	**5**
9.0 Effective Geotechnical Site Investigation process	7	7	7	6	5	5	**6.17**	**8**
10.0 Timely providing site information	6	9	7	7	4	7	**6.67**	**6**
11.0 Adequate Pre-Tender Budget Provisions	7	8	8	6	4	6	**6.50**	**7**
12.0 Limited interference by ill-informed Clients	6	7	5	6	5	7	**6.00**	**10**
13.0 Architect to submit plans for approval in advance	6	8	6	6	5	6	**6.17**	**8**
14.0 Improved cost data collection and storage in useable form	7	6	7	7	9	6	**7.00**	**5**
15.0 Reducing time lapse between pre and post contract periods	6	6	6	6	5	7	**6.00**	**9**

☞ Two responses from Quantity Surveyors not usable for the ten point score ranking only, otherwise useable for the rest of the data analysis.

Table C11: Highest Ranking Score Cost Control Measures

Cost Control Factor Number	Remedial Cost Control Measure	Cost Control Factor Ranking Score	Factor Classification	Most Liable Professional Personnel
1	➢ Comprehensive Client's Project Brief Development.	**1**	Highly Effective	Clients, Project Managers & Quantity Surveyors
2	➢ Comprehensive Project Planning	**1**		
3	➢ Reliable Pre-Contract Cost Estimates	**1**		
4	➢ Adequate Pre-Contract Project Coordination	**2**	Highly Effective	Project Managers
5	➢ Adequate Project Design Specification	**3**	Highly Effective	Architects & Engineers
6	➢ Appointment of reputable and experienced Project Team Managers	**4**	Highly Effective	Project Managers
7	➢ Comprehensive tendering procedures	**5**	Highly Effective	Project Managers & Quantity Surveyors
8	➢ Improved cost data collection and storage in useable form	**5**		
9	➢ Setting up reliable communication channels	**6**	Moderately Effective	Project Managers, Architects & Engineers
10	➢ Timely providing site information			

Table C12: Implementation Phase: ☞Ten Point Cost Control Measures Score Ranking

Remedial Control Measures	Project Managers	Architects	Engineers	Quantity Surveyors	Financial Managers	Construction Managers	Average Respondent Groups Score	Item Rank
1.0 Effective communication channels	7	10	8	7	8	8	**8.00**	**2**
2.0 Appointment of reputable and experienced Project Team Managers	7	8	8	6	6	7	**7.00**	**7**
3.0 Complete Project Designs	7	8	9	9	8	9	**8.33**	**1**
4.0 Reliable Cost Estimates	7	8	7	6	6	9	**7.17**	**6**
5.0 Comprehensive tendering procedures	7	8	6	6	4	8	**6.50**	**9**
6.0 Exhaustive tender adjudication	5	6	6	7	4	6	**5.67**	**13**
7.0 Timely Issuing Architectural Instructions Timely execution of the determination Clause on non-performing contractors	8	9	9	8	7	7	**8.00**	**2**
8.0 Minimum Bills of Quantity Errors	5	8	7	7	5	7	**6.50**	**9**
9.0 Comprehensive designs	6	9	7	7	5	9	**7.17**	**6**
10.0 Minimum specification changes	7	8	8	7	6	8	**7.33**	**5**
11.0 Timely resolving extension of time claims	7	7	8	7	8	8	**7.50**	**4**
12.0 Accurate remeasurement of provisional quantities	6	7	6	6	4	7	**6.00**	**11**
13.0 Good workmanship	6	8	7	7	9	7	**7.33**	**5**
14.0 Adequate Geotechnical Reports	4	6	5	6	3	6	**5.00**	**16**
15.0 Providing sufficient site condition information	4	7	5	6	3	7	**5.33**	**15**
16.0 Controlled Client's interference	5	7	6	5	4	7	**5.67**	**13**
17.0 Availability of specified building materials	7	6	7	6	4	8	**6.33**	**10**
18.0 Provision for materials price escalation	6	7	6	5	5	7	**6.00**	**11**
19.0 Minimum pressure from third parties	5	7	6	5	5	7	**5.83**	**12**
20.0 Adequate provision for statutory regulation and government policy costs (e.g. VAT, Labour, inflation)	5	5	5	5	5	7	**5.33**	**15**
21.0 Timely determination of non-performing contractors	7	8	9	7	7	8	**7.67**	**3**
22.0 Timely resolving of contractual claims	7	9	8	7	8	7	**7.67**	**3**
23.0 Timely payments for completed works	6	8	8	7	7	8	**7.33**	**5**
24.0 Consistent project reporting	6	8	7	6	7	7	**6.83**	**8**
25.0 Adequate project monitoring	6	8	7	7	7	7	**7.00**	**7**
26.0 Provision for PC and provisional sums adjustments	5	6	6	6	5	6	**5.67**	**13**
27.0 Adequate provision for *force majeure* (acts of God)	4	5	4	4	2	6	**4.17**	**17**
28.0 QS & Mechanical and Electrical Engineers to collaborate in drafting nominated sub-contracts documents	5	6	7	7	5	6	**6.00**	**10**
29.0 Pre-tender qualification system	6	6	4	5	6	7	**5.67**	**13**
30.0 Adequate performance monitoring of consultants & contractors	6	8	7	6	5	7	**6.50**	**9**
31.0 Improved release of project funds	5	5	6	6	4	8	**5.67**	**13**
32.0 Reducing personnel turnover	5	6	5	5	5	7	**5.50**	**14**

☞ Two responses from Quantity Surveyors not usable for the ten point score ranking only, otherwise useable for the rest of the data analysis.

Table C13: Highest Ranking Score Highest Ranking Score Cost Control Measures

Cost Control Factor Number	Remedial Cost Control Measures	Cost Control Factor Ranking Score	Factor Classification	Most Liable Professional Personnel
1	➢ Complete Project Designs.	**1**	Highly Effective	Architects & Engineers
2	➢ Effective communication channels	**2**	Highly Effective	Architects & Project Managers
3	➢ Timely Issuing Architectural Instructions Timely execution of the determination Clause on non-performing contractors	**2**		
4	➢ Timely determination of non-performing contractors	**3**	Highly Effective	Architects, Project Managers & Quantity Surveyors
5	➢ Timely resolving of contractual claims	**3**		
6	➢ Timely resolving extension of time claims	**4**	Highly Effective	Architects, & Quantity Surveyors
7	➢ Minimum specification changes	**5**	Highly Effective	Project Managers, Construction
8	➢ Good workmanship	**5**		Managers &
9	➢ Timely payments for completed works	**5**		Quantity Surveyors
10	➢ Reliable Cost Estimates	**6**	Highly Effective	Quantity Surveyors
11	➢ Comprehensive designs	**6**		& Architects

Table C14: Completion and Commissioning Phase: ☞Ten Point Cost Control Measures Score Ranking

Remedial Control Measures	Project Managers	Architects	Engineers	Quantity Surveyors	Financial Managers	Construction Managers	Average Respondent Groups Score	Item Rank
1.0 Appointment of Reputable and Experienced Project Team Managers	6	7	5	6	4	6	**5.67**	**10**
2.0 Minimum post contract variations	8	7	7	7	6	7	**7.00**	**5**
3.0 Timely Issued Architectural Instructions Variation Cost Assessment before issuing Architectural Instructions	8	7	8	7	8	7	**7.50**	**3**
4.0 Minimum BoQ Errors	5	7	6	6	5	7	**6.00**	**9**
5.0 Adequate design	7	8	5	6	6	8	**6.67**	**7**
6.0 Minimum Specification changes	7	7	6	7	6	8	**6.83**	**6**
7.0 Timely resolving extension of time claims	7	6	7	7	9	8	**7.33**	**4**
8.0 Good workmanship	7	7	9	7	9	8	**7.83**	**1**
9.0 Timely resolving payment disputes and Contractual claims	7	6	8	7	10	8	**7.67**	**2**
10.0 Adequate provision for *force majeure* (acts of God)	3	6	4	3	1	6	**3.83**	**12**
11.0 Regular consultation with Public Procure & Assets Disposal Board	5	6	4	5	3	5	**4.67**	**11**
12.0 Adequate consultation with service providers (BPC, BTC, WUC)	6	6	6	5	5	6	**5.67**	**10**
13.0 Monitoring of consultants for the production of final accounts	6	6	7	6	6	7	**6.33**	**8**

Table C15: Highest Ranking Score Highest Ranking Score Cost Control Measures

Cost Control Factor Number	Remedial Cost Control Measures	Cost Control Factor Ranking Score	Factor Classification	Most Liable Professional Personnel
1	➢ Good workmanship	**1**	Highly Effective	Construction Managers
2	➢ Timely resolving payment disputes and	**2**	Highly Effective	Project Managers, Architects & Quantity Surveyors
3	➢ Contractual claims	**2**		
4	➢ Timely Issued Architectural Instructions Variation Cost Assessment before issuing	**3**	Highly Effective	Architects
5	➢ Architectural Instructions	**3**		
6	➢ Timely resolving extension of time claims	**4**	Highly Effective	Architects & Quantity Surveyors
7	➢ Minimum post contract variations	**5**	Highly Effective	Architects & Engineers

☞ Two responses from Quantity Surveyors not usable for the ten point score ranking only, otherwise useable for the rest of the data analysis.

Conception / Planning / Designing Phase

Cost Overrun Causal Factors (Tables C16, C17, C18, C19, C20 & C21)

Table C16: Project Manager's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. N_r = 9). Severity Index is calculated from the total of highly and moderately frequent cost overrun causal factor responses.

Table C16: Project Managers Responses' Severity Index

Rank {1}	Cost Overrun Causal Factor {2}	Highly Frequent F_3 {3}	Moderatley Frequent F_2 {4}	Least Frequent F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity (%) $P_3=F/N_r x100$ {7}
1	Additional work required by client at the end of design period	4	5	-	9	100%
2	Ambigious/Inadequate Client's Project Brief	7	1	1	8	89%
3	Inadequate Project Planning	5	3	1	8	89%
3	Incomplete Design	5	3	1	8	89%
3	Government Bureaucracy	5	3	1	8	89%
4	Lack of Pre-Contrat Project Coordination	3	5	1	8	89%
5	Unavailability of reliable cost database/sources/bulletins for cost estimates	5	2	2	7	78%
6	Poor project mangement skills by client representatives	5	1	3	6	67%
7	Pre-contract budget constraints	4	2	3	6	67%
7	Extensions to tender validity period	4	2	3	6	67%
7	Uncoordinated legislation (eg advance payement to citizen contractors)	4	2	3	6	67%
8	Ineffectice communication channels	2	4	3	6	67%
8	Late release of project funds	2	4	3	6	67%
8	Lack of prompt decsion making by project managers	2	4	3	6	67%
9	Incompetent client representatives	1	5	3	6	67%
10	Lack of consistent project cost reporting	-	6	3	6	67%
11	Pressure from third parties (Political Agents/Influencial Clients)	3	2	4	5	56%
12	Unreliable Project Cost Estimates	1	4	4	5	56%
13	Inexperienced/Incompetent Project Team Personnel	1	3	5	4	44%
13	Limited information on site location and conditiobns	1	3	5	4	44%
13	Lack of serviced land	1	3	5	4	44%
14	Delayed planning permission by Local Authorities/Land Boards	1	2	6	3	33%
15	Inadequate Geotechnical Reports	-	2	7	2	22%

Six Cost Overrun Causal Factors with percentage severity of **80% and above**; classified as **Extremely Highly Frequent Factors (EHFF)** were identified by project managers. **From Table C16**: **EHFF; 80%≤ S ≥100%**

Rank	Cost Overrun Causal Factors (Extremely Highly Frequent Factors) (EHFF)	% Severity
1	Additional work required by client at the end of design period	100%
2	Ambiguous/Inadequate Client's Project Brief	89%
3	Inadequate Project Planning	89%
3	Incomplete Design	89%
3	Government Bureaucracy	89%
4	Lack of Pre-Contract Project Coordination	89%

Table C17: Architect's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. $N_r = 4$). Severity Index is calculated from the total of highly and moderately frequent cost overrun causal factor responses.

Table C17: Architects Responses' Severity Index

Rank {1}	Cost Overrun Causal Factor {2}	Highly Frequent F_3 {3}	Moderatley Frequent F_2 {4}	Least Frequent F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Ambigious/Inadequate Client's Project Brief	4	-	-	4	100%
2	Inadequate Project Planning	3	1	-	4	100%
2	Government Bureaucracy	3	1	-	4	100%
2	Additional work required by client at the end of design period	3	1	-	4	100%
3	Incomplete Design	2	2	-	4	100%
3	Unreliable Project Cost Estimates	2	2	-	4	100%
3	Pressure from third parties (Political Agents/Influencial Clients)	2	2	-	4	100%
3	Lack of consistent project cost reporting	2	2	-	4	100%
3	Incompetent client representatives	2	2	-	4	100%
4	Lack of Pre-Contrat Project Coordination	1	3	-	4	100%
4	Lack of prompt decsion making by project managers	1	3	-	4	100%
5	Lack of serviced land	2	1	1	3	75%
6	Ineffectice communication channels	1	2	1	3	75%
6	Inexperienced/Incompetent Project Team Personnel	1	2	1	3	75%
6	Pre-contract budget constraints	1	2	1	3	75%
6	Uncoordinated legislation (eg advance payement to citizen contractors)	1	2	1	3	75%
6	Late release of project funds	1	2	1	3	75%
6	Poor project mangement skills by client representatives	1	2	1	3	75%
7	Inadequate Geotechnical Reports	2	-	2	2	50%
8	Limited information on site location and conditiobns	1	1	2	2	50%
8	Extensions to tender validity period	1	1	2	2	50%
9	Delayed planning permission by Local Authorities/Land Boards	-	2	2	2	50%
10	Unavailability of reliable cost database/sources/bulletins for cost estimates	-	1	3	1	25%

Eleven Cost Overrun Causal Factors with percentage severity of **80% and above**; classified as **Extremely Highly Frequent Factors (EHFF)** were identified by Architects. **From Table C17**: **EHFF; 80%≤ S ≥100%**

Rank	Cost Overrun Causal Factors (Extremely Highly Frequent Factors) (EHFF)	% Severity
1	Ambiguous/Inadequate Client's Project Brief	100%
2	Inadequate Project Planning	100%
2	Government Bureaucracy	100%
2	Additional work required by client at the end of design period	100%
3	Incomplete Design	100%
3	Unreliable Project Cost Estimates	100%
3	Pressure from third parties (Political Agents/Influential Clients)	100%
3	Lack of consistent project cost reporting	100%
3	Incompetent client representatives	100%
4	Lack of Pre-Contract Project Coordination	100%
4	Lack of prompt decision making by project managers	100%

Table C18: Engineer's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 6). Severity Index is calculated from the total of highly and moderately frequent responses.

Table C18: Engineers Responses' Severity Index

Rank {1}	Cost Overrun Causal Factor {2}	Highly Frequent F_3 {3}	Moderatley Frequent F_2 {4}	Least Frequent F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Ambigious/Inadequate Client's Project Brief	5	1		**6**	**100%**
1	Incomplete Design	5	1		**6**	**100%**
2	Lack of prompt decsion making by project managers	4	2		**6**	**100%**
3	Unreliable Project Cost Estimates	3	3		**6**	**100%**
3	Lack of Pre-Contrat Project Coordination	3	3	-	**6**	**100%**
4	Inadequate Project Planning	2	3	1	**5**	**83%**
4	Lack of consistent project cost reporting	2	3	1	**5**	**83%**
4	Additional work required by client at the end of design period	2	3	1	**5**	**83%**
5	Incompetent client representatives	2	2	2	**4**	**67%**
5	Government Bureaucracy	2	2	2	**4**	**67%**
6	Late release of project funds	1	3	2	**4**	**67%**
6	Poor project mangement skills by client representatives	1	3	2	**4**	**67%**
7	Inadequate Geotechnical Reports	-	4	2	**4**	**67%**
7	Lack of serviced land		4	2	**4**	**67%**
8	Pre-contract budget constraints	2	1	3	**3**	**50%**
8	Pressure from third parties (Political Agents/Influencial Clients)	2	1	3	**3**	**50%**
9	Unavailability of reliable cost database/sources/bulletins for cost estimates	1	2	3	**3**	**50%**
9	Ineffectice communication channels	1	2	3	**3**	**50%**
9	Inexperienced/Incompetent Project Team Personnel	1	2	3	**3**	**50%**
10	Limited information on site location and conditiobns	-	3	3	**3**	**50%**
10	Extensions to tender validity period	-	3	3	**3**	**50%**
11	Uncoordinated legislation (eg advance payement to citizen contractors)		2	4	**2**	**33%**
12	Delayed planning permission by Local Authorities/Land Boards			6	**-**	**0%**

Eight Cost Overrun Causal Factors with percentage severity of **80% and above**; classified as **Extremely Highly Frequent Factors (EHFF)** were identified by Engineers. **From Table C18**: **EHFF; 80%≤ S ≥100%.**

Rank	Cost Overrun Causal Factors (Extremely Highly Frequent Factors) (EHFF)	% Severity
1	Ambiguous/Inadequate Client's Project Brief	**100%**
1	Incomplete Design	**100%**
2	Lack of prompt decision making by project managers	**100%**
3	Unreliable Project Cost Estimates	**100%**
3	Lack of Pre-Contract Project Coordination	**100%**
4	Inadequate Project Planning	**83%**
4	Lack of consistent project cost reporting	**83%**
4	Additional work required by client at the end of design period	**83%**

Table C19: Quantity Surveyor's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 17). Severity Index is calculated from the total of highly and moderately frequent cost overrun causal factors responses.

Table C19: Quantity Surveyor's Responses Severity Index

Rank {1}	Cost Overrun Causal Factor {2}	Highly Frequent F_3 {3}	Moderatley Frequent F_2 {4}	Least Frequent F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N,x100$ {7}
1	Incomplete Design	12	5		**17**	**100%**
2	Additional work required by client at the end of design period	9	8		**17**	**100%**
3	Inadequate Project Planning	5	11	1	**16**	**94%**
4	Ambigious/Inadequate Client's Project Brief	7	8	2	**15**	**88%**
4	Lack of prompt decsion making by project managers	7	8	2	**15**	**88%**
5	Lack of Pre-Contrat Project Coordination	5	8	7	**13**	**76%**
5	Ineffectice communication channels	5	8	4	**13**	**76%**
6	Pre-contract budget constraints	6	6	5	**12**	**71%**
7	Unreliable Project Cost Estimates	5	7	5	**12**	**71%**
7	Government Bureaucracy	5	7	5	**12**	**71%**
8	Lack of consistent project cost reporting	2	10	5	**12**	**71%**
9	Unavailability of reliable cost database/sources/bulletins for cost estimates	6	5	6	**11**	**65%**
10	Inexperienced/Incompetent Project Team Personnel	4	7	6	**11**	**65%**
11	Inadequate Geotechnical Reports	3	8	6	**11**	**65%**
11	Poor project mangement skills by client representatives	3	8	6	**11**	**65%**
12	Limited information on site location and conditiobns	2	9	6	**11**	**65%**
13	Uncoordinated legislation (eg advance payement to citizen contractors)	2	8	7	**10**	**59%**
13	Late release of project funds	2	8	7	**10**	**59%**
14	Incompetent client representatives	4	5	8	**9**	**53%**
15	Pressure from third parties (Political Agents/Influencial Clients)	3	6	8	**9**	**53%**
16	Extensions to tender validity period	1	7	9	**8**	**47%**
17	Lack of serviced land	2	4	11	**6**	**35%**
18	Delayed planning permission by Local Authorities/Land Boards	-	5	12	**5**	**29%**

Five Cost Overrun Causal Factors with percentage severity of **80% and above**; classified as **Extremely Highly Frequent Factors (EHFF)** were identified by Quantity Surveyors. **From Table C19**: **EHFF; 80%≤ S ≥100%.**

Rank	Cost Overrun Causal Factors (Extremely Highly Frequent Factors) (EHFF)	% Severity
1	Incomplete Design	**100%**
2	Additional work required by client at the end of design period	**100%**
3	Inadequate Project Planning	**94%**
4	Ambiguous/Inadequate Client's Project Brief	**88%**
4	Lack of prompt decision making by project managers	**88%**

Table C20: Financial Manager's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 3). Severity Index is calculated from the total of highly and moderately frequent cost overrun causal factors responses.

Table C20: Financial Manager Responses' Severity Index

Rank {1}	Cost Overrun Causal Factor {2}	Highly Frequent F_3 {3}	Moderatley Frequent F_2 {4}	Least Frequent F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P3=F/N_r x100$ {7}
1	Unreliable Project Cost Estimates	3			**3**	**100%**
1	Pre-contract budget constraints	3			**3**	**100%**
2	Additional work required by client at the end of design period	1	2	-	**3**	**100%**
3	Lack of consistent project cost reporting		3	-	**3**	**100%**
4	Incomplete Design	2	-	1	**2**	**67%**
4	Government Bureaucracy	2	-	1	**2**	**67%**
4	Uncoordinated legislation (eg advance payement to citizen contractors)	2		1	**2**	**67%**
5	Ambigious/Inadequate Client's Project Brief	1	1	1	**2**	**67%**
5	Lack of Pre-Contrat Project Coordination	1	1	1	**2**	**67%**
5	Ineffectice communication channels	1	1	1	**2**	**67%**
5	Unavailability of reliable cost database/sources/bulletins for cost estimates	1	1	1	**2**	**67%**
6	Inadequate Project Planning		2	1	**2**	**67%**
7	Inexperienced/Incompetent Project Team Personnel	1		2	**1**	**33%**
7	Inadequate Geotechnical Reports	1		2	**1**	**33%**
7	Pressure from third parties (Political Agents/Influencial Clients)	1	-	2	**1**	**33%**
7	Extensions to tender validity period	1		2	**1**	**33%**
7	Incompetent client representatives	1	-	2	**1**	**33%**
7	Late release of project funds	1		2	**1**	**33%**
7	Lack of prompt decsion making by project managers	1		2	**1**	**33%**
8	Limited information on site location and conditiobns		1	2	**1**	**33%**
8	Poor project mangement skills by client representatives	-	1	2	**1**	**33%**
9	Delayed planning permission by Local Authorities/Land Boards	-	-	3	**-**	**0%**
9	Lack of serviced land	-		3	**-**	**0%**

Four Cost Overrun Causal Factors with percentage severity of **80% and above**; classified as **Extremely Highly Frequent Factors (EHFF)** were identified by Financial Managers. **From Table C20**: **EHFF; 80%≤ S ≥100%.**

Rank	Cost Overrun Causal Factors (Extremely Highly Frequent Factors) (EHFF)	% Severity
1	Unreliable Project Cost Estimates	**100%**
1	Pre-contract budget constraints	**100%**
2	Additional work required by client at the end of design period	**100%**
3	Lack of consistent project cost reporting	**100%**

Table C21: Construction Manager's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 4). Severity Index is calculated from the total of highly and moderately frequent cost overrun causal factors responses.

Table C21: Construction Managers Responses' Severity Index

Rank {1}	Cost Overrun Causal Factor {2}	Highly Frequent F_3 {3}	Moderatley Frequent F_2 {4}	Least Frequent F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Lack of prompt decsion making by project managers	4			4	100%
2	Incomplete Design	3	1		4	100%
3	Inadequate Project Planning	2	2		4	100%
3	Pre-contract budget constraints	2	2		4	100%
3	Unavailability of reliable cost database/sources/bulletins for cost estimates	2	2		4	100%
3	Extensions to tender validity period	2	2		4	100%
3	Additional work required by client at the end of design period	2	2		4	100%
4	Lack of Pre-Contrat Project Coordination	1	3		4	100%
5	Ineffectice communication channels		4		4	100%
5	Limited information on site location and conditiobns		4		4	100%
5	Late release of project funds		4		4	100%
6	Pressure from third parties (Political Agents/Influencial Clients)	2	1	1	3	75%
6	Government Bureaucracy	2	1	1	3	75%
6	Lack of serviced land	2	1	1	3	75%
6	Poor project mangement skills by client representatives	2	1	1	3	75%
7	Ambigious/Inadequate Client's Project Brief	1	2	1	3	75%
8	Incompetent client representatives		3	1	3	75%
9	Inexperienced/Incompetent Project Team Personnel	1	1	2	2	50%
9	Inadequate Geotechnical Reports	1	1	2	2	50%
9	Uncoordinated legislation (eg advance payement to citizen contractors)	1	1	2	2	50%
10	Unreliable Project Cost Estimates		2	2	2	50%
10	Lack of consistent project cost reporting		2	2	2	50%
11	Delayed planning permission by Local Authorities/Land Boards			4	-	0%

Eleven Cost Overrun Causal Factors with percentage severity of **80% and above**; classified as **Extremely Highly Frequent Factors (EHFF)** were identified by Construction Managers. **From Table C21**: **EHFF; 80%≤ S ≥100%.**

Rank	Cost Overrun Causal Factors (Extremely Highly Frequent Factors) (EHFF)	% Severity
1	Lack of prompt decision making by project managers	100%
2	Incomplete Design	100%
3	Inadequate Project Planning	100%
3	Pre-contract budget constraints	100%
3	Unavailability of reliable cost database/sources/bulletins for cost estimates	100%
3	Extensions to tender validity period	100%
3	Additional work required by client at the end of design period	100%
4	Lack of Pre-Contract Project Coordination	100%
5	Ineffective communication channels	100%
5	Limited information on site location and conditions	100%
5	Late release of project funds	100%

Implementation Phase

Cost Overrun Causal Factors (Tables C22, C23, C24, C25, C26 & C27)

Table C22: Project Manager's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. N_r = 9). Severity Index is calculated from the total of highly and moderately frequent cost overrun causal factor responses.

Table C22: Project Managers Responses' Severity Index

Rank {1}	Cost Overrun Causal Factor {2}	Highly Frequent F_3 {3}	Moderatley Frequent F_2 {4}	Least Frequent F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Post contract variations	6	3	-	9	100%
1	Late architect's instructions	6	3		9	100%
2	Failure to Determinatte Non-performing Contractors	4	5	-	9	100%
3	Delay in resolving contractual claims	3	6	-	9	100%
4	Poor financial mangement by contractors	7	1	1	8	89%
5	Extension of time cliams	6	2	1	8	89%
5	Non-performance by main contractor or nominated sub-contractors	6	2	1	8	89%
6	Late extension of time claims	4	4	1	8	89%
6	Incomplete Design	4	4	1	8	89%
7	Lack of pre-qualification bidding system	3	5	1	8	89%
8	Adjustment to provisional & PC Sums (Mechanical/Electrical/Specialist)	4	3	2	7	78%
9	Poor workmanship	3	4	2	7	78%
9	Inadequate project monitoring	3	4	2	7	78%
10	Ineffective communication channels	2	5	2	7	78%
11	Prolonged tendering procedures	3	3	3	6	67%
12	Insufficient project funds	2	4	3	6	67%
13	Continuous client's interference	1	5	3	6	67%
13	Lack of control of nominated subcontrctors by project team	1	5	3	6	67%
14	Inexperienced/Incompetent Project Team Personnel	-	6	3	6	67%
14	Lack of consitent project cost reporting	-	6	3	6	67%
15	Client's requests for specifiaction changes	3	2	4	5	56%
15	Poor performance of consultants	3	2	4	5	56%
15	Lake of adequate funds due to budget restrictions	3	2	4	5	56%
16	Materials' price escalations	2	3	4	5	56%
16	Drastic change to scope of work during construction stage	2	3	4	5	56%
17	Unreliable Project Cost Estimates	1	4	4	5	56%
17	Statutory regulations & Government Policies (eg VAT, inflation)	1	4	4	5	56%
18	Re-measurement of provisional quantities	3	1	5	4	44%
18	Late provision of services (power, water, telephone etc)	3	1	5	4	44%
19	Delayed payments for completed work	2	2	5	4	44%
19	Late payments leading to increased claims	2	2	5	4	44%
20	In-exhaustive tender adjudication	1	3	5	4	44%
20	Contract documents (drawings/BoQ) errors	1	3	5	4	44%
20	Personnel turnover (skilled/competent)	1	3	5	4	44%
21	Design failures	-	4	5	4	44%
21	Pressure from third parties (Political Agents/Influencial Clients)	-	4	5	4	44%
22	Cumbersome payment procedures leading to contractual claims	0	4	5	4	44%
23	Scarcity of specified building materials	1	2	6	3	33%
23	Statutory labour cost escalations	1	2	6	3	33%
24	Pressure from international market conditions (eg fuel price fluctuations)	1	1	7	2	22%
24	Numerous provisional items in BoQ	1	1	7	2	22%
25	Inadequate geotechnical reports	-	1	8	1	11%
25	Adverse site conditions	-	1	8	1	11%
25	*Force majeure (acts of God)*	0	1	8	1	11%

Ten Cost Overrun Causal Factors with percentage severity of **80% and above**; classified as **Extremely Highly Frequent Factors (EHFF)** were identified. **From Table C22: EHFF; 80%≤ S ≥100%**

Rank	Cost Overrun Causal Factors (Extremely Highly Frequent Factors) (EHFF)	% Severity
1	Post contract variations	100%
1	Late architect's instructions	100%
2	Failure to Determinate Non-performing Contractors	100%
3	Delay in resolving contractual claims	100%
4	Poor financial management by contractors	89%
5	Extension of time claims	89%
5	Non-performance by main contractor or nominated sub-contractors	89%
6	Late extension of time claims	89%
6	Incomplete Design	89%
7	Lack of pre-qualification bidding system	89%

Table C23: Architect's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. $N_r = 4$). Severity Index is calculated from the total of highly and moderately frequent cost overrun causal factor responses.

Table C23: Architects Responses' Severity Index

Rank {1}	Cost Overrun Causal Factor {2}	Highly Frequent F_3 {3}	Moderatley Frequent F_2 {4}	Least Frequent F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Failure to determinatte Non-performing contractors	4	-	-	**4**	**100%**
2	Post contract variations	3	1	-	**4**	**100%**
2	Poor workmanship	3	1	-	**4**	**100%**
2	Non-performance by main contractor or nominated sub-contractors	3	1	0	**4**	**100%**
2	Poor financial mangement by contractors	3	1	0	**4**	**100%**
3	Incomplete Design	2	2	-	**4**	**100%**
3	Delay in resolving contractual claims	2	2	-	**4**	**100%**
3	Numerous provisional items in BoQ	2	2	0	**4**	**100%**
3	Poor performance of consultants	2	2	0	**4**	**100%**
4	Ineffectice communication channels	1	3	-	**4**	**100%**
4	Inexperienced/Incompetent Project Team Personnel	1	3	-	**4**	**100%**
4	Unreliable Project Cost Estimates	1	3	-	**4**	**100%**
4	Statutory labour cost escalations	1	3	1	**4**	**100%**
5	Extension of time cliams	-	4	-	**4**	**100%**
5	Materials' price escalations	-	4	-	**4**	**100%**
6	Statutory regulations & Government Policies (eg VAT, inflation)	2	1	1	**3**	**75%**
6	Lack of consitent project sot reporting	2	1	1	**3**	**75%**
6	Personnel turnover (skilled/competent)	2	1	1	**3**	**75%**
7	Client's requests for specifiaction changes	1	2	1	**3**	**75%**
7	Continuous client's interference	1	2	1	**3**	**75%**
7	Late extension of time claims	1	2	1	**3**	**75%**
7	Insufficient project funds	1	2	1	**3**	**75%**
7	Prolonged tendering procedures	1	2	1	**3**	**75%**
8	Contract documents (drawings/BoQ) errors	-	3	1	**3**	**75%**
8	Adjustment to provisional & PC Sums (Mechanical/Electrical/Specialist)	-	3	1	**3**	**75%**
9	Delayed payments for completed work	2	-	2	**2**	**50%**
9	Lack of control of nominated subcontrctors by project team	2	0	2	**2**	**50%**
10	Late architect's instructions	1	1	2	**2**	**50%**
10	Pressure from third parties (Political Agents/Influencial Clients)	1	1	2	**2**	**50%**
10	Inadequate project monitoring	1	1	2	**2**	**50%**
10	Lack of pre-qualification bidding system	1	1	2	**2**	**50%**
10	Late provision of services (power, water, telephone etc)	1	1	2	**2**	**50%**
10	Cumbersome payment procedures leading to contractual claims	1	1	2	**2**	**50%**
10	Lake of adequate funds due to budget restrictions	1	1	2	**2**	**50%**
10	In-exhaustive tender adjudication	1	1	2	**2**	**50%**
11	Re-measurement of provisional quantities		2	2	**2**	**50%**
11	Adverse site conditions	-	2	2	**2**	**50%**
11	Scarcity of specified building materials	-	2	2	**2**	**50%**
11	Pressure from international market conditions (eg fuel price fluctuations)	0	2	2	**2**	**50%**
11	Late payments leading to increased claims	0	2	2	**2**	**50%**
12	Inadequate geotechnical reports	1	-	3	**1**	**25%**
13	Design failures	-	1	3	**1**	**25%**
13	*Force majeure (acts of God)*	0	1	3	**1**	**25%**
13	Drastic change to scope of work during construction stage	0	1	3	**1**	**25%**

Fifteen Cost Overrun Causal Factors with percentage severity of **80% and above**; classified as **Extremely Highly Frequent Factors (EHFF)** were identified. **From Table C23**: **EHFF; 80%≤ S ≥100%**

Rank	Cost Overrun Causal Factors (Extremely Highly Frequent Factors) (EHFF)	% Severity
1	Failure to determinate Non-performing contractors	**100%**
2	Post contract variations	**100%**
2	Poor workmanship	**100%**
2	Non-performance by main contractor or nominated sub-contractors	**100%**
2	Poor financial management by contractors	**100%**
3	Incomplete Design	**100%**
3	Delay in resolving contractual claims	**100%**
3	Numerous provisional items in BoQ	**100%**
3	Poor performance of consultants	**100%**
4	Ineffective communication channels	**100%**
4	Inexperienced/Incompetent Project Team Personnel	**100%**
4	Unreliable Project Cost Estimates	**100%**
4	Statutory labour cost escalations	**100%**
5	Extension of time claims	**100%**
5	Materials' price escalations	**100%**

Table C24: Engineer's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 6). Severity Index is calculated from the total of highly and moderately frequent responses.

Table C24: Engineers Responses' Severity Index

Rank {1}	Cost Overrun Causal Factor {2}	Highly Frequent F_3 {3}	Moderatley Frequent F_2 {4}	Least Frequent F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Failure to determinatte Non-performing contractors	5	1		6	100%
1	Delay in resolving contractual claims	5	1		6	100%
2	Late architect's instructions	3	3	-	6	100%
2	Extension of time cliams	3	3	-	6	100%
2	Non-performance by main contractor or nominated sub-contractors	3	3	0	6	100%
3	Incomplete Design	5	-	1	5	83%
4	Post contract variations	4	1	1	5	83%
5	Contract documents (drawings/BoQ) errors	3	2	1	5	83%
5	Poor financial mangement by contractors	3	2	1	5	83%
5	Poor performance of consultants	3	2	1	5	83%
6	Re-measurement of provisional quantities	2	3	1	5	83%
6	Delayed payments for completed work	2	3	1	5	83%
6	Late extension of time claims	2	3	1	5	83%
7	Inexperienced/Incompetent Project Team Personnel	1	4	1	5	83%
7	Late payments leading to increased claims	1	4	1	5	83%
8	Lack of pre-qualification bidding system	3	1	2	4	67%
9	Unreliable Project Cost Estimates	2	2	2	4	67%
9	Prolonged tendering procedures	2	2	2	4	67%
9	Inadequate project monitoring	2	2	2	4	67%
9	Adjustment to provisional & PC Sums (Mechanical/Electrical/Specialist)	2	2	2	4	67%
9	Materials' price escalations	2	2	2	4	67%
10	Lack of control of nominated subcontrctors by project team	1	3	2	4	67%
10	Numerous provisional items in BoQ	1	3	2	4	67%
11	Ineffective communication channels	-	4	2	4	67%
11	Lack of consitent project sot reporting		4	2	4	67%
12	Design failures	2	1	3	3	50%
12	Client's requests for specifiaction changes	2	1	3	3	50%
13	In-exhaustive tender adjudication	1	2	3	3	50%
13	Poor workmanship	1	2	3	3	50%
13	Cumbersome payment procedures leading to contractual claims	1	2	3	3	50%
13	Personnel turnover (skilled/competent)	1	2	3	3	50%
14	Statutory regulations & Government Policies (eg VAT, inflation)		3	3	3	50%
15	Scarcity of specified building materials	1	1	4	2	33%
15	Pressure from third parties (Political Agents/Influencial Clients)	1	1	4	2	33%
15	Late provision of services (power, water, telephone etc)	1	1	4	2	33%
15	Drastic change to scope of work during construction stage	1	1	4	2	33%
15	Lake of adequate funds due to budget restrictions	1	1	4	2	33%
16	Continuous client's interference	-	2	4	2	33%
16	Statutory labour cost escalations	-	2	4	2	33%
17	Inadequate geotechnical reports	1	-	5	1	17%
17	Adverse site conditions	1	-	5	1	17%
18	Insufficient project funds	1	0	5	1	17%
19	Pressure from international market conditions (eg fuel price fluctuations)	0	1	5	1	17%
20	*Force majeure (acts of God)*	0	-	6	-	0%

Fifteen Cost Overrun Causal Factors with percentage severity of **80% and above**; classified as **Extremely Highly Frequent Factors (EHFF)** were identified. **From Table C24**: **EHFF; 80%≤ S ≥100%**

Rank	Cost Overrun Causal Factors (Extremely Highly Frequent Factors) (EHFF)	% Severity
1	Failure to determinate Non-performing contractors	100%
1	Delay in resolving contractual claims	100%
2	Late architect's instructions	100%
2	Extension of time claims	100%
2	Non-performance by main contractor or nominated sub-contractors	100%
3	Incomplete Design	83%
4	Post contract variations	83%
5	Contract documents (drawings/BoQ) errors	83%
5	Poor financial management by contractors	83%
5	Poor performance of consultants	83%
6	Re-measurement of provisional quantities	83%
6	Delayed payments for completed work	83%
6	Late extension of time claims	83%
7	Inexperienced/Incompetent Project Team Personnel	83%
7	Late payments leading to increased claims	83%

Table C25: Quantity Surveyor's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 17). Severity Index is calculated from the total of highly and moderately frequent cost overrun causal factors responses.

Table C25: Quantity Surveyors Responses' Severity Index

Rank {1}	Cost Overrun Causal Factor {2}	Highly Frequent F_3 {3}	Moderatley Frequent F_2 {4}	Least Frequent F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_t x100$ {7}
1	Post contract variations	13	4	-	17	100%
2	Failure to determinatte Non-performing contractors	11	6		17	100%
3	Late architect's instructions	7	10		17	100%
4	Delay in resolving contractual claims	6	11	-	17	100%
5	Poor financial mangement by contractors	9	7	1	16	94%
6	Extension of time cliams	8	7	2	15	88%
7	Incomplete Design	7	8	2	15	88%
8	Non-performance by main contractor or nominated sub-contractors	6	9	2	15	88%
9	Adjustment to provisional & PC Sums (Mechanical/Electrical/Specialist)	9	5	3	14	82%
10	Poor performance of consultants	4	10	3	14	82%
11	Drastic change to scope of work during construction stage	8	5	4	13	76%
12	Delayed payments for completed work	4	9	4	13	76%
12	Late extension of time claims	4	9	4	13	76%
13	Contract documents (drawings/BoQ) errors	3	10	4	13	76%
14	Ineffective communication channels	2	11	4	13	76%
14	Lack of consitent project sot reporting	2	11	4	13	76%
15	Inadequate project monitoring	4	8	5	12	71%
15	Lack of control of nominated subcontrctors by project team	4	8	5	12	71%
16	In-exhaustive tender adjudication	3	9	5	12	71%
17	Statutory regulations & Government Policies (eg VAT, inflation)	4	7	6	11	65%
18	Inexperienced/Incompetent Project Team Personnel	3	8	6	11	65%
19	Unreliable Project Cost Estimates	5	5	7	10	59%
19	Re-measurement of provisional quantities	5	5	7	10	59%
20	Client's requests for specifiaction changes	4	6	7	10	59%
21	Materials' price escalations	2	8	7	10	59%
21	Numerous provisional items in BoQ	2	8	7	10	59%
22	Lack of pre-qualification bidding system	6	3	8	9	53%
23	Insufficient project funds	4	5	8	9	53%
24	Prolonged tendering procedures	2	7	8	9	53%
24	Pressure from international market conditions (eg fuel price fluctuations)	2	7	8	9	53%
24	Late provision of services (power, water, telephone etc)	2	7	8	9	53%
24	Personnel turnover (skilled/competent)	2	7	8	9	53%
25	Lake of adequate funds due to budget restrictions	4	4	9	8	47%
25	Adverse site conditions	4	4	9	8	47%
26	Poor workmanship	3	5	9	8	47%
26	Pressure from third parties (Political Agents/Influencial Clients)	3	5	9	8	47%
27	Late payments leading to increased claims	2	6	9	8	47%
27	Cumbersome payment procedures leading to contractual claims	2	6	9	8	47%
28	Inadequate geotechnical reports	5	2	10	7	41%
29	Scarcity of specified building materials	2	5	10	7	41%
30	Statutory labour cost escalations	1	6	10	7	41%
31	Continuous client's interference	3	3	11	6	35%
32	Design failures	2	3	12	5	29%
33	*Force majeure (acts of God)*	1	2	14	3	18%

Ten Cost Overrun Causal Factors with percentage severity of **80% and above**; classified as **Extremely Highly Frequent Factors (EHFF)** were identified. **From Table C25**: **EHFF; 80%≤ S ≥100%.**

Rank	Cost Overrun Causal Factors (Extremely Highly Frequent Factors) (EHFF)	% Severity
1	Post contract variations	100%
2	Failure to determinate Non-performing contractors	100%
3	Late architect's instructions	100%
4	Delay in resolving contractual claims	100%
5	Poor financial management by contractors	94%
6	Extension of time claims	88%
7	Incomplete Design	88%
8	Non-performance by main contractor or nominated sub-contractors	88%
9	Adjustment to provisional & PC Sums (Mechanical/Electrical/Specialist)	82%
10	Poor performance of consultants	82%

Table C26: Financial Manager's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 3). Severity Index is calculated from the total of highly and moderately frequent cost overrun causal factors responses.

Table C26: Financial Managers Responses' Severity Index

Rank {1}	Cost Overrun Causal Factor {2}	Highly Frequent F_3 {3}	Moderatley Frequent F_2 {4}	Least Frequent F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Delay in resolving contractual claims	2	1		3	100%
1	Adjustment to provisional & PC Sums (Mechanical/Electrical/Specialist)	2	1	-	3	100%
1	Lack of control of nominated subcontrctors by project team	2	1		3	100%
1	Lack of pre-qualification bidding system	2	1		3	100%
1	Late extension of time claims	2	1		3	100%
2	Failure to determinatte Non-performing contractors	1	2	-	3	100%
2	Late payments leading to increased claims	1	2		3	100%
3	Late architect's instructions		3		3	100%
4	Poor workmanship	2		1	2	67%
4	Poor financial mangement by contractors	2		1	2	67%
5	Inexperienced/Incompetent Project Team Personnel	1	1	1	2	67%
5	Extension of time cliams	1	1	1	2	67%
5	Delayed payments for completed work	1	1	1	2	67%
5	Cumbersome payment procedures leading to contractual claims	1	1	1	2	67%
5	Non-performance by main contractor or nominated sub-contractors	1	1	1	2	67%
5	Late provision of services (power, water, telephone etc)	1	1	1	2	67%
5	Personnel turnover (skilled/competent)	1	1	1	2	67%
6	Ineffective communication channels	-	2	1	2	67%
6	Incomplete Design	-	2	1	2	67%
6	Lack of consitent project sot reporting		2	1	2	67%
7	Adverse site conditions	1	-	2	1	33%
7	Pressure from third parties (Political Agents/Influencial Clients)	1		2	1	33%
7	Statutory regulations & Government Policies (eg VAT, inflation)	1	-	2	1	33%
7	Pressure from international market conditions (eg fuel price fluctuations)	1		2	1	33%
7	Poor performance of consultants	1		2	1	33%
8	Prolonged tendering procedures		1	2	1	33%
8	In-exhaustive tender adjudication	-	1	2	1	33%
8	Post contract variations		1	2	1	33%
8	Contract documents (drawings/BoQ) errors		1	2	1	33%
8	Client's requests for specifiaction changes		1	2	1	33%
8	Re-measurement of provisional quantities		1	2	1	33%
8	Inadequate geotechnical reports		1	2	1	33%
8	Statutory labour cost escalations		1	2	1	33%
8	Materials' price escalations	-	1	2	1	33%
8	Inadequate project monitoring	-	1	2	1	33%
8	Numerous provisional items in BoQ		1	2	1	33%
8	Insufficient project funds		1	2	1	33%
8	Drastic change to scope of work during construction stage		1	2	1	33%
8	Lake of adequate funds due to budget restrictions		1	2	1	33%
9	Unreliable Project Cost Estimates			3	-	0%
9	Design failures			3	-	0%
9	Continuous client's interference			3	-	0%
9	Scarcity of specified building materials			3	-	0%
9	*Force majeure (acts of God)*			3	-	0%

Eight Cost Overrun Causal Factors with percentage severity of **80% and above**; classified as **Extremely Highly Frequent Factors (EHFF)** were identified. **From Table C26**:

EHFF; 80%≤ S ≥100%

Rank	Cost Overrun Causal Factors (Extremely Highly Frequent Factors) (EHFF)	% Severity
1	Delay in resolving contractual claims	100%
1	Adjustment to provisional & PC Sums (Mechanical/Electrical/Specialist)	100%
1	Lack of control of nominated subcontractors by project team	100%
1	Lack of pre-qualification bidding system	100%
1	Late extension of time claims	100%
2	Failure to determinate Non-performing contractors	100%
2	Late payments leading to increased claims	100%
3	Late architect's instructions	100%

Table C27: Construction Manager's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 4). Severity Index is calculated from the total of highly and moderately frequent cost overrun causal factors responses.

Table C27: Construction Managers Responses' Severity Index

Rank {1}	Cost Overrun Causal Factor {2}	Highly Frequent F_3 {3}	Moderatley Frequent F_2 {4}	Least Frequent F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Design failures	4			4	100%
2	Inexperienced/Incompetent Project Team Personnel	3	1		4	100%
2	Incomplete Design	3	1		4	100%
2	Prolonged tendering procedures	3	1		4	100%
2	Statutory regulations & Government Policies (eg VAT, inflation)	3	1		4	100%
2	Failure to determinatte Non-performing contractors	3	1		4	100%
2	Late extension of time claims	3	1		4	100%
3	Unreliable Project Cost Estimates	2	2		4	100%
3	In-exhaustive tender adjudication	2	2		4	100%
3	Late payments leading to increased claims	2	2		4	100%
3	Lake of adequate funds due to budget restrictions	2	2		4	100%
4	Client's requests for specifiaction changes	1	3		4	100%
4	Materials' price escalations	1	3		4	100%
4	Late provision of services (power, water, telephone etc)	1	3		4	100%
5	Numerous provisional items in BoQ		4		4	100%
5	Insufficient project funds		4		4	100%
6	Ineffective communication channels	3		1	3	75%
6	Late architect's instructions	3		1	3	75%
6	Extension of time cliams	3		1	3	75%
6	Re-measurement of provisional quantities	3		1	3	75%
6	Continuous client's interference	3		1	3	75%
6	Lack of control of nominated subcontrctors by project team	3		1	3	75%
7	Contract documents (drawings/BoQ) errors	2	1	1	3	75%
7	Pressure from third parties (Political Agents/Influencial Clients)	2	1	1	3	75%
7	Delay in resolving contractual claims	2	1	1	3	75%
7	Delayed payments for completed work	2	1	1	3	75%
7	Adjustment to provisional & PC Sums (Mechanical/Electrical/Specialist)	2	1	1	3	75%
7	Lack of pre-qualification bidding system	2	1	1	3	75%
7	Drastic change to scope of work during construction stage	2	1	1	3	75%
8	Post contract variations	1	2	1	3	75%
8	Statutory labour cost escalations	1	2	1	3	75%
8	Poor financial mangement by contractors	1	2	1	3	75%
8	Cumbersome payment procedures leading to contractual claims	1	2	1	3	75%
8	Personnel turnover (skilled/competent)	1	2	1	3	75%
9	Poor workmanship		3	1	3	75%
10	Adverse site conditions	2		2	2	50%
10	Poor performance of consultants	2		2	2	50%
11	Inadequate geotechnical reports		2	2	2	50%
11	Lack of consitent project sot reporting		2	2	2	50%
12	Non-performance by main contractor or nominated sub-contractors	1	1	2	2	50%
13	Scarcity of specified building materials	1		3	1	25%
14	Inadequate project monitoring		1	3	1	25%
14	*Force majeure (acts of God)*		1	3	1	25%
14	Pressure from international market conditions		1	3	1	25%

Sixteen Cost Overrun Causal Factors with percentage severity of **80% and above**; classified as **Extremely Highly Frequent Factors (EHFF)** were identified. **From Table C27**: **EHFF; 80%≤ S ≥100%.**

Rank	Cost Overrun Causal Factors (Extremely Highly Frequent Factors) (EHFF)	% Severity
1	Design failures	100%
2	Inexperienced/Incompetent Project Team Personnel	100%
2	Incomplete Design	100%
2	Prolonged tendering procedures	100%
2	Statutory regulations & Government Policies (eg VAT, inflation)	100%
2	Failure to determinate Non-performing contractors	100%
2	Late extension of time claims	100%
3	Unreliable Project Cost Estimates	100%
3	In-exhaustive tender adjudication	100%
3	Late payments leading to increased claims	100%
3	Lake of adequate funds due to budget restrictions	100%
4	Client's requests for specification changes	100%
4	Materials' price escalations	100%
4	Late provision of services (power, water, telephone etc)	100%
5	Numerous provisional items in BoQ	100%
5	Insufficient project funds	100%

Completion / Commissioning Phase

Cost Overrun Causal Factors (Tables C28, C29, C30, C31, C32 & C33)

Table C28: Project Manager's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. N_r = 9). Severity Index (%) calculated from the total of highly and moderately frequent cost overrun causal factor responses.

Table C28: Project Managers Responses' Severity Index

Rank {1}	Cost Overrun Causal Factor {2}	Highly Frequent F_3 {3}	Moderatley Frequent F_2 {4}	Least Frequent F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Late appointment of specialist sub-contractors	1	8	-	**9**	**100%**
2	Late architect's instructions	5	3	1	**8**	**89%**
2	Extension of time claims	5	3	1	**8**	**89%**
3	Post contract variations	4	4	1	**8**	**89%**
3	Slow progress in appointing new contractors for abortive works	4	4	1	**8**	**89%**
4	Delay in resolving contractual cliams	2	6	1	**8**	**89%**
5	Poor workmanship	3	4	2	**7**	**78%**
6	Clients' requests for specification changes	2	3	4	**5**	**56%**
7	Late provision of services (power/water/telephone etc)	3	1	5	**4**	**44%**
8	Bills of Quantities errors	1	2	6	**3**	**33%**
8	Inexperienced/Incompetent Project Team Personnel	1	1	7	**2**	**22%**
9	Design failures	-	2	7	**2**	**22%**
9	Cumbersome payment procedures leading to contractual claims	-	2	7	**2**	**22%**
10	*Force majeure (acts of God)*	-	-	9	**-**	**0%**

Six Cost Overrun Causal Factors with percentage severity of **80% and above**; classified as **Extremely Highly Frequent Factors (EHFF)** were identified. **From Table C28**: **EHFF; 80%≤ S ≥100%**

Rank	Cost Overrun Causal Factors (Extremely Highly Frequent Factors) (EHFF)	% Severity
1	Late appointment of specialist sub-contractors	**100%**
2	Late architect's instructions	**89%**
2	Extension of time claims	**89%**
3	Post contract variations	**89%**
3	Slow progress in appointing new contractors for abortive works	**89%**
4	Delay in resolving contractual claims	**89%**

Table C29: Architect's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. $N_r = 4$). Severity Index is calculated from the total of highly and moderately frequent cost overrun causal factor responses.

Table C29: Architects Responses' Severity Index

Rank {1}	Cost Overrun Causal Factor {2}	Highly Frequent F_3 {3}	Moderatley Frequent F_2 {4}	Least Frequent F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Slow progress in appointing new contractors for abortive works	3	1	-	**4**	**100%**
2	Poor workmanship	2	2	-	**4**	**100%**
3	Post contract variations	1	3	-	**4**	**100%**
3	Delay in resolving contractual cliams	1	3	-	**4**	**100%**
4	Extension of time claims	-	4	-	**4**	**100%**
5	Bills of Quantities errors	1	2	1	**3**	**75%**
5	Clients' requests for specification changes	1	2	1	**3**	**75%**
6	Late appointment of specialist sub-contractors	-	3	1	**3**	**75%**
7	Inexperienced/Incompetent Project Team Personnel	1	1	2	**2**	**50%**
8	Late architect's instructions	-	2	2	**2**	**50%**
8	*Force majeure (acts of God)*	-	2	2	**2**	**50%**
8	Late provision of services (power/water/telephone etc)	-	2	2	**2**	**50%**
8	Cumbersome payment procedures leading to contractual claims	-	2	2	**2**	**50%**
9	Design failures	-	1	3	**1**	**25%**

Five Cost Overrun Causal Factors with percentage severity of **80% and above**; classified as **Extremely Highly Frequent Factors (EHFF)** were identified. **From Table C29**: **EHFF; 80%≤ S ≥100%.**

Rank	Cost Overrun Causal Factors (Extremely Highly Frequent Factors) (EHFF)	% Severity
1	Slow progress in appointing new contractors for abortive works	**100%**
2	Poor workmanship	**100%**
3	Post contract variations	**100%**
3	Delay in resolving contractual claims	**100%**
4	Extension of time claims	**100%**

Table C30: Engineer's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 6). Severity Index is calculated from the total of highly and moderately frequent responses.

Table C30: Engineers Responses' Severity Index

Rank {1}	Cost Overrun Causal Factor {2}	Highly Frequent F_3 {3}	Moderatley Frequent F_2 {4}	Least Frequent F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Slow progress in appointing new contractors for abortive works	5	1	-	**6**	**100%**
2	Delay in resolving contractual cliams	4	2		**6**	**100%**
3	Late architect's instructions	3	3		**6**	**100%**
4	Post contract variations	2	4	-	**6**	**100%**
5	Poor workmanship	-	6		**6**	**100%**
6	Extension of time claims	3	1	2	**4**	**67%**
7	Bills of Quantities errors	1	3	2	**4**	**67%**
7	Cumbersome payment procedures leading to contractual claims	1	3	2	**4**	**67%**
8	Late appointment of specialist sub-contractors		4	2	**4**	**67%**
9	Design failures	2	1	3	**3**	**50%**
9	Clients' requests for specification changes	2	-	4	**2**	**33%**
10	Inexperienced/Incompetent Project Team Personnel	1	1	4	**2**	**33%**
10	Late provision of services (power/water/telephone etc)	1	1	4	**2**	**33%**
11	*Force majeure (acts of God)*	-	-	6	**-**	**0%**

Five Cost Overrun Causal Factors with percentage severity of **80% and above**; classified as **Extremely Highly Frequent Factors (EHFF)** were identified. **From Table C30**: **EHFF; 80%≤ S ≥100%.**

Rank	Cost Overrun Causal Factors (Extremely Highly Frequent Factors) (EHFF)	% Severity
1	Slow progress in appointing new contractors for abortive works	**100%**
2	Delay in resolving contractual claims	**100%**
3	Late architect's instructions	**100%**
4	Post contract variations	**100%**
5	Poor workmanship	**100%**

Table C31: Quantity Surveyor's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 17). Severity Index is calculated from the total of highly and moderately frequent cost overrun causal factors responses.

Table C31: Quantity Surveyors Responses' Severity Index

Rank {1}	Cost Overrun Causal Factor {2}	Highly Frequent F_3 {3}	Moderatley Frequent F_2 {4}	Least Frequent F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Post contract variations	4	10	3	**14**	**82%**
2	Delay in resolving contractual cliams	6	7	4	**13**	**76%**
3	Extension of time claims	6	6	5	**12**	**71%**
4	Late architect's instructions	5	7	5	**12**	**71%**
5	Slow progress in appointing new contractors for abortive works	8	3	6	**11**	**65%**
6	Poor workmanship	3	8	6	**11**	**65%**
7	Clients' requests for specification changes	4	6	7	**10**	**59%**
8	Inexperienced/Incompetent Project Team Personnel	1	9	7	**10**	**59%**
9	Late provision of services (power/water/telephone etc)	3	6	8	**9**	**53%**
10	Late appointment of specialist sub-contractors	2	7	8	**9**	**53%**
11	Bills of Quantities errors	1	7	9	**8**	**47%**
12	Cumbersome payment procedures leading to contractual claims	5	2	10	**7**	**41%**
13	Design failures	3	-	14	**3**	**18%**
14	*Force majeure (acts of God)*	1	2	14	**3**	**18%**

Four Cost Overrun Causal Factors with percentage severity of **80% and above**; classified as **Extremely Highly Frequent Factors (EHFF)** were identified. **From Table C31**: **EHFF; 80%≤ S ≥100%.**

Rank	Cost Overrun Causal Factors (Extremely Highly Frequent Factors) (EHFF)	% Severity
1	Post contract variations	**82%**
2	Delay in resolving contractual claims	**76%**
3	Extension of time claims	**71%**
4	Late architect's instructions	**71%**

Table C32: Financial Manager's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 3). Severity Index is calculated from the total of highly and moderately frequent cost overrun causal factors responses.

Table C32: Financial Managers Responses' Severity Index

Rank {1}	Cost Overrun Causal Factor {2}	Highly Frequent F_3 {3}	Moderatley Frequent F_2 {4}	Least Frequent F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_t x100$ {7}
1	Late architect's instructions	2	1		**3**	**100%**
2	Delay in resolving contractual cliams	1	2	-	**3**	**100%**
3	Slow progress in appointing new contractors for abortive works	2		1	**2**	**67%**
4	Extension of time claims	1	1	1	**2**	**67%**
4	Poor workmanship	1	1	1	**2**	**67%**
5	Bills of Quantities errors	-	2	1	**2**	**67%**
5	Clients' requests for specification changes		2	1	**2**	**67%**
5	Late appointment of specialist sub-contractors		2	1	**2**	**67%**
6	Late provision of services (power/water/telephone etc)	1		2	**1**	**33%**
6	Cumbersome payment procedures leading to contractual claims	1		2	**1**	**33%**
7	Post contract variations		1	2	**1**	**33%**
7	Design failures		1	2	**1**	**33%**
8	Inexperienced/Incompetent Project Team Personnel	-	-	3	**-**	**0%**
8	*Force majeure (acts of God)*	-		3	**-**	**0%**

Two Cost Overrun Causal Factors with percentage severity of **80% and above**; classified as **Extremely Highly Frequent Factors (EHFF)** were identified. **From Table C32**: **EHFF; 80%≤ S ≥100%**

Rank	Cost Overrun Causal Factors (Extremely Highly Frequent Factors) (EHFF)	% Severity
1	Late architect's instructions	**100%**
2	Delay in resolving contractual claims	**100%**

Table C33: Construction Manager's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 4). Severity Index is calculated from the total of highly and moderately frequent cost overrun causal factors responses.

Table C33: Construction Managers Responses' Severity Index

Rank {1}	Cost Overrun Causal Factor {2}	Highly Frequent F_3 {3}	Moderatley Frequent F_2 {4}	Least Frequent F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Inexperienced/Incompetent Project Team Personnel	3		1	**3**	**100%**
1	Late architect's instructions	3		1	**3**	**100%**
2	Post contract variations	2	1	1	**3**	**100%**
2	Design failures	2	1	1	**3**	**100%**
2	Extension of time claims	2	1	1	**3**	**100%**
2	Delay in resolving contractual cliams	2	1	1	**3**	**100%**
2	Cumbersome payment procedures leading to contractual claims	2	1	1	**3**	**100%**
3	Slow progress in appointing new contractors for abortive works	1	2	1	**3**	**100%**
4	Bills of Quantities errors		3	1	**3**	**100%**
4	Late appointment of specialist sub-contractors		3	1	**3**	**100%**
5	*Force majeure (acts of God)*	1	1	2	**2**	**67%**
5	Late provision of services (power/water/telephone etc)	1	1	2	**2**	**67%**
6	Clients' requests for specification changes		2	2	**2**	**67%**
7	Poor workmanship		1	3	**1**	**33%**

Ten Cost Overrun Causal Factors with percentage severity of **80% and above**; classified as **Extremely Highly Frequent Factors (EHFF)** were identified. **From Table C33**: **EHFF; 80%≤ S ≥100%.**

Rank	Cost Overrun Causal Factors (Extremely Highly Frequent Factors) (EHFF)	% Severity
1	Inexperienced/Incompetent Project Team Personnel	**100%**
1	Late architect's instructions	**100%**
2	Post contract variations	**100%**
2	Design failures	**100%**
2	Extension of time claims	**100%**
2	Delay in resolving contractual claims	**100%**
2	Cumbersome payment procedures leading to contractual claims	**100%**
3	Slow progress in appointing new contractors for abortive works	**100%**
4	Bills of Quantities errors	**100%**
4	Late appointment of specialist sub-contractors	**100%**

Remedial Cost Control Measures (Tables C34, C35, C36, C37, C38 & C39)

Conception / Planning / Designing Phase

Table C34: Project Manager's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. N_r = 9). Severity Index is calculated from the total of highly and moderately effective cost control remedial measure responses.

Table C34: Project Manager's Responses Severity Index (%)

Rank {1}	Remedial Cost Control Measures {2}	Highly Effective F_3 {3}	Moderatley Effective F_3 {4}	Least Effective F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Comprehensive Client's Project Brief Development	8	1	-	9	100%
2	Comprehensive Project Planning	7	2	-	9	100%
2	Adequate Pre-Contrat Project Coordination	7	2	-	9	100%
3	Comprehensive tendering procedures	5	4	-	9	100%
4	Adequate project design specification	6	2	1	8	89%
4	Reliable Project Cost Estimates	6	2	1	8	89%
5	Setting up effectice communication channels	5	3	1	8	89%
6	Improved cost date collection and storage in useable form	4	4	1	8	89%
7	Appointment of experienced/competent Project Team Personnel	7	-	2	7	78%
8	Architect to submitt plans for approval in advance	5	2	2	7	78%
9	Reducing time lapse between pre and post contract period	4	3	1	7	78%
10	Adequate Geotechnical Site Investigation Process	5	1	3	6	67%
10	Timely providing information on site location and conditiobns	5	1	3	6	67%
10	Adequate Pre-contract Budget Provisions	5	1	3	6	67%
11	Limited interference by ill-infromed clients	3	3	3	6	67%

Eight Remedial Cost Control Measures with percentage severity of **80% and above**; classified as **Extremely Highly Effective Measures (EHEM)** were identified. **From Table C34**: **EHFF; 80%≤ S ≥100%.**

Rank	Remedial Cost Control Measures (Extremely Highly Effective Measures) (EHEM)	% Severity
1	Comprehensive Client's Project Brief Development	100%
2	Comprehensive Project Planning	100%
2	Adequate Pre-Contract Project Coordination	100%
3	Comprehensive tendering procedures	100%
4	Adequate project design specification	89%
4	Reliable Project Cost Estimates	89%
5	Setting up effective communication channels	89%
6	Improved cost date collection and storage in useable form	89%

Table C35: Architect's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. $N_r = 4$). Severity Index is calculated from the total of highly and moderately effective cost control measure responses.

Table C35: Architects Responses' Severity Index

Rank {1}	Remedial Cost Control Measures {2}	Highly Effective F_3 {3}	Moderatley Effective F_3 {4}	Least Effective F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Comprehensive Client's Project Brief Development	4			**4**	**100%**
1	Comprehensive Project Planning	4			**4**	**100%**
1	Adequate Pre-Contrat Project Coordination	4			**4**	**100%**
1	Setting up effectice communication channels	4			**4**	**100%**
1	Appointment of experienced/competent Project Team Personnel	4			**4**	**100%**
1	Adequate project desgn specification	4			**4**	**100%**
1	Reliable Project Cost Estimates	4			**4**	**100%**
1	Timely providing information on site location and conditiobns	4			**4**	**100%**
1	Architect to submitt plans for approval in advance	4			**4**	**100%**
2	Comprehensive tendering procedures	3	1		**4**	**100%**
2	Adequate Geotechnical Site Investigation Process	3	1		**4**	**100%**
2	Adequate Pre-contract Budget Provisions	3	1		**4**	**100%**
3	Limited interference by ill-infromed clients	2	2		**4**	**100%**
4	Improved cost date collection and storage in useable form	1	3		**4**	**100%**
4	Reducing time lapse between pre and post contract period	1	3		**4**	**100%**

Fifteen Remedial Cost Control Measures with percentage severity of **80% and above**; classified as **Extremely Highly Effective Measures (EHEM)** were identified. **From Table C35**: **EHFF; 80%≤ S ≥100%.**

Rank	Remedial Cost Control Measures (Extremely Highly Effective Measures) (EHEM)	% Severity
1	Comprehensive Client's Project Brief Development	**100%**
1	Comprehensive Project Planning	**100%**
1	Adequate Pre-Contract Project Coordination	**100%**
1	Setting up effective communication channels	**100%**
1	Appointment of experienced/competent Project Team Personnel	**100%**
1	Adequate project design specification	**100%**
1	Reliable Project Cost Estimates	**100%**
1	Timely providing information on site location and conditions	**100%**
1	Architect to submit plans for approval in advance	**100%**
2	Comprehensive tendering procedures	**100%**
2	Adequate Geotechnical Site Investigation Process	**100%**
2	Adequate Pre-contract Budget Provisions	**100%**
3	Limited interference by ill-informed clients	**100%**
4	Improved cost date collection and storage in useable form	**100%**
4	Reducing time lapse between pre and post contract period	**100%**

Table C36: Engineer's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 6). Severity Index is calculated from the total of highly and moderately effective cost control remedial measures responses.

Table C36: Engineers Responses' Severity Index

Rank {1}	Remedial Cost Control Measures {2}	Highly Effective F_3 {3}	Moderatley Effective F_2 {4}	Least Effective F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Comprehensive Client's Project Brief Development	6			**6**	**100%**
1	Adequate project desgn specification	6			**6**	**100%**
2	Comprehensive Project Planning	5	1		**6**	**100%**
2	Adequate Pre-Contrat Project Coordination	5	1		**6**	**100%**
2	Reliable Project Cost Estimates	5	1		**6**	**100%**
3	Comprehensive tendering procedures	3	3		**6**	**100%**
3	Improved cost date collection and storage in useable form	3	3		**6**	**100%**
4	Adequate Pre-contract Budget Provisions	5	-	1	**5**	**83%**
5	Appointment of experienced/competent Project Team Personnel	4	1	1	**5**	**83%**
5	Timely providing information on site location and conditiobns	4	1	1	**5**	**83%**
6	Setting up effectice communication channels	2	3	1	**5**	**83%**
6	Architect to submitt plans for approval in advance	2	3	1	**5**	**83%**
6	Reducing time lapse between pre and post contract period	2	3	1	**5**	**83%**
7	Adequate Geotechnical Site Investigation Process	3	1	2	**4**	**67%**
8	Limited interference by ill-infromed clients	1	2	3	**3**	**50%**

Thirteen Remedial Cost Control Measures with percentage severity of **80% and above**; classified as **Extremely Highly Effective Measures (EHEM)** were identified. **From Table C36**: **EHFF; 80%≤ S ≥100%.**

Rank	Remedial Cost Control Measures (Extremely Highly Effective Measures) (EHEM)	% Severity
1	Comprehensive Client's Project Brief Development	**100%**
1	Adequate project design specification	**100%**
2	Comprehensive Project Planning	**100%**
2	Adequate Pre-Contract Project Coordination	**100%**
2	Reliable Project Cost Estimates	**100%**
3	Comprehensive tendering procedures	**100%**
3	Improved cost date collection and storage in useable form	**100%**
4	Adequate Pre-contract Budget Provisions	**83%**
5	Appointment of experienced/competent Project Team Personnel	**83%**
5	Timely providing information on site location and conditions	**83%**
6	Setting up effective communication channels	**83%**
6	Architect to submit plans for approval in advance	**83%**
6	Reducing time lapse between pre and post contract period	**83%**

Table C37: Quantity Surveyor's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 17). Severity Index is calculated from the total of highly and moderately effective cost control remedial measures responses.

Table C37: Quantity Surveyors Responses' Severity Index

Rank {1}	Remedial Cost Control Measures {2}	Highly Effective F_3 {3}	Moderatley Effective F_2 {4}	Least Effective F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Comprehensive Client's Project Brief Development	16	1		**17**	**100%**
2	Adequate project desgn specification	14	3	-	**17**	**100%**
3	Comprehensive Project Planning	13	4		**17**	**100%**
3	Reliable Project Cost Estimates	13	4		**17**	**100%**
4	Improved cost date collection and storage in useable form	8	9		**17**	**100%**
5	Adequate Pre-Contrat Project Coordination	11	5	1	**16**	**94%**
6	Adequate Pre-contract Budget Provisions	9	7	1	**16**	**94%**
7	Comprehensive tendering procedures	6	10	1	**16**	**94%**
8	Timely providing information on site location and conditiobns	10	5	2	**15**	**88%**
9	Appointment of experienced/competent Project Team Personnel	9	6	2	**15**	**88%**
10	Adequate Geotechnical Site Investigation Process	5	9	3	**14**	**82%**
11	Setting up effectice communication channels	7	6	4	**13**	**76%**
11	Reducing time lapse between pre and post contract period	7	6	4	**13**	**76%**
12	Architect to submitt plans for approval in advance	6	6	5	**12**	**71%**
13	Limited interference by ill-infromed clients	5	7	5	**12**	**71%**

Eleven Remedial Cost Control Measures with percentage severity of **80% and above**; classified as **Extremely Highly Effective Measures (EHEM)** were identified. **From Table C37**: **EHFF; 80%≤ S ≥100%.**

Rank	Remedial Cost Control Measures (Extremely Highly Effective Measures) (EHEM)	% Severity
1	Comprehensive Client's Project Brief Development	**100%**
2	Adequate project design specification	**100%**
3	Comprehensive Project Planning	**100%**
3	Reliable Project Cost Estimates	**100%**
4	Improved cost date collection and storage in useable form	**100%**
5	Adequate Pre-Contract Project Coordination	**94%**
6	Adequate Pre-contract Budget Provisions	**94%**
7	Comprehensive tendering procedures	**94%**
8	Timely providing information on site location and conditions	**88%**
9	Appointment of experienced/competent Project Team Personnel	**88%**
10	Adequate Geotechnical Site Investigation Process	**82%**

Table C38: Financial Manager's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 3). Severity Index is calculated from the total of highly and moderately effective cost control remedial measures responses.

Table C38: Financial Managers Responses' Severity Index

Rank {1}	Remedial Cost Control Measures {2}	Highly Effective F_3 {3}	Moderatley Effective F_2 {4}	Least Effective F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_t x100$ {7}
1	Reliable Project Cost Estimates	3			**3**	**100%**
2	Adequate Pre-Contrat Project Coordination	2	1		**3**	**100%**
2	Improved cost date collection and storage in useable form	2	1		**3**	**100%**
3	Comprehensive Project Planning	1	2	-	**3**	**100%**
3	Setting up effectice communication channels	1	2		**3**	**100%**
3	Adequate project desgn specification	1	2	-	**3**	**100%**
4	Comprehensive tendering procedures		3		**3**	**100%**
5	Reducing time lapse between pre and post contract period	2		1	**2**	**67%**
6	Comprehensive Client's Project Brief Development	1	1	1	**2**	**67%**
6	Limited interference by ill-infromed clients	1	1	1	**2**	**67%**
6	Architect to submitt plans for approval in advance	1	1	1	**2**	**67%**
7	Timely providing information on site location and conditiobns		2	1	**2**	**67%**
8	Appointment of experienced/competent Project Team Personnel	1		2	**1**	**33%**
8	Adequate Geotechnical Site Investigation Process	1		2	**1**	**33%**
9	Adequate Pre-contract Budget Provisions		1	2	**1**	**33%**

Seven Remedial Cost Control Measures with percentage severity of **80% and above**; classified as **Extremely Highly Effective Measures (EHEM)** were identified. **From Table C38**: **EHFF; 80%≤ S ≥100%.**

Rank	Remedial Cost Control Measures (Extremely Highly Effective Measures) (EHEM)	% Severity
1	Reliable Project Cost Estimates	**100%**
2	Adequate Pre-Contract Project Coordination	**100%**
2	Improved cost date collection and storage in useable form	**100%**
3	Comprehensive Project Planning	**100%**
3	Setting up effective communication channels	**100%**
3	Adequate project design specification	**100%**
4	Comprehensive tendering procedures	**100%**

Table C39: Construction Manager's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 4). Severity Index is calculated from the total of highly and moderately effective cost control remedial measures responses.

Table C39: Construction Managers Responses' Severity Index

Rank {1}	Remedial Cost Control Measures {2}	Highly Effective F_3 {3}	Moderatley Effective F_2 {4}	Least Effective F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Adequate project design specification	4			**4**	**100%**
2	Adequate Pre-Contrat Project Coordination	3	1		**4**	**100%**
2	Reliable Project Cost Estimates	3	1		**4**	**100%**
3	Comprehensive Project Planning	1	3		**4**	**100%**
3	Appointment of experienced/competent Project Team Personnel	1	3		**4**	**100%**
3	Reducing time lapse between pre and post contract period	1	3		**4**	**100%**
4	Setting up effectice communication channels	2	1	1	**3**	**75%**
4	Comprehensive tendering procedures	2	1	1	**3**	**75%**
5	Comprehensive Client's Project Brief Development	1	2	1	**3**	**75%**
5	Timely providing information on site location and conditiobns	1	2	1	**3**	**75%**
5	Adequate Pre-contract Budget Provisions	1	2	1	**3**	**75%**
5	Limited interference by ill-infromed clients	1	2	1	**3**	**75%**
5	Improved cost date collection and storage in useable form	1	2	1	**3**	**75%**
6	Adequate Geotechnical Site Investigation Process		3	1	**3**	**75%**
7	Architect to submitt plans for approval in advance	1	1	2	**2**	**50%**

Six Remedial Cost Control Measures with percentage severity of **80% and above**; classified as **Extremely Highly Effective Measures (EHEM)** were identified. **From Table C39**: **EHFF; 80%≤ S ≥100%.**

Rank	Remedial Cost Control Measures (Extremely Highly Effective Measures) (EHEM)	% Severity
1	Adequate project design specification	**100%**
2	Adequate Pre-Contract Project Coordination	**100%**
2	Reliable Project Cost Estimates	**100%**
3	Comprehensive Project Planning	**100%**
3	Appointment of experienced/competent Project Team Personnel	**100%**
3	Reducing time lapse between pre and post contract period	**100%**

Remedial Cost Control Measures (Tables C40, C41, C42, C43, C44 & C45)

Implementation Phase

Table C40: Project Manager's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. N_r = 9). Severity Index is calculated from the total of highly and moderately effective cost control remedial measure responses.

Table C40: Project Managers Responses' Severity Index

Rank {1}	Remedial Cost Control Measures {2}	Highly Effective F_3 {3}	Moderatley Effective F_2 {4}	Least Effective F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Timely resolving contractual claims	7	2	-	9	100%
2	Timely issuing if architect's instructions	5	4	-	9	100%
2	Timely resolving extension of time claims	5	4	-	9	100%
3	Complete Project Designs	7	1	1	8	89%
4	Effective communication channels	5	3	1	8	89%
4	Comprehensive tendering procedures	5	3	1	8	89%
4	Minimum specification changes	5	3	1	8	89%
4	Timely determination of Non-performing contractors	5	3	1	8	89%
5	Availability of specified building materials	4	4	1	8	89%
5	Timely payments for completed work	4	4	1	8	89%
5	Consitent project cost reporting	4	4	1	8	89%
5	Adequate monitoring of projects	4	4	1	8	89%
6	Acvcurate re-measurement of provisional quantities	3	5	1	8	89%
7	Appointment of experienced/competent Project Team Personnel	6	1	2	7	78%
7	Reliable Project Cost Estimates	6	1	2	7	78%
8	Good workmanship	5	2	2	7	78%
8	Adequate performance monitoring of consultants & contractors	5	2	2	7	78%
9	Comprehensive designs	4	3	2	7	78%
9	Provision for materials' price escalations	4	3	2	7	78%
10	Pre-Tender qualification bidding system	3	4	2	7	78%
10	Improved release of funds	3	4	2	7	78%
11	Controlled client's interference	2	5	2	7	78%
11	Reducing personnel turnover	2	5	2	7	78%
11	Collaboration of QS and Services Engineers for BoQ production	2	5	2	7	78%
12	Minimum Bills of Quantities errors	1	6	2	7	78%
12	Minimum Pressure from third parties (Political Agents/Influencial Clients)	1	6	2	7	78%
13	Exhaustive tender adjudication	4	2	3	6	67%
14	Adequate provision for Statutory regulation cost escalations	3	3	3	6	67%
15	Providing sufficient site condition information	2	3	4	5	56%
16	Adequate provision for PC and provisional sums	1	4	4	5	56%
17	Adequate geotechnical reports	1	3	5	4	44%
18	Inadequate provision for force majeure (acts of God)	1	2	6	3	33%

Thirteen Remedial Cost Control Measures with percentage severity of **80% and above**; classified as **Extremely Highly Effective Measures (EHEM)** were identified. **From Table C40**: **EHFF; 80%≤ S ≥100%.**

Rank	Remedial Cost Control Measures (Extremely Highly Effective Measures) (EHEM)	% Severity
1	Timely resolving contractual claims	100%
2	Timely issuing if architect's instructions	100%
2	Timely resolving extension of time claims	100%
3	Complete Project Designs	89%
4	Effective communication channels	89%
4	Comprehensive tendering procedures	89%
4	Minimum specification changes	89%
4	Timely determination of Non-performing contractors	89%
5	Availability of specified building materials	89%
5	Timely payments for completed work	89%
5	Consistent project cost reporting	89%
5	Adequate monitoring of projects	89%
6	Accurate re-measurement of provisional quantities	89%

Table C41: Architect's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. $N_r = 4$). Severity Index is calculated from the total of highly and moderately effective cost control measure responses.

Table C41: Architects Responses' Severity Index

Rank {1}	Remedial Cost Control Measures {2}	Highly Effective F_3 {3}	Moderatley Effective F_2 {4}	Least Effective F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Effective communication channels	4			4	100%
1	Appointment of experienced/competent Project Team Personnel	4			4	100%
1	Complete Project Designs	4			4	100%
1	Timely issuing if architect's instructions	4			4	100%
1	Comprehensive designs	4			4	100%
1	Minimum specification changes	4			4	100%
1	Good workmanship	4			4	100%
1	Timely resolving contractual claims	4			4	100%
1	Adequate monitoring of projects	4			4	100%
1	Adequate performance monitoring of consultants & contractors	4	0	0	4	100%
2	Reliable Project Cost Estimates	3	1		4	100%
2	Minimum Bills of Quantities Errors	3	1		4	100%
2	Acvcurate re-measurement of provisional quantities	3	1		4	100%
2	Providing sufficient site condition information	3	1		4	100%
2	Controlled client's interference	3	1		4	100%
2	Timely determination of Non-performing contractors	3	1		4	100%
2	Timely payments for completed work	3	1		4	100%
2	Consitent project cost reporting	3	1		4	100%
3	Comprehensive tendering procedures	2	2		4	100%
3	Timely resolving extension of time claims	2	2		4	100%
3	Minimum Pressure from third parties (Political Agents/Influencial Clients)	2	2		4	100%
4	Adequate geotechnical reports	1	3		4	100%
4	Provision for materials' price escalations	1	3	-	4	100%
4	Collaboration of QS and Services Engineers for BoQ production	1	3		4	100%
4	Reducing personnel turnover	1	3	0	4	100%
5	Pre-Tender qualification bidding system	2	1	1	3	75%
5	Improved release of funds	2	1	1	3	75%
6	Exhaustive tender adjudication	1	2	1	3	75%
6	Availability of specified building materials	1	2	1	3	75%
6	Adequate provision for PC and provisional sums	1	2	1	3	75%
7	Adequate provision for Statutory regulation cost escalations	-	3	1	3	75%
8	Inadequate provision for force majeure (acts of God)	1	1	2	2	50%

Twenty-Five Remedial Cost Control Measures with percentage severity of **80% and above**; classified as **Extremely Highly Effective Measures (EHEM)** were identified. **From Table C41**: **EHFF; 80%≤ S ≥100%.**

Rank	Remedial Cost Control Measures (Extremely Highly Effective Measures) (EHEM)	% Severity
1	Effective communication channels	100%
1	Appointment of experienced/competent Project Team Personnel	100%
1	Complete Project Designs	100%
1	Timely issuing if architect's instructions	100%
1	Comprehensive designs	100%
1	Minimum specification changes	100%
1	Good workmanship	100%
1	Timely resolving contractual claims	100%
1	Adequate monitoring of projects	100%
1	Adequate performance monitoring of consultants & contractors	100%
2	Reliable Project Cost Estimates	100%
2	Minimum Bills of Quantities Errors	100%
2	Accurate re-measurement of provisional quantities	100%
2	Providing sufficient site condition information	100%
2	Controlled client's interference	100%
2	Timely determination of Non-performing contractors	100%
2	Timely payments for completed work	100%
2	Consistent project cost reporting	100%
3	Comprehensive tendering procedures	100%
3	Timely resolving extension of time claims	100%
3	Minimum Pressure from third parties (Political Agents/Influential Clients)	100%
4	Adequate geotechnical reports	100%
4	Provision for materials' price escalations	100%
4	Collaboration of QS and Services Engineers for BoQ production	100%
4	Reducing personnel turnover	100%

Table C42: Engineer's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 6). Severity Index is calculated from the total of highly and moderately effective cost control remedial measures responses.

Table C42: Engineers Responses' Severity Index

Rank {1}	Remedial Cost Control Measures {2}	Highly Effective F_3 {3}	Moderatley Effective F_2 {4}	Least Effective F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Complete Project Designs	6			**6**	**100%**
1	Timely issuing if architect's instructions	6	-	-	**6**	**100%**
1	Timely determination of Non-performing contractors	6	-	-	**6**	**100%**
2	Appointment of experienced/competent Project Team Personnel	5	1		**6**	**100%**
2	Timely payments for completed work	5	1		**6**	**100%**
3	Minimum specification changes	4	2	-	**6**	**100%**
3	Timely resolving extension of time claims	4	2		**6**	**100%**
3	Timely resolving contractual claims	4	2		**6**	**100%**
3	Consitent project cost reporting	4	2		**6**	**100%**
3	Adequate monitoring of projects	4	2		**6**	**100%**
4	Effective communication channels	3	3		**6**	**100%**
4	Minimum Bills of Quantities errors	3	3		**6**	**100%**
5	Adequate performance monitoring of consultants & contractors	5	0	1	**5**	**83%**
6	Comprehensive designs	4	1	1	**5**	**83%**
6	Good workmanship	4	1	1	**5**	**83%**
6	Collaboration of QS and Services Engineers for BoQ production	4	1	1	**5**	**83%**
6	Reliable Project Cost Estimates	4	-	2	**4**	**67%**
7	Acvcurate re-measurement of provisional quantities	2	3	1	**5**	**83%**
7	Controlled client's interference	2	3	1	**5**	**83%**
7	Availability of specified building materials	2	3	1	**5**	**83%**
7	Adequate provision for PC and provisional sums	2	3	1	**5**	**83%**
8	Comprehensive tendering procedures	3	1	2	**4**	**67%**
8	Providing sufficient site condition information	3	1	2	**4**	**67%**
8	Improved release of funds	3	1	2	**4**	**67%**
9	Exhaustive tender adjudication	2	2	2	**4**	**67%**
9	Provision for materials' price escalations	2	2	2	**4**	**67%**
9	Minimum Pressure from third parties (Political Agents/Influencial Clients)	2	2	2	**4**	**67%**
10	Adequate provision for Statutory regulation cost escalations	-	4	2	**4**	**67%**
11	Reducing personnel turnover	2	1	3	**3**	**50%**
12	Pre-Tender qualification bidding system	1	**2**	**3**	**3**	**50%**
13	Adequate geotechnical reports	2	-	4	**2**	**33%**
14	Inadequate provision for force majeure (acts of God)	1	1	4	**2**	**33%**

Twenty-One Remedial Cost Control Measures with percentage severity of **80% and above**; classified as **Extremely Highly Effective Measures (EHEM)** were identified. **From Table C42**: **EHFF; 80%≤ S ≥100%.**

Rank	Remedial Cost Control Measures (Extremely Highly Effective Measures) (EHEM)	% Severity
1	Complete Project Designs	**100%**
1	Timely issuing if architect's instructions	**100%**
1	Timely determination of Non-performing contractors	**100%**
2	Appointment of experienced/competent Project Team Personnel	**100%**
2	Timely payments for completed work	**100%**
3	Minimum specification changes	**100%**
3	Timely resolving extension of time claims	**100%**
3	Timely resolving contractual claims	**100%**
3	Consistent project cost reporting	**100%**
3	Adequate monitoring of projects	**100%**
4	Effective communication channels	**100%**
4	Minimum Bills of Quantities errors	**100%**
5	Adequate performance monitoring of consultants & contractors	**83%**
6	Comprehensive designs	**83%**
6	Good workmanship	**83%**
6	Collaboration of QS and Services Engineers for BoQ production	**83%**
6	Reliable Project Cost Estimates	**83%**
7	Accurate re-measurement of provisional quantities	**83%**
7	Controlled client's interference	**83%**
7	Availability of specified building materials	**83%**
7	Adequate provision for PC and provisional sums	**83%**

Table C43: Quantity Surveyor's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 17). Severity Index is calculated from the total of highly and moderately effective cost control remedial measures responses.

Table C43: Quantity Surveyors Responses' Severity Index.

Rank {1}	Remedial Cost Control Measures {2}	Highly Effective F_3 {3}	Moderatley Effective F_2 {4}	Least Effective F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Complete Project Designs	17			17	100%
2	Timely issuing if architect's instructions	12	5	-	17	100%
3	Comprehensive designs	11	6		17	100%
4	Adequate monitoring of projects	10	7	-	17	100%
5	Minimum specification changes	9	8		17	100%
5	Timely resolving contractual claims	9	8		17	100%
5	Timely payments for completed work	9	8		17	100%
6	Minimum Bills of Quantities errors	8	9		17	100%
7	Effective communication channels	10	6	1	16	94%
8	Timely determination of Non-performing contractors	9	7	1	16	94%
9	Consitent project cost reporting	7	9	1	16	94%
10	Timely resolving extension of time claims	6	10	1	16	94%
11	Adequate provision for PC and provisional sums	4	12	1	16	94%
12	Good workmanship	11	4	2	15	88%
13	Appointment of experienced/competent Project Team Personnel	9	6	2	15	88%
13	Adequate performance monitoring of consultants & contractors	9	6	2	15	88%
14	Reliable Project Cost Estimates	8	7	2	15	88%
14	Improved release of funds	8	7	2	15	88%
15	Acvcurate re-measurement of provisional quantities	6	9	2	15	88%
16	Exhaustive tender adjudication	9	5	3	14	82%
17	Collaboration of QS and Services Engineers for BoQ production	8	6	3	14	82%
18	Pre-Tender qualification bidding system	7	7	3	14	82%
19	Adequate geotechnical reports	6	8	3	14	82%
19	Providing sufficient site condition information	6	8	3	14	82%
20	Availability of specified building materials	5	9	3	14	82%
21	Comprehensive tendering procedures	7	6	4	13	76%
22	Adequate provision for Statutory regulation cost escalations	6	7	4	13	76%
23	Reducing personnel turnover	4	9	4	13	76%
24	Controlled client's interference	7	5	5	12	71%
25	Minimum Pressure from third parties (Political Agents/Influencial Clients)	3	9	5	12	71%
26	Provision for materials' price escalations	6	5	6	11	65%
27	Inadequate provision for force majeure (acts of God)	1	3	13	4	24%

Twenty-Five Remedial Cost Control Measures with percentage severity of **80% and above**; classified as **Extremely Highly Effective Measures (EHEM)** were identified. **From Table C43**: **EHFF; 80%≤ S ≥100%.**

Rank	Remedial Cost Control Measures (Extremely Highly Effective Measures) (EHEM)	% Severity
1	Complete Project Designs	100%
2	Timely issuing if architect's instructions	100%
3	Comprehensive designs	100%
4	Adequate monitoring of projects	100%
5	Minimum specification changes	100%
5	Timely resolving contractual claims	100%
5	Timely payments for completed work	100%
6	Minimum Bills of Quantities errors	100%
7	Effective communication channels	94%
8	Timely determination of Non-performing contractors	94%
9	Consistent project cost reporting	94%
10	Timely resolving extension of time claims	94%
11	Adequate provision for PC and provisional sums	94%
12	Good workmanship	88%
13	Appointment of experienced/competent Project Team Personnel	88%
13	Adequate performance monitoring of consultants & contractors	88%
14	Reliable Project Cost Estimates	88%
14	Improved release of funds	88%
15	Accurate re-measurement of provisional quantities	88%
16	Exhaustive tender adjudication	82%
17	Collaboration of QS and Services Engineers for BoQ production	82%
18	Pre-Tender qualification bidding system	82%
19	Adequate geotechnical reports	82%
19	Providing sufficient site condition information	82%
20	Availability of specified building materials	82%

Table C44: Financial Manager's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 3). Severity Index is calculated from the total of highly and moderately effective cost control remedial measures responses.

Table C44: Financial Managers Responses' Severity Index

Rank {1}	Remedial Cost Control Measures {2}	Highly Effective F_3 {3}	Moderatley Effective F_2 {4}	Least Effective F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Effective communication channels	3			**3**	**100%**
1	Good workmanship	3			**3**	**100%**
2	Timely resolving extension of time claims	2	1		**3**	**100%**
2	Timely resolving contractual claims	2	1		**3**	**100%**
3	Timely issuing if architect's instructions	1	2		**3**	**100%**
3	Minimum specification changes	1	2		**3**	**100%**
3	Timely determination of Non-performing contractors	1	2		**3**	**100%**
3	Timely payments for completed work	1	2		**3**	**100%**
3	Consitent project cost reporting	1	2		**3**	**100%**
3	Adequate monitoring of projects	1	2		**3**	**100%**
4	Appointment of experienced/competent Project Team Personnel	2		1	**2**	**67%**
4	Reliable Project Cost Estimates	2		1	**2**	**67%**
4	Pre-Tender qualification bidding system	2		1	**2**	**67%**
5	Complete Project Desgns	1	1	1	**2**	**67%**
5	Collaboration of QS and Services Engineers for BoQ production	1	1	1	**2**	**67%**
5	Adequate performance monitoring of consultants & contractors	1	1	1	**2**	**67%**
6	Comprehensive designs		2	1	**2**	**67%**
6	Adequate provision for PC and provisional sums		2	1	**2**	**67%**
7	Controlled client's interference	1		2	**1**	**33%**
7	Provision for materials' price escalations	1		2	**1**	**33%**
7	Minimum Pressure from third parties (Political Agents/Influencial Clients)	1		2	**1**	**33%**
7	Adequate provision for Statutory regulation cost escalations	1		2	**1**	**33%**
7	Comprehensive tendering procedures	1		2	**1**	**33%**
7	Reducing personnel turnover	1		2	**1**	**33%**
8	Exhaustive tender adjudication		1	2	**1**	**33%**
8	Minimum Bills of Quantities errors		1	2	**1**	**33%**
8	Acvcurate re-measurement of provisional quantities		1	2	**1**	**33%**
8	Adequate geotechnical reports		1	2	**1**	**33%**
8	Providing sufficient site condition information		1	2	**1**	**33%**
8	Availability of specified building materials		1	2	**1**	**33%**
8	Improved release of funds		1	2	**1**	**33%**
9	Inadequate provision for force majeure (acts of God)			3	**-**	**0%**

Ten Remedial Cost Control Measures with percentage severity of **80% and above**; classified as **Extremely Highly Effective Measures (EHEM)** were identified. **From Table C44**: **EHFF; 80%≤ S ≥100%**

Rank	Remedial Cost Control Measures (Extremely Highly Effective Measures) (EHEM)	% Severity
1	Effective communication channels	100%
1	Good workmanship	100%
2	Timely resolving extension of time claims	100%
2	Timely resolving contractual claims	100%
3	Timely issuing if architect's instructions	100%
3	Minimum specification changes	100%
3	Timely determination of Non-performing contractors	100%
3	Timely payments for completed work	100%
3	Consistent project cost reporting	100%
3	Adequate monitoring of projects	100%

Table C45: Construction Manager's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 4). Severity Index is calculated from the total of highly and moderately effective cost control remedial measures responses.

Table C45: Construction Managers Responses' Severity Index.

Rank {1}	Remedial Cost Control Measures {2}	Highly Effective F_3 {3}	Moderatley Effective F_2 {4}	Least Effective F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Complete Project Designs	4			4	100%
1	Comprehensive designs	4			4	100%
2	Reliable Project Cost Estimates	3	1		4	100%
2	Minimum specification changes	3	1		4	100%
2	Timely resolving extension of time claims	3	1		4	100%
2	Timely determination of Non-performing contractors	3	1		4	100%
2	Improved release of funds	3	1		4	100%
3	Effective communication channels	2	2		4	100%
3	Timely issuing if architect's instructions	2	2		4	100%
3	Acvcurate re-measurement of provisional quantities	2	2		4	100%
3	Provision for materials' price escalations	2	2		4	100%
3	Adequate provision for Statutory regulation cost escalations	2	2		4	100%
3	Timely payments for completed work	2	2		4	100%
3	Consitent project cost reporting	2	2		4	100%
3	Adequate monitoring of projects	2	2		4	100%
4	Providing sufficient site condition information	1	3		4	100%
4	Minimum Pressure from third parties (Political Agents/Influencial Clients)	1	3		4	100%
4	Adequate performance monitoring of consultants & contractors	1	3		4	100%
5	Comprehensive tendering procedures	3		1	3	75%
5	Minimum Bills of Quantities errors	3		1	3	75%
5	Availability of specified building materials	3		1	3	75%
5	Timely resolving contractual claims	3		1	3	75%
6	Exhaustive tender adjudication	2	1	1	3	75%
6	Good workmanship	2	1	1	3	75%
6	Pre-Tender qualification bidding system	2	1	1	3	75%
7	Appointment of experienced/competent Project Team Personnel	1	2	1	3	75%
7	Adequate geotechnical reports	1	2	1	3	75%
7	Controlled client's interference	1	2	1	3	75%
7	Collaboration of QS and Services Engineers for BoQ production	1	2	1	3	75%
7	Reducing personnel turnover	1	2	1	3	75%
8	Inadequate provision for force majeure (acts of God)		3	1	3	75%
9	Adequate provision for PC and provisional sums	1	1	2	2	50%

Eighteen Remedial Cost Control Measures with percentage severity of **80% and above**; classified as **Extremely Highly Effective Measures (EHEM)** were identified. **From Table C45**: **EHFF; 80%≤ S ≥100%.**

Rank	Remedial Cost Control Measures (Extremely Highly Effective Measures) (EHEM)	% Severity
1	Complete Project Designs	100%
1	Comprehensive designs	100%
2	Reliable Project Cost Estimates	100%
2	Minimum specification changes	100%
2	Timely resolving extension of time claims	100%
2	Timely determination of Non-performing contractors	100%
2	Improved release of funds	100%
3	Effective communication channels	100%
3	Timely issuing if architect's instructions	100%
3	Accurate re-measurement of provisional quantities	100%
3	Provision for materials' price escalations	100%
3	Adequate provision for Statutory regulation cost escalations	100%
3	Timely payments for completed work	100%
3	Consistent project cost reporting	100%
3	Adequate monitoring of projects	100%
4	Providing sufficient site condition information	100%
4	Minimum Pressure from third parties (Political Agents/Influential Clients)	100%
4	Adequate performance monitoring of consultants & contractors	100%

Remedial Cost Control Measures (Table C46, C47, C48, C49, C50 & C51)

Completion / Commissioning Phase

Table C46: Project Manager's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. N_r = 9). Severity Index is calculated from the total of highly and moderately effective cost control remedial measure responses.

Table C46: Project Managers Responses' Severity Index

Rank {1}	Remedial Cost Control Measures {2}	Highly Effective F_3 {3}	Moderatley Effective F_2 {4}	Least Effective F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Minimum post contract variations	8	1	-	**9**	**100%**
1	Timely issuing of architect's instructions	8	1	-	**9**	**100%**
2	Timely resolving payment desputes and contractual claims	6	3	-	**9**	**100%**
3	Minimum specification changes	7	1	1	**8**	**89%**
4	Timely resolving extension of time claims	6	2	1	**8**	**89%**
4	Good workmanship	6	1	2	**7**	**78%**
5	Comprehensive designs	5	2	2	**7**	**78%**
5	Adequate consultation with service providers (BPC, BTC, WUC)	5	2	2	**7**	**78%**
6	Appointment of experienced/competent Project Team Personnel	5	1	3	**6**	**67%**
6	Monitoring of consultants for the production of final accounts	5	1	3	**6**	**67%**
7	Minimum Bills of Quantities Errors	2	4	3	**6**	**67%**
8	Regular consultation with Procurement Board	3	2	4	**5**	**56%**
9	Inadequate provision for force majeure (acts of God)	2	-	7	**2**	**22%**

Five Remedial Cost Control Measures with percentage severity of **80% and above**; classified as **Extremely Highly Effective Measures (EHEM)** were identified. **From Table C46**: **EHFF; 80%≤ S ≥100%.**

Rank	Remedial Cost Control Measures (Extremely Highly Effective Measures) (EHEM)	% Severity
1	Minimum post contract variations	**100%**
1	Timely issuing of architect's instructions	**100%**
2	Timely resolving payment disputes and contractual claims	**100%**
3	Minimum specification changes	**89%**
4	Timely resolving extension of time claims	**89%**

Table C47: Architect's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. N_r = 4). Severity Index is calculated from the total of highly and moderately effective cost control measure responses.

Table C47: Architects Responses' Severity Index

Rank {1}	Remedial Cost Control Measures {2}	Highly Effective F_3 {3}	Moderatley Effective F_2 {4}	Least Effective F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Comprehensive designs	4			**4**	**100%**
2	Appointment of experienced/competent Project Team Personnel	3	1		**4**	**100%**
2	Minimum post conytract variations	3	1		**4**	**100%**
2	Timely issuing of architect's instructions	3	1		**4**	**100%**
2	Minimum Bills of Quantities errors	3	1		**4**	**100%**
2	Minimum specification changes	3	1		**4**	**100%**
2	Good workmanship	3	1		**4**	**100%**
3	Timely resolving extension of time claims	2	2		**4**	**100%**
3	Timely resolving payment desputes and contractual claims	2	2		**4**	**100%**
4	Adequate consultation with service providers (BPC, BTC, WUC)	1	3		**4**	**100%**
5	Inadequate provision for force majeure (acts of God)		4		**4**	**100%**
5	Regular consultation with Procurement Board		4		**4**	**100%**
6	Monitoring of consultants for the production of final accounts	1	2	1	**3**	**75%**

Twelve Remedial Cost Control Measures with percentage severity of **80% and above**; classified as **Extremely Highly Effective Measures (EHEM)** were identified. **From Table C47**: **EHFF; 80%≤ S ≥100%**

Rank	Remedial Cost Control Measures (Extremely Highly Effective Measures) (EHEM)	% Severity
1	Comprehensive designs	**100%**
2	Appointment of experienced/competent Project Team Personnel	**100%**
2	Minimum post contract variations	**100%**
2	Timely issuing of architect's instructions	**100%**
2	Minimum Bills of Quantities errors	**100%**
2	Minimum specification changes	**100%**
2	Good workmanship	**100%**
3	Timely resolving extension of time claims	**100%**
3	Timely resolving payment disputes and contractual claims	**100%**
4	Adequate consultation with service providers (BPC, BTC, WUC)	**100%**
5	Inadequate provision for force majeure (acts of God)	**100%**
5	Regular consultation with Procurement Board	**100%**

Table C48: Engineer's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 6). Severity Index is calculated from the total of highly and moderately effective cost control remedial measures responses.

Table C48: Engineers Responses' Severity Index

Rank {1}	Remedial Cost Control Measures {2}	Highly Effective F_3 {3}	Moderatley Effective F_2 {4}	Least Effective F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Good workmanship	6			**6**	**100%**
2	Timely resolving payment desputes and contractual claims	5	1		**6**	**100%**
3	Timely issuing of architect's instructions	4	2		**6**	**100%**
4	Minimum post conytract variations	3	3	-	**6**	**100%**
5	Monitoring of consultants for the production of final accounts	5	-	1	**5**	**83%**
6	Timely resolving extension of time claims	4	1	1	**5**	**83%**
7	Minimum Bills of Quantities errors	3	1	2	**4**	**67%**
7	Adequate consultation with service providers (BPC, BTC, WUC)	3	1	2	**4**	**67%**
8	Minimum specification changes	2	2	2	**4**	**67%**
9	Comprehensive designs	2	1	3	**3**	**50%**
10	Appointment of experienced/competent Project Team Personnel	1	2	3	**3**	**50%**
10	Regular consultation with Procurement Board	1	2	3	**3**	**50%**
11	Inadequate provision for force majeure (acts of God)	1	1	4	**2**	**33%**

Six Remedial Cost Control Measures with percentage severity of **80% and above**; classified as **Extremely Highly Effective Measures (EHEM)** were identified. **From Table C48**: **EHFF; 80%≤ S ≥100%**

Rank	Remedial Cost Control Measures (Extremely Highly Effective Measures) (EHEM)	% Severity
1	Good workmanship	**100%**
2	Timely resolving payment disputes and contractual claims	**100%**
3	Timely issuing of architect's instructions	**100%**
4	Minimum post contract variations	**100%**
5	Monitoring of consultants for the production of final accounts	**83%**
6	Timely resolving extension of time claims	**83%**

Table C49: Quantity Surveyor's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 17). Severity Index is calculated from the total of highly and moderately effective cost control remedial measures responses.

Table C49: Quantity Surveyors Responses' Severity Index

Rank {1}	Remedial Cost Control Measures {2}	Highly Effective F_3 {3}	Moderatley Effective F_2 {4}	Least Effective F_1 {5}	Severity Index (%) $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Timely issuing of architect's instructions	13	3	1	**16**	**94%**
2	Minimum specification changes	10	6	1	**16**	**94%**
2	Timely resolving payment desputes and contractual claims	10	6	1	**16**	**94%**
3	Timely resolving extension of time claims	8	8	1	**16**	**94%**
4	Comprehensive designs	10	4	3	**14**	**82%**
4	Good workmanship	10	4	3	**14**	**82%**
4	Monitoring of consultants for the production of final accounts	10	4	3	**14**	**82%**
5	Minimum post conytract variations	9	5	3	**14**	**82%**
6	Appointment of experienced/competent Project Team Personnel	9	4	4	**13**	**76%**
7	Minimum Bills of Quantities errors	7	6	4	**13**	**76%**
8	Adequate consultation with service providers (BPC, BTC, WUC)	7	5	5	**12**	**71%**
9	Regular consultation with Procurement Board	3	9	5	**12**	**71%**
10	Inadequate provision for force majeure (acts of God)	2	4	11	**6**	**35%**

Eight Remedial Cost Control Measures with percentage severity of **80% and above**; classified as **Extremely Highly Effective Measures (EHEM)** were identified. **From Table C49**: **EHFF; 80%≤ S ≥100%.**

Rank	Remedial Cost Control Measures (Extremely Highly Effective Measures) (EHEM)	% Severity
1	Timely issuing of architect's instructions	**94%**
2	Minimum specification changes	**94%**
2	Timely resolving payment disputes and contractual claims	**94%**
3	Timely resolving extension of time claims	**94%**
4	Comprehensive designs	**82%**
4	Good workmanship	**82%**
4	Monitoring of consultants for the production of final accounts	**82%**
5	Minimum post contract variations	**82%**

Table C50: Financial Manager's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 3). Severity Index is calculated from the total of highly and moderately effective cost control remedial measures responses.

Table C50: Financial Managers Responses' Severity Index

Rank {1}	Remedial Cost Control Measures {2}	Highly Effective F_3 {3}	Moderatley Effective F_2 {4}	Least Effective F_1 {5}	Severity Index (%) $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N_r x100$ {7}
1	Timely resolving extension of time claims	3			**3**	**100%**
1	Good workmanship	3			**3**	**100%**
1	Timely resolving payment desputes and contractual claims	3			**3**	**100%**
2	Timely issuing of architect's instructions	2	1		**3**	**100%**
3	Comprehensive designs	1	2		**3**	**100%**
4	Minimum post conytract variations		3		**3**	**100%**
4	Minimum specification changes		3		**3**	**100%**
5	Monitoring of consultants for the production of final accounts	2		1	**2**	**67%**
6	Appointment of experienced/competent Project Team Personnel	1		2	**1**	**33%**
6	Regular consultation with Procurement Board	1		2	**1**	**33%**
6	Adequate consultation with service providers (BPC, BTC, WUC)	1		2	**1**	**33%**
7	Minimum Bills of Quantities errors		1	2	**1**	**33%**
8	Inadequate provision for force majeure (acts of God)			3	**-**	**0%**

Seven Remedial Cost Control Measures with percentage severity of **80% and above**; classified as **Extremely Highly Effective Measures (EHEM)** were identified. **From Table C50**: **EHFF; 80%≤ S ≥100%.**

Rank	Remedial Cost Control Measures (Extremely Highly Effective Measures) (EHEM)	% Severity
1	Timely resolving extension of time claims	**100%**
1	Good workmanship	**100%**
1	Timely resolving payment disputes and contractual claims	**100%**
2	Timely issuing of architect's instructions	**100%**
3	Comprehensive designs	**100%**
4	Minimum post contract variations	**100%**
4	Minimum specification changes	**100%**

Table C51: Construction Manager's Responses to Questionnaire Expressed in Percentage of total number of responses per professional group; (i.e. Nr = 4). Severity Index is calculated from the total of highly and moderately effective cost control remedial measures responses.

Table C51: Construction Manager's Responses Severity Index

Rank {1}	Remedial Cost Control Measures {2}	Highly Effective F_3 {3}	Moderatley Effective F_2 {4}	Least Effective F_1 {5}	Severity Index $F=F_3+F_2$ {6}	Percentage Severity $P_3=F/N,x100$ {7}
1	Minimum specification changes	3	1		**4**	**100%**
2	Timely issuing of architect's instructions	2	2		**4**	**100%**
2	Good workmanship	2	2		**4**	**100%**
3	Minimum Bills of Quantities errors	1	3		**4**	**100%**
3	Monitoring of consultants for the production of final accounts	1	3		**4**	**100%**
4	Comprehensive designs	3		1	**3**	**75%**
4	Timely resolving extension of time claims	3		1	**3**	**75%**
5	Minimum post conytract variations	2	1	1	**3**	**75%**
5	Timely resolving payment desputes and contractual claims	2	1	1	**3**	**75%**
6	Appointment of experienced/competent Project Team Personnel	1	2	1	**3**	**75%**
6	Adequate consultation with service providers (BPC, BTC, WUC)	1	2	1	**3**	**75%**
7	Inadequate provision for force majeure (acts of God)		3	1	**3**	**75%**
8	Regular consultation with Procurement Board	1	1	2	**2**	**50%**

Five Remedial Cost Control Measures with percentage severity of **80% and above**; classified as **Extremely Highly Effective Measures (EHEM)** were identified. **From Table C51**: **EHFF; 80%≤ S ≥100%.**

Rank	Remedial Cost Control Measures (Extremely Highly Effective Measures) (EHEM)	% Severity
1	Minimum specification changes	**100%**
2	Timely issuing of architect's instructions	**100%**
2	Good workmanship	**100%**
3	Minimum Bills of Quantities errors	**100%**
3	Monitoring of consultants for the production of final accounts	**100%**

4.7. Cost Overrun Causal Factors Rank Agreement Tables for all Professional Groups Combined

Conception / Planning / Designing Phase

Table C52 Combined Groups Rank Agreement Factors

S/No {1}	Cost Overrun Causal Factor {2}	Project Manag. Ranking (M) {3}	Architect Ranking (A) {4}	Enginers Ranking (E) {5}	Quantity Surveyors Ranking (Q) {6}	Financial Manag. Ranking (F) {7}	Contruct. Ranking (C) {8}	Sum of Rankings (RA= (Σ MA EQFC) {9}	Rank Agreem. Factor (RA= (Σ MA EQFC)/N {10}	Percent. Agreem. Factor (PAR= RAmax-RAi/RAmax (%) {11}	Standard Deviation (s) (Σ PA) {12}	Squares of Deviat^n $(s)^2$ {13}	Ranking Order {14}
1	Incomplete Desgn	3	3	1	1	4	2	14	0.61	**80**	26	676	**1**
2	Additional work required by client at the end of design period	1	2	4	2	2	3	14	0.61	**80**	26	676	**1**
3	Ambigious/Inadequate Client's Project Brief	2	1	1	4	5	7	20	0.87	**71**	20	400	**2**
4	Inadequate Project Planning	3	2	4	3	6	3	21	0.91	**70**	19	361	**3**
5	Lack of Pre-Contrat Project Coordination	4	4	3	5	5	4	25	1.09	**64**	15	225	**4**
6	Lack of prompt decsion making by project managers	8	4	2	4	7	1	26	1.13	**63**	14	196	**5**
7	Government Bureaucracy	3	2	5	7	4	6	27	1.17	**61**	13	169	**6**
8	Pre-contract budget constraints	7	6	8	6	1	3	31	1.35	**55**	9	81	**7**
9	Unreliable Project Cost Estimates	12	3	3	7	1	10	36	1.57	**48**	4	16	**8**
10	Lack of consistent project cost reporting	10	3	4	8	3	10	38	1.65	**46**	2	4	**9**
11	Ineffectice communication channels	8	6	9	5	5	5	38	1.65	**46**	2	4	**9**
12	Unavailability of reliable cost database/cost estimates	5	10	9	9	5	3	41	1.78	**41**	- 1	1	**10**
13	Poor project mangement skills by client representatives	6	6	6	11	8	6	43	1.87	**38**	- 3	9	**11**
14	Late release of project funds	8	6	6	13	7	5	45	1.96	**35**	- 5	25	**12**
15	Incompetent client representatives	9	3	5	14	7	8	46	2.00	**34**	- 6	36	**13**
16	Pressure from third parties (Political Agents/Influencial Clients)	11	3	8	15	7	6	50	2.17	**28**	- 10	100	**14**
17	Uncoordinated legislation (eg citizen contractors empowerment)	7	6	11	13	4	9	50	2.17	**28**	- 10	100	**14**
18	Extensions to tender validity period	7	8	10	16	7	3	51	2.22	**27**	- 11	121	**15**
19	Inexperienced/Incompetent Project Team Personnel	13	6	9	10	7	9	54	2.35	**22**	- 14	196	**16**
20	Inadequate Geotechnical Reports	15	7	7	11	7	9	56	2.43	**20**	- 16	256	**17**
21	Limited information on site location and conditiobns	13	8	10	12	8	5	56	2.43	**20**	- 16	256	**17**
22	Lack of serviced land	13	5	7	17	9	6	57	2.48	**18**	- 17	289	**18**
23	Delayed planning permission by Local Authorities/Land Boards	14	9	12	18	9	11	73	3.17	-	- 33	1,089	**19**

Values of Kendell's Coefficient of Rank Correlation Analysis:

Kendell's coefficient of Rank correlation (τ): $\boldsymbol{\tau} = (\mathbf{S})/\{\mathbf{K}^2\}(n^{-1})[n^3-n]$; $\boldsymbol{\tau = 0.005}$; indicates perfect agreement between the professionals.

Chi-square (χ^2): $\boldsymbol{\chi^2} = \mathbf{K}$ (n-1) τ; $\boldsymbol{\chi^2 = 4.74}$; is not significant when tested at both 0.05 and 0.01 levels of significance. **S** = 5,286, **K** = 43, n = 23.

(Good Agreement Values: $0 \leq \boldsymbol{\tau} \leq 1.0$ and Disagreement Values: $0 > \boldsymbol{\tau} \leq -1.0$)

Where; **S** = sum of squares of standard deviation; **K** = total number of professionals that ranked the variable factors; and n = number of listed variable factors.

4.7.1 Responsible Parties' Percentage Contributions

Cost Overrun Causal Factors have been classified into **(a)** Extremely Highly Frequent Factors **(EHFF); 80%≤ PAR ≥100%, (b)** Highly Frequent Factors **(HFF) 70% ≤ PAR < 80%, (c)** Moderately Frequent Factors **(MFF) 60% ≤ PAR < 70%** and **(d)** Least Frequent Factors **(LFF); 0% ≤ PAR < 60%.** From these classifications, seven possible responsible parties; Clients, Project Mangers, Architects, Engineers, Quantity Surveyors, Financial Managers/Advisers (Planning Officials) and Contractors, have been apportioned contribution percentages (JCT Contract by Ramus (1993)).

Table C53 Responsible Parties' Percentage Contributions

Rank Order	Cost Overrun Causal Factor Classification	% Agreem. Factor (PAR)	Aver. % Agreem. Factor	Parties' Percentage Contribution						
	(a) Extremely Highly Frequent Factor (EHFF): **80%≤ PAR ≥100%**			**Clients**	**Project Managers**	**Architects**	**Engins.**	**Quantity Surveyors**	**Financial Manag.**	**Contractors**
1	Incomplete Design	80				√				
1	Additional work required by client at the end of design period	80	80.0	√						
	Responsible Party Percentage Contribution			50	0	50	0	0	0	0
	(b) Highly Frequent Factor (HFF): **70%≤ PAR < 80%**									
2	Ambiguous/Inadequate Client's Project Brief	71	70.5	√						
3	Inadequate Project Planning	70			√					
	Responsible Party Percentage Contribution			50	50	0	0	0	0	0
	(c) Moderately Frequent Factor (MFF): **60%≤ PAR < 70%**									
4	Lack of Pre-Contract Project Coordination	64			√					
5	Lack of prompt decision making by project managers	63	62.7		√					
6	Government Bureaucracy	61		√						
	Responsible Party Percentage Contribution			33.3	66.7	0	0	0	0	0
	(d) Least Frequent Factor (LFF): **0%≤ PAR < 60%**									
7	Pre-contract budget constraints	55							√	
8	Unreliable Project Cost Estimates	48						√		
9	Lack of consistent project cost reporting	46						√		
9	Ineffective communication channels	46			√					
10	Unavailability of reliable cost database/cost estimates	41						√		
11	Poor project management skills by client representatives	38		√						
12	Late release of project funds	35							√	
13	Incompetent client representatives	34		√						
14	Pressure from third parties (Political Agents/Influential Clients)	28	31.6	√						
14	Uncoordinated legislation (eg citizen contractors empowerment)	28		√						
15	Extensions to tender validity period	27			√					
16	Inexperienced/Incompetent Project Team Personnel	22			√					
17	Inadequate Geotechnical Reports	20					√			
17	Limited information on site location and conditions	20		√						
18	Lack of serviced land	18		√						
19	Delayed planning permission by Local Authorities/Land Boards	0		√						
	Responsible Party Percentage Contribution			44	19	0	6	19	12	0
	Responsible Party Aver. Percentage Contribution			44	34	12	2	5	3	0

The table above show that Clients and Architects are exclusively accountable for the first two cost overrun causal factors that are rated as extremely high (ie PAR≤80%).

4.7.2 Parties' Percentage Contributions

Conception / Planning / Designing Phase

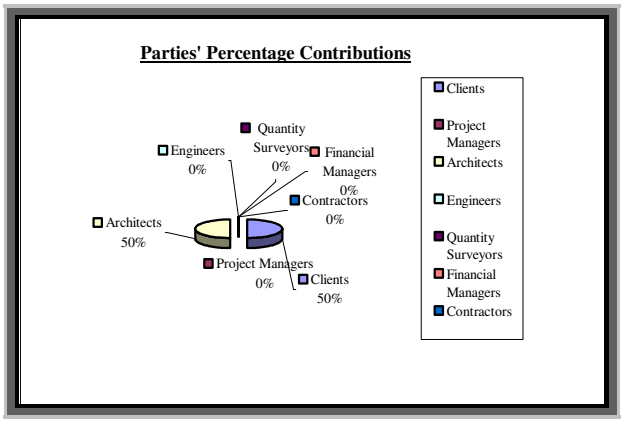


Figure C5: Extremely Highly Frequent Factors **(EHFF); 80% ≤ PAR ≥100%**

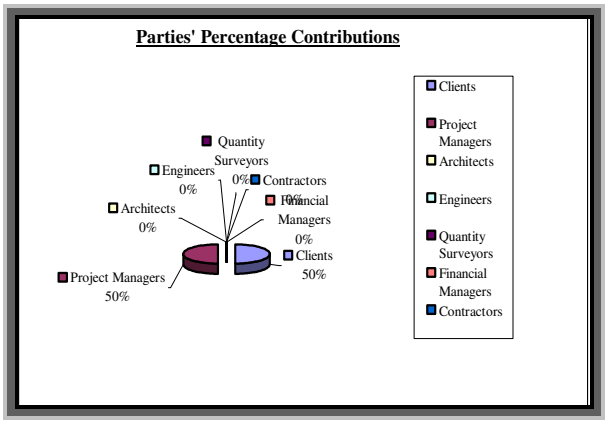


Figure C6: Highly Frequent Factors **(HFF) 70% ≤ PAR < 80%**

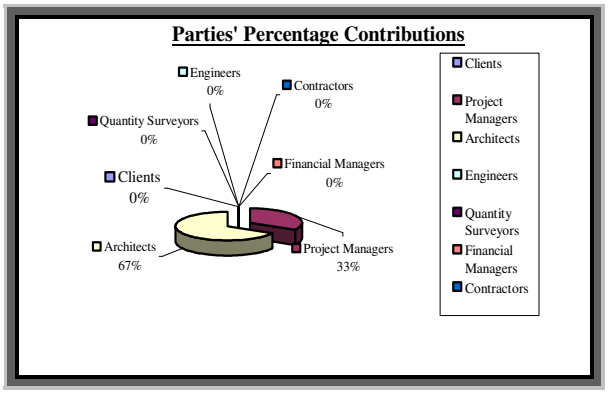


Figure C7: Moderately Frequent Factors **(MFF) 60% ≤ PAR < 70%**

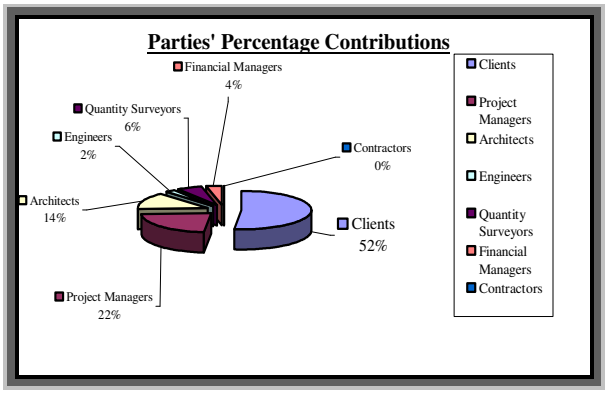


Figure C8: Least Frequent Factors **(LFF); 0% ≤ PAR < 60%**

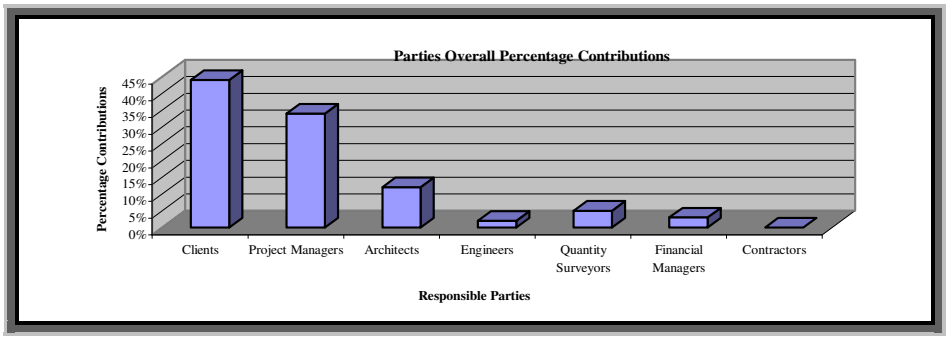


Figure C9: All Parties Overall Contributions

Figures C5 to C9, show that Clients, Project Mangers, Architects, Quantity Surveyors and Financial Mangers play a major contributory role in perpetrating the overall cost overrun causal factors; during the conception/planning/designing phase of the projects development cycle.

Implementation Phase

Table C54: Combined Groups Rank Agreement Factors

S/No {1}	Cost Overrun Causal Factor {2}	Project Manag. Ranking (M) {3}	Architect Ranking (A) {4}	Enginers Ranking (E) {5}	Quantity Surveyors Ranking (Q) {6}	Financial Manag. Ranking (F) {7}	Contruct. Ranking (C) {8}	Sum of Rankings (RA= (∑ MA EQFC) {9}	Rank Agreem. Factor (RA= (∑ MA EQFC)/N {10}	Percent. Agreem. Factor (PAR= RAmax-RAi/RAmax (%) {11}	Standard Deviation (s) (∑ PA) {12}	Squares of Deviat° (s)² {13}	Ranking Order {14}
1	Failure to Determinate Non-performing Contractors	2	1	1	2	2	2	10	0.23	**89**	53	2,809	**1**
2	Delay in resolving contractual claims	3	3	1	4	1	7	19	0.43	**80**	44	1,936	**2**
3	Post contract variations	1	2	4	1	8	8	24	0.55	**73**	39	1,521	**3**
4	Late architect's instructions	1	10	2	3	3	6	25	0.57	**72**	38	1,444	**4**
5	Incomplete Design	6	3	3	7	6	2	27	0.61	**70**	36	1,296	**5**
6	Poor financial mangement by contractors	4	2	5	5	4	8	28	0.64	**69**	35	1,225	**6**
7	Extension of time cliams	5	5	2	6	5	6	29	0.66	**68**	34	1,156	**7**
8	Late extension of time claims	6	7	6	12	1	2	34	0.77	**62**	29	841	**8**
9	Non-performance by main contractor/sub-contractors	5	2	2	8	5	12	34	0.77	**62**	29	841	**8**
10	Adjustment to provisional & PC Sums	8	8	9	9	1	7	42	0.95	**54**	21	441	**9**
11	Inexperienced/Incompetent Project Team Personnel	14	4	7	18	5	2	50	1.14	**44**	13	169	**10**
12	Poor performance of consultants	15	3	5	10	7	10	50	1.14	**44**	13	169	**10**
13	Ineffective communication channels	10	4	11	14	6	6	51	1.16	**43**	12	144	**11**
14	Lack of control of nominated subcontrctors	13	9	10	15	1	6	54	1.23	**40**	9	81	**12**
15	Lack of pre-qualification bidding system	7	10	8	22	1	7	55	1.25	**39**	8	64	**13**
16	Delayed payments for completed work	19	9	6	12	5	7	58	1.32	**35**	5	25	**14**
17	Prolonged tendering procedures	11	7	9	24	8	2	61	1.39	**32**	2	4	**15**
18	Unreliable Project Cost Estimates	17	4	9	19	9	3	61	1.39	**32**	2	4	**15**
19	Contract documents (drawings/BoQ) errors	20	8	5	13	8	7	61	1.39	**32**	2	4	**15**
20	Lack of consitent project cost reporting	14	6	11	14	6	11	62	1.41	**31**	1	1	**16**
21	Poor workmanship	9	2	13	26	4	9	63	1.43	**30**	-	-	**17**
22	Materials' price escalations	16	5	9	21	8	4	63	1.43	**30**	-	-	**17**
23	Inadequate project monitoring	9	10	9	15	8	14	65	1.48	**28**	- 2	4	**18**
24	Client's requests for specifiaction changes	15	7	12	20	8	4	66	1.50	**27**	- 3	9	**19**
25	Re-measurement of provisional quantities	18	11	6	19	8	6	68	1.55	**24**	- 5	25	**20**
26	Late payments leading to increased claims	19	11	7	27	2	3	69	1.57	**23**	- 6	36	**21**
27	In-exhaustive tender adjudication	20	10	13	16	8	3	70	1.59	**22**	- 7	49	**22**
28	Drastic change to scope of work during construction stage	16	13	15	11	8	7	70	1.59	**22**	- 7	49	**22**
29	Numerous provisional items in BoQ	24	3	10	21	8	5	71	1.61	**21**	- 8	64	**23**
30	Insufficient project funds	12	7	18	23	8	5	73	1.66	**19**	- 10	100	**24**
31	Late provision of services (power, water, telephone etc)	18	10	15	24	5	4	76	1.73	**15**	- 13	169	**25**
32	Personnel turnover (skilled/competent)	20	6	13	24	5	8	76	1.73	**15**	- 13	169	**25**
33	Lack of adequate funds due to budget restrictions	15	10	15	25	8	3	76	1.73	**15**	- 13	169	**25**
34	Continuous client's interference	13	7	16	31	9	6	82	1.86	**9**	- 19	361	**26**
35	Statutory regulations & Government Policies	17	6	14	30	8	8	83	1.89	**8**	- 20	400	**27**
36	Cumbersome payment procedures leading to contractual claims	22	10	13	27	5	8	85	1.93	**6**	- 22	484	**28**
37	Pressure from third parties	21	10	15	26	7	7	86	1.95	**5**	- 23	529	**29**
38	Design failures	21	13	12	32	9	1	88	2.00	**2**	- 25	625	**30**
39	Statutory labour cost escalations	23	6	16	30	8	8	91	2.07	- **1**	- 28	784	**31**
40	Adverse site conditions	25	11	17	25	7	10	95	2.16	- **6**	- 32	1,024	**32**
41	Pressure from international market conditions	24	11	19	24	7	14	99	2.25	**-10**	- 36	1,296	**33**
42	Scarcity of specified building materials	23	11	15	29	9	13	100	2.27	- **11**	- 37	1,369	**34**
43	Inadequate geotechnical reports	25	12	17	28	8	11	101	2.30	- **12**	- 38	1,444	**35**
44	*Force majeure (acts of God)*	25	13	20	33	9	14	114	2.59	**-27**	- 51	2,601	**36**

Values of Kendell's Coefficient of Rank Correlation Analysis:

Kendell's coefficient of Rank correlation (τ): $\boldsymbol{\tau} = (\mathbf{S})/\{\mathbf{K}^2\}(n^{-1})[n^3-n]$; **$\tau = 0.007$**; indicates perfect agreement between the professionals.

Chi-square (χ^2): $\boldsymbol{\chi^2} = \mathbf{K}\ (n-1)\ \tau$; **$\chi^2 = 12.94$; is not significant when tested at both 0.05 and 0.01 levels of significance.

S = 25,935, **K** = 43, n = 44. (Good Agreement Values:$0 \leq \boldsymbol{\tau} \leq 1.0$ and Disagreement Values: $0 > \boldsymbol{\tau} \leq -1.0$)

Where; **S =** sum of squares of standard deviation; **K** = total number of professionals that ranked the variable factors; and n = number of listed variable factors.

4.7.3 Responsible Parties' Percentage Contributions

Cost Overrun Causal Factors have been Classified into (a) **Extremely Highly Frequent Factors** (EHFF); 80%≤ PAR ≥100%, (b) **Highly Frequent Factors** (HFF) 70% ≤ PAR < 80%, (c) **Moderately Frequent Factors** (MFF) 60% ≤ PAR < 70% **and** (d) **Least Frequent Factors** (LFF); 0% ≤ PAR < 60%. **From these classifications, seven possible responsible parties; Clients, Project Mangers, Architects, Engineers, Quantity Surveyors, Financial Managers/Advisers (Planning Officials) and Contractors, have been apportioned contribution percentages. The table below show that Clients and Architects are exclusively accountable for the first two cost overrun causal factors that are rated as extremely high (ie PAR≤80%)** (JCT Contract by Ramus (1993)).

Table C55 Responsible Parties' Percentage Contributions

Rank Order	Cost Overrun Causal Factor Classification	% Agreem. Factor (PAR)	Aver. % Agreem. Factor	Party Percentage Contributions						
	(a) Extremely Highly Frequent Factor (EHFF): **80%≤ PAR ≥100%**			Clients	Project Managers	Architects	Engineers	Quantity Surveyors	Financial Managers	Contractors
1	Failure to Determinate Non-performing Contractors	89	84.5		√					
2	Delay in resolving contractual claims	80						√		
	Responsible Party Percentage Contribution			0	50		0	50	0	0
	(b) Highly Frequent Factor (HFF): **70%≤ PAR < 80%**									
3	Post contract variations	73	71.7			√				
4	Late architect's instructions	72				√				
5	Incomplete Design	70				√				
	Responsible Party Percentage Contribution			0	0	100	0	0	0	0
	(c) Moderately Frequent Factor (MFF): **60%≤ PAR < 70%**									
6	Poor financial management by contractors	69	65.3							√
7	Extension of time claims	68								√
8	Late extension of time claims	62								√
8	Non-performance by main contractor/sub-contractors	62								√
	Responsible Party Percentage Contribution			0	0	0	0	0	0	100
	(d) Least Frequent Factor (LFF): **0%≤ PAR < 60%**									
9	Adjustment to provisional & PC Sums	54	25.2					√		
10	Inexperienced/Incompetent Project Team Personnel	44			√					
10	Poor performance of consultants	44			√					
11	Ineffective communication channels	43			√					
	Lack of control of nominated subcontractors	40								√
13	Lack of pre-qualification bidding system	39			√					
14	Delayed payments for completed work	35						√		
15	Prolonged tendering procedures	32			√					
15	Unreliable Project Cost Estimates	32						√		
15	Contract documents (drawings/BoQ) errors	32						√		
16	Lack of consistent project cost reporting	31						√		
17	Poor workmanship	30								√
17	Materials' price escalations	30								√
18	Inadequate project monitoring	28				√				
19	Client's requests for specification changes	27		√						
20	Re-measurement of provisional quantities	24						√		
21	Late payments leading to increased claims	23						√		
22	In-exhaustive tender adjudication	22			√					
22	Drastic change to scope of work during construction stage	22			√					
23	Numerous provisional items in BoQ	21						√		
24	Insufficient project funds	19							√	
25	Late provision of services (power, water, telephone etc)	15		√						
25	Personnel turnover (skilled/competent)	15			√					
25	Lack of adequate funds due to budget restrictions	15							√	
26	Continuous client's interference	9		√						
27	Statutory regulations & Government Policies	8		√						
28	Cumbersome payment procedures leading to contractual claims	5		√						
29	Pressure from third parties	5		√						
30	Design failures	2				√				
31	Statutory labour cost escalations	-1		√						
32	Adverse site conditions	-6					√			
33	Pressure from international market conditions	-1-		√						
34	Scarcity of specified building materials	-11								√
35	Inadequate geotechnical reports	-12					√			
36	*Force majeure (acts of God)*	-27								
	Responsible Party Percentage Contribution			24	24	6	5	24	5	12
	Responsible Party Aver. Percentage Contribution			6	19	27	1	19	1	28

4.7.4 Parties' Percentage Contributions

Implementation Phase

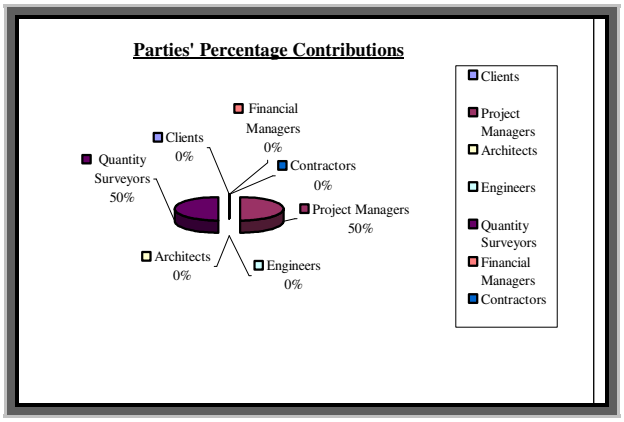


Figure C10: Extremely Highly Frequent Factors **(EHFF); 80%≤ PAR ≥100%**

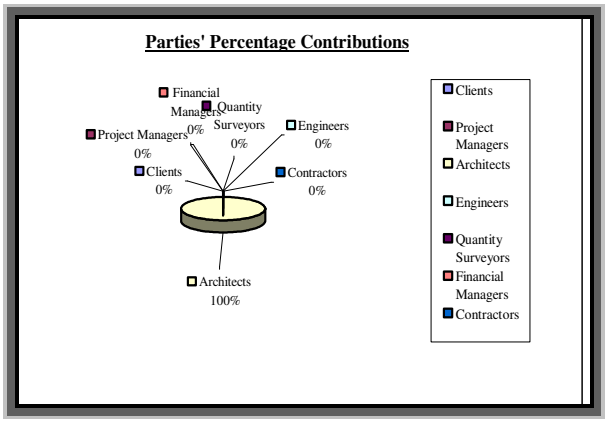


Figure C11: Highly Frequent Factors **(HFF) 70% ≤ PAR < 80%**

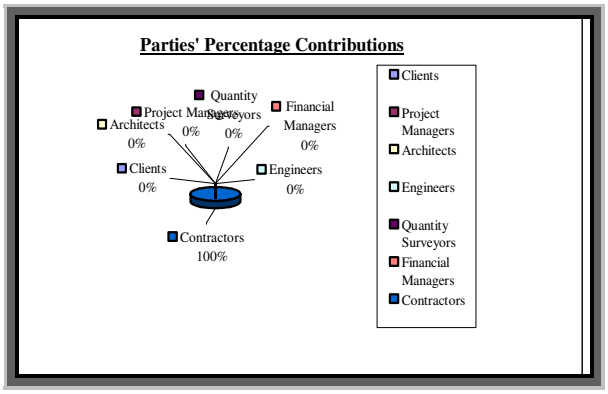


Figure C12: Moderately Frequent Factors **(MFF) 60% ≤ PAR < 70%**

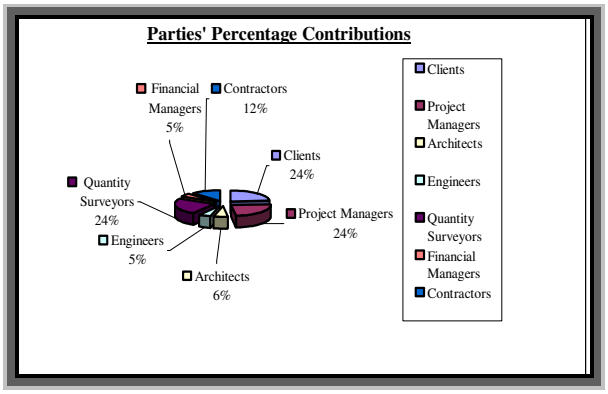


Figure C13: Least Frequent Factors **(LFF); 0% ≤ PAR < 60%**

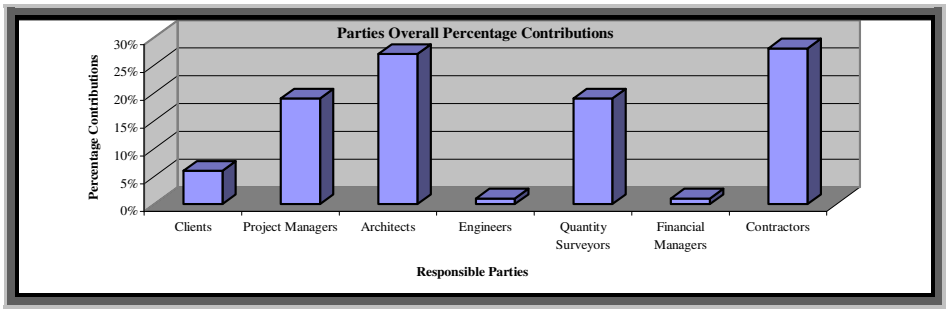


Figure C14: All Parties Overall Contributions

Figure C10 to **C14** show that Contractors, Architects, Quantity Surveyors, Project Mangers, and Clients, play a major contributory roll in perpetrating the overall cost overrun causal factors; during the implementation phase of the projects development cycle.

Completion & Commissioning Phase

Table C56: Combined Groups Rank Agreement Factors

S/No {1}	Cost Overrun Causal Factor {2}	Project Manag. Ranking (M) {3}	Architect Ranking (A) {4}	Enginers Ranking (E) {5}	Quantity Surveyors Ranking (Q) {6}	Financial Manag. Ranking (F) {7}	Contruct. Ranking (C) {8}	Sum of Rankings (RA= (Σ MA EQFC) {9}	Rank Agreem. Factor (RA= (Σ MA EQFC)/N {10}	Percent. Agreem. Factor (PAR= RAmax-RAi/RAmax (%) {11}	Standard Deviation (s) (Σ PA) {12}	Squares of Deviat^n $(s)^2$ {13}	Ranking Order {14}
1	Delay in resolving contractual cliams	4	3	2	2	2	2	15	1.07	**81**	18	324	**1**
2	Slow progress in appointing new contractors for abortive works	3	1	1	5	3	3	16	1.14	**79**	17	289	**2**
3	Late architect's instructions	2	8	3	4	1	1	19	1.36	**76**	14	196	**3**
4	Post contract variations	3	3	4	1	7	2	20	1.43	**74**	13	169	**4**
5	Extension of time claims	2	4	6	3	4	2	21	1.50	**73**	12	144	**5**
6	Poor workmanship	5	2	5	6	4	7	29	2.07	**63**	4	16	**6**
7	Late appointment of specialist sub-contractors	1	6	8	10	5	4	34	2.43	**56**	- 1	1	**7**
8	Clients' requests for specification changes	6	5	9	7	5	6	38	2.71	**51**	- 5	25	**8**
9	Bills of Quantities errors	8	5	7	11	5	4	40	2.86	**49**	- 7	49	**9**
10	Inexperienced/Incompetent Project Team Personnel	8	7	10	8	8	1	42	3.00	**46**	- 9	81	**10**
11	Cumbersome payment procedures leading to contractual claims	9	8	7	12	6	2	44	3.14	**44**	- 11	121	**11**
12	Late provision of services (power/water/telephone etc)	7	8	10	9	6	5	45	3.21	**42**	- 12	144	**12**
13	Design failures	9	9	9	13	7	2	49	3.50	**37**	- 16	256	**13**
14	*Force majeure (acts of God)*	10	8	11	14	8	5	56	4.00	**28**	- 23	529	**14**

Values of Kendell's Coefficient of Rank Correlation Analysis:

Kendell's coefficient of Rank correlation (τ): $\boldsymbol{\tau} = (\mathbf{S})/\{\mathbf{K}^2\}(n^{-1})[n^3-n]$; $\boldsymbol{\tau = 0.007}$; indicates perfect agreement between the professionals.

Chi-square (χ^2): $\boldsymbol{\chi^2} = \mathbf{K}(n-1)\ \tau$; $\boldsymbol{\chi^2 = 13.70}$; is not significant when tested at both 0.05 and 0.01 levels of significance.
S = 4,636, **K** = 43, n = 14. (Good Agreement Values: $0 \leq \boldsymbol{\tau} \leq 1.0$ and Disagreement Values: $0 > \boldsymbol{\tau} \leq -1.0$).

Where; **S** = sum of squares of standard deviation; **K** = total number of professionals that ranked the variable factors; and n = number of listed variable factors.

4.7.5 Responsible Parties' Percentage Contributions

Cost Overrun Causal Factors have been Classified into **(a)** Extremely Highly Frequent Factors **(EHFF); 80%≤ PAR ≥100%, (b)** Highly Frequent Factors **(HFF) 70% ≤ PAR < 80%, (c)** Moderately Frequent Factors **(MFF) 60% ≤ PAR < 70%** and **(d)** Least Frequent Factors **(LFF); 0% ≤ PAR < 60%.** From these classifications, seven possible responsible parties; Clients, Project Mangers, Architects, Engineers, Quantity Surveyors, Financial Managers/Advisers (Planning Officials) and Contractors, have been apportioned contribution percentages (JCT Contract by Ramus (1993)).

Table C57 Responsible Parties' Percentage Contributions

Rank Order	Cost Overrun Causal Factor Classification	% Agreem. Factor (PAR)	Aver. % Agreem. Factor	Party Percentage Contributions						
	(a) Extremely Highly Frequent Factor (EHFF): **80%≤ PAR ≥100%**			**Clients**	**Project Managers**	**Architects**	**Engins.**	**Quantity Surveyors**	**Financial Manag.**	**Contractors**
1	Delay in resolving contractual claims	**81**	**81**					√		
	Responsible Party Percentage Contribution			**0**	**0**	**0**	**0**	**100**	**0**	**0**
	(b) Highly Frequent Factor (HFF): **70%≤ PAR < 80%**									
2	Slow progress in appointing new contractors for abortive works	**79**			√					
3	Late architect's instructions	**76**				√				
4	Post contract variations	**74**	**75.5**			√				
5	Extension of time claims	**73**						√		
	Responsible Party Percentage Contribution			**0**	**25**	**50**	**0**	**25**	**0**	**0**
	(c) Moderately Frequent Factor (MFF): **60%≤ PAR < 70%**									
6	Poor workmanship	**63**	**63.0**							√
	Responsible Party Percentage Contribution			**0**	**0**	**0**	**0**	**0**	**0**	**100**
	(d) Least Frequent Factor (LFF): **0%≤ PAR < 60%**									
7	Late appointment of specialist sub-contractors	**56**			√					
8	Clients' requests for specification changes	**51**		√						
9	Bills of Quantities errors	**49**						√		
10	Inexperienced/Incompetent Project Team Personnel	**46**			√					
11	Cumbersome payment procedures leading to contractual claims	**44**	**44.1**	√						
12	Late provision of services (power/water/telephone etc)	**42**		√						
13	Design failures	**37**					√			
14	*Force majeure (acts of God)*	**28**								
	Responsible Party Percentage Contribution			**43**	**29**	**0**	**14**	**14**	**0**	**0**
	Responsible Party Aver. Percentage Contribution			**11**	**14**	**12**	**4**	**34**	**0**	**25**

The table above shows that the Quantity Surveyors are exclusively accountable for the only cost overrun causal factor that is rated as extremely high (ie PAR≤80%).

4.7.6 Parties' Percentage Contributions

Completion / Commissioning Phase

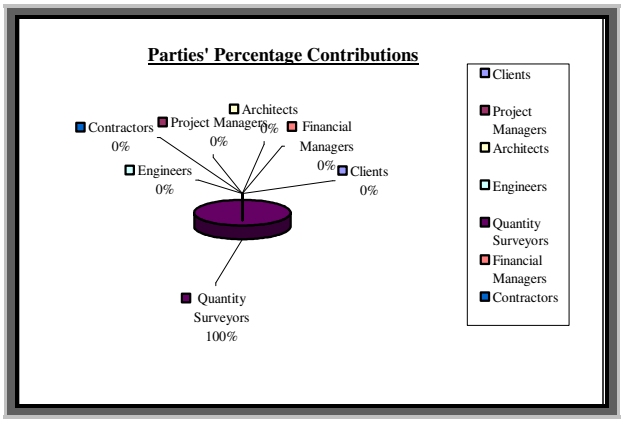


Figure C15: Extremely Highly Frequent Factors **(EHFF); 80% ≤ PAR ≥100%**

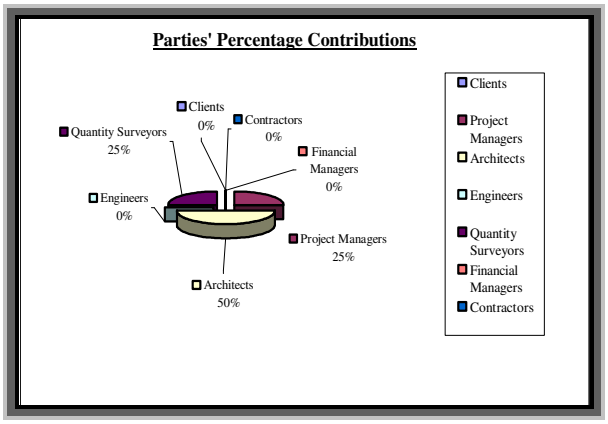


Figure C16: Highly Frequent Factors **(HFF) 70% ≤ PAR < 80%**

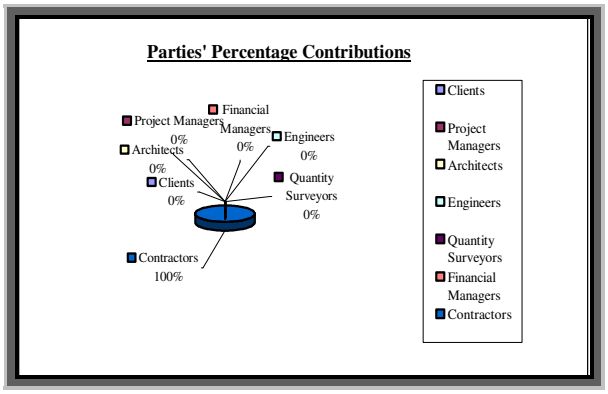


Figure C17: Moderately Frequent Factors **(MFF) 60% ≤ PAR < 70%**

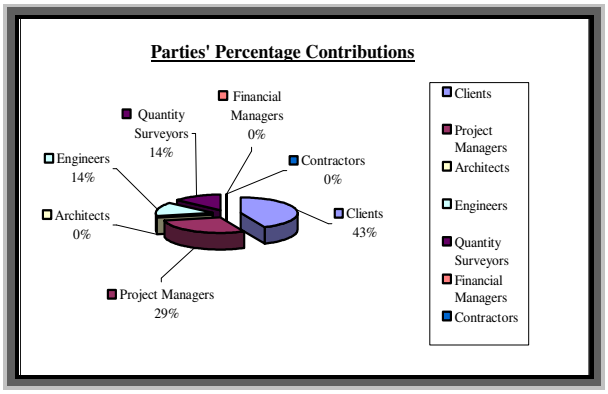


Figure C18: Least Frequent Factors **(LFF); 0% ≤ PAR < 60%**

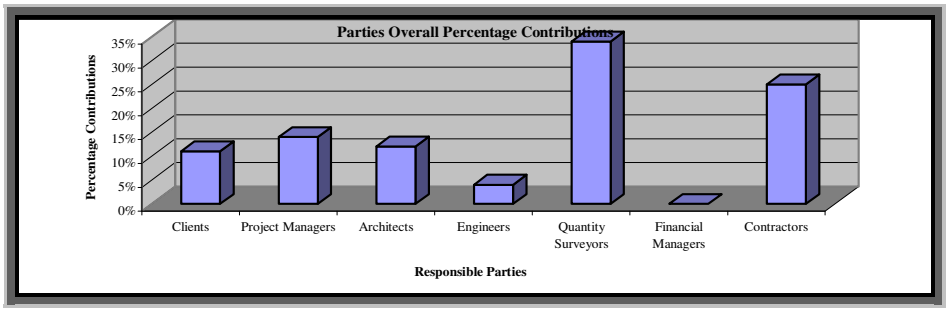


Figure C19: All Parties Overall Contributions

Figure C15 to **C19** show that Quantity Surveyors, Contractors, Project Mangers, Architects and Clients in that order, play a major contributory roll in perpetrating the overall cost overrun causal factors; during the completion / commissioning phase of the projects development cycle.

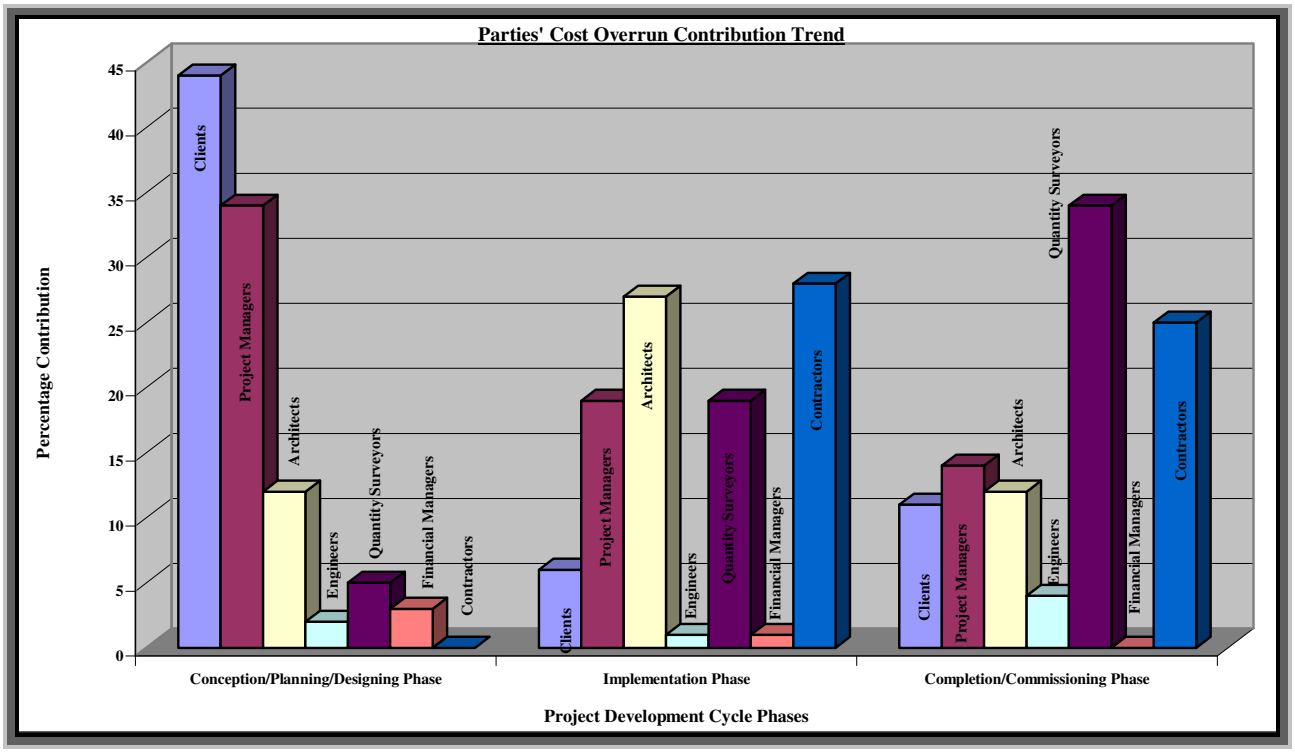


Figure C20: All Parties Overall Contributions During Project's Development Cycle

Figure C20; Summarises the cost overrun responsibility trend as follows:

(i) Clients, Project Managers and Architects in that order, are major cost overrun contributors at conception/planning/design phase.

(ii) Contractors, Architects, Projects Mangers and Quantity Surveyors in that order, play a major role during implementation phase.

(iii) Quantity Surveyors, Contractors, Project Managers and Clients in that order, dominate the completion and commissioning phase.

4.8 Remedial Cost Control Measures Rank Agreement Table for all Professionals Combined

Remedial Cost Control Measures Rank Agreement (Tables C58 to C63)

Conception / Planning / Designing Phase

Table C58 Cost Control Measures Rank Agreement Factors

S/No {1}	Remedial Cost Control Measures {2}	Project Manag. Ranking (M) {3}	Architect Ranking (A) {4}	Enginers Ranking (E) {5}	Quantity Surveyors Ranking (Q) {6}	Financial Manag. Ranking (F) {7}	Contruct. Ranking (C) {8}	Sum of Rankings (RA= (Σ MA EQFC) {9}	Rank Agreem. Factor (RA= (Σ MA EQFC)/N {10}	Percent. Agreem. Factor (PAR= RAmax-RAi/RAmax (%) {11}	Standard Deviation (s) (Σ PA) {12}	Squares of Deviat^n $(s)^2$ {13}	Ranking Order {14}
1	Adequate project desgn specification	4	1	1	2	3	1	12	0.80	**92**	36	1,296	**1**
2	Reliable Project Cost Estimates	4	1	2	3	1	2	13	0.87	**92**	35	1,225	**1**
3	Comprehensive Project Planning	2	1	2	3	3	3	14	0.93	**91**	34	1,156	**2**
4	Adequate Pre-Contrat Project Coordination	2	1	2	5	2	2	14	0.93	**91**	34	1,156	**2**
5	Comprehensive Client's Project Brief Development	1	1	1	1	6	5	15	1.00	**90**	33	1,089	**3**
6	Comprehensive tendering procedures	3	2	3	7	4	4	23	1.53	**85**	25	625	**4**
7	Improved cost date collection and storage in useable form	6	4	3	4	2	5	24	1.60	**84**	24	576	**5**
8	Setting up effective communication channels	5	1	6	11	3	4	30	2.00	**80**	18	324	**6**
9	Appointment of experienced/competent Project Team Personnel	7	1	5	9	8	3	33	2.20	**79**	15	225	**7**
10	Timely providing information on site location and conditiobns	10	1	5	8	7	5	36	2.40	**77**	12	144	**8**
11	Adequate Pre-contract Budget Provisions	10	2	4	6	9	5	36	2.40	**77**	12	144	**8**
12	Reducing time lapse between pre and post contract period	9	4	6	11	5	3	38	2.53	**75**	10	100	**9**
13	Architect to submitt plans for approval in advance	8	1	6	12	6	7	40	2.67	**74**	8	64	**10**
14	Adequate Geotechnical Site Investigation Process	10	2	7	10	8	6	43	2.87	**72**	5	25	**11**
15	Limited interference by ill-infromed clients	11	4	8	13	6	5	47	3.13	**69**	1	1	**12**

Values of Kendell's Coefficient of Rank Correlation Analysis:

Kendell's coefficient of rank correlation (τ): $\boldsymbol{\tau} = (\mathbf{S})/\{\mathbf{K}^2\}(n^{-1})[n^3-n]$; $\boldsymbol{\tau = 0.021}$; indicates perfect agreement between the professionals.

Chi-square (χ^2): $\boldsymbol{\chi^2} = \mathbf{K}\ (n-1)\ \tau$; $\boldsymbol{\chi^2 = 12.64}$; is not significant when tested at both 0.05 and 0.01 levels of significance.

S = 6,780, **K** = 43, n = 15. (Good Agreement Values: $0 \leq \boldsymbol{\tau} \leq 1.0$ and Disagreement Values: $0 > \boldsymbol{\tau} \leq -1.0$).

Where; **S =** sum of squares of standard deviation; **K** = total number of professionals that ranked the variable factors; and n = number of listed variable factors.

4.8.1 Remedial Cost Control Measures: Responsible Parties' Percentage Contributions

Remedial Cost Control Measures have been Classified into **(a)** Extremely Highly Effective Measures **(EHEM); 80%≤ PAR ≥100%, (b)** Highly Effective Measures **(HEM) 70% ≤ PAR < 80%, (c)** Moderately Effective Measures **(MEF) 60% ≤ PAR < 70%** and **(d)** Least Effective Measures **(LEM); 0% ≤ PAR < 60%.** From these classifications, seven possible responsible parties; Clients, Project Mangers, Architects, Engineers, Quantity Surveyors, Financial Managers/Advisers (Planning Officials)) and Contractors, have been apportioned contribution percentages (JCT Contract by Ramus (1993)).

Table C59 Responsible Parties' Percentage Contributions

Rank Order	Remedial Cost Control Measure Classification	% Agreem. Factor (PAR)	Aver. % Agreem. Factor	Party Percentage Contributions						
	(a) Extremely Highly Effective Measure (EHEM): **80%≤ PAR ≥100%**			**Clients**	**Project Managers**	**Architects**	**Engins.**	**Quantity Surveyors**	**Financial Manag.**	**Contractors**
1	Adequate project design specification	**92**				√				
1	Reliable Project Cost Estimates	**92**						√		
2	Comprehensive Project Planning	**91**			√					
2	Adequate Pre-Contract Project Coordination	**91**			√					
3	Comprehensive Client's Project Brief Development	**90**	**88.1**	√						
4	Comprehensive tendering procedures	**85**			√					
5	Improved cost date collection and storage in useable form	**84**						√		
6	Setting up effective communication channels	**80**			√					
	Responsible Party Percentage Contribution			**12**	**50**	**13**	**0**	**25**	**0**	**0**
	(b) Highly Effective Measure (HEM): **70%≤ PAR < 80%**									
9	Appointment of experienced/competent Project Team Personnel	**79**			√					
10	Timely providing information on site location and conditions	**77**		√						
11	Adequate Pre-contract Budget Provisions	**77**							√	
12	Reducing time lapse between pre and post contract period	**75**	**75.7**		√					
13	Architect to submit plans for approval in advance	**74**				√				
14	Adequate Geotechnical Site Investigation Process	**72**					√			
	Responsible Party Percentage Contribution			**17**	**33**	**17**	**17**	**0**	**16**	**0**
	(c) Moderately Effective Measure (HEM): **60%≤ PAR < 70%**									
15	Limited interference by ill-informed clients	**69**	**69**	√						
	Responsible Party Percentage Contribution			**100**	**0**	**0**	**0**	**0**	**0**	**0**
	Responsible Party Aver. Percentage Contribution			**43**	**27**	**10**	**6**	**8**	**6**	**0**

The table above shows that the Clients, Project Managers, Architects and Quantity Surveyors are exclusively accountable for several cost overrun causal factors that are rated as extremely high (ie PAR≤80%).

4.8.2 Remedial Cost Control Measures: Parties' Percentage Contributions:

Conception / Planning / Designing Phase

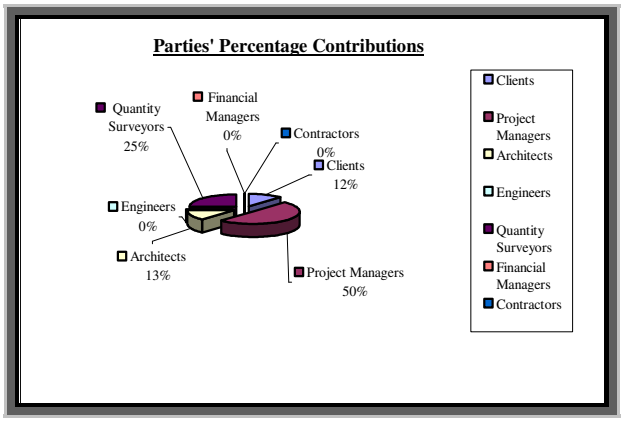


Figure C21: Extremely Highly Effective Measures **(EHEM); 80% ≤ PAR ≥100%**

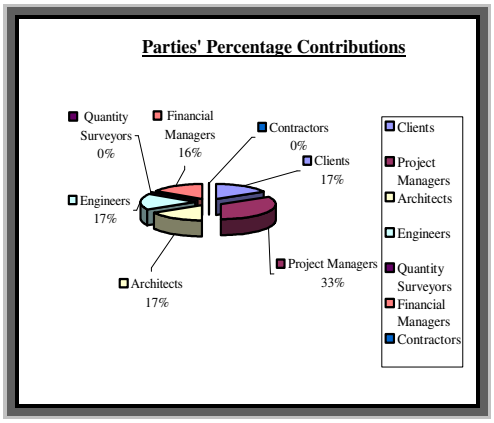


Figure C22: Highly Effective Measures **(HEM) 70% ≤ PAR < 80%**

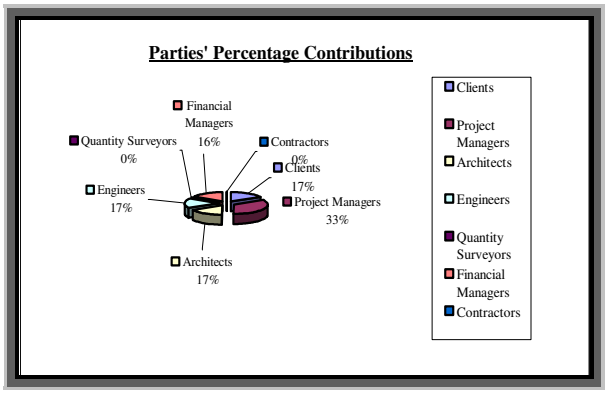


Figure C23: Moderately Effective Measures **(MEM) 60% ≤ PAR < 70%**

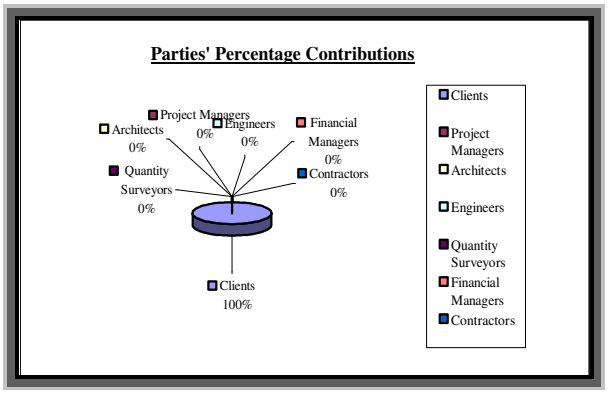


Figure C24: Least Effective Measures **(LEM); 0% ≤ PAR < 60%**

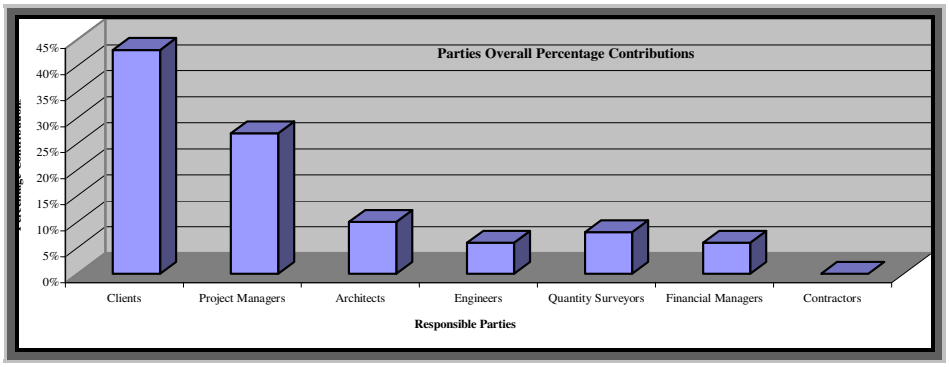


Figure C25: All Parties Overall Contributions

Figures C21 to **C25,** show that Clients, Project Managers, Architects and Quantity Surveyors in that order, can play a major contributory roll in implementing effective remedial cost control measures; during the conception/planning/designing phase of the projects development cycle.

Implementation Phase

Table C60 Cost Control Measures Rank Agreement Factors

S/No {1}	Remedial Cost Control Measures {2}	Project Manag. Ranking (M) {3}	Architect Ranking (A) {4}	Enginers Ranking (E) {5}	Quantity Surveyors Ranking (Q) {6}	Financial Manag. Ranking (F) {7}	Contruct. Ranking (C) {8}	Sum of Rankings (RA= (Σ MA EQFC) {9}	Rank Agreem. Factor (RA= (Σ MA EQFC)/N {10}	Percent. Agreem. Factor (PAR= RAmax-RAi/RAmax (%) {11}	Standard Deviation (s) (Σ PA) {12}	Squares of Deviat" (s)" {13}	Ranking Order {14}
1	Complete Project Designs	3	1	1	1	5	1	12	0.38	**77**	29	841	**1**
2	Timely issuing of architect's instructions	2	1	1	2	3	3	12	0.38	**77**	29	841	**1**
3	Timely resolving contractual claims	1	1	3	5	2	5	17	0.53	**68**	24	576	**2**
4	Minimum specification changes	4	1	3	5	3	2	18	0.56	**66**	23	529	**3**
5	Adequate monitoring of projects	5	1	3	4	3	3	19	0.59	**64**	22	484	**4**
6	Effective communication channels	4	1	4	7	1	3	20	0.63	**62**	21	441	**5**
7	Timely determination of Non-performing contractors	4	2	1	8	3	2	20	0.63	**62**	21	441	**5**
8	Timely payments for completed work	5	2	2	5	3	3	20	0.63	**62**	21	441	**5**
9	Timely resolving extension of time claims	2	3	3	10	2	2	22	0.69	**58**	19	361	**6**
10	Consistent project cost reporting	5	2	3	9	3	3	25	0.78	**52**	16	256	**7**
11	Comprehensive designs	9	1	6	3	6	1	26	0.81	**50**	15	225	**8**
12	Appointment of experienced/competent Project Team Personnel	7	1	2	13	4	7	34	1.06	**35**	7	49	**9**
13	Good workmanship	8	1	6	12	1	6	34	1.06	**35**	7	49	**9**
14	Reliable Project Cost Estimates	7	2	6	14	4	2	35	1.09	**33**	6	36	**10**
15	Adequate performance monitoring of consultants & contractors	8	1	5	13	5	4	36	1.13	**31**	5	25	**11**
16	Minimum Bills of Quantities errors	12	2	4	6	8	5	37	1.16	**29**	4	16	**12**
17	Accurate re-measurement of provisional quantities	6	2	7	15	8	3	41	1.28	**22**	-	-	**13**
18	Improved release of funds	10	5	8	14	8	2	47	1.47	**10**	- 6	36	**14**
19	Comprehensive tendering procedures	4	3	8	21	7	5	48	1.50	**8**	- 7	49	**15**
20	Collaboration of QS and Services Engineers for BoQ production	11	4	6	17	5	7	50	1.56	**5**	- 9	81	**16**
21	Availability of specified building materials	5	6	7	20	8	5	51	1.59	**3**	- 10	100	**17**
22	Pre-Tender qualification bidding system	10	5	12	18	4	6	55	1.72	**-5**	- 14	196	**18**
23	Adequate provision for PC and provisional sums	16	6	7	11	6	9	55	1.72	- **5**	- 14	196	**18**
24	Providing sufficient site condition information	15	2	8	19	8	4	56	1.75	- **7**	- 15	225	**19**
25	Provision for materials' price escalations	9	4	9	26	7	3	58	1.81	- **11**	- 17	289	**20**
26	Controlled client's interference	11	2	7	24	7	7	58	1.81	**-11**	- 17	289	**20**
27	Exhaustive tender adjudication	13	6	9	16	8	6	58	1.81	**-11**	- 17	289	**20**
28	Minimum Pressure from third parties	12	3	9	25	7	4	60	1.88	- **14**	- 19	361	**21**
29	Adequate provision for Statutory regulation cost escalations	14	7	10	22	7	3	63	1.97	- **20**	- 22	484	**22**
30	Reducing personnel turnover	11	4	11	23	7	7	63	1.97	**-20**	- 22	484	**22**
31	Adequate geotechnical reports	17	4	13	19	8	7	68	2.13	**-30**	- 27	729	**23**
32	Adequate provision for force majeure (acts of God)	18	8	14	27	9	8	84	2.63	- **60**	- 43	1,849	**24**

Values of Kendell's Coefficient of Rank Correlation Analysis:

Kendell's coefficient of rank correlation (τ): $\boldsymbol{\tau} = (\mathbf{S})/\{\mathbf{K}^2\}(n^{-1})[n^3-n]$; $\boldsymbol{\tau = 0.006}$; indicates perfect agreement between the professionals.

Chi-square (χ^2): $\boldsymbol{\chi^2} = \mathbf{K}(n-1)\ \tau$; $\boldsymbol{\chi^2 = 8.00}$; is not significant when tested at both 0.05 and 0.01 levels of significance.

S = 11,268, **K** = 43, n = 32. (Good Agreement Values: $0 \leq \boldsymbol{\tau} \leq 1.0$ and Disagreement Values: $0 > \boldsymbol{\tau} \leq -1.0$).

Where; **S** = sum of squares of standard deviation; **K** = total number of professionals that ranked the variable factors; and n = number of listed variable factors.

4.8.3 Remedial Cost Control Measures: Responsible Parties' Possible Percentage Contributions

Remedial Cost Control Measures have been Classified into **(a)** Extremely Highly Effective Measures **(EHEM); 80%≤ PAR ≥100%, (b)** Highly Effective Measures **(HEM) 70% ≤ PAR < 80%, (c)** Moderately Effective Measures **(MEF) 60% ≤ PAR < 70%** and **(d)** Least Effective Measures **(LEM); 0% ≤ PAR < 60%.** From these classifications, seven possible responsible parties; Clients, Project Mangers, Architects, Engineers, Quantity Surveyors, Financial Managers/Advisers (Planning Officials)) and Contractors, have been apportioned contribution percentages (JCT Contract by Ramus (1993)).

Table C61 Responsible Parties' Possible Percentage Contributions

Rank Order	Remedial Cost Control Measure Classification	% Agreem. Factor (PAR)	Aver. % Agreem. Factor	Party Percentage Contribution						
	(a) **Highly** Effective Measure (HEM): 70%≤ PAR < 80%			Clients	Project Managers	Architects	Engineers	Quantity Surveyors	Financial Managers	Contractors
1	Complete Project Designs	77	77			√				
1	Timely issuing of architect's instructions	77				√				
	Responsible Party Percentage Contribution			0	0	100	0	0	0	0
	(c) Moderately Effective Measure (MEM): **60%≤ PAR < 70%**									
2	Timely resolving contractual claims	68						√		
3	Minimum specification changes	66				√				
4	Adequate monitoring of projects	64				√				
5	Effective communication channels	62	64.0		√					
5	Timely determination of Non-performing contractors	62			√					
5	Timely payments for completed work	62						√		
	Responsible Party Percentage Contribution			0	34	33	0	33	0	0
	d) Least Effective Measure (LEM): **0%≤ PAR < 60%**									
6	Timely resolving extension of time claims	58				√				
7	Consistent project cost reporting	52						√		
8	Comprehensive designs	50				√				
9	Appointment of experienced/competent Project Team Personnel	35			√					
9	Good workmanship	35								√
10	Reliable Project Cost Estimates	33						√		
11	Adequate performance monitoring of consultants & contractors	31			√					
12	Minimum Bills of Quantities errors	29						√		
13	Accurate re-measurement of provisional quantities	22						√		
14	Improved release of funds	10							√	
15	Comprehensive tendering procedures	8			√					
16	Collaboration of QS and Services Engineers for BoQ production	5	28.5					√		
17	Availability of specified building materials	3								√
18	Pre-Tender qualification bidding system	-5			√					
18	Adequate provision for PC and provisional sums	-5						√		
19	Providing sufficient site condition information	-7		√						
20	Provision for materials' price escalations	-11						√		
20	Controlled client's interference	-11		√						
20	Exhaustive tender adjudication	-11			√					
21	Minimum Pressure from third parties	-14		√						
22	Adequate provision for Statutory regulation cost escalations	-20						√		
22	Reducing personnel turnover	-20			√					
23	Adequate geotechnical reports	-30					√			
24	Adequate provision for force majeure (acts of God)	-60						√		
	Responsible Party Percentage Contribution			13	25	8	4	38	4	8
	Responsible Party Average Percentage Contribution			5	13	9.5	1.5	66	1.5	3.5

The table above shows that the Architects are exclusively accountable for implementation of the first two highly effective cost control measures that are rated at (70%≤ PAR < 80%).

4.8.4 Remedial Cost Control Measures: Parties' Percentage Contributions:

Implementation Phase

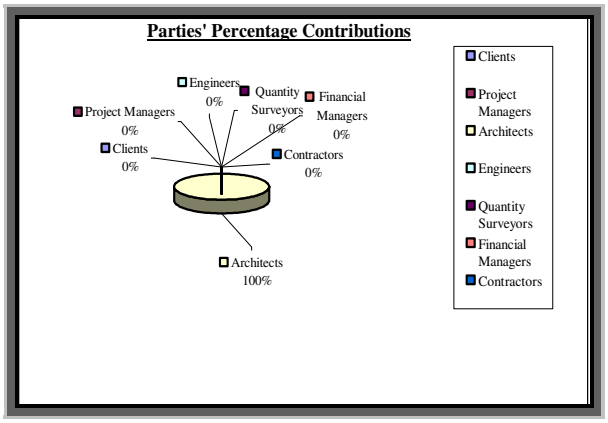


Figure C26: Highly Effective Measures **(HEM) 70% ≤ PAR < 80%**

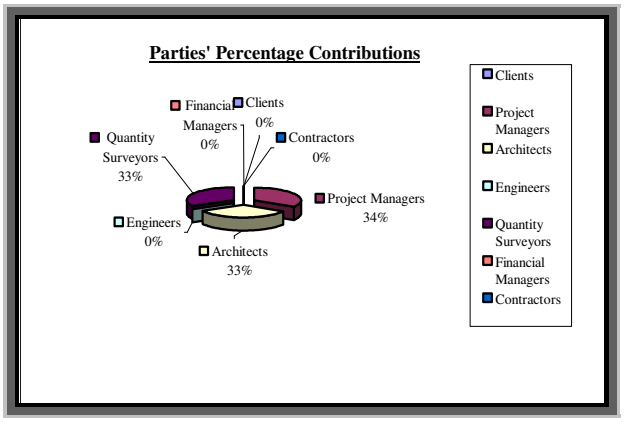


Figure C27: Moderately Effective Measures **(MEM) 60% ≤ PAR < 70%**

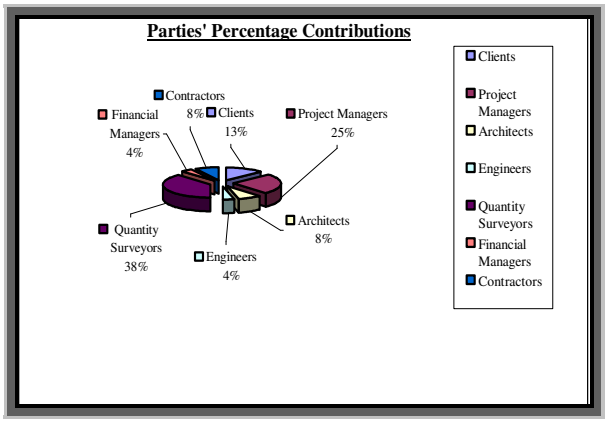


Figure C28: Least Effective Measures **(LEM) 0% ≤ PAR < 60%**

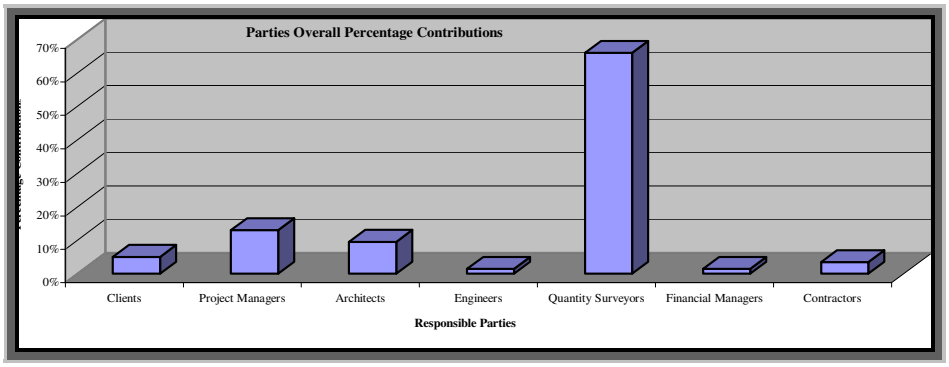


Figure C29: All Parties Overall Contributions

Figures C26 to **C29,** show that Quantity Surveyors, Project Mangers and Architects in that order, can play a major contributory roll in implementing effective remedial cost control measures; during the implementation phase of the projects development cycle.

Completion / Commissioning Phase

Table C62 Cost Control Measures Rank Agreement Factors

S/No {1}	Remedial Cost Control Measures {2}	Project Manag. Ranking (M) {3}	Architect Ranking (A) {4}	Enginers Ranking (E) {5}	Quantity Surveyors Ranking (Q) {6}	Financial Manag. Ranking (F) {7}	Contruct. Ranking (C) {8}	Sum of Rankings (RA= (Σ MA EQFC) {9}	Rank Agreem. Factor (RA= (Σ MA EQFC)/N {10}	Percent. Agreem. Factor (PAR= RAmax-RAi/RAmax (%) {11}	Standard Deviation (s) (Σ PA) {12}	Squares of Deviat" (s)" {13}	Ranking Order {14}
1	Timely issuing of architect's instructions	1	2	3	1	2	2	**11**	0.85	**82**	17	289	**1**
2	Good workmanship	4	2	1	4	1	2	**14**	1.08	**77**	14	196	**2**
3	Timely resolving payment desputes and contractual claims	2	3	2	2	1	5	**15**	1.15	**75**	13	169	**3**
4	Minimum specification changes	3	2	8	2	4	1	**20**	1.54	**67**	8	64	**4**
5	Minimum post contract variations	1	2	4	5	4	5	**21**	1.62	**65**	7	49	**5**
6	Timely resolving extension of time claims	4	3	6	3	1	4	**21**	1.62	**65**	7	49	**5**
7	Comprehensive designs	5	1	9	4	3	4	**26**	2.00	**57**	2	4	**6**
8	Monitoring of consultants for the production of final accounts	6	6	5	4	5	3	**29**	2.23	**52**	- 1	1	**7**
9	Minimum Bills of Quantities errors	7	2	7	7	7	3	**33**	2.54	**45**	- 5	25	**8**
10	Appointment of experienced/competent Project Team Personnel	6	2	10	6	6	6	**36**	2.77	**40**	- 8	64	**9**
11	Adequate consultation with service providers	5	4	7	8	6	6	**36**	2.77	**40**	- 8	64	**9**
12	Regular consultation with Procurement Board	8	5	10	9	6	8	**46**	3.54	**23**	- 18	324	**10**
13	Adequate provision for force majeure (acts of God)	9	5	11	10	8	7	**50**	3.85	**17**	- 22	484	**11**

Values of Kendell's Coefficient of Rank Correlation Analysis:

Kendell's coefficient of rank correlation (τ): $\boldsymbol{\tau} = (\mathbf{S})/\{\mathbf{K}^2\}(n^{-1})[n^3-n]$; **$\tau$ = 0.006** indicates perfect agreement between the professionals.

Chi-square (χ^2): $\boldsymbol{\chi^2} = \mathbf{K}\ (n-1)\ \tau$; **$\chi^2$ = 3.10 ;** is not significant when tested at both 0.05 and 0.01 levels of significance.

S = 1,782, **K** = 43, n = 13. (Good Agreement Values: $0 \leq \boldsymbol{\tau} \leq 1.0$ and Disagreement Values: $0 > \boldsymbol{\tau} \leq -1.0$).

Where; **S =** sum of squares of standard deviation; **K** = total number of professionals that ranked the variable factors; and n = number of listed variable factors.

Remedial Cost Control Measures have been Classified into **(a)** Extremely Highly Effective Measures **(EHEM); 80%≤ PAR ≥100%, (b)** Highly Effective Measures **(HEM) 70% ≤ PAR < 80%, (c)** Moderately Effective Measures **(MEF) 60% ≤ PAR < 70%** and **(d)** Least Effective Measures **(LEM); 0% ≤ PAR < 60%.** From these classifications, seven possible responsible parties; Clients, Project Mangers, Architects, Engineers, Quantity Surveyors, Financial Managers/Advisers (Planning Officials)) and Contractors, have been apportioned contribution percentages (JCT Contract by Ramus (1993)).

Table C63 Responsible Parties' Possible Percentage Contributions

Rank Order	Remedial Cost Control Measure Classification	% Agreem. Factor (PAR)	Aver. % Agreem. Factor	Party Percentage Contributions						
	(a) Extremely Highly Effective Measure (EHEM): **80%≤ PAR ≥100%**			**Clients**	**Project Managers**	**Architects**	**Engins.**	**Quantity Surveyors**	**Financial Manag.**	**Contractors**
1	Timely issuing of architect's instructions	82	82.0			√				
	Responsible Party Percentage Contribution			0	0	100	0	0	0	0
	(b) Highly Effective Measure (HEM): **70%≤ PAR < 80%**									
2	Good workmanship	77	76.0							√
3	Timely resolving payment disputes and contractual claims	75			√					
	Responsible Party Percentage Contribution			0	50	0	0	0	0	50
	(c) Moderately Effective Measure (MEM): **60%≤ PAR < 70%**									
4	Minimum specification changes	67	65.7			√				
5	Minimum post contract variations	65				√				
6	Timely resolving extension of time claims	65						√		
	Responsible Party Percentage Contribution			0	0	67	0	33	0	0
	d) Least Effecive Measure (LEM): **0%≤ PAR < 60%**									
7	Comprehensive designs	57	39.1				√			
8	Monitoring of consultants for the production of final accounts	52			√					
9	Minimum Bills of Quantities errors	45						√		
10	Appointment of experienced/competent Project Team Personnel	40			√					
11	Adequate consultation with service providers	40			√					
12	Regular consultation with Procurement Board	23			√					
13	Adequate provision for force majeure (acts of God)	17								
	Responsible Party Percentage Contribution			0	67	0	17	16	0	0
	Responsible Party Aver. Percentage Contribution			0	54	18	5	13	0	10

The table above shows that the architects are exclusively accountable for implementation of the only extremely highly effective cost control measures that are rated at (80%≤ PAR < 100%).

4.8.5 Remedial Cost Control Measures: Parties' Percentage Contributions:

Completion / Commissioning Phase

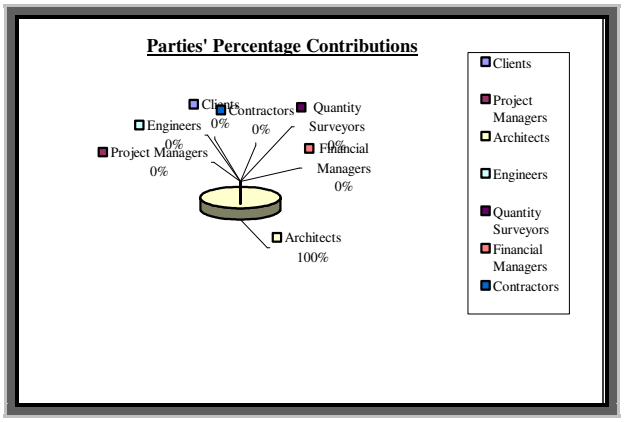


Figure C30: Extremely Highly Effective Measures **(EHEM); 80% ≤ PAR ≥100%**

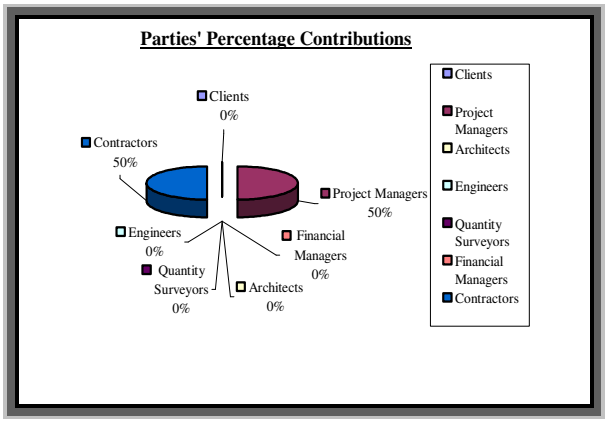


Figure C31: Highly Effective Measures **(HEM) 70% ≤ PAR < 80%**

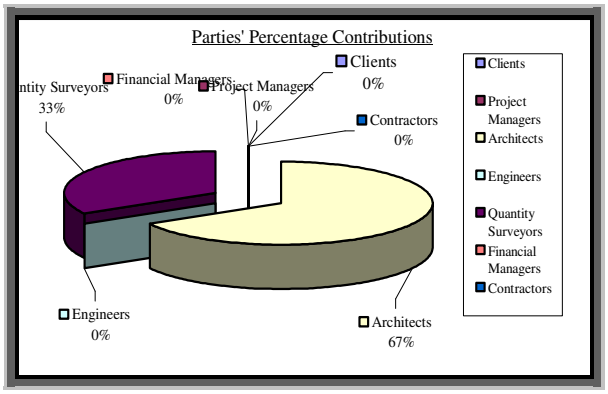


Figure C32: Moderately Effective Measures **(MEM) 60% ≤ PAR < 70%**

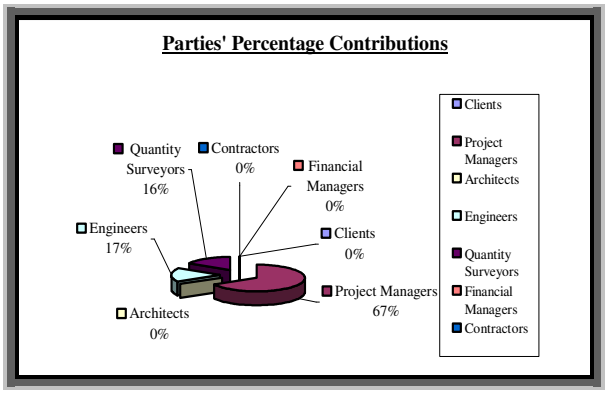


Figure C33: **Least** Effective Measures **(LEM); 0% ≤ PAR < 60%**

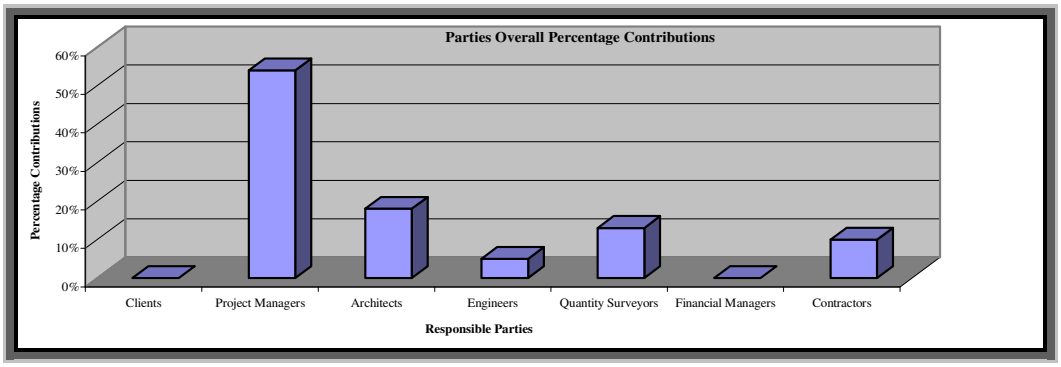


Figure C34: All Parties Overall Contributions

Figures C30 to **C34,** show that Project Mangers, Architects, Quantity Surveyors and Contractors in that order, can play a major contributory role in implementing effective remedial cost control measures;; during the completion / commissioning phase of the projects development cycle.

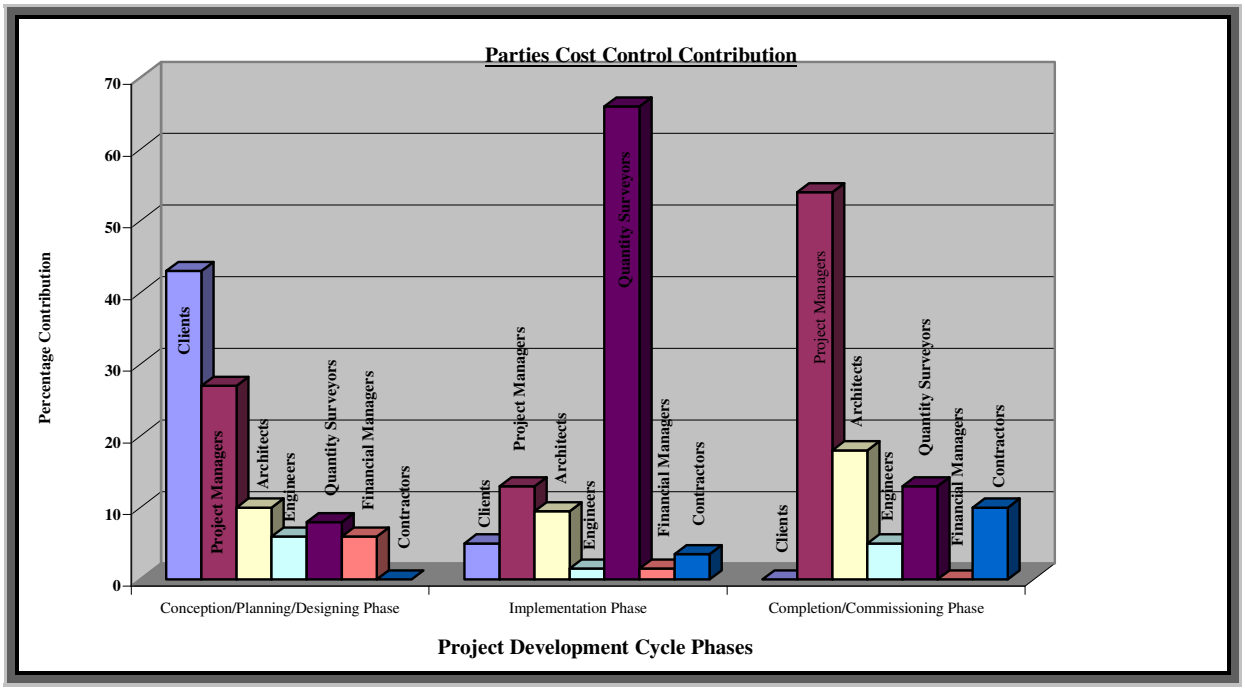


Figure C35: All Parties Overall Contributions During Project's Development Cycle

Figure C35; summarises the cost overrun remedial control measures' implementation responsibility trend as follows:

(i) Clients, Project Managers, Architects and Quantity Surveyors in that order, can play a major cost control remedial implementation role at conception / planning / designing phase.

(ii) Quantity Surveyors, Projects Mangers and Architects in that order, play a major role during implementation phase.

(iii) Project Managers, Architects, Quantity Surveyors and Contractors in that order; dominate the completion and commissioning phase.

CASE STUDY PROJECTS

Case Study No 1: The Executive House Project



Figure C36: The Executive House



Figure C37: The Executive House

Assessment findings:

The project was awarded for a contract sum of Three million Pula (P3.0 M) in 1999, and was anticipated for completion in June 2002. It was finally completed in June 2003 at a final account value of Five Million Five Hundred Pula (P5.5 M), which means a cost overrun of Two million five hundred Pula (P2.5 M); and time overrun of twelve months.

(a) Comments by Project team members:

(i) Principal Procurement Specialist with twelve (12) years work experience (Project management and quantity surveying field):

Major cost overrun causal factors:

- "Insufficient design".

Remedial Cost control measures adopted:

- "Issuing AIs"

Effectiveness of remedial cost control measures:

- "Unsuccessful measures".

(ii) Principal Architect with thirty-six (36) years works experience:

Major cost overrun causal factors:

- "Client required additional security base, a relatively small but expensive structure"
- "Inadequate site administration by contractor caused significant delay"

- "Poor finishes required work to be redone – leading to further delay"

Remedial Cost control measures adopted:

- "New site agent employed to complete the project"

Effectiveness of remedial cost control measures:

- "New site agent employed too late to affect programme, however, there was a significant improvement in quality, and co-ordination of the services installation"

Conclusion and lessons learnt on Case Study Project No. 1

The major causes of cost overruns in this project were: (i) Insufficient project design, (ii) poor contract administration by the contractor, (iii) use of unskilled/incompetent work personnel and
(iv) poor workmanship.

These problems all stem from the project design stage, which involved the client, the project managers, and project team. The lapses at that stage, coupled with the contractor's contract misadministration were fertile ground for generating excessive cost overrun and project completion delay.

Case Study No 2: The Botswana Radio and Television Project



Figure C38: The Botswana Radio and Television



Figure C39: The Botswana Radio and Television

Assessment findings:

The project was awarded for a contract sum of One Hundred and Fifty-Five Million Pula (P155.0 M) in 1999, and was anticipated for completion in February 2001. It was finally completed in March 2002 at a final account value of Two Hundred and Eighty-Nine Million Pula (P289.0 M), which means a cost overrun of One hundred and thirty-four million (P134.0 M); and time overrun of eleven months.

(a) Comments by Project team members:

(i) Chief Project Coordinator; eighteen (18) years work experience (Project Management and Engineering field):

Major cost overrun causal factors:

- "Inadequacy of design brief"
- "Lack of coordination of team members"

Remedial Cost control measures adopted:

- "Stop-Gap measures"
- "Daily monitoring"
- Adjustment instruction".

Effectiveness of remedial cost control measures:

- "Ineffective; project stated out badly".

(ii) Consultant Quantity Surveyor fifteen (15) years works experience:

Major cost overrun causal factors:

- "Incomplete design (maybe wrong procurement method)"
- "Originally fast-track project but later changed"
- "Client interference (omit buildings and later add them back)"
- "Loss and expense claims, mainly due to the above three reasons"
- "Claim conscious contractor"
- "Quotations for works since BoQ items were different from work done"

Remedial cost control measures adopted:

- "Complete re-measurement of project"
- "Agreement of time-related costs for loss and expense"

Effectiveness of remedial cost control measures:

- "No savings achieved as new contract amount was established"

Conclusion and lessons learnt on Case Study Project No. 2

The major causes of cost overruns in this project are: (i) inadequacy of project design brief,
(ii) Inappropriate project procurement method, (iii) incomplete project design, (iv) client's indecision, (v) necessary contractual claims by the contractor.

The problems started from the project conception/planning/design phase, which involved the client, the project managers, and project team. The professional lapses of the project personnel in question at the stage, resulted in the project starting on a wrong footing. The contractor was to a greater extent contractually entitled for compensation for extra works added to the project. Excessive cost overruns and project completion delays were not avoidable.

Case Study No 3: The Trophy Storage Facility Project



Figure C40: The Trophy Storage Facility



Figure C41: The Trophy Storage Facility

Assessment findings:

The project was awarded for a contract sum of Ten Million Five Hundred Thousand Pula (P10.5 M) in 2002, and was anticipated for completion in August 2003. It is now anticipated for completion in 2005, at a final cost of Twelve Million Pula (P12.0 M). That would mean a cost overrun of One Million Five Hundred Thousand Pula (P1.5 M); and time overrun of approximately nineteen months.

(a) Comments by Project team members:

(i) Quantity Surveyor; five (5) years work experience:

Major cost overrun causal factors:

- "Post contract variations"
- "Contractual claims"
- "Termination of electrical nominated sub-contractor"
- "Poor project coordination"

Remedial Cost control measures adopted:

- "Effective communication"
- "Solving contractual claims on time"

Effectiveness of remedial cost control measures:

- "The project went on by 15% more than the contract sum".

(ii) Consultant Mechanical Engineer Eight (8) years work experience:

Major cost overrun causal factors:

- "Extension of time claims as a result of delayed appointment of electrical sub-contractor"

Remedial Cost control measures adopted:

- "Documents issued on time when contractors are actually busy on site"

(iii) Project Architect; fourty-eight (48) years work experience:

Major cost overrun causal factors:

- "Additional work in foundations due to detection of collapsible soil necessitating re-design"
- "Errors in structural drawings/bending schedules"
- "Delays in providing information by consultant engineer"
- "Delays in appointing electrical sub-contractor to replace original one who left site"

Remedial Cost control measures adopted:

- "Items 1-3 could only have been avoided by appointing new consultant engineer"
- "To-date item 4 is still outstanding due to the long drawn-out process in government of determining the original sub-contractor"

Effectiveness of remedial cost control measures:

- "No remedial measure adopted. Would suggest more effective scrutinizing consultants past performance on projects, and strengthening of determination procedure".

(iv) Chief Project Coordinator; nineteen (19) years work experience:

Major cost overrun causal factors:

- "Subcontractor's default"
- "Insufficient/incomplete design"
- "Coordination inadequacy"
- "Management competency of main contractor"

Remedial Cost control measures adopted:

- "Legal determination of sub-contractor"
- "Issue variations"
- "More regular co-ordination meeting"
- "Direct advice/suggestions"

Effectiveness of remedial cost control measures:

- "5% savings anticipated"

Conclusion and lessons learnt on Case Study Project No. 3

The major causes of cost overruns in this project are: (i) incomplete project design (ii) tender document errors (iii) non-performance/default by electrical subcontractor (iv) project manager/coordinator's indecision to determinate the defaulting sub-contractor, (v) unnecessary delays, that led to contractual claims by the main contractor.

The problems in the project surfaced at implementation phase though they partly originate from design phase flaws. They revolve around the project team professional competence, the project managers/coordinator's decision-making capacity and partly the main/sub contractor's performance. The professional lapses of the project team and project managers/coordinators poor contractual problem handling capacity exacerbated potentially costly contractual problem that will lead to excessive cost overruns and the inevitable project completion delay.

Case Study No 4: The Makgadikgadi Game Proof Fence Project (Section 'B')



Figure C42:The Makgadikgadi Game Proof Fence



Figure C43: The Makgadikgadi Game Proof Fence

Assessment findings:

The project was awarded for a contract sum of Twelve Million Six Hundred Thousand Pula (P12.6 M) in 2003, and was anticipated for completion in January 2004. It is now anticipated for completion in January 2005, at a final cost of Thirteen Million Five Hundred Thousand Pula (P13.5 M). That would mean a cost overrun of Nine hundred thousand Pula (P0.9 M); and time overrun of approximately twelve months.

(a) Comments by Project team members:

(i) Project Quantity Surveyor; four (4) years work experience:

Major cost overrun causal factors:

- "Changing fence alignment after the contractor had done work"
- "Excessive number of trees to be cut down along the fence line"
- "Application of herbicide which was not originally in the contract"
- "Additional solar panels to improve electrical power supply"

Remedial Cost control measures adopted:

- "Variations were restricted only to the necessary items"
- "Timely assessment of variation quotations and the issuing of contract instructions"

Effectiveness of remedial cost control measures:

- "Prompt action on decision making improved to control further unnecessary cost"

(ii) Project Architect; fourteen (14) years work experience:

Major cost overrun causal factors:

- "Inadequate briefing from client"
- "Lack of familiarity with site conditions"
- "Fence erected across elephants' migration routes"

Remedial Cost control measures adopted:

- "Provision of adequate contingencies"

(iii) Chief Project Coordinator; nineteen (19) years work experience:

Major cost overrun causal factors:

- "Main contractor's poor contract management skills"
- "Poor site supervision by contractor's site agent"

Remedial Cost control measures adopted:

- "Deployment of site supervisors
- "Regular monitoring of progress"
- "Enforcement of contract clauses"

Effectiveness of remedial cost control measures:

- "Intervention was a bit too late, resulting in minimal cost savings"

Conclusion and lessons learnt on Case Study Project No. 4

The major causes of cost overruns in this project are: (i) inadequate project brief design (ii) incomplete tender documents (iii) main contractor's contract mismanagement (iv) necessary contract variations for additional works

The problems in the project originate from conception/planning/design phase flaws. They revolve around the client, project team professional knowledge, the main contractor's performance. The client's inadequate contribution on the project brief design led to professional lapses of the project team when preparing the tender documents. The tender document then carried insufficient information, resulting in issuing of post contract variation orders. There will be excessive cost overruns and project completion delays.

Case Study No 5: The Serowe Sports Facility Project



Figure C44: The Serowe Sports Facility



Figure C45: The Serowe Sports Facility

Assessment findings:

The project was awarded for a contract sum of Twenty-Seven Million Pula (P27.0 M) in 2000, and was anticipated for completion in 2002. It was finally completed in 2003, at a final cost of Fourty-two Million Pula (P42.0 M). That would mean a cost overrun of Fifteen Million Pula (P15.0 M); and time overrun of approximately twelve months.

(a) Comments by Project team members:

(i) Project Manager; fourty (40) years work experience:

Major cost overrun causal factors:

- "Black cotton soil problem encountered at construction stage"
- "Further design modification to address black cotton soil problem"
- "Ineffective engineering designs meant to remedy the black cotton soil problem"
- "Insufficient drawing details"

Remedial Cost control measures adopted:

- "Variations orders were issued and additional funding was obtained from the client to deal with extra costs"

Effectiveness of remedial cost control measures:

- "The cost saving methods were not effective and cost overruns unavoidable"

Conclusion and lessons learnt on Case Study Project No. 5

The major causes of cost overruns in this project are: (i) inadequate soil investigation project (ii) inadequate project design (iii) insufficient tender document details (iv) civil engineers professional incompetence.

The problems in the project originate from conception/planning/design phase flaws. They revolve around the project team professional competence. The civil engineers' insufficient professional competence at the design stage led to inadequate tender document production. The tender document then carried insufficient information, resulting in issuing of post contract variation orders. There were unavoidable cost overruns encountered during construction.

Case Study No 6: The Molepolole Sports Facility Project



Figure C46: The Molepolole Sports Facility



Figure C47: The Molepolole Sports Facility

Assessment findings:

The project was awarded for a contract sum of Twelve Million Pula (P12.0 M) in 2000, and was anticipated for completion in 2001. It was completed in 2002, at a final cost of Twelve Million Two Hundred Thousand Pula (P12.2 M). That would mean a cost overrun of Two hundred thousand Pula (P0.2 M); and with no time overrun.

(a) Comments by Project team members:

(i) Project Manager; fourty (40) years work experience:

Major cost overrun causal factors:

- "Insufficiently detailed tender documents resulting in issuing of contract variation orders at construction stage"

Remedial Cost control measures adopted:

- "Variations orders were issued and additional funding was obtained from the client to deal with extra costs"

Effectiveness of remedial cost control measures:

- "There cost saving methods were not effective and cost overruns unavoidable"

Conclusion and lessons learnt on Case Study Project No. 6

The major causes of cost overruns in this project are: (i) inadequate project design specification, (ii) Necessary contract variations for additional works.

The problems in the project originate from conception/planning/design phase flaws. They revolve around the project team professional competence, especially the civil engineers. The tender document carried insufficient information, resulting in issuing of post contract variation orders. There were unavoidable cost overruns.

Case Study No 7: The Botswana Police College Project



Figure C48: The Botswana Police College



Figure C49: The Botswana Police College

Assessment findings:

The project was awarded for a contract sum of One hundred and ninety-one Million Pula (P191.0 M) in 1999, and was anticipated for completion in September 2000. It was finally completed in February 2001, at a final cost of One Hundred and Eighty-Seven Million Pula (P187.0 M). That would mean a cost saving of four million Pula (P4.0 M); and time overrun of approximately three months.

(a) Comments by project team members:

(i) Project Quantity Surveyor; ten (10) years work experience:

Major cost overrun causal factors:

- "No cost overrun"

Remedial cost control measures adopted:

- "Competent contractor and efficient tender document"

Effectiveness of remedial cost control measures:

- "Successful: 4.0M savings"

(ii) Project Managers; thirty-five (35) years work experience:

Major cost overrun causal factors:

- "Additional facility buildings"
- "Additional minor works"
- "Delayed commencement date"
- "Delayed tender adjudication and award"

Remedial Cost control measures adopted:

- "Preliminary site servicing works permitted"
- "Advance civil works for site preparation"
- "Availability of site residence staff"
- "Claims control and high monthly progress monitoring"
- "Time management and financial monitoring scheme in place"

Effectiveness of remedial cost control measures:

- "Project was kept within performance requirements and financial budget despite spending on additional works"
- Successful cost savings: P 4.0M savings"

(iii) Chief Project Coordinator; sixteen (16) years work experience:

Major cost overrun causal factors:

- "Additional earthworks"
- "Additional mechanical and electrical works"

Remedial Cost control measures adopted:

- "Preliminary site servicing works permitted"
- "Advance civil works for site preparation"
- "Availability of site residence staff"
- "Claims control and high monthly progress monitoring"
- "Time management and financial monitoring scheme in place"

Effectiveness of remedial cost control measures:

- "Project was kept within performance requirements and financial budget despite spending on additional"
- Successful cost savings: P 4.0M savings"

Conclusion and lessons learnt on Case Study Project No. 7

There were no cost overruns in this project.

The cost control measures were highly achievable as a result of high competent project team and the appointment of a highly competent contractor. Though there was a time overrun of three months, there was still a 2% cost saving achieved on the project.

Summary on Case Study Projects Findings

Case Study Project	Original Contract Value (Million Pula)	Original Contract Completion Date	Final Contract value (Million Pula)	Percentage Cost Overrun	Duration Increase
(1) The Executive House	P 3.0 M (Year 1999)	2002	P 5.5 M (Year 2003)	73.3%	(1 year delay)
(2) The Botswana radio and TV Station	P 155.0 M (Year 1999)	2001	P 289.0 M (Year 2002)	86.5%	(1 year delay)
(3) The Trophy Storage Facility	P 10.5 M (Year 2002)	2003	P 12.0 M (Year 2005)	14.3%	(2 year delay)
(4) The Makgadikgadi Game Fence	P 12.6 M (Year 2003)	2004	P 13.5 M (Year 2005)	7.1%	(1 year delay)
(5) The Serowe Sports Facility	P 27.0 M (Year 2000)	2002	P 42.0 M (Year 2003)	55.6%	(1 year delay)
(6) The Molepolole Sports Facility	P 12.0 M (Year 2000)	2001	P 0.2 M (Year 2002)	1.7%	(1 year delay)
(7) The Botswana Police College	P 191.0 M (Year 1999)	2000	P 187.0 M (Year 2001)	-2.1%	(1 year delay)
AVERAGE % COST & DURATION OVERARUN				33.8%	1.1 year delay

The average percentage cost overrun for the case study projects is 33.8%, with a time delay of 1.1 year. The projects were started at the beginning of the five year development plan and only completed at the end of the year plan at an extra; resulting in budgetary constraints on the new projects.

Table C64: Major Cost Overrun Causal Factors

Case Study Project	Cost Overrun Causal Factor	Cost Overrun Causal Factor Classification									
		Case Study Analysis			Respondents' Ranking			Kendell's Correlation Coefficient			Triangulation Agreement Percentage (%)
		HF	MF	LF	HF	MF	LF	HF	MF	LF	
1	➢ Insufficient design	✓			✓			✓			100%
	➢ Additional work	✓				✓		✓			67%
	➢ Poor workmanship			✓			✓		✓		67%
	➢ Poor site management			✓			✓		✓		67%
2	➢ Inadequate design	✓			✓			✓			100%
	➢ Lack of project coordination		✓			✓			✓		100%
	➢ Client interference			✓		✓				✓	67%
	➢ Contractual claims		✓			✓			✓		100%
3	➢ Post contract variations		✓			✓		✓			67%
	➢ Lack of project coordination		✓			✓			✓		100%
	➢ Contractual claims		✓			✓			✓		100%
	➢ Subcontractor's non-performance			✓		✓			✓		0%
	➢ Additional work			✓		✓		✓			0%
	➢ Design errors		✓			✓		✓			67%
	➢ Failure to terminate non-performing subcontractor			✓	✓			✓			67%
	➢ Poor site management			✓	✓				✓		0%
4	➢ Project redesign	✓				✓		✓			67%
	➢ Contract variations		✓			✓		✓			67%
	➢ Inadequate project brief	✓			✓			✓			100%
	➢ Poor site management			✓	✓				✓		0%
5	➢ Project design modifications	✓				✓		✓			67%
	➢ Inadequate design	✓				✓		✓			67%
6	➢ Inadequate design	✓				✓		✓			67%
7	➢ Additional work		✓			✓		✓			67%
	➢ Delayed tender adjudication and award			✓		✓				✓	67%

Where: HF – Highly Frequent, MF – Moderately Frequent and LF – Least Frequent

Table C65: The Most Effective Cost Control Measures

Case Study Project	Effective Cost Control Measures	Effective Cost Control Measure Classification									
		Case Study Analysis			Respondents' Ranking			Kendell's Correlation Coefficient			Triangulation Agreement Percentage (%)
		HE	ME	LE	HE	ME	LE	HE	ME	LE	
1	➢ Competent project personnel	✓			✓			✓			100%
2	➢ Improved project monitoring	✓			✓				✓		100%
3	➢ Effective communication	✓				✓		✓			67%
	➢ Resolving contractual claims	✓			✓					✓	67%
	➢ Determination of non-performing subcontractor		✓		✓				✓		67%
	➢ Improved project coordination		✓		✓			✓			67%
	➢ Issuing contract variations			✓	✓			✓			67%
4	➢ Timely issuing contract variations		✓		✓			✓			67%
	➢ Provision of sufficient Contingencies		✓		✓					✓	0%
	➢ Improved project monitoring		✓		✓				✓		67%
5	➢ Issuing contract variations			✓	✓				✓		67%
6	➢ Issuing contract variations			✓	✓				✓		67%
7	➢ Competent contractor and monitoring team	✓			✓			✓			100%
	➢ Time and financial management facilities in place	✓			✓			✓			100%

Where: HF – Highly Effective, MF – Moderately Effective and LF – Least Effective

A P P E N D I X ‘D’

EXPERT GROUP SURVEY QUESTIONNAIRE SYNOPSIS:

SUBJECT: CONSTRUCTION PROJECT'S COST OVERRUNS IN BOTSWANA (A FIVE YEAR REVIEW) (YEAR 1999 – 2004)

~IDENTIFYING MAJOR CAUSAL FACTORS AND EFFECTIVE REMEDIAL CONTROL MEASURES FOR PROJECT'S COST OVERRUNS~.

I, Mr. Pelontle Dibonwa would like to solicit your professional opinion and comments on this pilot survey; with respect to the above-mentioned subject. You are requested to list down additional causal factors and remedial control measures for cost overruns which you deem vital, in the subsequent tables. In addition, please provide professional advice and comments on the validity of the survey.

Please note that the pilot survey information will be used to formulate a wider scope survey on this subject, which will be addressed to a larger group of several stakeholders including Project Managers, Architects, Engineers, Quantity Surveyors, Project Financial Planning Officers and Construction Managers. They will be requested to tick the appropriate box, in order to reflect their professional opinion with regard to the degree to which they would apportion the effects of the respective causal factors and or remedial control measures, and also rank them on a ten (10) point basis (e.g. over for Highly Frequent causes: [Seven to Ten Points], Moderately Frequent causes: [Five to Six Points], and Least Frequent Causes: [Zero to Four points]).

Optimum confidentiality will be exercised on the information provided and it will be exclusively used only for an academic thesis report conferred with the University of the Witwatersrand, in South Africa. It will also be vital for the purpose of effective project planning and implementation procedures, by professionals involved with construction projects. You are therefore requested to indicate your field of expertise/practice (i.e. Project Management, Architecture, Engineering, Quantity Surveying, Project Financial Planning or Construction Management), as well as your work experience (practice) duration. The other personal particulars may be provided optionally.

Field of Expertise/Practice (please tick box): Project Management : †

Architecture: †

Engineering: †

Quantity Surveying: †

Project Financial Planning: †

Construction Manager †

Other (please specify) _____

Work Experience Duration (Practice) : _____

Name of Company (optional) : _____

Name of Professional (optional) : _____

Title Held (Post in Practice) : _____

Date : _____

The following causal factors have been identified as some of the contributory causal factors which lead to project cost overruns, during the three major phases of the Project's Life Cycle i.e. Conception/Planning/Designing Phase, Implementation Phase and Completion and Commissioning Phase; all to a different degree. You are therefore, requested to list down additional causal factors for cost overruns which you deem vital in the tables below. In addition, please provide professional advice and comments on the validity of the survey.

1.0 Conception / Planning / Designing Phase

Causes of Cost Overrun	Highly Frequent Cause	Moderately Frequent Cause	Least Frequent Cause	Ten (10) Point Ranking
1.0 Ambiguous/Inadequate Client's Project Brief.	†	†	†	
2.0 Inadequate Project Planning	†	†	†	
3.0 Lack of Pre-contract Project Coordination	†	†	†	
4.0 Ineffective Communication Channels	†	†	†	
5.0 Inexperience/Incompetent Project Team Personnel	†	†	†	
6.0 In-exhaustive tender adjudication	†	†	†	
7.0 Incomplete Designs	†	†	†	
8.0 Unreliable Project Cost Estimates	†	†	†	
9.0 Prolonged tendering procedures	†	†	†	
10.0 Inadequate Geotechnical Reports.	†	†	†	
11.0 Site location and conditions	†	†	†	
12.0 Pre-Contract Budget Constraints	†	†	†	
13.0 Pressure from third Parties (e.g. Incompetent & Forceful Client, Political Agents)	†	†	†	
14.0 Lack of Consistent Project Cost Reporting	†	†	†	

Conception / Planning / Designing Phase

Additional Causes of Cost Overrun	Highly Frequent Cause	Moderately Frequent Cause	Least Frequent Cause	Ten (10) Point Ranking
15.0	┼	┼	┼	
16.0	┼	┼	┼	
17.0	┼	┼	┼	
18.0	┼	┼	┼	
19.0	┼	┼	┼	
20.0	┼	┼	┼	
21.0	┼	┼	┼	
22.0.	┼	┼	┼	
23.0	┼	┼	┼	
24.0	┼	┼	┼	
25.0	┼	┼	┼	
26.0	┼	┼	┼	

Professional advice and comments on survey:

2.0 Implementation Phase

Causes of Cost Overrun	Highly Frequent Cause	Moderately Frequent Cause	Least Frequent Cause	Ten (10) Point Ranking
1.0 Ineffective Communication Channels	┼	┼	┼	
2.0 Inexperience/Incompetent Project Team Personnel	┼	┼	┼	
3.0 Incomplete Designs	┼	┼	┼	
4.0 Unreliable Project Cost Estimates	┼	┼	┼	
5.0 Prolonged tendering procedures	┼	┼	┼	
6.0 Post Contract Variations	┼	┼	┼	
7.0 Late Architect's Instructions	┼	┼	┼	
8.0 Bills of Quantities Errors	┼	┼	┼	
9.0 Design Failures	┼	┼	┼	
10.0 Clients requests for specification changes	┼	┼	┼	
11.0 Extension of time claims	┼	┼	┼	
12.0 Re-measurement of provisional quantities	┼	┼	┼	
13.0 Poor workmanship	┼	┼	┼	
14.0 Inadequate Geotechnical Reports.	┼	┼	┼	
15.0 Site location and conditions	┼	┼	┼	
16.0 Continuous Client's interference	┼	┼	┼	
17.0 Scarcity of Specified Building Materials	┼	┼	┼	
18.0 Materials price escalations	┼	┼	┼	
19.0 Pressure from third Parties (e.g. Incompetent & Forceful Client, Political Agents)	┼	┼	┼	
20.0 Statutory Regulations & Government Policies (e.g. VAT, Labour costs, inflation)	┼	┼	┼	
21.0 Failure to Determinate No-Performing Contractors	┼	┼	┼	
22.0 Delay in Resolving Contractual Claims	┼	┼	┼	
23.0 Delayed Payments for completed Work	┼	┼	┼	
24.0 Lack of consistent Project Cost Reporting	┼	┼	┼	
25.0 Inadequate Project Monitoring	┼	┼	┼	
26.0 Adjustment to Provisional & PC Sums	┼	┼	┼	
27.0 *Force majeure* (acts of God)	┼	┼	┼	
Additional Causes of Cost Overrun	Highly Frequent Cause	Moderately Frequent Cause	Least Frequent Cause	Ten (10) Point Ranking
28.0	┼	┼	┼	
29.0	┼	┼	┼	
30.0	┼	┼	┼	

31.0	†	†	†	
32.0	†	†	†	
33.0	†	†	†	

Professional advice and comments on survey:

Completion and Commissioning Phase

Causes of Cost Overrun	Highly Frequent Cause	Moderately Frequent Cause	Least Frequent Cause	Ten (10) Point Ranking
1.0 Inexperience/Incompetent Project Team Personnel	□	□	□	
2.0 Post Contract Variations	□	□	□	
3.0 Late Architect's Instructions	□	□	□	
4.0 Bills of Quantities Errors	□	□	□	
5.0 Design Failures	□	□	□	
6.0 Clients requests for specification changes	□	□	□	
7.0 Extension of time claims	□	□	□	
8.0 Poor workmanship	□	□	□	
9.0 Delay in Resolving Contractual Claims	□	□	□	
10.0 *Force majeure* (acts of God)	□	□	□	
Additional Causes of Cost Overrun	Highly Frequent Cause	Moderately Frequent Cause	Least Frequent Cause	Ten (10) Point Ranking
11.0	□	□	□	
12.0	□	□	□	
13.0	□	□	□	
14.0	□	□	□	
15.0	□	□	□	
16.0	□	□	□	

Professional advice and comments on survey:

Cost Overrun Remedial Control Measures

The following are some of the remedial control measures that could be employed to counteract unreasonable cost overruns, during the three major phases of Project's Life Cycle i.e. Conception / Planning / Designing Phase, Implementation Phase and Completion and Commissioning Phase; all to a different degree. You are therefore, requested to list down additional causal factors for cost overruns which you deem vital in the tables below. In addition, please provide professional advice and comments on the validity of the survey.

1.0 Conception / Planning / Designing Phase

Remedial Control Measures	Highly Effective	Moderately Effective	Least Effective	Ten (10) Point Ranking
Comprehensive Client's Project Brief Development.	†	†	†	
2.0 Comprehensive Project Planning	†	†	†	
3.0 Adequate Pre-Contract Project Coordination	†	†	†	
4.0 Setting up reliable communication channels	†	†	†	
5.0 Appointment of reputable and experienced Project Team Managers	†	†	†	
6.0 Adequate Project Design Specification	†	†	†	
7.0 Reliable Pre-Contract Cost Estimates	†	†	†	
8.0 Comprehensive tendering procedures	†	†	†	
9.0 Effective Geotechnical Site Investigation process	†	†	†	
10.0 Timely providing site information	†	†	†	
11.0 Adequate Pre-Tender Budget Provisions	†	†	†	
12.0 Limited interference by ill-informed Clients	†	†	†	

Conception / Planning / Designing Phase

Additional Remedial Control Measures	Highly Effective	Moderately Effective	Least Effective	Ten (10) Point Ranking
13.0	†	†	†	
14.0	†	†	†	
15.0	†	†	†	
16.0	†	†	†	
17.0	†	†	†	
18.0	†	†	†	

Professional advice and comments on survey:

2.0 Implementation Phase

Remedial Control Measures	Highly Effective	Moderately Effective	Least Effective	Ten (10) Point Ranking
1.0 Effective communication channels	†	†	†	
2.0 Appointment of reputable and experienced Project Team Managers	†	†	†	
3.0 Complete Project Designs	†	†	†	
4.0 Reliable Cost Estimates	†	†	†	
5.0 Comprehensive tendering procedures	†	†	†	
6.0 Exhaustive tender adjudication	†	†	†	
7.0 Timely Issuing Architectural Instructions Timely execution of the determination Clause on non-performing contractors	†	†	†	
8.0 Minimum Bills of Quantity Errors	†	†	†	
9.0 Comprehensive designs	†	†	†	
10.0 Minimum specification changes	†	†	†	
11.0 Timely resolving extension of time claims	†	†	†	
12.0 Accurate remeasurement of provisional quantities	†	†	†	
13.0 Good workmanship	†	†	†	
14.0 Adequate Geotechnical Reports	†	†	†	
15.0 Providing sufficient site condition information	†	†	†	
16.0 Controlled Client's interference	†	†	†	
17.0 Availability of specified building materials	†	†	†	
18.0 Provision for materials price escalation	†	†	†	
19.0 Minimum pressure from third parties	†	†	†	
20.0 Adequate provision for statutory regulation and government policy costs (e.g. VAT, Labour, inflation)	†	†	†	
21.0 Timely determination of non-performing contractors	†	†	†	
22.0 Timely resolving contractual claims	†	†	†	
23.0 Timely payments for completed works	†	†	†	
24.0 Consistent project reporting	†	†	†	
25.0 Adequate project monitoring	†	†	†	
26.0 Provision for PC and provisional sums adjustments	†	†	†	
27.0 Adequate provision for *force majeure* (acts of God)	†	†	†	
Additional Remedial Control Measures	Highly Effective	Moderately Effective	Least Effective	Ten (10) Point Ranking
28.0	†	†	†	

29.0	┼	┼	┼	
30.0	┼	┼	┼	
31.0	┼	┼	┼	
32.0	┼	┼	┼	
33.0	┼	┼	┼	

Professional advice and comments on survey:

Completion and Commissioning Phase

Remedial Control Measures	Highly Effective	Moderately Effective	Least Effective	Ten (10) Point Ranking
Appointment of Reputable and Experienced Project Team Managers	†	†	†	
2.0 Minimum post contract variations	†	†	†	
3.0 Timely Issued Architectural Instructions Variation Cost Assessment before issuing Architectural Instructions	†	†	†	
4.0 Minimum BoQ Errors	†	†	†	
5.0 Adequate design	†	†	†	
6.0 Minimum Specification changes	†	†	†	
7.0 Timely resolving extension of time claims	†	†	†	
8.0 Good workmanship	†	†	†	
9.0 Timely resolving payment disputes and Contractual claims	†	†	†	
10.0 Adequate provision for *force majeure* (acts of God)	†	†	†	
Additional Remedial Control Measures	Highly Effective	Moderately Effective	Least Effective	Ten (10) Point Ranking
11.0	†	†	†	
12.0	†	†	†	
13.0	†	†	†	
14.0	†	†	†	
15.0	†	†	†	
16.0	†	†	†	

Professional advice and comments on survey:

A P P E N D I X ‘E’

QUESTIONNAIRE SYNOPSIS:

SUBJECT: CONSTRUCTION PROJECT'S COST OVERRUNS IN BOTSWANA
(A FIVE YEAR REVIEW) (YEAR 1999 – 2004)

~IDENTIFYING MAJOR CAUSAL FACTORS AND EFFECTIVE REMEDIAL COST CONTROL MEASURES FOR GOVERNMENT BUILDING CONSTRUCTION PROJECT'S COST OVERRUNS~.

I Mr. Pelontle Dibonwa would like to solicit your professional opinion on the above-mentioned subject. The information provided will be treated with optimum confidentiality and used specifically for an academic thesis report conferred with the University of the Witwatersrand, in South Africa. It would also be vital for the purpose of effective project planning and implementation procedures, by professionals involved with construction projects. You are therefore, requested to indicate your field of expertise/practice (i.e. Project Management, Architecture, Engineering, Quantity Surveying, Project Financial Planning or Construction Management), as well as your work experience (practice) duration. The other personal particulars can be provided optionally.

Field of Expertise/Practice (please tick [√] box):

Project Management: †
Architecture: †
Engineering: †
Quantity Surveying: †
Project Financial Planning: †
Construction Manager †
Other (please specify) _____

Work Experience Duration (Practice): _____
Name of Company (optional): _____
Name of Professional (optional): _____
Title Held (Post in Practice): _____
Date: _____

The following causal factors have been identified as some of the contributory factors which lead to project cost overruns, during the three major phases of Construction Project's Life Cycle i.e. Conception / Planning / Designing Phase *(ending with signing of Certificate for Readiness to Tender)*, Implementation Phase *(ending with issuing of Certificate for Practical Completion)*, and Completion and Commissioning Phase *(ending with issuing of Certificate of Making Good Defects), (refer Figure 1 on Page 13)*; all to a different degree. Please tick [√] the appropriate box, in order to reflect your professional opinion with regard to the degree to which you would apportion the effects of the respective causal factor, and also rank it on a ten (10) point basis (i.e. for Highly Frequent Causes: [Seven to Ten Points], Moderately Frequent Causes: [Five to Six Points], and Least Frequent Causes: [Zero to Four points]).

1.0 Conception / Planning / Designing Phase

Causes of Cost Overrun	Highly Frequent Cause [7-10 points ranking]	Moderately Frequent Cause [5-6 points ranking]	Least Frequent Cause [0-4] points ranking]	Ten (10) Point Ranking
1.0 Ambiguous/Inadequate Client's Project Brief.	†	†	†	
2.0 Inadequate Project Planning	†	†	†	
3.0 Lack of Pre-contract Project Coordination	†	†	†	
4.0 Ineffective Communication Channels	†	†	†	
5.0 Inexperienced/Incompetent Project Team Personnel	†	†	†	
6.0 Incomplete Designs	†	†	†	
7.0 Unreliable Project Cost Estimates	†	†	†	
8.0 Inadequate Geotechnical Reports.	†	†	†	
9.0 Limited information on Site location and conditions	†	†	†	
10.0 Pre-Contract Budget Constraints	†	†	†	
11.0 Pressure from third Parties (e.g. Incompetent & Forceful Client, Political Agents)	†	†	†	
12.0 Lack of Consistent Project Cost Reporting	†	†	†	
13.0 Delayed planning permission by Local Authorities/Land Boards	†	†	†	
14.0 Unavailability of reliable cost database/sources/bulletins for cost estimates	†	†	†	
15.0 Extensions to tender validity period	†	†	†	
16.0 Incompetent client representatives	†	†	†	
17.0 Government bureaucracy	†	†	†	
18.0 Un-coordinated legislation (e.g. Advance Payment to citizen contractors)	†	†	†	
19.0 Late release of project funds	†	†	†	
20.0 Lack of Serviced Land	†	†	†	
21.0 Additional work requests from client at the end of the design period	†	†	†	
22.0 Poor project management skills by Client Representatives	†	†	†	
23.0 Lack of prompt decision making by Project Mangers	†	†	†	

2.0 Implementation Phase

Causes of Cost Overrun	Highly Frequent Cause [7-10 points ranking]	Moderately Frequent Cause [5-6 points ranking]	Least Frequent Cause [0-4] points ranking]	Ten (10) Point Ranking
1.0 Ineffective Communication Channels	┼	┼	┼	
2.0 Inexperienced/Incompetent Project Team Personnel	┼	┼	┼	
3.0 Incomplete Designs	┼	┼	┼	
4.0 Unreliable Project Cost Estimates	┼	┼	┼	
5.0 Prolonged tendering procedures	┼	┼	┼	
6.0 In-exhaustive tender adjudication	┼	┼	┼	
7.0 Post Contract Variations	┼	┼	┼	
8.0 Late Architect's Instructions	┼	┼	┼	
9.0 Contract Document (drawings/BoQs) Errors	┼	┼	┼	
10.0 Design Failures	┼	┼	┼	
11.0 Clients requests for specification changes	┼	┼	┼	
12.0 Extension of time claims	┼	┼	┼	
13.0 Re-measurement of provisional quantities	┼	┼	┼	
14.0 Poor workmanship	┼	┼	┼	
15.0 Inadequate Geotechnical Reports.	┼	┼	┼	
16.0 Adverse Site Conditions	┼	┼	┼	
17.0 Continuous Client's interference	┼	┼	┼	
18.0 Scarcity of Specified Building Materials	┼	┼	┼	
19.0 Statutory labour escalations	┼	┼	┼	
20.0 Materials price escalations	┼	┼	┼	
21.0 Pressure from third Parties (e.g. Incompetent & Forceful Client, Political Agents)	┼	┼	┼	
22.0 Statutory Regulations & Government Policies (e.g. VAT, Labour costs, inflation)	┼	┼	┼	
23.0 Failure to Determinate No-Performing Contractors	┼	┼	┼	
24.0 Delay in Resolving Contractual Claims	┼	┼	┼	
25.0 Delayed Payments for completed Work	┼	┼	┼	
26.0 Lack of consistent Project Cost Reporting	┼	┼	┼	
27.0 Inadequate Project Monitoring	┼	┼	┼	
28.0 Adjustment to Provisional & PC Sums (Mechanical/Electrical/Specialist Services)	┼	┼	┼	
29.0 *Force majeure* (acts of God)	┼	┼	┼	

30.0 Pressure from international market conditions (eg fuel price fluctuations)	┼	┼	┼	
31.0 Lack of control of mechanical & electrical contract by architect & team	┼	┼	┼	
32.0 Numerous provisional items in BoQ	┼	┼	┼	
33.0 Non performance by main contractor or nominated sub-contractors	┼	┼	┼	
34.0 Late extension of time claims	┼	┼	┼	
35.0 Late payments leading to increased claims	┼	┼	┼	
36.0 Lack of Pre-Qualification bidding system	┼	┼	┼	
37.0 Late provision of services (power, water, telephone etc)	┼	┼	┼	
38.0 Poor financial management by contractors	┼	┼	┼	
39.0 Poor performance of consultants	┼	┼	┼	
40.0 Insufficient project funds	┼	┼	┼	
41.0 Cumbersome payment procedures leading to contractual claims	┼	┼	┼	
42.0 Drastic change of scope of work during construction stage	┼	┼	┼	
43.0 Personnel turnover (skilled/competent)	┼	┼	┼	
44.0 Lack of adequate funds due to budget restrictions	┼	┼	┼	

Completion and Commissioning Phase

Causes of Cost Overrun	Highly Frequent Cause [7-10 points ranking]	Moderately Frequent Cause [5-6 points ranking]	Least Frequent Cause [0-4] points ranking]	Ten (10) Point Ranking
1.0 Inexperience/Incompetent Project Team Personnel	†	†	†	
2.0 Post Contract Variations	†	†	†	
3.0 Late Architect's Instructions	†	†	†	
4.0 Bills of Quantities Errors	†	†	†	
5.0 Design Failures	†	†	†	
6.0 Clients requests for specification changes	†	†	†	
7.0 Extension of time claims	†	†	†	
8.0 Poor workmanship	†	†	†	
9.0 Delay in Resolving Contractual Claims	†	†	†	
10.0 *Force majeure* (acts of God)	†	†	†	
11.0 Slow process for appointing new contractors to rectify abortive works after contract determinations	†	†	†	
12.0 Late provision of services (power/water/ telephone etc)	†	†	†	
13.0 Late appointment of specialist sub-contractors	†	†	†	
14.0 Cumbersome payment procedures leading to contractual claims	†	†	†	

Cost Overrun Remedial Control Measures

The following are some of the remedial cost control measures that could be employed to counteract unreasonable cost overruns, during the three major phases of Construction Project's Life Cycle i.e. Conception / Planning / Designing Phase *(ending with signing of Certificate for Readiness to Tender)*, Implementation Phase *(ending with issuing of Certificate for Practical Completion)*, and Completion and Commissioning Phase *(ending with issuing of Certificate of Making Good Defects),*
(Refer Figure 1 on Page 13); all to a different degree of effectiveness. Please tick [√] the appropriate box, in order to reflect your professional opinion with regard to the degree of effectiveness which you would apportion the respective remedial process, and also rank it on a ten (10) point basis (i.e. for Highly Frequent Causes: [Seven to Ten Points], Moderately Frequent Causes: [Five to Six Points], and Least Frequent Causes: [Zero to Four points]).

1.0 Conception / Planning / Designing Phase

Remedial Control Measures	Highly Effective [7-10 points ranking]	Moderately Effective [5-6 points ranking]	Least Effective [0-4 points ranking]	Ten (10) Point Ranking
Comprehensive Client's Project Brief Development.	†	†	†	
2.0 Comprehensive Project Planning	†	†	†	
3.0 Adequate Pre-Contract Project Coordination	†	†	†	
4.0 Setting up reliable communication channels	†	†	†	
5.0 Appointment of reputable and experienced Project Team Managers	†	†	†	
6.0 Adequate Project Design Specification	†	†	†	
7.0 Reliable Pre-Contract Cost Estimates	†	†	†	
8.0 Comprehensive tendering procedures	†	†	†	
9.0 Effective Geotechnical Site Investigation process	†	†	†	
10.0 Timely providing site information	†	†	†	
11.0 Adequate Pre-Tender Budget Provisions	†	†	†	
12.0 Limited interference by ill-informed Clients	†	†	†	
13.0 Architect to submit plans for approval in advance	†	†	†	
14.0 Improved cost data collection and storage in useable form	†	†	†	
15.0 Reducing time lapse between pre and post contract periods	†	†	†	

2.0 Implementation Phase

Remedial Control Measures	Highly Effective [7-10 points ranking]	Moderately Effective [5-6 points ranking]	Least Effective [0-4 points ranking]	Ten (10) Point Ranking
1.0 Effective communication channels	†	†	†	
2.0 Appointment of reputable and experienced Project Team Managers	†	†	†	
3.0 Complete Project Designs	†	†	†	
4.0 Reliable Cost Estimates	†	†	†	
5.0 Comprehensive tendering procedures	†	†	†	
6.0 Exhaustive tender adjudication	†	†	†	
7.0 Timely Issuing Architectural Instructions Timely execution of the determination Clause on non-performing contractors	†	†	†	
8.0 Minimum Bills of Quantity Errors	†	†	†	
9.0 Comprehensive designs	†	†	†	
10.0 Minimum specification changes	†	†	†	
11.0 Timely resolving extension of time claims	†	†	†	
12.0 Accurate remeasurement of provisional quantities	†	†	†	
13.0 Good workmanship	†	†	†	
14.0 Adequate Geotechnical Reports	†	†	†	
15.0 Providing sufficient site condition information	†	†	†	
16.0 Controlled Client's interference	†	†	†	
17.0 Availability of specified building materials	†	†	†	
18.0 Provision for materials price escalation	†	†	†	
19.0 Minimum pressure from third parties	†	†	†	
20.0 Adequate provision for statutory regulation and government policy costs (e.g. VAT, Labour, inflation)	†	†	†	
21.0 Timely determination of non-performing contractors	†	†	†	
22.0 Timely resolving of contractual claims	†	†	†	
23.0 Timely payments for completed works	†	†	†	
24.0 Consistent project reporting	†	†	†	
25.0 Adequate project monitoring	†	†	†	
26.0 Provision for PC and provisional sums adjustments	†	†	†	
27.0 Adequate provision for *force majeure* (acts of God)	†	†	†	
28.0 QS & Mechanical and Electrical Engineers to collaborate in drafting nominated sub-contracts documents	†	†	†	

29.0 Pre-tender qualification system	†	†	†	
30.0 Adequate performance monitoring of consultants & contractors	†	†	†	
31.0 Improved release of project funds	†	†	†	
32.0 Reducing personnel turnover	†	†	†	

Completion and Commissioning Phase

Remedial Control Measures	Highly Effective [7-10 points ranking]	Moderately Effective [5-6 points ranking]	Least Effective [0-4 points ranking]	Ten (10) Point Ranking
Appointment of Reputable and Experienced Project Team Managers	†	†	†	
2.0 Minimum post contract variations	†	†	†	
3.0 Timely Issued Architectural Instructions Variation Cost Assessment before issuing Architectural Instructions	†	†	†	
4.0 Minimum BoQ Errors	†	†	†	
5.0 Adequate design	†	†	†	
6.0 Minimum Specification changes	†	†	†	
7.0 Timely resolving extension of time claims	†	†	†	
8.0 Good workmanship	†	†	†	
9.0 Timely resolving payment disputes and Contractual claims	†	†	†	
10.0 Adequate provision for *force majeure* (acts of God)	†	†	†	
11.0 Regular consultation with Public Procure & Assets Disposal Board	†	†	†	
12.0 Adequate consultation with service providers (BPC, BTC, WUC)	†	†	†	
13.0 Monitoring of consultants for the production of final accounts	†	†	†	

A P P E N D I X ‘F’

CASE STUDY QUESTIONNAIRE SYNOPSIS:

SUBJECT: CONSTRUCTION PROJECT'S COST OVERRUNS IN BOTSWANA
(A FIVE YEAR REVIEW) (YEAR 1999 – 2004)

~IDENTIFYING MAJOR CAUSAL FACTORS AND EFFECTIVE REMEDIAL CONTROL MEASURES FOR BUILDING CONSTRUCTION PROJECT'S COST OVERRUNS~.

I, Mr. Pelontle Dibonwa would like to solicit your professional opinion and comments on the special case study project referred to on page 3; with respect to the above-mentioned subject. You are requested to comment on causal factors and remedial cost control measures for cost overruns/or cost savings which have been associated with the project.

Please note that this questionnaire survey information will be exclusively used only for academic purpose; in the production of a thesis report conferred with the University of the Witwatersrand, in South Africa. Optimum confidentiality will be exercised on its use. It will also be vital for the purpose of effective project planning and implementation procedures, by professionals involved with construction projects.

In addition, you are requested to indicate your field of expertise/practice (i.e. Project Management, Architecture, Engineering, Quantity Surveying, Project Financial Planning or Construction Management), as well as your work experience (practice) duration. The other personal particulars may be provided optionally.

Field of Expertise/Practice (please tick box [√]):Project Management : ☐
Architecture: ☐
Engineering: ☐
Quantity Surveying: ☐
Project Financial Planning: ☐
Construction Manager ☐
Other (please specify) _____

Work Experience Duration (Practice): _____

Name of Company (optional) : _____

Name of Professional (optional) : _____

Title Held (Post in Practice) : _____

Date : _____

Personal Professional Experience – Case Study Project

You are requested to give your personal professional view on the following project(s) in which you have had specific first hand experience, where cost control measures were successfully/or unsuccessful employed. Only brief point views are required.

_____ Project

Project Details:

Project Contract (TB No) : _____

Project Site Location : _____

Estimated Tender Price : _____

Tender Amount : _____

Date of Commencement : _____

Expected Date for Completion : _____

Final Date of Completion : _____

Final Account Amount : _____

Tender Price Excess/Savings : _____

Professional Comments:

(a) Major Cost Overrun Causal Factors:

_____
_____
_____
_____

(b) Remedial Measures Adopted to Control Cost Overrun:

_____
_____
_____
_____

(c) Effectiveness of Remedial Control Cost Measures (% savings achieved):

_____
_____
_____
_____