KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI,GHANA

Implementing Value Engineering on Road Projects in Ghana

by

Philip Agyekum Antwi
(BSc Civil Engineering)

A Thesis submitted to the Department of Building Technology, College of Art and Built Environment
in partial fulfilment of the requirements for the degree of

MASTER OF SCIENCE
(Construction Management)

NOVEMBER 2015

DECLARATION

I hereby certify that all material contained within this report is my own work towards the award of MSc Construction Management and that, to the best of my knowledge, it contains no material previously published by another person, nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

…….

Student Name and ID

……..

Signature

…….

Date

Certified by:

…….

Supervisor Name

……..

Signature

…….

Date

Certified by:

…….

Head of Department Name

……..

Signature

…….

Date

ABSTRACT

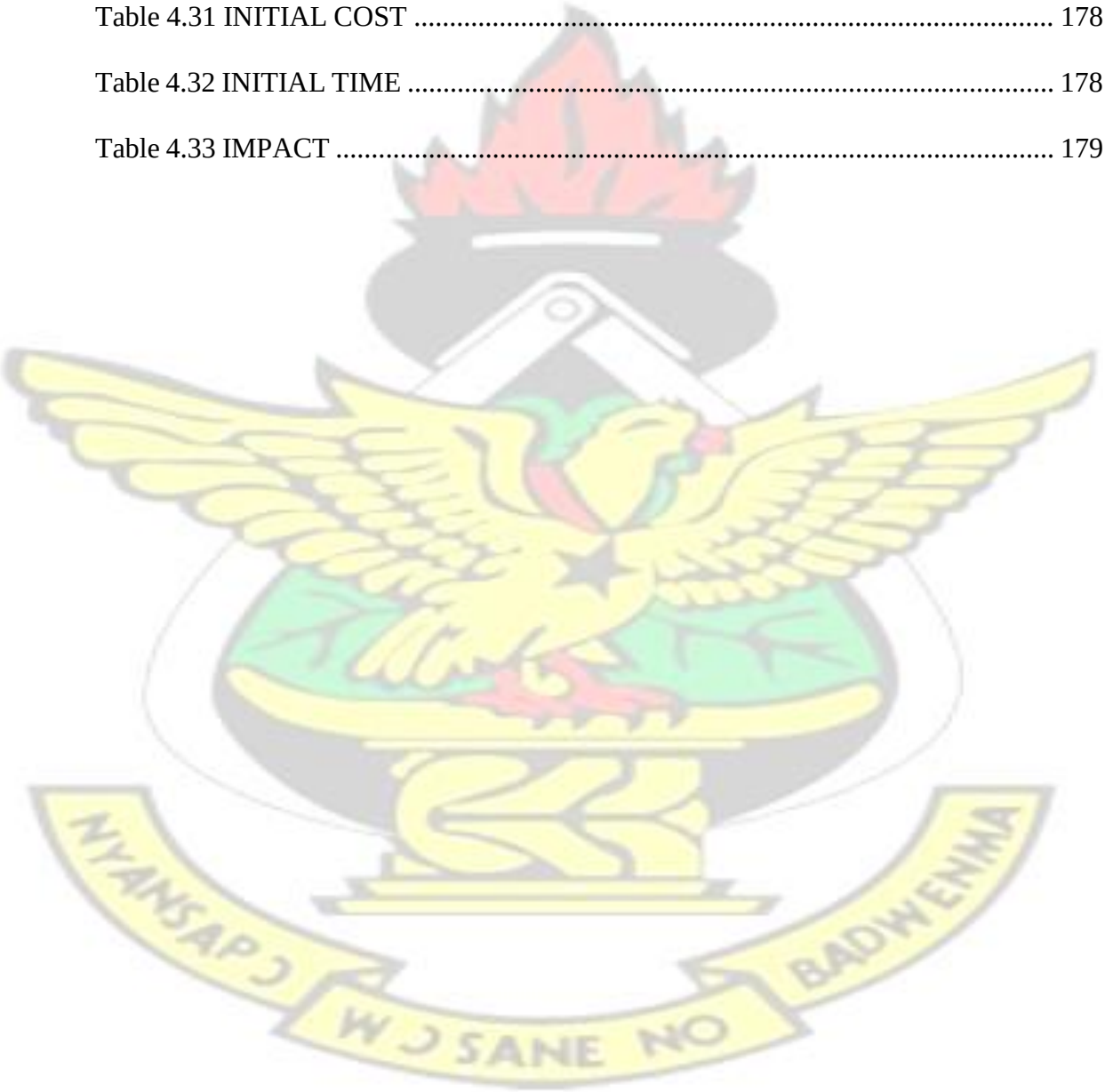
The inadequate and unsatisfactory Value for Money (VFM) achieved on road projects in developing countries like Ghana has been so pervasive and still remains an inevitable issue and a canker. Road Infrastructure and Support Agencies (RISA) under the Ministry of Roads and Highways (MRH) with its experienced and astute Road Professionals (RPs) or Technical Professionals (TPs) still continue to be confronted with VFM issues even though almost all road projects in Ghana are believed to have a VFM agenda. The capital intensive nature of road projects in developing countries, like Ghana coupled with its inevitable myriad of challenges still poses so much threats to road project administration in the country both now and even in the future. The attempt to achieve an optimum VFM through an advanced VFM practice integration into the conventional VFM practice remains the only solution to remedying these problems or challenges that have bedeviled this unrealized VFM agenda. Accordingly, the study was conducted with the aim of establishing the usefulness of Value Engineering (VE) on road projects in Ghana to promote its implementation. A quantitative survey research design was adopted and consequently, a closed-ended questionnaire was employed in eliciting responses from respondents in the Road Infrastructure and Support Agencies (RISA) under the Ministry of Roads and Highways (MRH) in Koforidua, Eastern region. Data were, thus, subjected to statistical analysis tests using descriptive (exploratory) and inferential (hypothetical or bivariate) tests. Inferential tests included parametric tests (Pearson Correlation tests and Analysis of Variance (ANOVA) tests) adopted for the Continuous data and the nonparametric tests (Binomial and Chi-square tests) employed for the Nominal data. Based on the overall statistical tests, it was revealed that Value Engineering (VE) Integration into each of the nine (9) knowledge areas of Project Management (PM) was

of significance and high value with mean score responses greater than 3.5 and significance values greater than 0.05. Throughout the study it was as well revealed that Value Engineering (VE) technique was as powerful a tool to be implemented on road projects in Ghana since respondents were very much convinced about the effectiveness of this practice for an optimum VFM on road projects in Ghana since the conventional VFM practice was seen to be deficient in its attempt to accomplish an optimum VFM agenda. This study is, thus, geared towards promoting the implementation of an optimum VFM agenda on road projects in Ghana to enhance the existing Road Project Management (RPM) practices and Road Professionals (RPs) expertise. It is, therefore, recommended that all Road Professionals (RPs) within the Road Infrastructure and Support Agencies (RISA) under the Ministry of Roads and Highways (MRH) are given an intensive training on 'Value Engineering (VE) Integration into Road Project Management (RPM)' by way of a Value Engineering (VE) Highway Model and accordingly, 'Value Engineering (VE) Control Clauses' integrated into road contract documents. The study explores a relatively new area and consequently serves as the basis to spur future research.

Keywords: Value Engineering, Project Management, Road Infrastructure and Support Agencies in Ghana, Road Construction Projects, Value for Money

TABLE OF CONTENTS

LIST OF TABLES



LIST OF FIGURES

LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
ASTM	American Society for Testing Materials
CCRT	Conventional Cost Reduction Technique
DFR	Department of Feeder Roads
DUR	Department of Urban Roads
EVM	Earned Value Management
FA	Functional Analysis
FAST	Functional Analysis System Technique
GHA	Ghana Highway Authority
GhIE	Ghana Institution of Engineers
GhIS	Ghana Institution of Surveyors
KTC	Koforidua Training Centre
LCC	Life Cycle Cost
MRH	Ministry of Roads and Highways
PM	Project Management
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
RISA	Road Infrastructure and Support Agencies
RPs	Road Professionals
SPSS	Statistical Package for the Social Sciences
ST	Systems Thinking

TPs	Technical Professionals

VA	Value Analysis
VBM	Value Based Management
VC	Value Clause
VE	Value Engineering
VEA	Value Engineering Analysis
VECP	Value Engineering Change Proposal
VES	Value Engineering System
VFM	Value for Money
VM	Value Management
VP	Value Planning
VT	Value Thinking

DEDICATION

I dedicate this work to my parents, SAMUEL YAW ANTWI, and GRACE YAA ANTWI, for their selfless, relentless and unflinching contribution towards my academic life in particular and my life in general.

ACKNOWLEDGMENTS

I am very grateful to the Almighty God for his care and protection throughout my academic endeavour. I am also very much grateful to my indefatigable supervisor Mr. J. C. Danku for his directions, advice, encouragement, and inspiration. Your cordiality and quick response to my submission were incomparable, a hallmark and a trademark.

My sincere gratitude goes to Professor Edward Badu, Provost of the college of Art and Built Environment, KNUST for his personal interest and assistance in my academic improvement and my thesis, Ing. Kwamina Addison, Operations Manager of the Department of Feeder Roads, Koforidua, and Ing. Emmanuel Opoku Adusei, Assistant Engineer at the Koforidua Training Centre of the Ministry of Roads and Highways, for all the care and help given to me, God richly bless you.

Finally, to my friend and colleague Mr. Stephen Akunyumu, a Teaching Assistant (KNUST), who has contributed immensely to the success of this project.

CHAPTER ONE

OVERALL INTRODUCTION

1.1 RESEARCH BACKGROUND

Road projects, the world over, are capital intensive and mostly of abysmal service quality especially in developing countries, like Ghana, where financial challenges as a result of the economy and dependence on external source of funding (Narh, 2014) for road projects exist. As such, there is the urgent need to ensure that all our road projects are such that we achieve an optimum 'Value for Money' (VFM) through an effective and efficient Value Engineering (VE) benchmarking technique so that the functional performance of these projects when officially opened for use are enhanced in their lifespan since Value engineering (VE) practice underscore the need for an efficient economic analysis through the Life Cycle Cost (LCC) of the road construction systems, the road construction materials as well as the road construction methods but not the initial road construction costs alone.

Dzah (2005) after conducting a survey on Consultants in the Ghanaian construction industry realized that the conventional Value for Money (VFM) technique was not the same as VE (that is, the advanced VFM technique), which implied that no optimum VFM has been achieved so far since the potential for VE practice was not in existence. As a result, VE should be promoted in its implementation on large scale Ghanaian construction works such as very complex, sophisticated and capital intensive structures like highways, bridges, dams, skyscrapers, inter alia (Ji, 2002) for VFM adequacy. Asset management responsibilities are also relevant as far as the VE technique is concerned in achieving the core objectives aimed at improving the sustainability of assets and teams employed to

preserve them at minimal total costs (Gibbons *et al.*, 2012). To be able to fulfil this robust task in order to encourage its realization on road projects in Ghana, there is the need to institute road VE multidisciplinary teams as a supplement to the existing road project teams; introduce Value Clauses (VC) in road contract documents; encourage a method enhancement incentive program to enable contractors gain rewards for optimizing construction techniques on road projects and finally, promote a cost saving incentive program on road projects in Ghana as a VE attempt for VFM adequacy on these road projects (Ji, 2002).

It therefore stands out that, the most critical issue now is the drive to promote the implementation of VE on road projects in Ghana by way of establishing the usefulness of this VE practice in this thesis to equip Road Professionals (RPs), that is, the civil engineers, the quantity surveyors, the land surveyors, the contracts managers, among others working under the Ministry of Roads and Highways (MRH) with the needed technical and managerial expertise in VE (Bowen *et al.*, 2011), by embracing the best practices of VE techniques and standards for optimum VFM on road projects thus the topic, 'Implementing Value Engineering (VE) on road projects in Ghana'.

1.2 PRELIMINARY LITERATURE

The inventor of VE, Miles (1972), defines VE as a systematized, imaginative methodology which has for its drive the operative documentation and dismissal of excessive expenditures which does not meet the performance characteristics of their clients. VE has these representative structures: Job plan; VE team; Timing of study; Required documentation; Functional Analysis (FA); and Formal approaches. In fact, as far as VE is concerned, achieving value at the most sustainable LCC is the modus

operandi. Its difference from the conventional VFM technique is distinctively by the element of Functional Analysis (FA) or the Functional Analysis System Technique (FAST), which as far as road projects are concerned can be sequenced as follows: Choosing a road component (e.g.; subgrade, sub-base, etc.); Outlining its functions; Classifying these functions as basic or secondary functions; Assigning costs to each of these classified functions; and finally, exploring the significance and projected performance altitudes of these functions to choose the optimum functional requirement for the road component which will satisfy the stated and implied needs of the client.

According to Kelly *et al.* (2004), VE for construction projects relates to the practice of ascertaining the functional requirements of construction projects in an unambiguous carefully evaluated value scheme as predefined by the owners and beneficiaries of the construction projects. All road projects perform some functions, some are basic whiles others are secondary, thus, the Functional Analysis System Technique (FAST) involves the documentation of the functions the client desires the project to perform using block illustrations to pass on information speedily. VE theories also facilitate the assessments of varied methods of construction for accomplishing the anticipated basic functions without compromising on the desired quality of work (Mansour *et al*., 2013). Official methodologies to VE/VM are: The Charette Methodology (administered by the design team at the end of the compilation of the project brief but before the design commences); The 40-hour workshop Methodology (a weeklong VE study undertaken by a second and independent design team to review preliminary designs); and The Value Engineering Change Proposal (VECP) Methodology (Contractors are stimulated to deliver alternative but economically feasible designs, elements, specifications or method statements). VE/VM/VP/VA/VBM is, therefore, a meticulous methodology to gaining the value,

quality or worth of all the integrated components of a project by establishing essential functions of these integrated project components conveyed at least feasible LCC without compromising on its quality and other performance requirements.

This VE theory exists because, by and large, RPs are to assess the best ways to execute road projects by liaising with road contractors. In the developed countries, for instance on government projects, if the contractor's VECP is endorsed by the VE team, 55% of all earnings from fixed price contracts and 25% from cost reimbursement contracts are given to the Contractor (U.S. World News Report, 1988). Procedures for optimum returns was also established by Dell'Isola in 1982 which was recognised by the implementation of VE on construction projects as follows: 1%-3% for overall budget; 5%-10% for huge amenities; and 0.5%-1% for incentive contracting. As a result the application of VE methodologies have significantly realised about 5-35% cost savings with a return on investment of about 200-222% (Chung *et al.,* 2009) and with cost discounts in the range of 15 -20% (Heggade, 2002).

1.3 PROBLEM STATEMENT

'Mr. Victor Annan, a highway engineer, upon updating the Eastern Regional Minister about the state of works on the Suhum-Nsawam road project remarked that it was commenced on August 13, 2006 and was expected to have been completed on August 14, 2008 but the completion date was changed to October 31, 2011 due to its myriad of setbacks…' (Ghana News Agency, 2011)

As far as the weak economy of Ghana is concerned, most road projects have not been sufficiently and adequately managed well over the past years now for VFM adequacy (for example, the Suhum-Nsawam road project, inter-alia, with their attendant time overruns, cost overruns, unmanageable risks, low performance or quality, ad-hoc variations, high initial costs, high maintenance costs (routine maintenance and periodic

maintenance), just to mention a few, resulting in very high LCC. One major contributing outcome to this assertion is that, the achievement of an adequate VFM through VE by RPs in Ghana still remains questionable and road projects are rendered either challenged or impaired. As a result of this, it has become so essential and imperative for professionals in developing countries to adopt this VE practice (Bowen *et al.*, 2010).

A general overview of the road sector in Ghana depicts that most of the road projects in Ghana have also been capital intensive from time immemorial with very poor service quality of roads which don't even meet their useful or functional lives when designed and constructed; even when funding has also been a major issue to grapple with up till now. In spite of all these myriad of challenges on road projects, Chan *et al.* (2014) emphatically established that all construction professionals respond to inevitable challenges and stresses with differing coping strategies as a result of their unique cultural environmental values which builds up structural relationships and consequently informs their performance.

However, in the midst of all these internal and external VFM challenges construction professionals are faced with, VE becomes an all-inclusive strategy and impetus to achieve VFM by equipping RPs in Ghana to apply VE on road projects since as per Jaapar (2000), in an attempt to achieve an optimum value with the conventional VFM technique, neither quality nor value can be guaranteed. Professionals in the road sector have an onus as far as the nation's road networks are concerned in order to reduce the overall project costs, without reducing the quality and other performance requirements of road networks in Ghana to achieve an adequate VFM.

In summary, as far as the economy of Ghana is concerned, there is a serious problem with achieving VFM adequacy on road projects since they have been found by the general public platform as projects that don't last since road projects have up till now not achieved an adequate VFM as a consequence of its inadequate existing management techniques and practices by RPs. It is sad to also note that, there are also instances in Ghana where issues arising from value, cost and quality have led to the postponement of major road projects such as the Suhum-Nsawam road project, inter alia. Therefore the need to spend some time, money and process values on VE to reduce the high budgets and low productivities (Ji, 2002) in order to avoid such risks cannot be overemphasized. This is to ensure that the design, construction and maintenance of roads in Ghana receive a well valued system through value/quality analysis and planning for adequate management from inception to completion so that in as much as cost is reduced (to avoid cost overruns), schedules are also properly managed (to avoid time overruns) and the quality is as well not compromised but maintained, not ignoring safety, to be able to deliver successful projects (not challenged or impaired ones).

1.4 RESEARCH QUESTIONS

This research is to be based on the premise and assertion that road projects in Ghana have hitherto not adequately or satisfactorily achieved an optimum VFM and thus, the need to promote the implementation of VE on road projects in Ghana led to the investigation of these questions:

(i) What overall VFM (conventional and advanced) practice or technique is administered on road projects in Ghana?

(ii) What road PM practices are currently in place in Ghana to achieve VFM by RPs?

(iii) Are there any VFM potencies of these PM practices towards achieving an optimum VFM on road projects in Ghana?

(iv) What are the certainty levels of these RPs towards VE concepts?

(v) How effective will the advanced VFM practice be from the conventional VFM practice?

1.5 RESEARCH AIM WITH OBJECTIVES

1.5.1 Research Aim

This thesis sought to establish the usefulness of Value Engineering (VE) on road projects in Ghana to promote its implementation.

1.5.2 Objectives

This thesis also sought to address the following measurable objectives:

(i) To examine how the conventional VFM practice is being administered on road projects in Ghana to be able to assess its VFM limitations;

(ii) To determine the certainty levels of RPs in Ghana towards Value Engineering (VE) to discover how convinced they are about this advanced VFM practice;

(iii) To compare the conventional VFM practice with the advanced VFM practice to evaluate the VFM adequacy of VE; and

(iv) To establish the usefulness of Value Engineering (VE) on road projects in Ghana to promote its implementation.

1.6 SIGNIFICANCE OF THE STUDY

'Many interventions are being made on executing road projects in Ghana to accelerate productive activities in the country since about a billion Ghana cedis has been pumped

into this sector which demands a lot of concerted efforts from now till 2019…' (The Presidency State of the Nation Address, 2015)

Road construction projects in Ghana are essential in enhancing socio-economic activities in the country. Agriculture, Mining and other socio-economic activities of Ghana thrive so much on the sustainable management of very good road projects without which activities are suddenly halted. Again, road projects stimulate growth and development as well as representing a real dominant force in developing countries such as Ghana (Narh, 2014). When roads become so expensive to maintain as a result of the inadequate VFM by professionals, economic activities retard and there is an associated high propensity for costs to be incurred by the nation.

To optimize this, an adequate VFM agenda through a VE methodology is to be adopted and implemented on road projects in Ghana. This is to ensure that road projects both now and in the future receive adequate VFM, since as per this technique, RPs are predominantly responsible and liable for whichever approach embraced. The theoretical and practical application in the use of VA and FAST tools throughout this thesis will be hammered on so that in the end RPs will be enhanced in their functional service delivery for the robust, resilient, sustainable, adequate and satisfactory VFM on road projects in Ghana since for the past few years a lot of heightened interest has been generated among development professionals in developing countries on the use of project or organizational values as a tool for driving project performance through VE (Buchko, 2007).

It is strongly believed that at the end of this thesis, there will be a facelift in the VFM agenda of road projects in Ghana and as a result, RPs will be enhanced in their functional deliveries for the betterment of this nation.

1.7 SCOPE OF THE STUDY

The extent of this thesis was geared towards establishing the effectiveness and usefulness of VE among RPs in Ghana to promote the implementation of VE on road projects since to a large extent these professionals should have an additional responsibility to serve as Value Analysts or Functional Analysts for road projects in Ghana and also to achieve an optimum VFM for the Government of Ghana. Even though VE has different stakeholders, my entire concentration is to equip these RPs whose immense contribution on the VE team will achieve an adequate VFM for road projects in Ghana. Given the prominent role with which RPs play on road projects in Ghana, these choice of respondents is pragmatically to ensure the maximum impact of this thesis on all stakeholders of road projects, including the Government of Ghana. The national economy is to receive a facelift if VE is seriously embraced for road projects henceforth with the introduction of, for instance,' value clauses' in road contracts by professionals directly involved in road management and project administration in Ghana.

1.8 RESEARCH STRATEGY AND PROCEDURE

Research strategies are techniques, plans or procedures of solving research problems. A quantitative research design was adopted for the sake of the purpose of this thesis since there was the need to establish theories before establishing findings from questionnaire data. The Research style was a Survey one and the approach was quantitative with predominantly closed-ended response structures. Target population were the RPs or TPs within the Road Infrastructure and Support Agencies (RISA) of MRH and the sampled or study population were these RPs or TPs in Koforidua. A judgmental or purposive sampling technique was used in selecting **thirty-four (34)** respondents (see Fig. 4.1 in

Appendix C) with a purpose (only RPs with MRH) since the target population was undefined and sources or methods of data collection were both primary (quantitative field survey data) and secondary (both published and unpublished works). The research data collection instrument or method was self-administered through an internet-based survey questionnaire medium. Questionnaire was made up of categorical (nominal) data responses and continuous (ratio) data responses. The categorical data were presented pictorially using bar charts and pie charts whiles the continuous data were presented accordingly using line graphs. In the statistical analysis section, both data received descriptive (exploratory) and inferential (hypothetical or bivariate) statistical tests to establish the level of significance of the p-value on the respective hypothetical assumptions. As such non-parametric (Binomial and Chi-square) tests were employed as per the categorical data and parametric (Pearson correlation and ANOVA) tests were used for the continuous data. In effect, this thesis employed a two-stage research procedure: desk study and field research, after which relevant data were analyzed using essential research analytical tools and techniques (Statistical Package for the Social Sciences (SPSS) and MS EXCEL to establish the usefulness of VE on road projects in Ghana to encourage its implementation.

1.9 LIMITATIONS OF THE STUDY

As with any research endeavor this study also had certain limitations.

(i) The study was only limited geographically to the RISA under the MRH of Koforidua in the Eastern region. Thus the sample used for the study was more or less affected by the statistical tests. There was the possibility of the

statistical mean values being affected if the sample size was increased or extended to other regions in Ghana.

(ii) The study was also limited to the RPs or TPs in the MRH, who don't only make up the road project team. There was the likelihood of responses being affected with the inclusion of contractors in the survey.

(iii) The study as well included certain questions with categorical response figure. There was the likelihood that if these figures were discretized the statistical analysis performed on such data would have rendered the p value valid, as in, $p > 0.05$

(iv) The statistical analysis was also done at a confidence level of predominantly 95%. This could have as well been achieved predominantly at other confidence levels, which could have rendered all significant mean value responses with significant p-values throughout the inferential statistical analysis.

(v) The quantitative research strategy was only adopted throughout the study. This could have been equally achieved by a qualitative research approach.

(vi) The study was only limited to establishing the usefulness of VE on road projects in Ghana. This could have been succeeded by as well developing a VE model which could have also validated the responses the more

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

The goal of any road project is to provide an adequate VFM to the client organization (thus, the government of Ghana). Achieving this VFM through an adequate Road Project Management (RPM) techniques is all about Value Analysis (VA) and Value Planning (VP). Astute RPs don't only use previous managerial knowledge but apply managerial acumen as well. When we say management is inadequate, it underscores the fact that only previous managerial knowledge is applied to delivering works, however, managerial acumen is lacked and thus, no VFM is achieved. Managerial acumen stems from the premises that a limitation in previous knowledge or concept exists and as such the need to do a proper review of the existing body of managerial knowledge, thus, an advanced managerial knowledge which paves the way for managerial wisdom to achieve an optimum VFM.

As far as the management of road projects in Ghana is concerned, there is still more to be done (The Presidency State of the Nations Address, 2015). This is so because, road projects have formed significant and substantial portions of the annual estimated budget of all projects in Ghana for the past decades. Road projects in Ghana, in spite, of the characteristic premium placed on its execution even to the extent of endearing past and present governments to citizens to win their votes, have over the years recorded an incomprehensible mismanaged system of approach since the current road management system seems not to adequately improve upon the roles or functions of RPs in their administration in Ghana. Most road projects executed in Ghana, for instance, the

SuhumNsawam interchange, have seriously recorded insufficient management issues which have led to the most severe time overruns, cost overruns, value issues, quality issues, just to mention a few. All these issues primarily rest on the RPs of Ghana to really assist the government of the day with their technical (VE) and managerial (VM) acumen which is still not sufficient. To therefore inform this phenomenon of managerial value inadequacies in Ghana and arrest its future unsustainable infrastructure menace, an intensive literature review has been undergone to ascertain and thereby establish the gaps between the advanced VFM practice (that is, VE) and the conventional VFM practice (that is, PM techniques) so as to establish the usefulness of VE on road projects in Ghana through a robust VFM practice (that is, FAST) to be achieved by Road Professionals (RPs) in Ghana who have an additional responsibility to ensure that all road projects achieve a satisfactory VFM for the nation. By so doing, this thesis will ensure the effective and efficient application of VE on road projects in Ghana. It is of great importance to note that the main difference between the advanced VFM management system and the conventional VFM management system for road projects lies on the element of functional analysis to achieve an optimum VFM. Whereas the advanced VFM system seeks to select the optimum LCC of resources (material, method, inter alia) among alternative functional elements of a road component (subgrade, sub-base, base, primer seal, just to mention a few), the conventional VFM system only seeks to achieve an optimum cost of resources for these road components. According to the ASTM E201312, the functional analysis follows these steps:

(i) Choosing a road component;

(ii) Outlining its functions;

(iii) Classifying the functions (basic and secondary);

(iv) Assigning costs to each of these function; and finally,

(v) Exploring the significance and projected performance altitudes of these characterized and assigned functions for the equivalent road component.

O'Farrell (2010) established that professionals at this present age are being confronted with so much risks and challenges in their attempt to render services to the client organization since their roles or functions in administering an adequate VFM requires a serious upgrade and improvement owing to the fact that even contractors are now establishing very strong bonds with clients and are no longer ready to cover up their failures. There stands the urgent need by RPs to embrace VE techniques so as to ensure an enhancement of the traditional ways of executing projects to achieve an optimum VFM.The ensuing review of relevant literature is to address the following: the advanced VFM system; the conventional VFM system and the characteristic gap between them, which is the Functional Analysis System Technique (FAST, the robust VFM system). Value Management (VM), Value Engineering (VE) and Value-Based Management (VBM) in relation to road construction processes provide a total picture of an adequate VFM on Road Projects, the platform of this thesis, 'Implementing VE on road projects in Ghana'. The main reason for implementing VE on road projects is to eliminate redundant costs while maintaining or enhancing performance and quality levels (Wao, 2014).

The introduction and history of VE, method & practice, outlines of value and prospect of VM constitute the value philosophy or thinking of the advanced VFM management system for road construction projects (Kelly *et al.*, 2004). The PM outline, Measure for PM of a project and the PM study areas encapsulates system philosophy or thinking of

the conventional VFM management system for construction projects (PMBOK 4th edition).The only limitation over here is the absence of an adequate VFM system in each of the PM knowledge areas of which it is recommended for a thorough revision of this edition of the PMBOK to be VE/VM inclusive for an optimum VFM intervention , thereby, moving the paradigm from a conventional VFM management system to an advanced VFM management system for an optimum, a satisfactory or an adequate VFM practice and as such endorsing VE as an embodiment of each of the PM tools and techniques. By so doing, the aim of this thesis to establish the usefulness of VE on road projects in Ghana to promote and encourage its adoption and implementation will be realized.

2.2 THE ADVANCED VFM MANAGEMENT SYSTEM (VE-PM INTEGRATION)

2.2.1 ADVANCED VFM PHILOSOPHIES

- It is interesting to note that all expected values of professionals can impact the acceptance of managing behaviours to stressful situations in construction. There is therefore the need to acknowledge this fact as a professional and try as much as possible to mitigate it since for a successful VE methodology the human or process values takes precedent of the project or product values for a VBM to achieve the best VFM (Chan *et al.*, 2014).
- VE methodology has as well championed the cause of great efforts being made to break down the high-cost and low efficiency structures (e.g.: in the Korean Construction Industry), thereby improving service quality but lowering cost (JI,

2002). VE is also very significantly adopted to improve the effectiveness and efficiency of assets and teams employed to maintain them at optimal total cost (Gibbons *et al*., 2012).

- Whiles VM/VE might be widely known among professionals, it is likely for its minimal practice as a result of the misperception that VM might be just a mere cost reduction tool, which is not so (Bowen *et al*., 2011).
- Leaders' value behaviours directly relate to value behaviours of subordinates. This means that the role of organizational leaders are so important in determining the outcomes of the VM techniques since subordinates model their values after leaders in organisations to achieve increased organizational performance (Buchko, 2007).
- VM is also a very robust, potent and adaptable tool to obtaining ground-breaking solutions to organizational problems (Jay and Bowen, 2015).
- Enhancing comprehension of the nature, characteristics, problems, theoretical foundation and process for the development of the VM framework is also essential at the project briefing stage of projects (Yu *et al.,* 2005).
- Whiles VM techniques is generally known by certain categories of professionals, it is less widely practiced (Bowen *et al*., 2010).
- A client-value oriented strategy to management can help companies impart a factoriented decision-making procedure in the firm to encourage quicker development through discrepancy client venture (Kothari and Lackner, 2006).

- Even though VM processes might be practiced for a long time by certain professionals in a particular setting, it doesn't necessarily mean that the VM processes have been well embraced and accordingly countless movements should be taken to apply and advance its full potential to improve VFM for customers' organisations (Shen and Liu, 2004).
- The practice of a value-adding toolbox to help road professionals (RPs) to resolve practical project difficulties with regards to client prospects of value is vital and much priority should be placed on this (Thomson *et al.*, 2006).
- An increased project management quality decreases alternative value (Ford and Bhargav, 2006).
- The concept of value can also be reviewed from Lean Construction (LC) perspective just as it is being reviewed now from the VE perspective (SalvatierraGarrido, 2011).
- VM during the construction phase is deemed basic and essential (intrinsic) to the main contractor's roles or functions (Perera *et al.*, 2011a).
- In areas where VM is practiced, it seems not to be applied at the most appropriate phase of projects, which could have made it more effective (Perera *et al.*, 2011b).
- VM enhances professional's roles or functions through the Technology Transfer (TT) process (Waroonkun *et al.*, 2008).
- Research has it that sustainable development (which is a topmost priority of construction projects) is an expanse which has inordinate probable for the implementation of VM procedure to ensure sustainable design and development (Shen and Yu, 2012).

- ‘Greatest value’ procurement can decrease the initial costs of delivery in construction (Kashiwagi, 2003).
- All potential measures of performance address performance in 3 key areas: scope, schedule and budget, in a performance management framework by using Earned Value Management (EVM) in their administration of construction projects (Alvarado *et al*., 2005).
- Public engagement outcomes positively influence the information and analysis phase of VM in the job plan (Leung and Yu, 2014).
- Added value analysis is a management tool that can identify the strengths and weaknesses to make informed decisions on projects (Mosweu, 2006).
- Trends and suggestions are appropriate paradigms for sustaining EVM practice (De Marco and Narbaev, 2013)
- Global Project Management (PM) problems are relationship-based (VBM) (Wilkinson, 2001)
- Synthesis of previously disconnected literature facilitates construction innovation, efficiency and productivity (Loosemore and Richard, 2015).
- Electronic requirements information management framework helps to simplify the lifecycle management of the requirements of clients (Jallow *et al.*, 2014).
- Capital projects like the engineering of projects or systems seldom realize their full potential because value in is not equal to value out (Van Zyl, 1999).
- VM is a powerful and versatile approach to obtaining innovative solutions to organizational problems (Jay and Bowen, 2015).

- Non-Value Adding Activities (NVAAs) influence project performance negatively in relations to cost and time variations (Emuze *et al.,* 2014).
- Value Thinking (VT), VE and the advanced VFM system provides impetus for VM of construction projects techniques; Systems Thinking (ST), CCRT and the conventional VFM system catapults PM of construction projects. VM is, thus, different from PM in VT; VE is also different from CCRT in FAST; and the advanced VFM system is different from the conventional VFM system by the robust VFM system (Male *et al*., 2006).
- Project-Based Management (PBM) faces many challenges whereas CommunityBased Management (CBM, or VBM) rather emphasizes the value and importance of managing knowledge (Bresnen *et al.,* 2003).
- VE is a cause of changes/variations in construction; VM is the best option to manage a variation, thus, VE is not a major cause of variations (Ibbs *et al.,* 2001).
- A Robust Framework for demonstrating VFM in an alliance project is feasible (MacDonald *et al*., 2013).
- Projects cost more and takes longer time without the principles and practices of the advanced VFM methodology (Harrison, 1985).
- Project values influence project quality expectation (Thomson *et al.,* 2006).

2.2.2 VE IN TRANSPORTATION

It is about thirty-four (34) years now that the National Cooperative Highway Research Program's (NCHRP's) original expression about Value Engineering (VE) in transportation services came into fruition (Wilson, 2005). NCHRP Amalgamation of Highway Practice abridged significant clarifications in addition to the anticipated

transportation agency prospects during that period. State Transportation Agencies (STAs) keep on facing and overcoming such difficulties even now. In numerous occurrences, STAs have established fruitful VE agenda, as a significant tactic, to aid them to profitably and efficiently provide needed infrastructure in addition to satisfying their clients and significant interested parties. VE remains a methodical evaluation in a transportation development, invention, or procedure to advance requirement, excellence, and life-cycle cost (LCC) by an autonomous versatile group of experts. The VE procedure, expressed in terms of a Job Plan, outlines an arrangement of happenings embarked on through a VE research, earlier, throughout, and after a VE workshop. Throughout the VE workshop, the VE team engrosses contextual matters, expresses and categorizes the scheme (or invention or procedure) purposes, recognizes innovative methodologies to deliver the purposes, and then assesses, advances, and displays the VE schemes to significant assessment creators. It is the emphasis on the purposes that the development, invention, or procedure need to accomplish that separates VE from other quality-enhancement or cost-optimising methodologies. In the United States, VE, or more precisely, the value practice, has been adopted to advance transportation projects for additional thirty (30) years. Conventionally, VE has been adopted by transportation agencies and municipal organizations to decrease or circumvent extra capital construction expenses. Nevertheless, VE can show a wider character to reinforce functioning choice creation for transportation projects to enhance project specifications and functions, stabilize project goals, and accomplish public prospects. The implementation of VE on transportation projects has progressed significantly from the time when NCHRP Synthesis of Highway Practice was publicised. In the United States, centralized and municipal guidelines have been established and realized demanding value research for great overheads of projects.

Numerous transportation agencies nowadays have project conveyance policies in operation that integrate VE and, in selected instances, project finance endorsements that are relatively secured to the achievement of VE research. The implementation of VE as a Project Management (PM) tool or the integration of VE into PM enhances growth and could be additionally improved by distributing data on the implementation and administration of present or existing VE techniques and plans in Ghana. Again, VE can also be used on either small or large transportation projects to generate optimum savings and returns. Clark (1999) in an attempt to employ VE in improving returns of small transportation projects that will make use of available personnel and require little VE training established that it was worth it since it yielded best value savings, methods and procedures.

The paramount operation for the VE effort and practice is in the project initiation phase, as a result of the fact that if variations can be established at this phase the chief cost investments being realised by the customer will not be enjoyed with the contractor (O'Farrell 2010).

2.2.3 BRIEF ACCOUNT OF VE PRACTICE

VE/VM/VA or Value Planning (VP) materialized in the US in the 1940s, just around the period when stimulating choices needed to be completed concerning the substitute design selections desirable to address the general shortage of possessions. Lawrence D. Miles, Manager of Purchasing, was then asked to deliver operative and optimal solutions to enhance VFM. This package, labelled Value Analysis (VA), was discovered in December 1947. Miles appreciated the fact that the purposes accomplished by an invention made up the strategy to enhanced VFM. As a result, it was acknowledged that the VE/VM was

exclusive (not determined by the traditional design procedures). VM has, several times, been improperly viewed as cost cutting. This emanated from erroneous interventions to deliver economical invention or development costs without truly appreciating how it should be implemented. Nonetheless, it is explicit that right from the onset, VE/VM stood for development. Even though the value and design groups eventually attains similar assignments (the best profitable invention or development), the methodologies employed are completely dissimilar. The Department of Defense's (DOD) Bureau of Ships in 1954, was the principal U.S. government agency to adopt VM in its procurement accomplishments. The Bureau of Ships christened its package as Value Engineering (VE).

According to Wao (2014), the VE policy should be credited to Lawrence D. Miles. The VE name is the most widely acknowledged since the commencement in 1959 of the Society of American Value Engineers (SAVE). VE is also called Value Management (VM), Value analysis (VA) or Value Planning (VP) (Wao, 2014). However, it was not until late 1961 that the VE program was formally applied throughout the Department of Defence (DOD) in the USA. This department introduced VE programs by employing fulltime value engineers and by introducing VE incentive clauses into their construction contracts, allowing contractors to prepare VE changes and share the savings realized from its applications. The VE practices became embraced in the USA due to its benefits which included cost savings in projects. In 1988, it was introduced to federal departments and agencies. In fact, the governors of Minnesota in 1987 and Indiana in 1988 instituted a VE Week celebration (Younker, 2003).

In 1996, SAVE developed within the USA and it was believed that it should be extended to the international community so that they could also take advantage. The Ontario Highway Industry in North America introduced VE into their system that same year for the construction project delivery processes which presented VE in highway safety programs (Road talk, 2000). In 2010, British government and Alberta infrastructure embraced VM program (Rabbi, 2012). SAVE International is presently working with many agencies to promote the understanding, training, knowledge, facilitation, and enhancements of VE practices across the globe.

Since the inception of VE, a number of projects have employed and benefited from it. These include projects which are costly, repetitive, complex in construction, subject to external audit, and those applying design modifications or changes in materials or components (Annappa and Panditrao, 2012). These implementations are in areas of amplified costs which includes costly materials, complicated designs or an increase in the variety of components which entails the examination of suitable options (Annappa and Panditrao 2012).

2.2.4 THE OVERALL VE CONCEPT

VE is an advanced PM tool for establishing quality interventions at optimum costs. Different researchers and VE reports use VE, VA, VP, and VM as synonymous and interchangeable terms. For example, the California Department of Transportation (Caltrans) refers to VE as VA (Bremmer Consulting, 2010). Also, the VE approach is sometimes called value control, value assurance or value improvement. However, ASTM E1699-10 uses the term VP to depict VA of systems or project at the initial stage of the

VE process. Nonetheless, the motivation is similar and the main aim is to obtain an optimum cost while enhancing the performance and quality of projects.

SAVE International expresses VE as a methodical implementation of documented value policies which recognise the purpose of an invention or a package at an optimum overall budget (Rohn, 2004; SAVE, 2007). Supplementary expressions as well arouse the impression for mankind to be christened the principal administrators in the VE/VM technique (i.e., the VBM). Thus, VE in this state can be expressed as a structured implementation of both practical understanding and common logic focused on the discovery and removal of superfluous budgets and delivering an optimum complete VFM particularly for municipal projects (Chen *et al*., 2010; Rohn, 2004). In fact, the exact distinguishing feature of humans is supreme to the accomplishment of VE, such as good leadership skills, superior verbal and communication skills, participation, and recognition of team members (Chung *et al.*, 2009). The team is better when it is versatile in nature. Thus, VE can also be expressed as a logical tactic of documented practices by versatile groups which expresses the purpose of an invention or package, controls the value of that purpose, produces genuine options by using imaginative thinking of the team, and delivers the requisite functions, dependably at the optimum overall cost (Sharma and Srivastava, 2011).

In the Departments of Defense (DOD) and Transportation (DOT), VE is expressed as a function oriented method. Specifically, the DOD manual expresses VE as a methodical determination geared towards examining the practical necessities of DOD schemes, apparatus, amenities, measures, procedures and deliveries aimed at accomplishing the required purposes at the optimum overall costs, in agreement with the required routine,

security, dependability, excellence, and sustainability (Benstin *et al.*, 2011). This expression is related to the Rohn (2004) definition which depicts VE as a function oriented management technique for enhanced design and construction. Remarkably, in the United States of America, VE is applied to reduce costs without decreasing the levels of performance while India's focus on VE is tied to any substitute design with the ultimate aim of reducing the cost of the project (Annappa and Pandritao, 2012). This can create an error of the VE process and its usage on road projects.

Bearing in mind the diverse VE meanings above, Value Management (VM) poses similar explanations except for the fact that some researchers have decided that it is a management style using VE methodologies. Thus, Male (2007) expresses VM as a practice or technique of an enhanced PM with its aim of integrating changes in views between stakeholders and customers as to the true significance of value. According to Male (2007), this is accomplished through an organized, methodical, investigative function-based and an administrative process which involves an illustrative, versatile group set up and organized in a hands-on workshop condition. That is, VE is a management technique that has a main objective of attaining an optimum purposeful equilibrium between budget, dependability, quality, and specifications of an invention, a development plan, procedure or a road construction scheme. Hence, VM is a systematical management style for enhancing value in construction projects upon delivery. Remarkably, there is no standard expression of VM in the literature. European standards only express it as a management style (Male, 2007).

In as much as VE has been identified as a procedure to solve construction problems, reduce costs, improve quality and performance (Younker, 2003), it is also important to

understand what VE is not. VE is neither a proposal program nor a typical cost reduction program used to cut corners in construction (Srivastava and Sharma, 2011). Other VE traditions are that VE is just cost reduction tool dealing with functions rather than products, i.e., it delays projects, criticizes designs, focuses on initial costs, and diminishes quality (Bremmer Consulting, 2010). It is also apparent that VE has a variety of explanations. The common aspects are: multi-disciplinary team, structured approach, function orientation, and creative thinking. In fact, VE is not just a cost reduction method but a decision-making, consensus-based problem solving and value enhancement technique for versatile teams (Kmetty, 2013).

As a consequence of the diverse discrepancies in the theoretical, case studies and industrial implementations of VE expressions across different settings, Jessup and Mitchell (2013) in their effort to develop a standard approach for this methodology in the civil engineering industry as a result of the fact that the pioneering country for VE methodology (Northern America) seems not to be reunited in VE meanings with their European counterparts, came up with a suggestion to go back to the pioneering country's original VE process of FA with the addition of constraints' triangle (time, cost, quality).It is hence proper that for any implementation of VE anywhere in the world (not ignoring Ghana), the original concept of VE/VM/VBM/VA/VP together with its goals should be kept complete notwithstanding the effort to contextualize it in that setting.

From the expresssions, the objectives of VE can be concluded evidently. The main objective of VE has been to reduce cost while maintaining or enhancing performance and quality requirements. Looking back, from the origin of VE, Miles (1962) acknowledged the objective of VE as a significant aspect for realizing better approaches to quality and

reliability of products at an optimum cost. Some researchers recognize VE as a cost cutting tool (Dlugatch, 1973; Heggade, 2002; Tohidi, 2011), while others rebound the cost effectiveness without abandoning performance (Benstin *et al*., 2011; Dlugatch, 1973; Huber, 2012). Others state that there are three aspects of value, namely, function, quality, and cost, which are important objectives. Specifically, enhancing quality, minimizing total costs, reducing construction time, ensuring safe operations, and ensuring ecological and environmental goals are met (Rohn, 2004).

Nevertheless, VE still remains a methodical implementation of standard procedures which recognize the function of a system, institute the value of those purposes and then deliver only the essential purposes that run into or exceed its needed specification level at the best complete budget (Wixson, 2004). Rohn (2004) expresses it as a practical procedure adopted in the design phase to avoid problems in the later stages of construction and operation where creating superior designs is the chief objective. Male (1998) expresses it as a pre-emptive challenge addressing and pursuing facility which optimizes the performance worth of a facility or system through running its expansion from theory to practice through a well-organised group approach. The team makes unambiguous decisions through constant standardising to the worth specifications of the owners. Male *et al.* (2007) declared this notion by stating that VE and VM originates its supremacy from being a group based practice by means of a purposeful analysis to inspect and deliver an invention, facility, or development at the best full life specifications and budget without devaluing worth.

Past research depicts that there are diverse number of members that can form a definitive VE team. It presented that the team members with varied backgrounds could differ from

5-25 subject to the intricacy of the scheme with larger schemes needing additional expert members. This correspondences with the implication from additional research in which the extent of the group and span of the research is contingent with the extent and budget of the facility (Road talk, 2000). However, a VE group of 5-7 members with varied capacities of proficiency and an extensive variety of technical know-how has been established to characteristically give the best VFM outcomes (Rohn, 2004). The group needs to comprise professionals who are experienced in the VM of comparable facilities (ASTM E1699-10).

Generally, the VE team leader should regulate the dynamics of the multidisciplinary team with effective communication and imagination. ASTM E1699-10 upholds that the team leader should be an individual with strong leadership, management, and communication skills. The level of communication is anticipated to be high. This is considered by high levels of trust and better member cooperation which improves and activates maximum idea creation. Characteristically, the synergistic level of communication should be aimed at in any VE process. The phase is considered by the team's maximum cooperation and maximum trust. Maximum creation of ideas and good communication are also major features of the phase. The VE leader should be trained in VE philosophies and have knowledge as a team member, a leader or a facilitator of a previous VE project or study. The team leader should be able to diffuse any friction among members into a high level of resourcefulness.

Attention should be paid to the Function Analysis System Technique (FA) because it is a vital technique for assimilating and synchronizing the VE team and also a good communication and coordination tool for use in the function analysis phase (Wao, 2014).

This is because it can join both the requirements of the owner and technical know-how of multidisciplinary team members into a single unit (Chen *et al.,* 2010).

The accomplishment of a VE procedure hangs on expedited and directed group power, higher administration provision, vigorous involvement of the customers and/or possessors, capability of the implementer, and employing a high-ranking manager as a superior and package leader of the facility (Chung *et al.,* 2009; Sharma and Srivastava, 2011). There also exists an important aspect, which says that VE must integrate a multidisciplinary team of professionals in which the results must have quantitative measures so as to enhance communication among the team members (Boock and Chau, 2007; Heggade, 2002).

Others contend that the victory of VE in a project depends on the character of the group leader, customer input, association with the design group and the characteristic of the facility itself since some VE teams can have a large number of participants (Chen *et al.,* 2010). Achievement is contingent on the association of the VE varied group which is predominantly predefined by the operational communications and the planned actions of the team members. Nevertheless, Male (2007) expresses that the accomplishment of VE is predefined by the rudiments of the VE procedure which embrace the study procedure, obligation by group participants involved in the project, administration of the VE procedure, decision-making obligation, and well-organized assistance.

Road projects may result in poor value especially when the VE process is not followed correctly. These can include not following required ethical VE standards or encouraging errors in the VE process. Team leaders writing final reports without the agreement of the team members can encourage poor value. This is because the members have no

possession of the final VE report, likely to cause conflict among them (Smith, 1999). Too many conclusions based on feelings rather than facts can undesirably impact the outcome of the VE process. Lack of systematized effort, highly compressed time frame, lack of yardsticks for measuring value, wrong beliefs, habitual thinking, rigidity without consideration for changing technology, function and value among other factors, may result in poor value (Sharma and Srivastava, 2011). Other factors to escape include: the reluctance to look for advice, failure to accept lack of knowledge of certain dedicated characteristics of facility expansion, undesirable approaches such as the inability to recognize originality or innovations, lack of good communication among team members, jealousy, misunderstandings, and friction among members (Sharma and Srivastava, 2011).

The effect of traditional methods of construction project cost reduction can permeate into the VE process. These must be screened off completely because such methods can easily hinder creativity from team members (Tohidi, 2011). Generally, anything that can lead to poor value should be circumvented as much as possible. This is because they can prejudice the implementation plan and process of VE methodology in projects leading to unwanted outcomes. In doing this, there seems to be no single understanding of when in the design and construction process it is best used. But one important aspect is that VE implementation should start early in the project schedule (SAVE International, 2007; Sharma and Srivastava, 2011) and that VE studies should not be implemented when more than 50-60% of design has been accomplished. Advantages associated with the early VE use include more units affected by saving actions and also lower implementation costs both in the short run and long run.

The VE procedure can be used in three stages of construction project: planning and design, which is the most important stage to apply VE, construction, and maintenance and operation. Some research have revealed that VE should be ongoing over the life cycle of a project while others show that VE is effective after the commencement of construction (Chung *et al.*, 2009). One thing that is serious to the implementation of the VE process in construction is that it should not disturb the schedule. The VE methodology should not add time to the schedule, that is, it should not disturb the critical path of the project schedule.

Areas of VE implementations may include: engineering, e.g., design and product improvement; manufacturing, e.g., material handling, equipment design and production; purchasing, e.g., new product information; sales, e.g., reduced sales of a product; construction, e.g., planning, scheduling, and labor; systems and procedures, e.g., reproduction services; maintenance, e.g., work scheduling; and energy conversion, e.g., procedures and life cycle cost assessment. Generally, suitable applications of VE should emphasise on participating in VE achievement issues and circumvent the pathways that can promote reduced worth or place a strategy for refining reduced value should it arise during the VE practice. Comprehending the VE job plan or phases is important for the outstanding accomplishment or application of VE procedure. Different VE studies use different steps or phases. Dlugatch (1973) stated seven steps while SAVE International assembles VE as a six step process. Benstin *et al.* (2011) described eight VE segments: orientation phase, information phase, function analysis phase, creativity phase, evaluation phase, development phase, presentation phase, and implementation phase. The American Society for Testing and Materials (ASTM) standard E1699-10 defines the VE

process as eight phases and pre-workshop preparation step (ASTM E1699-10). These phases are: (i) Information phase: This is the documentation stage of the problem to be unraveled, assessment of the possibility of implementing VE study for the problem, collecting necessary data or information about the problem, and assigning the needed resources and team to undertake the study. This step answers the question, 'What is it? What does it cost?'

(ii) Function analysis phase: Over here, the VE team recognizes and analyzes functions, regulate worth, and know the new implications in terms of time, quality, safety, aesthetics, energy, environmental impact, and other owner requirements. This step answers the question, 'What does it do?'

(iii) Speculative or creative phase: The VE team involve themselves in a brainstorming conference. Free flow of ideas is encouraged and judgment is suspended until the ideas have been exhausted. From the list of ideas, the team develops alternative ways of meeting the owner's requirements. This answers the question, 'What else will it do?'

(iv) Evaluation phase: The VE team conduct analysis and appraisals of the alternatives established. The standards for evaluation are listed out including the merits and demerits of each alternative. A ranking procedure is established. The top ranking usually becomes the best alternative which meets the owner's requirements. This answers the question, 'Will it work? What does it cost?'

(v) Development phase: The optimum alternative is selected. The viability of this optimum alternative is determined. This include initial estimated costs, life

cycle costs, and necessary technical information about the best alternative. This answers the question, 'What work best from among the alternatives?'

(vi) Presentation phase: The VE team present the alternatives established to the design professionals and/or the owner so that they fully understand the significance of the alternatives before implementation. Written report is arranged which spell out the cost savings in addition to other supporting documentations. Communication is important here and to the complete success of VE process. This answers the question, 'What are the specific ideas? Can ideas be grouped?'

(vii) Implementation phase The VE team prepares implementation plan and schedule to ensure that implementation is carried out effectively. The owner and design professionals meet to agree on the final outlook of the alternatives. This stage answers the question, 'Can approval be obtained?'

(viii) Final acceptance phase: The design professionals are answerable for determining technical viability of each alternative and also implementing those substitutes that meet the specifications of the owner. In the event of any alternative not fully meeting the function or requirement of the owner at a particular time, the owner may instruct the design professionals to conduct further analysis so as to decide the practicability of implementing such alternatives. If some specific alternatives are not implemented, the design professionals are responsible for documenting reasons for nonimplementation. These must be communicated to the VE team and the owner.

This answers the question, 'Which alternatives can be accepted?'

Some VE studies combine some of the phases defined in ASTM E1699-10. Male (2007) recognizes only three phases: orientation or diagnostic, workshop, and implementation.

These exact number of phases is not critical but it is essential that all the significant phases in the VE procedure are dealt with. These key steps are: information gathering phase, function analysis phase, creativity phase, evaluation phase, development phase, presentation phase, and implementation phase. In an attempt to realize this, solidarity and good application of resources is encouraged while coming up with a high level resourcefulness (Tohidi, 2011). The concentration of the VE team should be on generating an optimum worth through consideration to budget, specifications, and functional levels. FAST is an important tool for achieving this optimum value.

VM practices even though practiced by recognized and registered professionals in some international countries still poses difficulties in its applications by them. For instance, in an attempt to explore the existing VM practices in China and its future prospects, Liu and Shen (2005) established certain difficulties in the current VM practices in China as the major differences between Chinese and their overseas' counterparts VM practice and as a result outlined the three major impediments to the Chinese current VM practices as: Incomplete scope of implementations; exploiting mathematical tools in VM studies; and the unsuitable procedures implemented to encourage VM realisations; based on the following difficulties elicited and ranked in descending order of impact from respondents in both the manufacturing and construction industry: Inadequate national VM standards; Inadequate VM knowledge; Inadequate qualified VM facilitators; Inadequate time to carry out VM; Protective attitude of other professional teams; Too costly to execute VM;

VM extends product/project finishing times; and the break to standard work programme. Some of the formal approaches to VE/VM are: The Charette Approach (administered by the design team at the end of the compilation of the project brief but before the design commences); The 40-hour workshop Approach (a weeklong VE study undertaken by a second and independent design team to review preliminary designs); and The Value Engineering Change Proposal (VECP) Approach (Contractors are encouraged to submit alternative but economically feasible designs, elements, specifications or method statements). In the U.S., for instance, for municipal projects, if the contractor's VECP is recognized by the professional team the contractor accepts 55% of the investments for fixed price contracts and 25% for cost reimbursement contracts (U.S. News and World Report, 1988). Guidelines for maximum returns was also found by Dell'Isola in 1982 which was recognised by the application of VE to construction projects as follows: 1%3% for total budget; 5%-10% for large facilities; and 0.5%-1% for incentive contracting. Other studies have also shown the application of VE methodologies which have substantially realised about 5-35% cost savings with a return on investment of about 200222% (Chung *et al.*, 2009), with cost discounts in the range of 15 -20% (Heggade, 2002).

2.2.5 THE VALUE FOR MONEY (VFM) RELATIONSHIP

The VFM relationship on projects consist of two standards: achieving process (human) values before product (project) values. This is vehemently acknowledged as a strategy to accomplishing VFM. Wandahi (2005) in his attempt to investigate the improved emphasis on the lack of efficiency growth in the building construction industry which produces productive consequences revealed that the eventual demonstration of satisfactory management practices is founded on a value consideration, thus, VM, VE

and VBM. VM underscores the ability to integrate client needs and requirements and needs with its distribution and completion. Value-Based Management (VBM)

emphasizes the united productivity of the facility organization through the utilization of human worth (i.e., process values) as an additional management instrument. Therefore, the difference between VM and VBM lies in the definition of value (Wandahi, 2005). By and large, the knowledge of Value Management (VM) is to appreciate the Value for Money (VFM) connection from the client's viewpoint. Value Management (VM) and Value Engineering (VE) are associated with the value delivery to the customer outfit (Wandahi, 2005). Value in VM & VE meaning is continuously quantified in a VFM connection. Accordingly, it can be predefined that value is not equal to money, even though a link does occur. In VM and VE, value is carefully associated to the project, its purposes and accompanied facilities. The VFM linkage comes into operation when a client asks himself 'did the project achieve any worth?' The client is therefore producing a value decision where the expected financial amount is set up against the observed worth of the project (Thomson *et al.*, 2006).

The current and greatest leading observation of the value practice is the provision of value to the client outfit in a "Value for Money (VFM)" relationship. This is what the management concepts of Value Engineering (VE) and Value Management (VM) emphasises. Value Management (VM) is realised at the commencement phase of the construction practice and process to accommodate and relay the client outfit's requests, necessities, and requirements. The agenda for this is to secure these requests, necessities, and requirements as accommodated in the design explanation. Value Engineering (VE) is applied in the margin between the design phase and the construction phase to enhance

the cost of the design explanation and to safeguard the viability of the design. Conversely, an additional value proposition is in operation (Wandahi, 2005). This value model is deep-rooted in a thoughtfulness of values as human standards of right or wrong, hence it affects human character and movements. This value configuration is utilised in the practice of Value-Based Management (VBM), which dynamically rests on generating mutual values of the project establishment. This generates an additional cooperationbased philosophy, which has been exposed to be more practical than the conventional management systems like performance, duration, investments, etc. In that way ValueBased Management (VBM) is to be observed as an additional management technique, which should advance the effectiveness of VFM on road projects.

VFM has different implication to different people. It may be a reproduction of people's feelings and needs at a particular time. It can be biased in some cases in that what is considered to be of good value for one may not necessarily be of good value to another. For example, if you feel that you have your money or quality or performance worth then you have 100% value (Kasi, 2009). Also, if you feel that if something costs more than you think it should, then there is a tendency to improve the value or reduce the cost. Some may confuse value with cost or price. It is a mistaken belief that when something costs more, it is worth more, i.e., it has a high value. But value is not synonymous to cost. It may be perceived as a ratio of positive and negative aspects of system or project.

Miles (1962) established that VA is the productive documentation of redundant budgeted costs, thus, those that don't meet the client specifications or performance requirements. Consequently, value can be measured as a combination of quality and cost (more like worth or utility). The ratio of quality to cost can be treated as the value of a product,

service, or system. If cost can be reduced for the same quality or quality can be increased for same cost, then value improvement is said to have occurred.

SAVE International (2007) views value as a fair return in properties, facilities or cash for scheme or project. Realizing true worth becomes an objective, and it is met by analyzing functions of systems and resources available for use to fulfill the functions. SAVE International (2007) recommends that the function should be measured by performance requirements while resources to be measured in materials, labor, prices or cost, time, or other. Kasi (2009) indicated that value is accomplished when the project has a high performance while reaching a desired acceptance at a reasonable cost. Typically, value is maximized by optimizing the equation:

(i) Value = function / cost; or

(ii) Value = worth to you / price you pay; or

(iii) Value = performance / cost ; or

(iv) Value = function / resources

The main goal is to accomplish a ratio of 1:1 or greater which characterizes optimum value. Four (4) types of value are significant in VE. These are: use, esteem, cost, and exchange values or worth. Use value relates to the use of the product or system while esteem value relates to value accruing from owning a product. Cost value relates to costs required to produce a building product such as the sum of labor, materials, and other costs. Exchange value relates to the properties or qualities that enable people to exchange a product or system for something else.

VE is a creative, structured process used to identify needless costs in projects. Miles

(1962) defines these costs as costs that do not add quality, appearance or performance over the life of the product. VE is a strategic and efficient system that leads to a deeper search for the knowledge required to make a decision, which may not be the knowledge which is initially thought to be needed. Benstin *et al.* (2011) says that the VE process must induce ingenious minds where the multidisciplinary team departs from status quo and delves deeply into seeking various options at reduced costs while enhancing performance and quality.

The cost can be measured in monetary terms. It comprises both initial and life cycle costs. However, worth is different. To measure worth, the product or service or system is first converted into its functions and reference data are used to define the cost of each function. The cost of the basic function and the required secondary functions define the worth.

The value or worth of the function is the optimum overall price or cost to consistently perform or achieve a given function. ASTM E 1699-10 specifies that the VE team sets the cost targets or value of each functional components. The worth becomes the VE team's approximation of the optimum cost required to perform the requisite function. The estimated cost for delivering the function in any given case is provided. Associating function cost to function worth helps in identifying areas for potential value improvement in projects. Dividing the estimated cost for any given functional component by the VE group's benchmark cost in providing the function establishes its cost-to-worth parameter. Any ratio bigger than one (1) poses likely chance to improve value of a system or project.

The value estimates depend on the accuracy of the available information and the carefulness of the VE study. The VE team and the design professionals should be in full agreement on the systems requiring value improvement.

Obtaining maximum benefits has been the main reason or objective behind implementing VE procedures in construction. These benefits can manifest themselves in design improvements, cost savings, continuous improvement, accelerated inclusion of fresh resources and improved road project methods, worker eagerness from involvement in decision making processes, improved skills accruing from team participation, optimized quality and performance requirements, and improved functional reliability and system performance (Rohn, 2004). Accomplishing these benefits require greater understanding of human dynamics and facilitation skills, i.e., understanding team dynamics to get the most output from the team.

Successful VE projects have shown the significance of integrating a good multidisciplinary team of engineers or builders right from the beginning of a project. Synergistic team communications have been identified as important to the success of a VE team. As described earlier, the VE team uses FAST to fully understand the project with regard to its functions. Performance requirement cost is determined, aggregated, and compared to reference data, which is typically the VE teams' estimation of benchmark costs. This determines the value or cost-worth of systems. A system's cost-worth ratio greater than 1:1 implies that the system needs value improvement. Value is realized when the cost of new system developed by VE team to provide the function is less than the original system.

The VE team will recognize areas of poor or low value, which may be done through a function-cost matrix. If a function accounts for a large percentage of building or product cost, then it is a potential area for value enhancement. By identifying alternative ways to accomplish a function, the cost can possibly be reduced and the value enhanced.

However, not all system or services are connected to cost only. In an analysis, a system can be connected to its performance or quality in which VE can be used to find possible areas for quality or performance improvements. In road construction projects, the concept of VFM is an opportunity to address quality or performance requirements of road components. VE is a process to enhance performance and quality outcomes of road projects.

2.3 THE CONVENTIONAL VFM MANAGEMENT SYSTEM (PM WITHOUT VE)

2.3.1 CONVENTIONAL VFM PHILOSOPHIES

- Limitations exists in PM practices and thus a modern PM practice should be directed towards achieving VFM: an evolutionary theory to various aspects of PM practices (Whitty, 2011).
- Professionals in their effort to manage projects which can either make or break them, need to establish an equilibrium between their strategic and operational concerns (Czuchry and Yasin, 2003).
- Further improvements and expansions are always required even in areas that have even gone a long way in the proper project and construction management practice (Zou *et al.,* 2007).
- PM maturity assessment approach provides compact and proportional studies in PM techniques in companies and businesses, thereby providing a set of benchmarking tools to identify key areas of opportunity for improvement in PM (Kwak and Ibbs, n.d.).

- PM studies the success of systems thinking whereas VM studies the success of value thinking (Morris, 2004).
- It has been commonly seen that there is no obvious practice of PM; all practices are implied or tacit. This therefore limits its implementation in the PMBOK Guide by PMI (Koskela and Howell, 2002).
- Attempts should be geared towards mounting PM techniques that support PM consultants improve their aptitude to both professionally execute projects and successfully optimize returns (Morris, 2010).
- Differences exists in current practice of PM across the globe (Fortune *et al.*, 2011).
- A more open approach to problem-solving in projects leads to better solutions (Cavaleri *et al.,* 2012).
- A cooperative approach is required to develop PM thinking (Soderlund and Geraldi, 2012).
- The systems thinking approach draws direct correlation among PM practices and knowledge areas (Kerzner, 2009).
- An ideal factor in determining the level of maturity in PM is the complexities of projects executed. (Albrecht and Spang, 2014)
- The number one goal of VE is to provide adequate value for a construction project through adequate management (Wao, 2014).

In an effort to improve value outcomes for projects through a VE procedure, it was realized that the conventional value engineering process (ASTM E 1699-10 VA standard) had certain limitations as against the alternate VE methods (characteristic worth in the FA , creativity and evaluation segments) based on eliciting responses from respondents (students, faculty experts and expert VE practitioners) thereby providing a framework for modified value engineering practice

(Wao, 2014).In the research setting of Florida, the researcher realized that VE was already being practiced by professionals but had several limitations and needed to modify what they already practised. Dzah (2005) in an attempt to investigate the nature, extent and level of VE in the Ghanaian construction Industry, realized by eliciting responses from clients, consultants and contractors that the cost reduction technique practiced was not VE and as a result established that the introduction of VE will not have adverse effect on the traditional roles of consultants, thereby outlining six out of ten essential factors for the successful implementation of VE in Ghana. Thus, it stands to reason that, managerial inadequacies still saturates the traditional roles of RPs in Ghana and indeed it has become necessary for their conventional VFM management system which is not a VFM agenda or not VE/VM to be upgraded to an advanced VFM management system by the incorporation of the elements of FAST to enhance their roles through a robust VFM management system (the FAST).

2.3.2 THE OVERALL CONVENTIONAL VFM CONCEPT

The PMBOK Guide (2008; 4th edition) stipulates the following conventional VFM framework (each without VE integrated) which has been used so far on road projects in Ghana but has VFM limitations:

(i) Project Integration Management (PIM) is the technique and action necessary to recognize, express, amalgamate, unite, and organize actions within the Project Management (PM) process groups.

(ii) Project Scope Management (PSM) comprises all the procedures necessary to guarantee that the project comprises all the work, and only all the work necessary to accomplish the project magnificently. It is principally dependent on regulating what is and what is not in the scope.

(iii) Project Time Management (PTM) comprises all the procedures necessary to guarantee and accomplish the judicious accomplishment of the project.

(iv) Project Cost Management (PCM) is a technique that utilizes knowledge and expertise to quantify cost and efficiency through the complete life cycle of enterprise level projects. Commencing with approximation, an energetic instrument in PCM, definite past cost data is employed to precisely plan all characteristics of the project. It comprises all the procedures in planning, estimating, budgeting, financing, funding, managing, and controlling costs so that the project can be accomplished within the accepted budget.

(v) Project Quality Management (PQM) is a procedure to guarantee that all project activities needed to design, plan and implement a project are effective and efficient with reference to the function of the objective and its performance characteristics. It comprises all the procedures and actions of the performing group that regulate quality strategies, purposes, and duties so that the project will fulfil the requirements for which it was undertaken.

(vi) Project Human Resource Management (PHRM) comprises all the procedures mandatory to create the most operative use of all the people involved with the project, as well as all stakeholders. This comprises all the procedures that coordinate, administer, and direct the project team.

(vii) Project Communications Management (PComM) comprises all the procedures compulsory to guarantee that there is an operative communication throughout the life of the project. It comprises as well all the procedures necessary to guarantee judicious and suitable planning, collection, creation,

distribution, storage, retrieval, management, control, monitoring and the eventual characteristics of project information.

(viii) Project Risk Management (PRM) is the documentation, evaluation, and ranking of risks followed by corresponding cost-effective application of resources to minimize, monitor and control the probability and/or impacts of unfortunate events or to optimise the realization of opportunities. It comprises all the procedures of conducting risk management planning, identification, analysis, response planning, and controlling risk of a project.

(ix) Project Procurement Management (PPM) comprises all the procedures essential to purchase or acquire products, services, or results required from outside the project team.

(x) Project Stakeholders Management (PSTM) comprises all the procedures necessary to categorize all people or organisations impacted by the project, examining stakeholder expectations and impact on the project, and developing suitable management strategies for successfully engaging stakeholders in project assessment and implementation.

2.3.3 EXECUTING ROAD PROJECTS IN GHANA

Road project execution in Ghana goes through these processes:

(i) Before any road in Ghana is constructed in any region, the first stage is the prioritization and selection based on its importance, worst conditions or state, surface conditions, its value in relation to farming or other economic activities, just to mention a few, by the Road Engineer in an area liaising with the Local Assemblies or Authorities.

(ii) The next stage is for the Road Engineer to undertake a field condition survey to be able to know the optimum design interventions or solutions like culverts, u-drains, base, sub-base, primer seal, inter-alia, for the selected or prioritised road in the area.

(iii) A desk study is then conducted by the Road Engineer and Surveyor to investigate the hydrological and catchment areas or zones by studying the road map of the area. This is to enable the team come up finally with a feasible and viable design intervention or solution for the road area prioritised.

(iv) A Quantity Surveyor (Q/S) is then tasked to come up with an estimate based on the design information finally supplied by the Road Engineer.

(v) The Q/S then brings it back to the Road Engineer who then vets it to ensure that it is an optimum estimate.

(vi) The Road Area Engineer then sends this vetted estimate to the Regional Manager, who as well vets it and if found satisfactory attaches a cover letter.

(vii) This is then sent to the National Director of the Road Agency, who looks at the budget at his disposal and sees whether it is feasible or viable to execute.

(viii) If it is found to be feasible as per budget, Tendering is done to select the lowest evaluated bidder or contractor for the task.

(ix) Conditions of Contract and possession of site are offered to the successful Road Contractor, who then moves to site to commence works.

(x) During construction or maintenance works, these RPs offer effective supervision, Quality assurance, Monitoring and control. If the Contractor

raises any certificate for payments, these RPs vet the certificate to ensure that an optimum VFM is achieved for the state.

The Ministry of Roads and Highways (MRH) is the ministry accountable for Road Project Management (RPM) and road maintenance in Ghana. Road Infrastructure and Support Agencies (RISA) under MRH are:

(i) Ghana Highways Authority (GHA); (ii) Department of Urban Roads (DUR);

(iii) Department of Feeder Roads (DFR);

(iv) Koforidua Training Centre (KTC); and

(v) Ghana Road Fund Secretariat (GRFS);

The vision of the MRH is to provide and retain a combined, economical, harmless and supportable road transport network receptive to the needs of users, supporting development and poverty alleviation.

The mission of the ministry is to transport the mandatory guidelines, monitor and assess packages and projects to safeguard the delivery of inexpensive, combined, innocuous, receptive and supportable road transport network that will meet the financial, communal and ecological needs as well as national and international principles.

2.3.3.1 Budget Program Summary

(I) Program 1: Management and Administration

(II) Program 2: Road Construction

(III) Program 3: Road Rehabilitation and Maintenance

(IV) Program 4: Road Safety and Environment

2.3.3.2 Road Networks in Ghana

Road networks are to improve convenience and mobility of humans, goods and services. The following road networks are constructed:

(i) Trunk Roads

The trunk road network provides essential regional and inter-regional market connectivity services, including ferries with the aim of filling in the gaps in the network. The trunk road network also links Ghana to its neighbouring countries.

(ii) Feeder Roads

The feeder road network includes the delivery of safe and all weather reachable feeder roads at optimum cost which ease the movements of people, goods and services to encourage socio-economic development, in particular agriculture. Supplementary to decrease in transport cost, enhanced rural road travel dependability have the added impact of increasing access to social services and employment prospects especially to women and to those living in poverty.

(iii) Urban Roads

The urban road network delivers an all-weather city road access in support of the economic growth taking place in all Metropolitan and Municipalities across the Country.

2.4 THE ROBUST VFM MANAGEMENT SYSTEM

2.4.1 FUNCTIONAL ANALYSIS SYSTEM TECHNIQUE (FAST)

Value Engineering Analysis (VEA) can also be used in selecting the optimum method of construction among a number of alternatives for very complex and capital intensive projects like road projects, box-girder bridges, among others, which are so sensitive that there is the need to undertake a real functional element analysis to arrive at the best value

construction method alternative but still maintaining performance, quality etc. (Mansour *et al.*, 2013; Sadawi, 2008).

Established in 1964 by Charles Bytheway, FAST recognizes the basic and secondary functions of systems (Borza, 2011; Bytheway, 2007). ASTM E1699-10 expresses basic functions as those that are essential for the project to perform and must be fulfilled in any project system's alternatives developed, while secondary functions are defined as supporting functions that enhance the project performance, i.e., they define characteristics, qualities and methodologies that improve the rudimentary functions.

Road system or component functions discovered by a VE team can be recorded logically using the FAST method (Nick *et al.*, 2000). FAST and the use of function as a basic language assist in understanding how and why things work by eliciting discussion or argument. Functions are described as words, and FAST links words into sentences and develops arguments using a graphical FAST diagram. Verb-noun pairs are used as basic linguistic elements to obtain a clear understanding of the specific system under study. The objective of FAST is to shape agreement in the VE team on where and how the structures being investigated fit in the outline of the road project (Bytheway, 2007; Kmetty, 2013).

The sequential procedure of function analysis is to select a road component, define the needs and desires (functions), classify the functions, allocate cost to each function, and analyze the importance and expected performance level of the functions (ASTM E201312). The process involves describing the function using a verb followed by a noun. The pair should be an action verb followed by a quantifiable noun. This enables the function to be quantified effectively.

The FAST diagram helps the users calculate the ratio of total cost to critical path function cost, i.e., the VE value index. The purpose in a project is the advanced order function. The association between an advanced order function and its subordinate function is predefined by asking 'Why' the function achieves as it does and corresponding answer constitutes the advanced order function. The logic check must be completed by asking 'How' the higher order function is realized. The answer must be the lower order function. The basic function is to the right of the left hand scope line and the secondary functions are to the right hand of the basic function and continue to the lower order function by asking 'How' questions (ASTM E2013-12; Kasi, 2009).

Generally, the main goal of function analysis is to develop a full understanding of the road system's or project's purpose. Once there is complete understanding of the functions, the project team members can then select areas for maximum return on the value study resources that are available for the project, i.e., areas of maximum value to the owner (SAVE, 1998). This, therefore, implies that the Functional Management (FM) or VM of road projects is achievable by reconciling the knowledge and strengthening of project functionalities.

It is important to note and has become explicit that management is all about analysis and planning. Thus, Functional/Value Management (FVM) is all about Functional/Value Analysis (FVA) and Functional/Value Planning (FVP).

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

An intellectual endeavor aimed at discovering, interpreting and revising the body of existing human knowledge is called an academic research. According to Fellows and Liu (2008), a research can be expressed as a journey which leads to a discovery or not. Even if no discovery is made, some contributions will be made to the pool of available knowledge within the area of research. It is an attempt to solve the research aims and objectives by addressing the research questions and theoretical assumptions or hypothetical assumptions reinforcing the thesis in order to digest the research topic. It is also a careful, methodical and systematic investigation which leads to a contribution to the existing repository of facts. Every thesis should have procedures aimed at addressing the research aims and objectives so that the research topic can be well executed. This is the systematic formula to solving every thesis topic.

In Chapter two, an extensive literature on Value Engineering (VE) was reviewed as an advanced intervention to achieving an optimum Value for Money (VFM) on road projects leading to the identification of the key research questions. These questions also highlighted on the advanced as against the conventional VFM practice to establish the VFM limitations by way of a meticulous assessment of the certainty levels of the Road Professionals (RPs) or Technical Professionals (TPs) to the advanced VFM practice or VE and its effectiveness on road projects in Ghana. In this chapter, the following procedures or formulae to solving the research topic, including the aims and objectives have been addressed:

(i) Establishing the relation to the research methodology;

(ii) Research strategy, approach and design;

(iii) Population, sampling and sampling techniques;

(iv) Sources of data and data collection instruments;

(v) Data processing, presentation, analysis and discussion of results; and (vi) Ethical issues and considerations.

3.2 ESTABLISHING THE RELATION TO THE RESEARCH METHODOLOGY

As far as this research topic is concerned, it stands out that there are basically three issues of utmost concern and relevance:

(i) VE (as an advanced VFM tool);

(ii) Project Management (PM, as a conventional VFM tool); and the

(iii) VFM adequacy of VE over PM.

The reason is that, road projects in Ghana have been known over the years as projects that have incurred inadequacy of VFM as a result of the unabated pitfalls in the PM administration of the project deliverables whose direct correlation with VFM cannot be overemphasized. This, therefore, was based on establishing the significance for an adequate and a satisfactory VFM through the Functional Analysis System Technique (FAST) for road projects in Ghana by looking at the PM techniques which have achieved inadequate VFM and the VE technique which is believed to yield a satisfactory VFM. For this reason, it was necessary to explore or investigate these techniques in relation to VFM by administering questionnaires to RPs within the MRH. The relevance in methodology emanated from the premise that, VE encapsulated in each of the PM knowledge area can be adequately applied on road projects in Ghana for an optimum

VFM performance, thus the topic, 'Implementing VE on road projects in Ghana'.

3.3 RESEARCH STRATEGY, APPROACH AND DESIGN

This stage represents the techniques developed to solving this research problem by the quantitative research strategy, approach and design. It addressed the following key areas: research design; research style and research approach or strategy. The descriptive or survey or quantitative research design describes phenomena without influencing results. It is concerned with conditions and relationship that exists. The following steps were used in this type of research design:

(i) Clearly defined problems and research questions;

(ii) Method of data collection determined;

(iii) Sample of study selected;

(iv) Data collected through a data collection instrument (survey questionnaire);

(v) Data edited, coded, entered in SPSS and EXCEL, presented graphically and analysed; and

(vi) Results interpreted.

The quantitative research design was used to investigate into the research topic, aim and objectives, to establish the VFM adequacy for the satisfactory VM of road projects in Ghana right from theory through to findings; the research style is the survey and the research approach is the quantitative approach or strategy. In an attempt to digest this thesis problem statement, it was imperative to logically establish relationships among variables in questions and explore relationships devoid of external influences (Nenty, 2009). Accordingly, Nenty (2009) addresses that research design encompasses the techniques through which we can explore and analyze relationship among the variables involved in the problem statement and accordingly discuss the weakness of specific

processes over others. This research design is a principal plan with demonstrations on how the research is to be steered. Nevertheless, this thesis implements a questionnaire survey as an effort to establish the usefulness of value engineering on road projects in Ghana to promote its implementation. It is an undeniable fact that the solitary accessible technique of accomplishing the existing image of an agency, a firm, a professional body, an establishment, among others is a survey (Janes, 1999). As a result, Ayyash *et al.* (2011) contends that a survey helps to deliver developments in the population. Additionally, survey questionnaire has been recognized to be less costly and not time consuming to undertake (Ayyash *et al.*, 2011).

The justification to the trend of the researcher in the direction of the conduct of research is very vital (Bryman, 1992; Baiden, 2006). Naoum (1998) outlines research approach as the investigation of research objectives. Consequently, Baiden (2006) emphasized that, the three key aspects of research approaches are quantitative, qualitative, and triangulation. Nevertheless, the option to embrace any particular approach hangs on the aim of the study, the type of study, as well as the accessibility of information for the thesis (Naoum, 1998 cited from Baiden, 2006). Therefore, this research adopts a quantitative strategy or approach. Fellows and Liu (2008) defines quantitative strategies as approaches that tend to communicate positivism or the theories of knowledge in an attempt to collect realistic information, to examine connections among evidences and how such evidences and connections unite with philosophies and the discoveries of the research in earlier collected works. As such, scientific procedures are employed to achieve dimensional – computed statistics and the analyses of the information produce enumerated results and

deductions resulting from evaluation of the outcomes in the light of the philosophy and collected works (Fellows and Liu, 2008).

A quantitative approach was implemented in this thesis owing to the circumstance that quantitative studies followed a deductive method in relation to philosophy and is concerned with the design quantification and sampling (Naoum, 2002). Quantitative study is also unprejudiced and objective in nature and oriented on testing a hypothesis or theory composed of variables (Naoum 2002). Naoum (2002), specified the common data collection methods used in quantitative studies as questionnaires, tests and existing databases. Rigid and dependable documents are frequently assembled in quantitative studies and, thus, stresses on quantification. The samples assembled are frequently enormous and illustrative. This means that quantitative study outcomes can be comprehensively likened to a greater population within satisfactory inaccuracy bounds.

3.4 POPULATION, SAMPLING AND SAMPLING TECHNIQUE

Population in research design and methodology is any clearly defined set of objects, subjects, phenomena, cases, events or activities identified with the aim and objectives of sampling, and about which we want to obtain data. Thus, Population discusses the state in which a collection or units of concern are situated in a geographical region of importance during the period of undertaking the research (Taylor-Powell and Steele, 1996). A Target population is a population in which data is required (that is, the Road Infrastructure and Support Agencies (RISA) within MRH of Ghana) but a sampled or a study population is the population from which a sample is actually obtained for study as a result of certain essential constraints or limitations to research (that is, the Road Infrastructure and Support Agencies (RISA) within MRH in Koforidua). A valid

conclusion can be drawn from this target population since this target population and sampled population are similar in the characteristics under study. Accordingly, this research focused on the Road Professionals (RPs) or the Technical Professionals (TPs) in Road Infrastructure and Support Agencies (RISA) in Koforidua, a representative sample of the RPs or TPs in the MRH. These RPs or TPs comprised Regional Managers (RM),

Maintenance Managers (MAINTE), Operation Managers (OPM), Engineers (ENG), Assistant Engineers (AENG), Quantity Surveyors (QS), Land Surveyors (LS), Contract Managers (CM), Material Engineers (MATE), Technician Engineers (TENG), among others.

The purpose of sampling was to deliver a concrete means of permitting the data collection and processing components of the study to be accepted whilst guaranteeing the sample provided a good illustration of the population, thus, an illustrative sample (Fellows and Liu, 2008). Sampling is simply using a part of a population under study to epitomize the entire population. Nonetheless, Taylor-Powell and Steele (1996) contended that may not be essential if the entire population is small. Owing to the nature and kind of information needed; the multidisciplinary nature of the Value Engineering (VE) team and the resources available for this research survey, the focus on these RPs or TPs in Koforidua was to underscore the fact that the ability to achieve VFM is predominantly accomplished at each of the regional levels within the Road Infrastructure and Support Agencies (RISA) of MRH, however, Koforidua has one of the training centres for RPs or TPs within the Road Infrastructure and Support Agencies (RISA) also under MRH. Road Project

Administration to a large extent takes place at the regional levels and thus the achievement of an optimum VFM agenda rests to a larger extent on these Regional RPs or TPs who act as Regional Managers, Contract Managers, Maintenance Managers, Operation Managers, Materials Engineers, Regional Surveyors, Quantity Surveyors, inter alia, in each of the ten regions of Ghana. Judgmental or Purposive sampling was used to select the sampled population within the targeted population since the target population was undefined, that is, there was difficulty in accessing the sample frame. Accordingly, the sample size was determined as **thirty-four (34)** by census constituting all the RPs or TPs within the RISA under the MRH in Koforidua (as in Table 3.1).

Table 3.1 Sample size determined by Census

		Frequency	Percent
Valid	DFR	13	38.2
	DUR	7	20.6
	GHA	9	26.5
	KTC	5	14.7
	Total	34	100.0

Judgmental or Purposive Sampling was the sampling technique used. This procedure became necessary in this context because there was the need to reach my targeted sample quickly as a result of the fact that all these RISA under the MRH in Ghana were also identified in Koforidua and accordingly sampling for proportionality was not a primary concern. Koforidua was selected with a purpose of the presence of the Koforidua Training Centre for the training of Ministry of Roads and Highways Road Professionals even in

addition to the other Road Infrastructure and Support Agencies since there was some level of difficulty in coming up with a sampling frame.An undefined target population existed.

3.5 DATA SOURCES AND DATA COLLECTION INSTRUMENTS

Data originating from primary source (quantitative) and secondary source (published and unpublished materials from internal and external source) were employed for this study. The data were gathered to include every phase of the study. Neville (2007) contended that research should comprise practical study data. Thus primary data are essential to the conduct of any study. The primary data in this study targeted the population aforementioned.

For the past years, scientific approaches of data collection have come to control the arena of evaluation (Taylor-Powell and Steele, 1996). The data collection instrument or method was through a self-administered internet survey questionnaire targeting RPs or TPs within the Road Infrastructure and Support Agencies (RISA) of the MRH in Koforidua. Questionnaires were self-administered on-line because there was the need to speedily and straightforwardly get a lot of data from respondents in an ethical way without personally being involved to influence respondents' responses. The response structure on the questionnaire was predominantly closed-ended questions and also tried as much as possible to exhaust alternative multiple-choice questions in appropriate cases with the use of the phrase: others (please specify). Closed-ended questions were adopted because of its simplicity and ease in analysis. Piloting of questionnaires were done by targeting only about three (3) Engineers in DFR after which there was the need to finally restructure my questionnaire which ensured a 100% response rate. It is important to note that these

piloted questionnaire were not included in my results since these three (3) respondents were once again served with the revised questionnaires.

The questionnaire sought to establish the usefulness of Value Engineering (VE) on road projects in Ghana to encourage its implementation. This questionnaire comprised five thematic areas with one independent variable (i) and four dependent variables (ii, iii, iv, and v):

(i) Respondents Profile; and questions on

(ii) Conventional VFM practice;

(iii) RPs or TPs' varying opinions on VE;

(iv) Advanced VFM practice; and finally

(v) Establishing the effectiveness of VE on road projects in Ghana.

The response structure to the rating questions was by the use of a 5-point likert scale.

3.6 DATA PROCESSING, PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS

Quantitative Statistical Data Analysis is the meticulous processing of data, its critical examination, pictorial presentation, performance of quantitative statistical tests (exploratory and hypothetical tests), interpretation and discussion to understand the respective data parts, significance levels of hypotheses and relationships geared towards discovering its trends. The collected questionnaires were edited, coded and entered into the Statistical Package for Social Sciences (SPSS) 16.0 and Microsoft Excel for analysis. The questionnaire data sets were basically categorical (nominal) and continuous (ratio). The analysis of these data sets were executed and accomplished by these statistical tools. Interpretation of the argument in this area of VE were successively exhibited graphically

and also in tabular form. Nominal data involving the actual information about the respondents (the independent variable) as well as the nominal data from the first dependent variable were presented in pie charts and bar graphs. These graphs were used to show the proportion of occurrences of categories or values or groupings for each associated variable. Line graphs were also used for the remaining three dependent variables with continuous data. These Line graphs were used to show the trends for each dependent variable. These data from the independent variable were nominal and as such analysed by descriptives (modes or frequencies) and inferentials of non-parametric tests comprising binomial tests for questions with two choice (yes or no) responses and chisquare tests for questions with multiple choice responses. The dependent variables comprised one nominal and three continuous variable datasets. The nominal variable data were analysed using descriptives (modes or frequencies) and inferentials of nonparametric tests comprising chi-square tests alone since all questions were with multiple choice responses. The remaining dependent variables of exclusively continuous variable data were accordingly analysed using descriptives (mean, standard deviations and variances) and inferential (hypothetical or bivariate) parametric statistical methods (Pearson correlation tests and ANOVA tests) of data analysis. The ANOVA tests were used because there was the need to handle these Road Infrastructure and Support Agencies (RISA) as independent groupings of four namely DFR, GHA, DUR and KTC. These inferential statistical data analysis methods were employed based on certain hypothetical assumptions made before initiating the statistical tests using SPSS. Some of these general assumptions made parametrically and non-parametrically were:

(i) Continuous data were assumed parametrically to follow a normal distribution curve with means (averages) as distinct measures of central tendencies;

(ii) Confidence Levels were assumed at predominantly 95% with a complement significance level of p=5%; those set at 99% had a corresponding p=1%;

(iii) Data sets were measured parametrically and non-parametrically with continuous data and nominal data respectively;

(iv) The RISA (DFR, GHA, DUR, KTC) were considered as independent groupings with data sets accordingly subjected to appropriate statistical tests;

(v) The Pearson's Correlation tests were determined from the relatedness of variables as follows:

Let H_O = Null Hypothesis and H_A = Alternative Hypothesis

Now test hypotheses:

H_O : variables are related

H_A : variables are not related

But for $p < 0.05$ reject null hypothesis (that is, there is statistical significance and corresponding hypothetical responses are rendered invalid since their pvalue has violated and defied the set significance level of 0.05) and for $p > 0.05$ accept null hypothesis (thus, no statistical significance and as such corresponding hypothetical responses are accommodated);

(vi) ANOVA tests were determined from the premise that the mean differences between and within groupings were the same and can be seen as follows:

Let H_O = Null Hypothesis and H_A = Alternative Hypothesis

Now test hypotheses:

H_O : mean differences between and within groupings are the same

H_A : mean differences between and within groupings are not the same

But for $p < 0.05$ reject null hypothesis (that is, there is statistical significance as a result of the significant mean differences and corresponding hypothetical responses are rendered invalid since their p-value has violated and defied the set significance level of 0.05) and for $p > 0.05$ accept null hypothesis (thus, no statistical significance with no significant mean differences and as such corresponding hypothetical responses are accommodated);

(vii) Chi-square test was employed to decide whether there was significant association between variables X and Y as follows: Let H_O = Null Hypothesis and H_A = Alternative Hypothesis

Now test hypotheses:

H_O : Variable X and Variable Y are independent

H_A : Variable X and Variable Y are not independent

But for $p < 0.05$ reject null hypothesis (that is, there is statistical significance and corresponding hypothetical responses are rendered invalid since their pvalue has violated and defied the set significance level of 0.05) and for $p > 0.05$ accept null hypothesis (thus, no statistical significance and as such corresponding hypothetical responses are accommodated);

(viii) For the Binomial tests there was the determination of whether a quantity of a single dichotomous variable was equivalent to the assumed population value as follows:

Let H_O = Null Hypothesis and H_A = Alternative Hypothesis

Now test hypotheses:

H_O : Quantity of a single dichotomous variable is equivalent to the assumed population value

H_A : Quantity of a single dichotomous variable is not equivalent to the assumed population value

But for $p < 0.05$ reject null hypothesis (that is, there is statistical significance and corresponding hypothetical responses are rendered invalid since their pvalue has violated and defied the set significance level of 0.05) and for $p > 0.05$ accept null hypothesis (thus, no statistical significance and as such corresponding hypothetical responses are accommodated);

(ix) Each of the RPs or TPs respondents belonged to only one of the groupings.

(x) Parametric data sets had scores for the continuous data with only small variations between respondents as well as small variations from their group means. That is, there were no significant outliers to reduce the validity of results.

(xi) All parametric data sets were independent in relationships but non-parametric data sets were not.

(xii) Assumed homogeneous variances for all parametric data but heterogeneous for non-parametric data.

(xiii) Typical data sets for parametric tests were continuous and that for nonparametric were nominal.

(xiv) Nominal data were assumed non-parametrically and as such based on the frequencies in the categories of responses given

The choice of statistical tests depended on the following:

(i) The level of data (nominal , continuous)

(ii) The number of independent groupings (greater than two)

(iii) Data collected from independent groupings or related groupings (independent groupings of DFR, GHA, DUR, KTC)

(iv) Characteristics of the data (normally distributed or not)

The result of the study were assessed with the research objectives and questions. Thus, the tables and charts were employed for data presentations and SPSS for data analysis using descriptive and inferential statistical methods of quantitative data analysis.

3.7 ETHICAL ISSUES AND CONSIDERATIONS

Fisher (2010) underscores the need for the display of decorum and research ethics to ensure that respondents are highly protected and their privacies are also held in high esteem. This study has not been a means of harming any respondent in whatsoever manner. In negotiating access to research, I tried to negotiate the terms of reference with these Road Infrastructure and Support Agencies (RISA) I carried out the research in.

This study was assembled with philosophies geared towards guarding the confidentiality of each and every respondent who, in the course of the study was asked to provide pertinent or commercially appreciated statistics about themselves (hereinafter referred to as a subject of the study). Before one becomes a subject, the person was educated about the goals, approaches, expected benefits and probable dangers of the study. No respondent becomes a subject unless the respondent is fully in the know of or familiar with the data referred to in the foregoing section.

Ethical considerations and issues for this thesis were as follows:

(i) Protection of respondents from any malicious act;

(ii) Provision of a reliable preliminary introduction of thesis to respondents prior to the answering of questionnaires;

(iii) Protection of the privacy of respondents; and

(iv) Honesty with other professional colleagues.

CHAPTER FOUR DATA PROCESSING, PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS

4.1 INTRODUCTION

Clearly this chapter presents the analysis and discussion of the primary data collected from the **thirty-four (34)** respondents (RPs or TPs) within the Road Infrastructure and Support Agencies (RISA) of the MRH (Refer to Table 3.1). Owing to the nature and kind of information needed; the multidisciplinary nature of the Value Engineering (VE) team and the resources available for this research survey, the focus on these RPs or TPs in Koforidua was to underscore the fact that the ability to achieve VFM is predominantly accomplished at each of the regional levels within the Road Infrastructure and Support Agencies (RISA) of MRH, however, Koforidua has one of the training centres for RPs or TPs within the Road Infrastructure and Support Agencies (RISA) also under MRH. Road Project Administration to a large extent takes place at the regional levels and thus the achievement of an optimum VFM agenda rests to a larger extent on these Regional RPs or TPs who act as Regional Managers, Contract Managers, Maintenance Managers, Operation Managers, Materials Engineers, Regional Surveyors, Quantity Surveyors, inter alia, in each of the ten regions of Ghana. Judgmental or Purposive sampling was used to select the sampled population within the targeted population since the target population was undefined, that is, there was difficulty in accessing the sample frame. Accordingly, the sample size was determined as **thirty-four (34)** by census constituting all the RPs or TPs within the RISA under the MRH in Koforidua (DFR, GHA, DUR and KTC). This chapter, therefore, presents the analysis and the discussion of data gathered from respondents in DFR, DUR, GHA and KTC within the RISA of the MRH in Koforidua.

Respondents were the Road Professionals (RPs) or Technical Professionals (TPs) within these Agencies with **thirteen (13)** from DFR, **nine (9)** from GHA, **seven (7)** from DUR and **five (5)** from KTC all in Koforidua.

It is of great importance to note that this chapter focused on the presentation of the results of the analysis and discussion to establish the usefulness and the effectiveness of Value Engineering (VE) on road projects in Ghana so that this advanced VFM tool can be adopted and encouraged in its implementation.

All of the **thirty-four (34) questionnaires** administered were responded to adequately and completely (100% response rate), as a result of the fact that I instituted successive follow-ups even after administering questionnaires by email and as well quoted with plea on the cover page of questionnaire a time limit for responses to questions.

4.2 ANALYSIS OF THE INDEPENDENT VARIABLE

The Profile of all respondents (the independent variable) in the section one (1) of questionnaire covered the Road Agencies of respondents, their current job positions, educational levels, professional affiliations, professional experience, VE knowledge and the extent of VE practice within the agencies. These captured data of respondents were to expound and illustrate the genuineness, richness, reliability and authentic nature of all response data, discussions and findings in this thesis. An extensive analysis has been made over here to investigate and draw conclusions from the research objectives to substantiate the research aim and topic. Statistical Analysis used over here were Descriptive Statistical Analysis (Modes or Frequencies) and Inferential (Hypothetical or Bivariate) Statistical Analysis (Non-parametric: Binomial and Chi-square tests)

4.2.1 DESCRIPTIVES

Road Infrastructure and Support Agencies (RISA) of respondents

RISA are the implementing Agencies of all road projects under the MRH at all regional levels in Ghana. As part of the questions posed to respondents in the questionnaire, there was the need to categorize responses from the semi-autonomous RISA under the MRH in Koforidua, namely, DFR, DUR, GHA and KTC. Respondents in these category were solely the Road Professionals (RPs) or the Technical Professionals (TPs). This study could have equally ignored this disintegration within the RISA under MRH since they all have a common task to administer road projects in Ghana, however, it became so necessary because they all have unique mission and vision statements.

Table 4.12 RISA

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DFR	13	38.2	38.2	38.2
	DUR	7	20.6	20.6	58.8
	GHA	9	26.5	26.5	85.3
	KTC	5	14.7	14.7	100.0
	Total	34	100.0	100.0	

The motive supporting the selection of these category of respondents was as a result of the different and semi-autonomous road project administration at regional levels so as to draw and bring out distinctively the independent road project administration among these Support Agencies. The following highlights the breakdown of responses from the **thirty four (34)** respondents (refer to Table 4.12): **thirteen (13)** respondents came from DFR, **nine (9)** respondents came from GHA, **seven (7)** respondents came from DUR and **five**

(5) respondents came from KTC, representing **38.24%**, **26.47%**, **20.59%** and **14.71%** respectively.

Job position of respondents

Job positions depict the offices and departments of operation of respondents in terms of their managerial administration and technical expertise within the RISA under MRH. The job positions of respondents apparently connect with their level of involvement in decision making and implementation of optimum road project policies within the RISA of the MRH. Accordingly, respondents were asked to indicate their job positions in order to give authority, credibility and reliability to the sort of response that shall be elicited. It is apparent from Fig. 4.2 that from DFR, **one (1)** Regional Manager, **three (3)** Operation Managers, Quantity Surveyors were **three (3)** and **one (1)** Quantity Surveyor Technician**,** Land Survey Technicians were **three (3), two (2)** Materials Laboratory Technicians; that from GHA, **one (1)** Regional Manager, **one (1)** Maintenance Manager**, one (1)** Quantity Surveyor and **two (2)** Quantity Surveyor Technicians, **one (1)** Materials Laboratory Engineer and **two (2)** Materials Laboratory Technicians, **one (1)** Land Surveyor; that from DUR, **One (1)** Regional Manager**, two (2)** Engineers, Quantity Surveyors were **two (2), one (1)** Land Surveyor, **one (1)** Materials Laboratory Technician; that from KTC, **two (2**) Engineers, **two (2)** Assistant Engineers and only **one (1)** Quantity Surveyor. Thus in all, **8.82%, 2.94%, 8.82%, 20.59%, 5.88%, 2.94%, 29.41%, 14.71%, 5.89%** represented responses from Regional Managers, Maintenance Managers, Operation Managers, Quantity Surveyors, Land Surveyors, Material Engineers, Technician Engineers, Engineers and Assistant Engineers respectively.

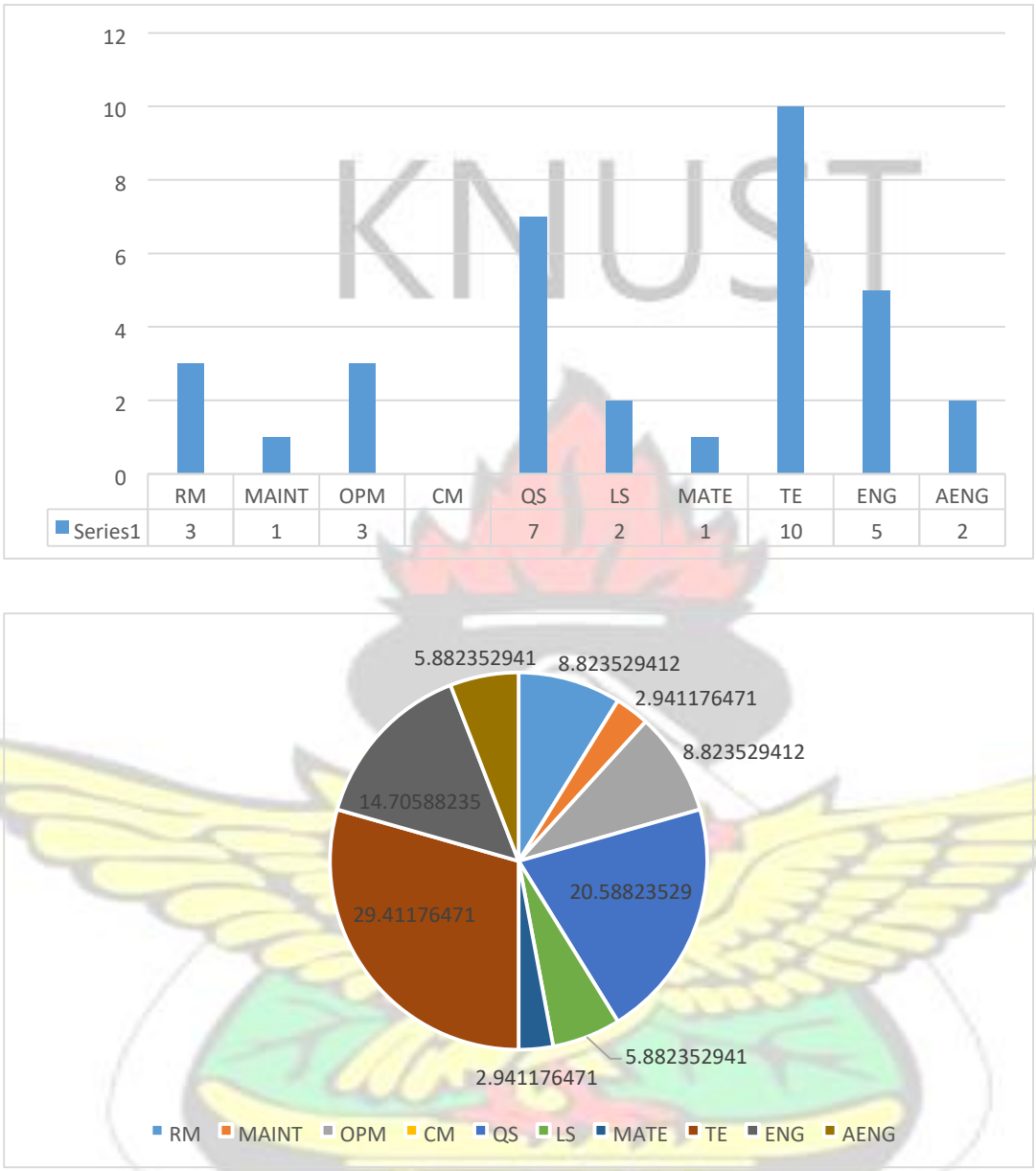
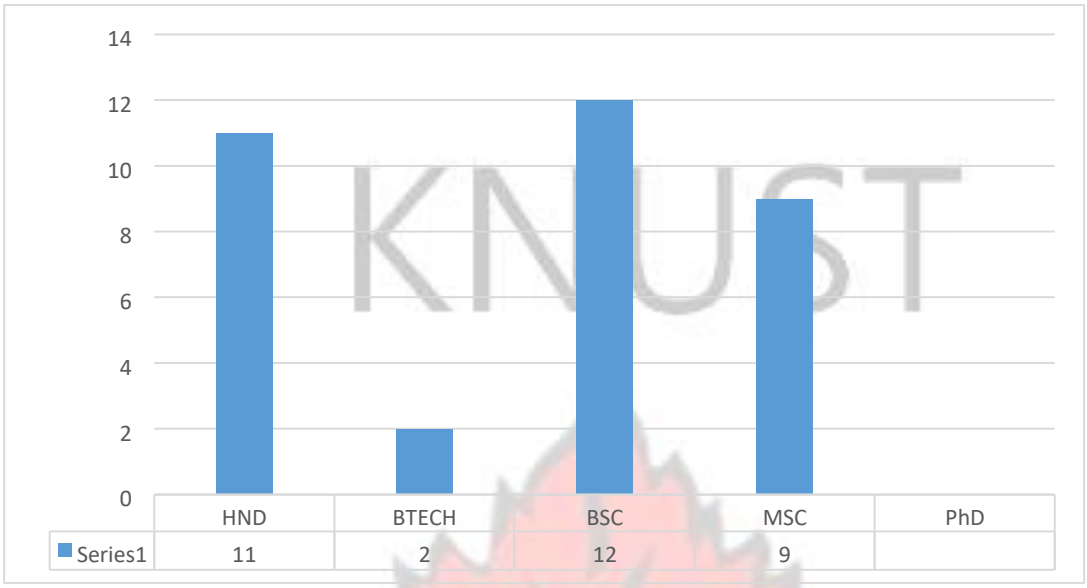


Fig. 4.2 Job Positions of Respondents

Educational qualifications of respondents

Educational qualifications represent the fully certified academic levels or stages attained by respondents. This portrays the levels of wide knowledge and training achieved by respondents so far. The question for respondents to identify their levels of education was

presented in the questionnaire to identify the educational achievements of these respondents since the levels of their educational qualifications to a larger extent determined their knowledge worth, value and propensity to their corresponding official positions attained within their respective road agencies and hence their participation in road PM critical decisions such as issues on VFM policies. Such involvements as well determined the quality, value, worth and functionality of responses given. Cursory look at Fig. 4.3 revealed that majority of the respondents were BSc holders, followed by HND holders, then BSc holders with very few being BTECH holders. Among these **thirtyfour (34)** respondents, BSc holders were **twelve (12)** representing **35.29%,** HND Holders were **eleven (11)** representing **32.35%,** MSc Holders were **nine (9)** representing **26.47%** and BTECH Holders were **two (2)** representing **5.88%.** In DFR, out of a total of **thirteen (13)** respondents, HND Holders were **six (6)** representing **46.15%**, followed by **four (4)** BSc Holders representing **30.77%** and **three (3)** MSc Holders representing **23.08%.** From GHA, out of a total of **nine (9)** respondents, HND Holders were **four (4)** representing **44.44%,** followed by **three (3)** BSc Holders representing **33.33%** and **two (2)** MSc Holders representing **22.22%.** In DUR out of a total of **seven (7)** respondents, HND Holder was only **one (1)** representing **14.29%,** BSc Holders were **five (5)** representing **71.43%** and **one (1)** MSc Holder also representing **14.29%**. Finally from KTC, out of a total of **five (5)** respondents, BTECH Holders were **two (2)** representing **40%** and MSc Holders were **three (3)** representing **60%.**



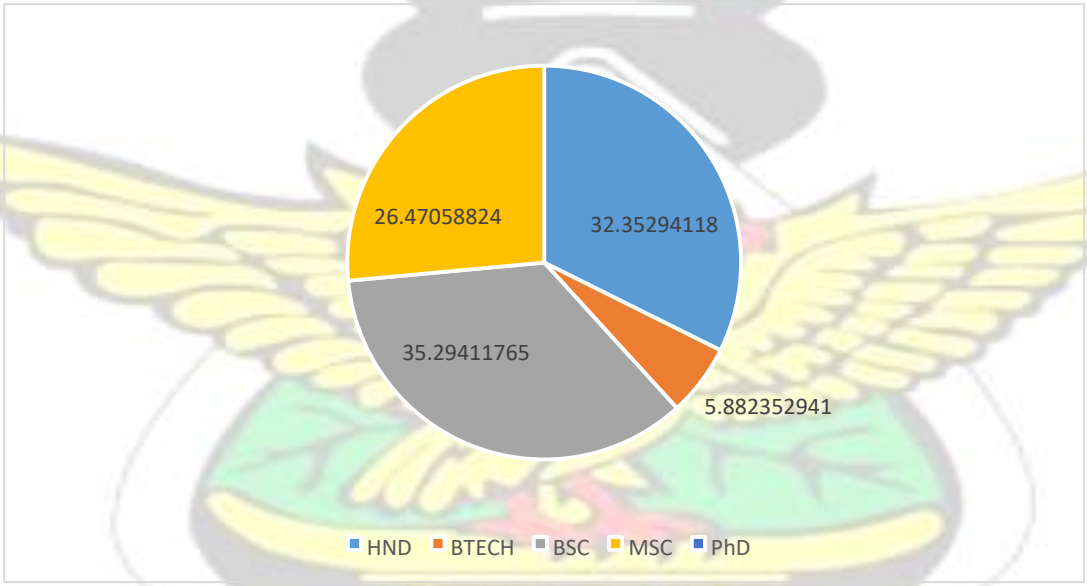
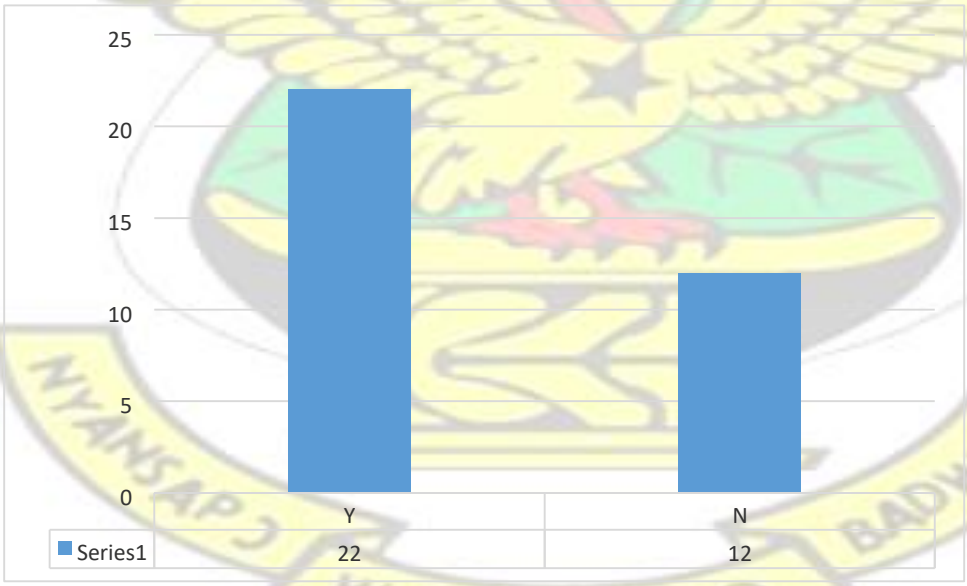


Fig. 4.3 Educational Levels of Respondents

Professional affiliation of respondents

Professional bodies are the licensed regulating bodies with the sole powers conferred on them to control and manage the practicing of all these Technical Professionals (TPs) in

Ghana. These licensed bodies have the powers to inculcate into these TPs with sound professional ethics which attaches much prestige, reliability, honorability, legality and credibility to these professionals affiliated to them. Some of these regulating bodies when it comes to road project administration are GhIE and GhIS. The question to know whether or not these RPs or TPs respondents were affiliated to any professional bodies in Ghana was an attempt to ensure a complete credibility, reliability and legality of responses given and to draw out distinctively the ability to implement VE or not on road projects at the end of this thesis. Being part of a professional body meant that a respondent has been recognized by law to practice in the country and thus all responses given by such respondents should be held valid, legal and credible for implementation at the national level. Cursory look at Fig.4.4 illustrates the yes or no responses to respondents' professional affiliations representing **twenty-two (22)** and **twelve (12)** responses for **64.71%** yes and **35.29%** no responses respectively.



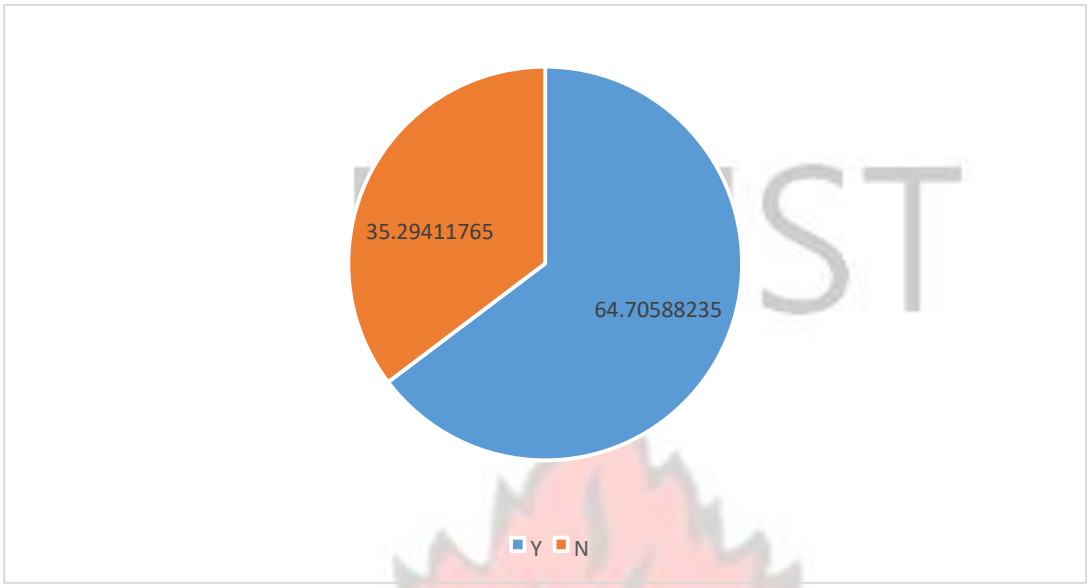


Fig. 4.4 Professional Affiliation of Respondents

Professional experience of respondents

Experience is indeed the best teacher. Professional experience has a direct correlation with the technical expertise of respondents. Road Professionals (RPs) practice go with experience as a result of its challenging nature and unique approaches almost always. An attempt was made to discover the working experience of these TPs The brain behind this question was to ascertain the working experience of respondents on road projects. so as to give relevance to the quality and credibility of answers given out by each respondent who is more likely to have engaged in a number of road projects with different challenges encountered as well as different project management approaches in an attempt to achieve VFM.Therefore, these rich experience was so vital in the filling of the questionnaires. Cursory look at Fig.4.5 showed the breakdown of the working experiences of these respondents. Obviously, from Fig. 4.5 majority of the respondents have between 6 and

10 years, followed by few between 1 to 5 years, 11 to 15 years and finally, above 15 years. Thus, **2 (5.88%), 14 (41.18%), 8 (23.53%), 10 (29.41%)** were the responses received for **1to5, 6to10, 11to15 and above 15 years** of working experience respectively.

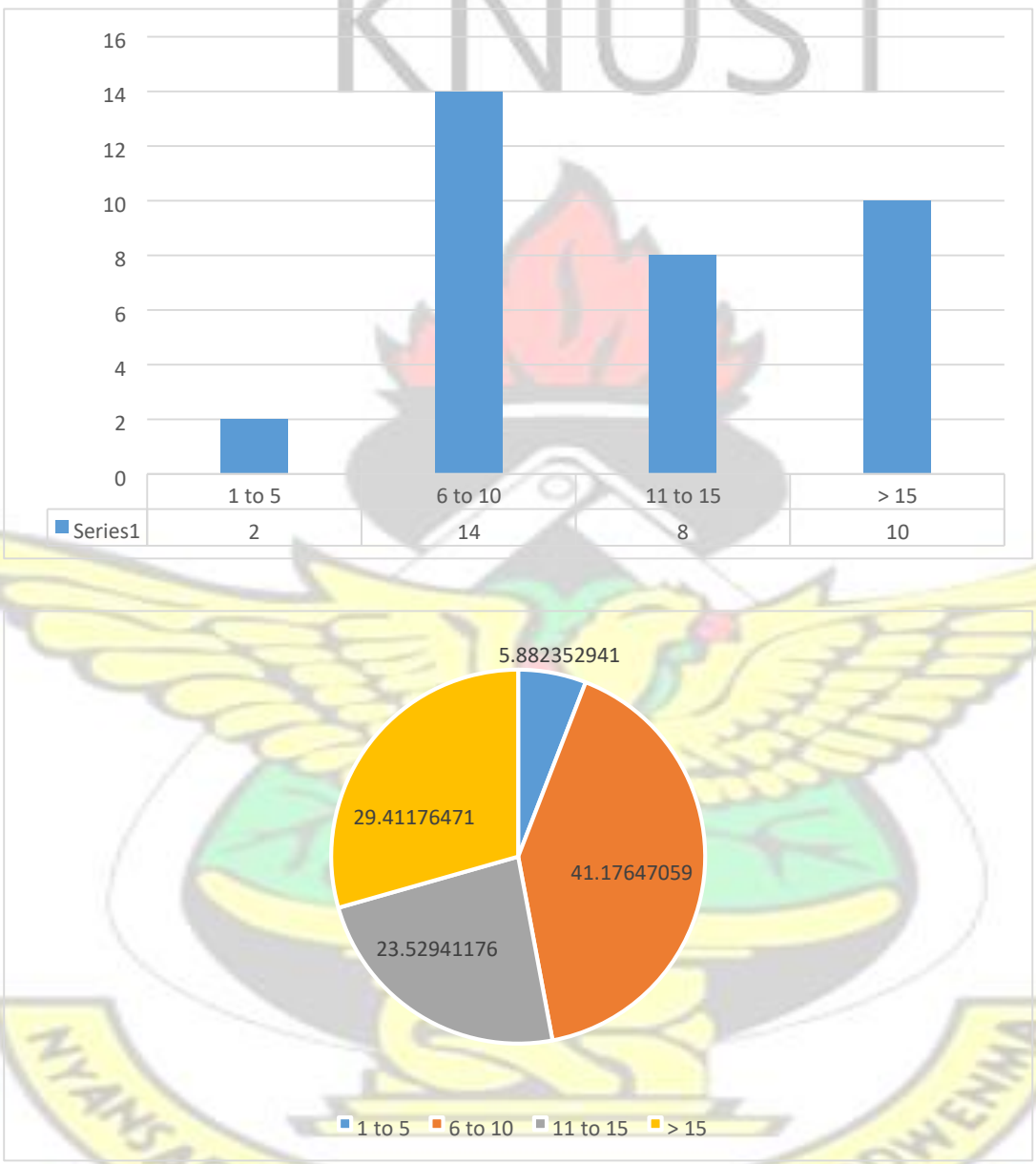
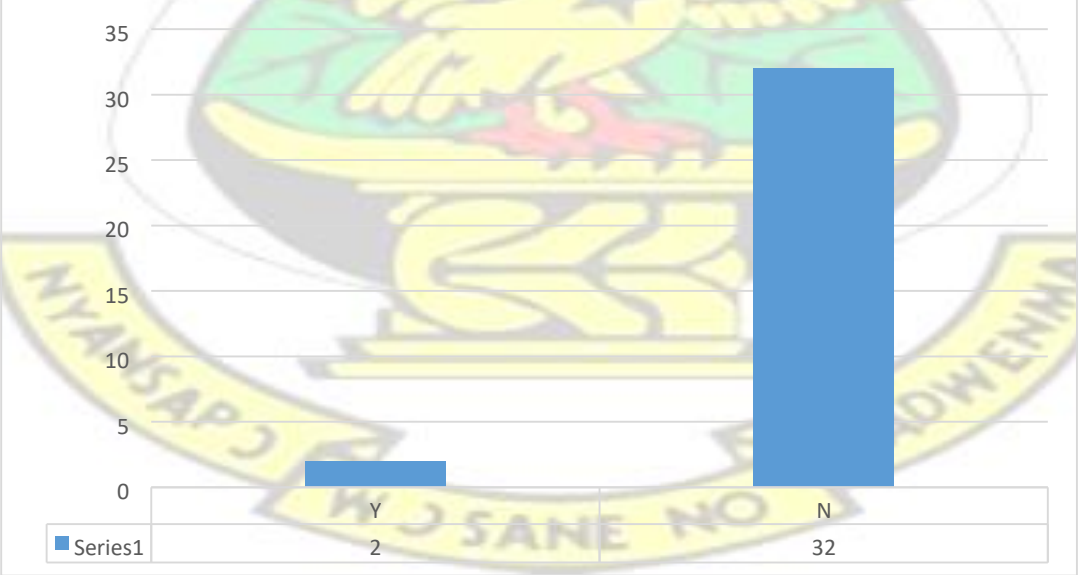


Fig. 4.5 Professional Experience of Respondents

Value Engineering (VE) awareness levels among respondents

Value Engineering (VE) originated in US in the 1940s at a period when imperative choices were to be taken concerning the alternate design selections required to overcome the inherent scarcity of resources. Upon its successful endorsement and implementation at that time, VE has been embraced by so many countries even including some countries in Africa and has also been implemented on different construction projects. It, thus, became so necessary to investigate into its existence since there appears to be a limitation to the achievement of VFM on road projects in Ghana. The rationale behind this question was to elucidate the level of knowledge, awareness, nature and extent of VE knowledge and its existence on road projects in Ghana from each of the **thirty four (34)** RPs or TPs respondents in Koforidua as an attempt to establish whether or not some level of awareness has already been created among these RPs in Ghana since the inception of VE in the US. It was, thus, revealed from the survey questionnaires administered that only **two (2)** respondents from KTC were aware of VE representing **5.88%.** All other responses to their awareness of VE was a big **94.12%** NO (Refer to Fig. 4.6).



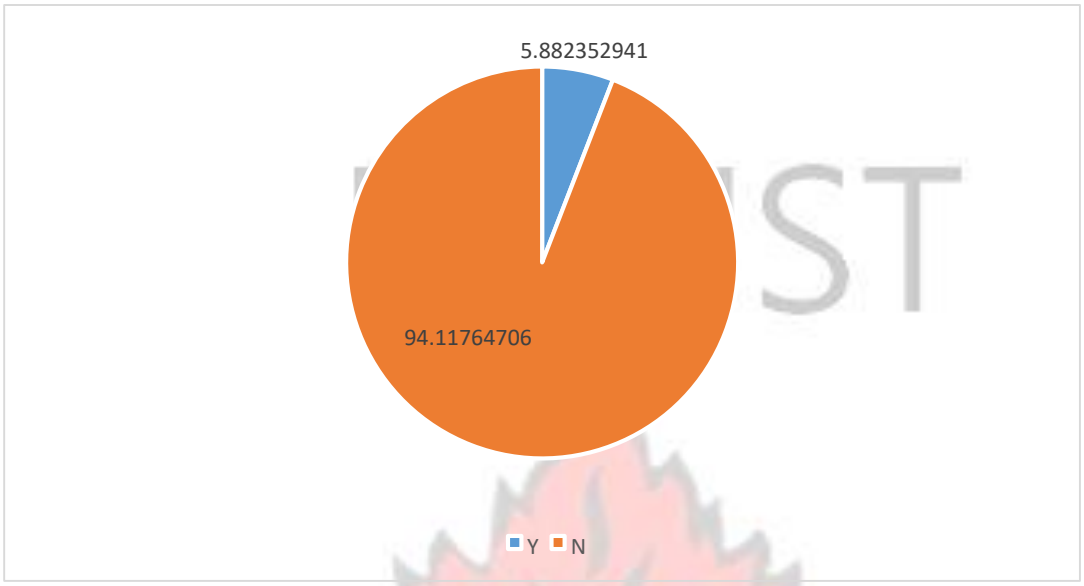
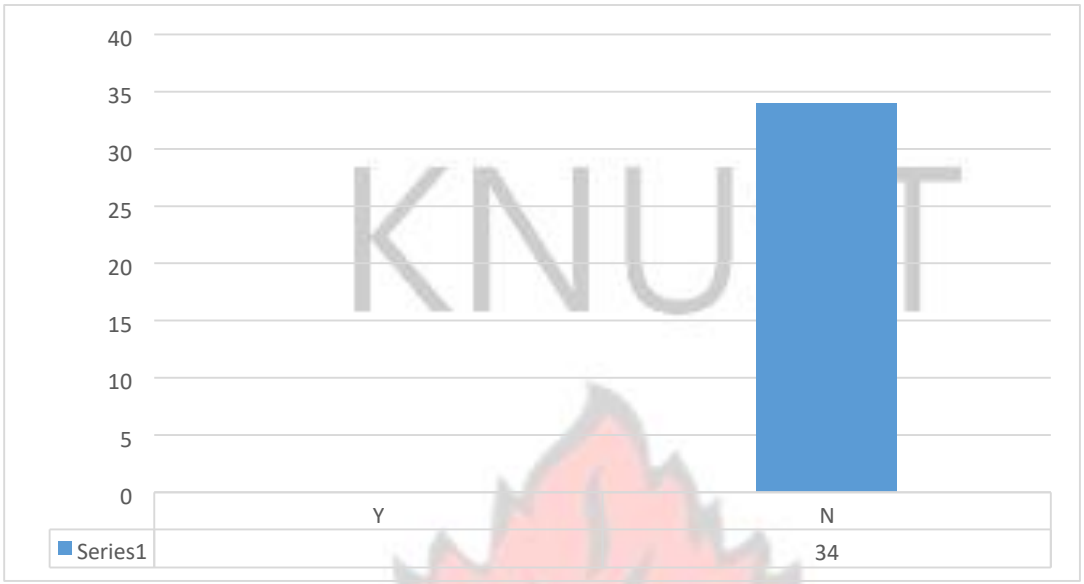


Fig. 4.6 VE Knowledge of Respondents

Value Engineering (VE) practice within the Road Infrastructure and Support Agencies (RISA) of respondents

An attempt to achieve an optimum VFM on road projects in Ghana required an adoption of VE, its practice and implementation. This was an effort made to investigate into the limitation in VFM agenda on road projects in Ghana. Accordingly, the question posed in the questionnaire was to be sure of the responses given on the awareness levels by individual respondents so as to bring out the true confirmation to the whether or not these respondents were actually practicing VE in their various outfits. It was revealed here that respondents in their attempt to achieve VFM on road projects were still using the old system of achieving VFM which was not VE being practiced. All responses given by respondents was a **100%** NO to the practice of VE in their respective Road Agencies, which therefore established the fact that no optimum VFM has been achieved so far on road projects in Ghana (Refer to Fig. 4.7)



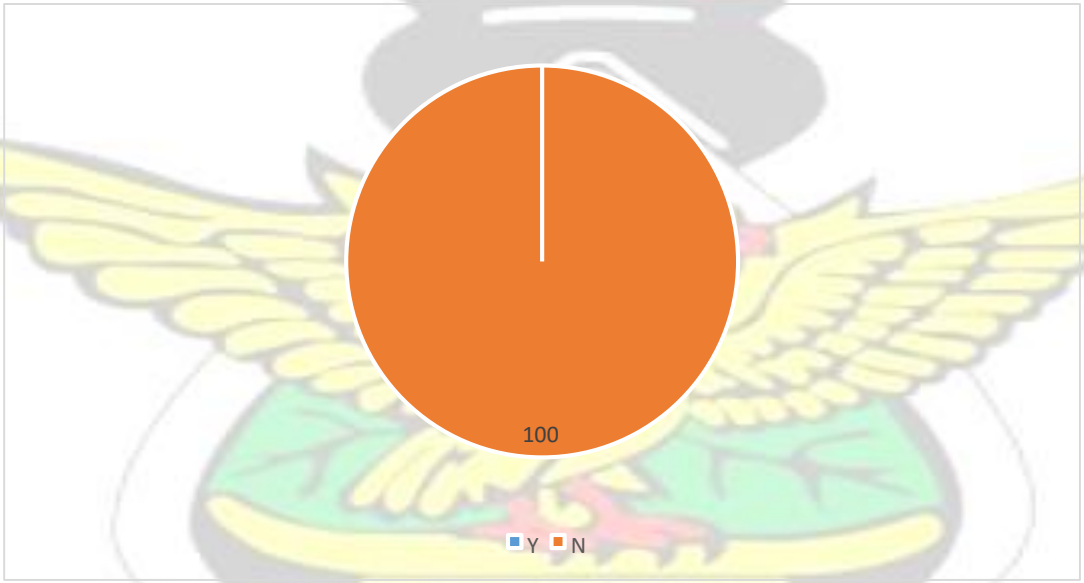


Fig. 4.7 VE Implementation on Road Projects

4.2.2 INFERENTIALS

The practical implication of the descriptives for this independent variable has been achieved completely through relevant and sound inferential (hypothetical or bivariate)

statistical tests. These statistical tests have been based on the fact that the data sets from this section are **100%** nominal. However, it is of much importance to note here that, questions (quite apart from the data sets) posed here were of two distinct types with corresponding responses:

(i) Multiple – choice questions; and

(ii) Dichotomous questions.

Out of the **seven (7)** questions presented in this section **one (1)** of questionnaire, **three (3)** were dichotomous questions (questions with only two alternative responses, thus, 'yes' or 'no') and the remaining **four (4)** were multiple-choice questions (questions with more than **two (2)** alternative responses). The hypothetical tests for these questions were the binomial and the chi-square tests for the dichotomous and the multiple-choice questions respectively.

Binomial Tests for Dichotomous Questions

The **three (3)** dichotomous questions posed over here were questions on:

(i) The Professional Affiliations of the TPs respondents;

(ii) Their VE awareness levels; and

(iii) Their VE practice in their respective RISA

Cursory look at Table 4.35;

Let H_O = Null Hypothesis and H_A = Alternative Hypothesis Now

test hypotheses based on the following assumptions:

H_O : Quantity from a single dichotomous variable is equivalent to the assumed population value

H_A : Quantity from a single dichotomous variable is not equivalent to the assumed population value

But for $p < 0.05$ reject null hypothesis (that is, the proportion of responses from a single dichotomous variable are not almost the same as its presumed population value since the variability of responses is significantly different, there is statistical significance and corresponding number of responses given are rendered invalid or insignificant for consideration here since their p-value has violated and defied the set significance level of 0.05) and for $p > 0.05$ accept null hypothesis (thus, the proportion of responses from a single dichotomous variable are almost the same as the presumed population value since the variability of responses is not significantly different among respondents, there is no statistical significance and as such corresponding hypothetical responses are accommodated);

Professional Affiliations of Respondents

From table 4.35, $p > 0.05$ since p is seen as 0.121 from the table. This, therefore, meant that the proportion of 'yes' or 'no' responses by the respective respondents are almost the same as their respective presumed population values of **twenty-two (22)** and **twelve (12),** respectively. Thus, it is accepted now that the variability in responses is not significantly different in each group. The number of responses given by each group of respondents are therefore valid, reliable, significant, consistent, in agreement and in harmony. Thus, there was coherence, evenness, consistency, and harmony of responses by respondents.

Table 4.35 BINOMIAL TEST

		Category	N	Observed Prop.	Test Prop.	Asymp. Sig. (2-tailed)
PBODY	Group 1	1	22	.65	.50	.121[a]
	Group 2	2	12	.35		
	Total		34	1.00		
VEKNWLG	Group 1	2	32	.94	.50	.000[a]
	Group 2	1	2	.06		
	Total		34	1.00		
VEINRISA	Group 1	2	34	1.00	.50	.000[a]
	Total		34	1.00		

a. Based on Z Approximation.

1. Yes
2. No

VE Awareness Levels of Respondents

From table 4.35, $p < 0.05$ since p is seen as 0.000 from the table. This, therefore, meant that the proportion of 'no' or 'yes' responses by the respective respondents were not almost the same as their respective presumed population values of **thirty-two (32)** and **two (2),** respectively. Thus, it is accepted now that the variability in responses is significantly different in each group. Perhaps, there could still be respondents who were outliers in each group and have thus influenced the responses negatively or may be the population value was too small to validate the test proportion results. Even though by and large almost all of the respondents or majority of the respondents may not be aware, it has become obvious that may be some have influenced this responses negatively, since may be they did not understand the question well. The number of responses given by each

group of respondents are therefore invalid, unreliable, insignificant, inconsistent, not in agreement and not in harmony, even though they may still not be privy to the concept of VE as an advanced VFM tool on the whole.

VE practice in the respective RISA

From table 4.35, $p < 0.05$ since p is seen also as 0.000 from the table. This, therefore, meant that the proportion of the 'no' responses by all the respondents were not almost the same as their respective presumed population values of **thirty-four (34).** Thus, it is accepted now that the variability in responses is significantly different in this group. Perhaps, there could still be respondents who were outliers in the group and have thus influenced the responses negatively or may be the population value was too small to validate the test proportion results. Even though by and large almost all of the respondents or majority of the respondents may not be practicing VE in their respective RISA, it has become obvious that may be some have influenced these responses negatively, since may be they did not understand the question well. The number of responses given by the group of respondents are therefore invalid, unreliable, insignificant, inconsistent, not in agreement and not in harmony, even though they may still not be practicing this concept of VE as an advanced VFM tool on the whole.

Chi-square Tests for Multiple-Choice Questions

The **four (4)** multiple-choice questions posed over here were questions on:

(i) The Road Infrastructure and Support Agencies (RISA) of the TPs respondents;

(ii) Their current positions;

(iii) Their educational levels; and

(iv) Their years of professional experience.

Cursory Look at Tables 4.25, 4.26, 4.27, 4.28 and corresponding 4.29;

Let H_O = Null Hypothesis and H_A = Alternative Hypothesis Now

test hypotheses based on the following assumptions:

H_O : Variable X and Variable Y are Independent

H_A : Variable X and Variable Y are not Independent

But for $p < 0.05$ reject null hypothesis (that is, Variable X and Variable Y are not independent since the variability of responses is significantly different, there is statistical significance and the corresponding number of responses are rendered invalid or insignificant for consideration here since their p-value has violated and defied the set significance level of 0.05) and for $p > 0.05$ accept null hypothesis (thus, Variable X and Variable Y are independent since the variability of responses is not significantly different among respondents, there is no statistical significance and as such corresponding hypothetical responses are accommodated);

Road Infrastructure and Support Agencies (RISA) of the TPs respondents

From table 4.25 (in the appendix) and the corresponding test statistics (refer to table 4.29), $p > 0.05$ since p is seen as 0.249 from the table. This, therefore, meant that the individual respondents were independent in terms of the RISA they belonged to since their respective expected frequencies were almost the same as their observed frequencies. Thus variability in their frequencies were not significantly different. The frequencies collated

are therefore valid, reliable, significant, consistent, in agreement and in harmony as a result of the fact that these RPs respondents are all different in terms of the RISA they belong to. Finally, it has become clear now that respondents from DFR are different from GHA, different from DUR, different from KTC in that wise, implying, no two agencies are related even though they all came under one umbrella of the MRH. This, therefore, validated the assertion that these RISA are semi-autonomous bodies under the MRH. Thus, there was coherence, evenness, consistency, and harmony of responses by respondents.

Table 4.29 Test Statistics

	RISA	POSITION	EDUCATION	JBEXP
Chi-Square	4.118[a]	13.059[b]	7.176[a]	10.471[a]
df	3	7	3	3
Asymp. Sig.	.249	.071	.066	.015

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 8.5.

b. 8 cells (100.0%) have expected frequencies less than 5. The minimum expected cell frequency is 4.3.

Current Positions of Respondents

From table 4.26 (in the appendix) and the corresponding test statistics (refer to table 4.29), $p > 0.05$ since p is seen as 0.071 from the table. This, therefore, meant that the individual respondents were independent in terms of their ranks in their respective Road Agencies since their respective expected frequencies were almost the same as their observed frequencies. Thus variability in their frequencies were not significantly different. The frequencies collated are therefore valid, reliable, significant, consistent, in agreement and

in harmony as a result of the fact that these RPs respondents are all different in terms of their respective job positions and job ranks or promotional levels. Finally, it has become so clear now that the RM is different from the MAINTE, different from the OPM, different from the MATE, different from the QS, different from the ENG, different from the AENG, different from the LS, different from the TENG, in that wise, implying, no two positions are related since one is higher in rank than the other even though they are all in the same Road Agency. This, therefore, validated the assertion that, for instance, the RMs are higher in terms of ranks than the OPMs within their respective RISA under the MRH. Thus, there was coherence, evenness, consistency, and harmony of responses by respondents.

Educational Levels of Respondents

From table 4.27 (in the appendix) and the corresponding test statistics (refer to table 4.29), $p > 0.05$ since p is seen as 0.066 from the table. This, therefore, meant that the individual respondents were independent in terms of their educational levels attained since their respective expected frequencies were almost the same as their observed frequencies. Thus variability in their frequencies were not significantly different. The frequencies collated are therefore valid, reliable, significant, consistent, in agreement and in harmony as a result of the fact that these RPs respondents are all different in terms of their educational qualifications and in terms of their knowledge worth. Finally, it has become so clear now that the MSc holders in the RISA are different from the BSc holders, different from the BTECH holders, different from the HND holders, in that wise, implying, MSc and a BSc holder are not related in any way. This, therefore, validated the assertion that, for instance, the MSc holders are more knowledgeable than say the HND holders in the RISA of the

MRH which also had some correlation with their promotional levels since say an HND holder cannot become a RM. Thus, there was coherence, evenness, consistency, and harmony of responses by respondents.

Professional Experience of Respondents

From table 4.28 (in the appendix) and the corresponding test statistics (refer to table 4.29), $p < 0.05$ since p is seen as 0.015 from the table. This, therefore, meant that the individual respondents were related (not independent) in terms of their job experiences in their respective Road Agencies since their respective expected frequencies were not almost the same as their observed frequencies. Thus variability in their frequencies were significantly different. The frequencies collated are therefore invalid, unreliable, insignificant, inconsistent, not in agreement and not in harmony since the respective job experience are within a range, may be, should the job experience be discretized, it would have annulled this anomaly and validated the null hypothesis. Thus, perhaps, the questionnaire alternative responses needed to have been stated in specifics, say, 5 years experience, 7years experience, 15 years experience, in that wise.

4.3 ANALYSIS OF THE DEPENDENT VARIABLES

The dependent variables were represented over here by the following categories of sections: conventional VFM practice**;** VE varying perceptions among RPs in Ghana; advanced VFM practice and the usefulness of VE on road projects in Ghana. An extensive analysis has been made over here to investigate and draw conclusions from the research objectives to substantiate the research aim and topic. Statistical Analysis used over here were Descriptive Statistical Analysis (Means, Standard Deviation and Variance) and Inferential (Hypothetical or Bivariate) Statistical Analysis (Non-parametric: Chi-square,

Parametric: Pearson Correlation and Analysis of Variance -ANOVA tests)

4.3.1 DESCRIPTIVES

Conventional VFM practice

Conventional VFM is the traditional way of achieving VFM which stems from the assertion that PM less VE yields an inadequate VFM on road projects in Ghana. It has been observed that RPs in Ghana are seriously glued to PM practices for an optimum VFM which from literature is believed to be deficient in VFM. Mostly for road contract documents in Ghana an attempt to achieve VFM has been through Project Time, Cost and Quality Management which form part of the PM knowledge areas. Even though it has always been the agenda of the project team to achieve VFM always from road projects as a result of its capital intensive nature and difficulties in sourcing fund, it stands to reason that no optimum VFM has been achieved even through this system. An attempt to achieve VFM with this conventional system is seen by a mere reduction in costs of resources, project deliverables, among others which is not VE and does not lead to an optimum VFM. The reason is that this conventional system lacks the element of functional analysis to achieve an optimum VFM. About **six (6)** questions were asked under this section of the dependent variable all in an effort to examine how the conventional system is limited in VFM. These questions presented clearly distinguished among responses the types of road projects being administered by RISA in Ghana and its extraordinary execution, the years executed whether before 1990, 2000 or beyond 2000, its initial budgeted cost, its initial budgeted time, its associated impacts with respect to the **three (3)** main controls in road contracts (time, cost and quality), and its overall assessment (whether successful, challenged or impaired).It is important to note that a

successful road project is a project that is executed on time and within approved budget and has all its original specifications; a challenged road project is one that is completed and implemented over time, over budget and has only fewer features as was originally specified; and an impaired or failed road project is one that is cancelled at some point during its development cycle. These responses were invited so as to establish whether in terms of achieving an optimum VFM by going the traditional PM ways (which from literature is believed to be limited) there was absolutely no element of functionality attached to delivering VFM to the client organization. From the **thirty-four (34)** responses received, it has become obvious to establish the fact that almost all of the seemingly extraordinary and remarkable projects that these astute professional respondents have managed so far especially from the commencement of the year 2000 have all recorded challenges as a result of its inevitable associated impacts. Cursory look at Fig. 4.8 to Fig.4.13 revealed the following:

(i) From Fig.4.8, it has been discovered that feeder road projects, trunk road projects, urban road projects and feeder donor funded road projects have been remarkably managed by respondents in the categories of **14(41.18%), 10 (29.41%), 9 (26.47%) and 1(2.94%)** respectively. Feeder road projects and trunk road projects are being administered more than the others under MRH, perhaps, because of the financing of such projects.

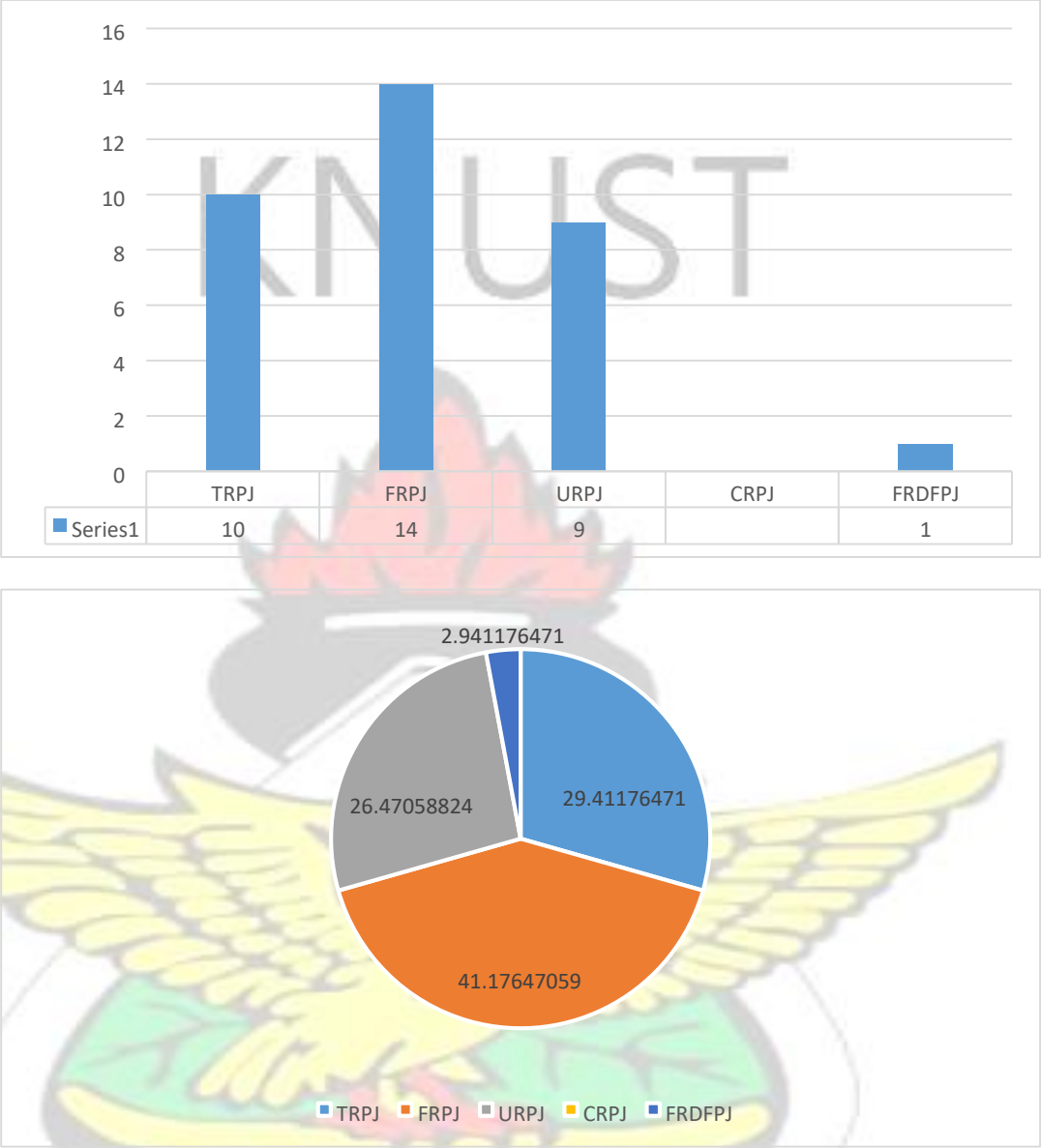


Fig. 4.8 PM (without VE) Extraordinary Road Projects

(ii) From Fig. 4.9, it has been discovered from responses that all road projects were remarkably managed as per respondents from the year 2000 and as such it becomes clear that nothing has really changed up till now as far as achieving an adequate VFM for the client organization is concerned.

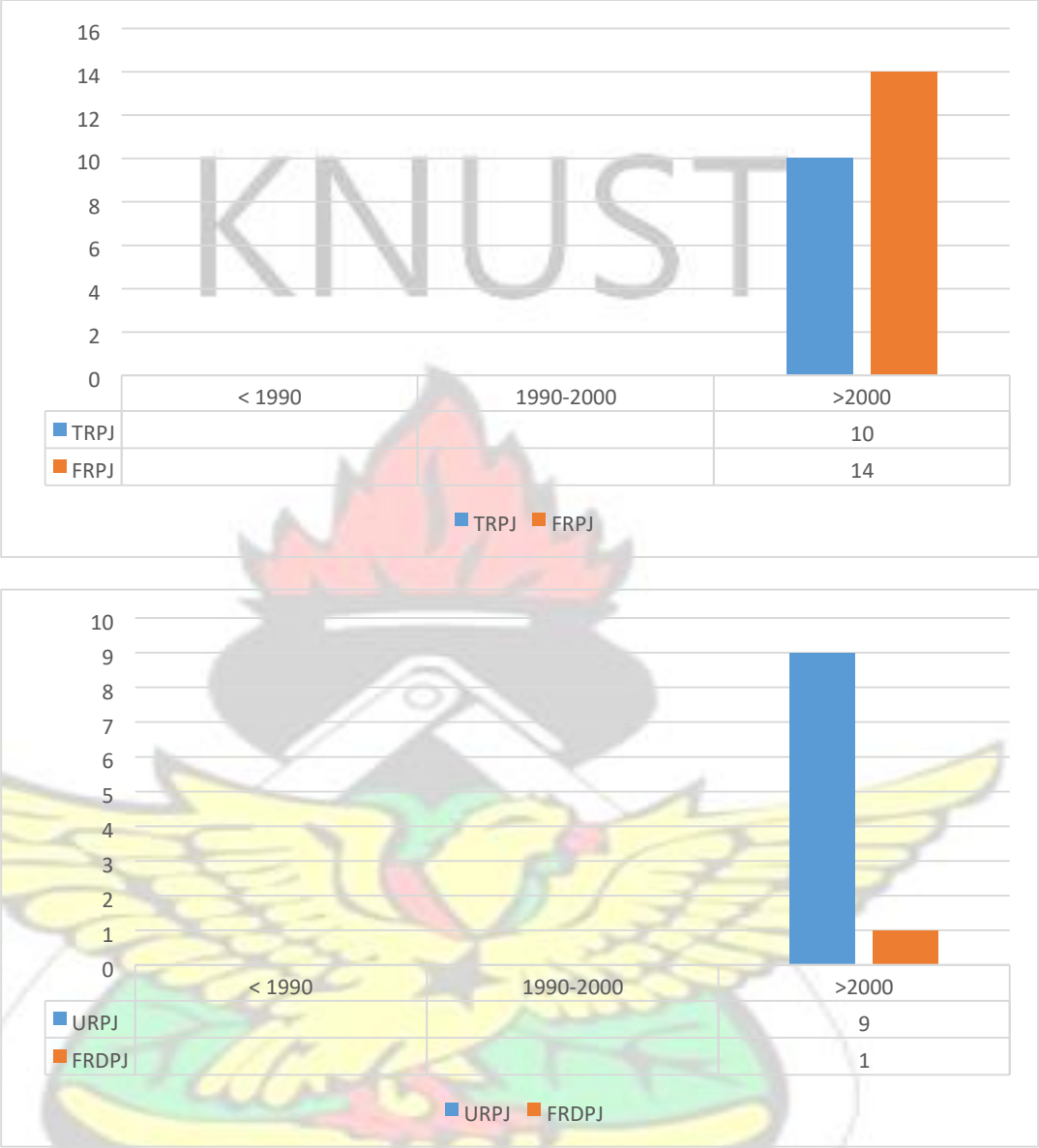
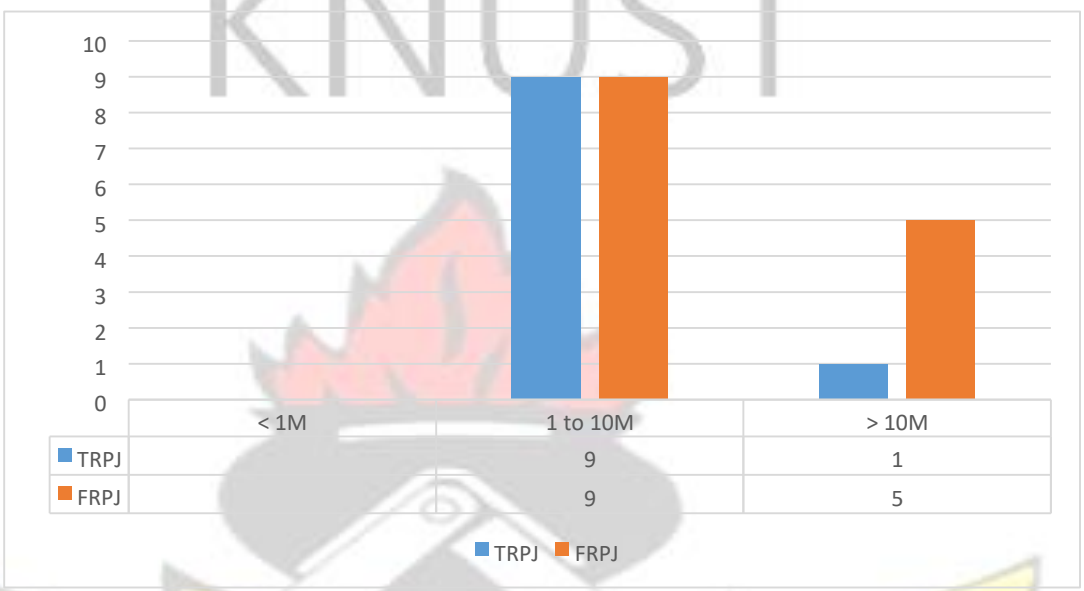
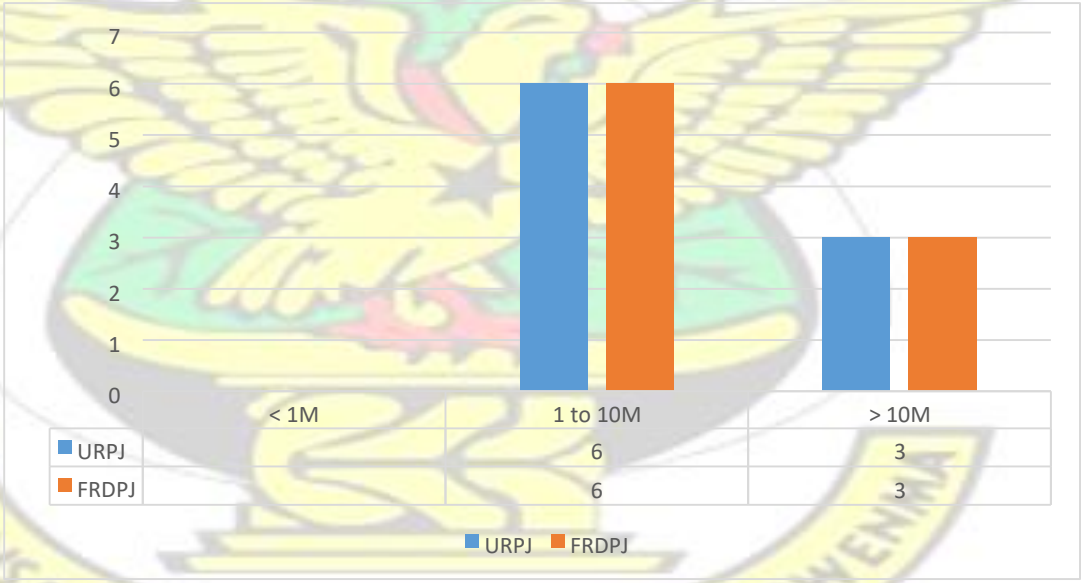


Fig. 4.9 Execution year of Extraordinary Road Projects

(iii) From Fig.4.10, **twenty-five (25)** road projects received initial budgeted costs between **1 to 10 million Ghana cedis** representing **73.53%** and **nine (9)** remarkable road projects were executed with an intial budgeted cost of **above 10 million Ghana cedis** also representing **26.47%.** This establish the capital

intensive nature of road projects even up till now which if no attempt is made to achieve an optimum VFM through VE in each PM practice, will in no time render the road ministry challenged.





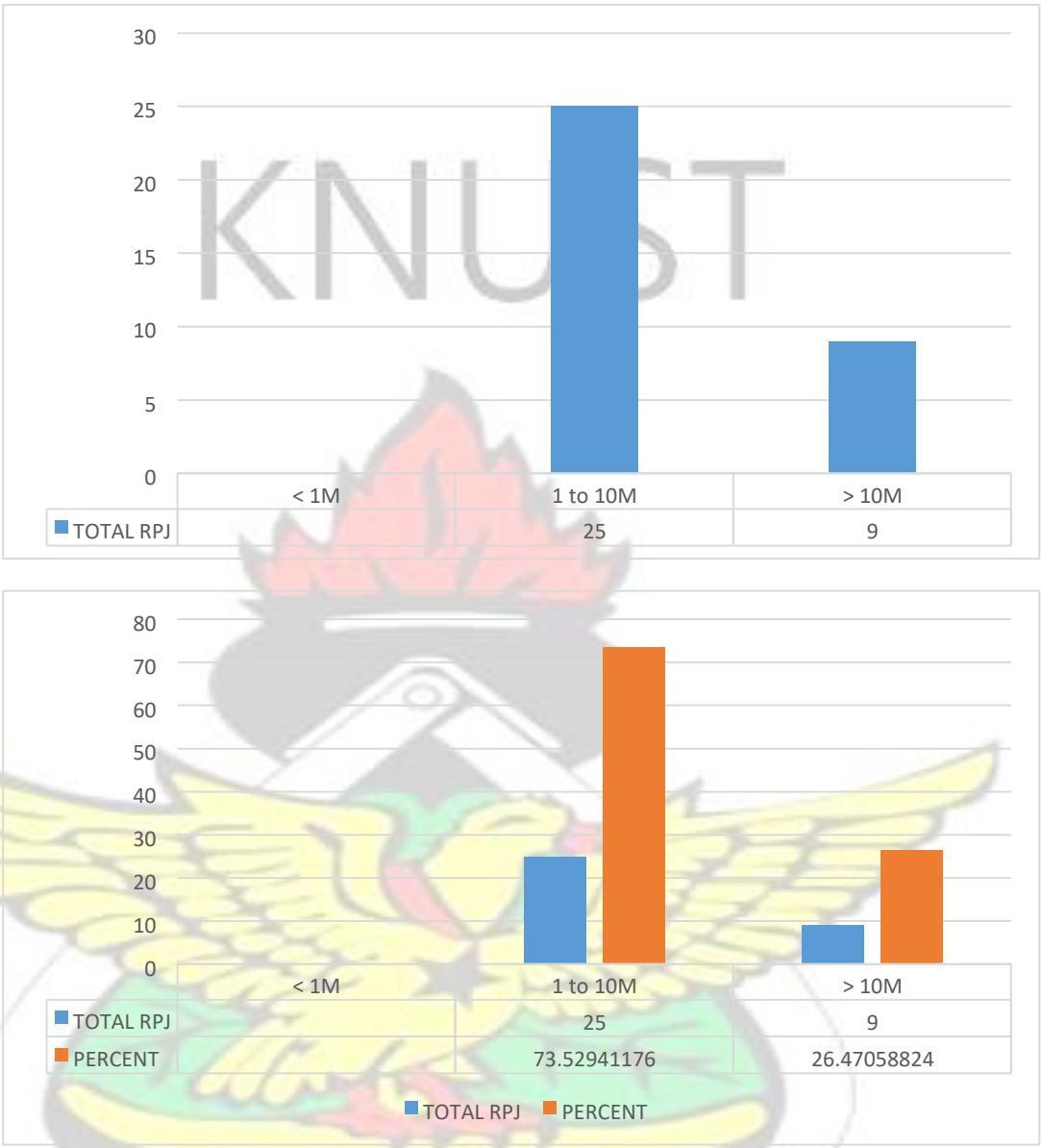
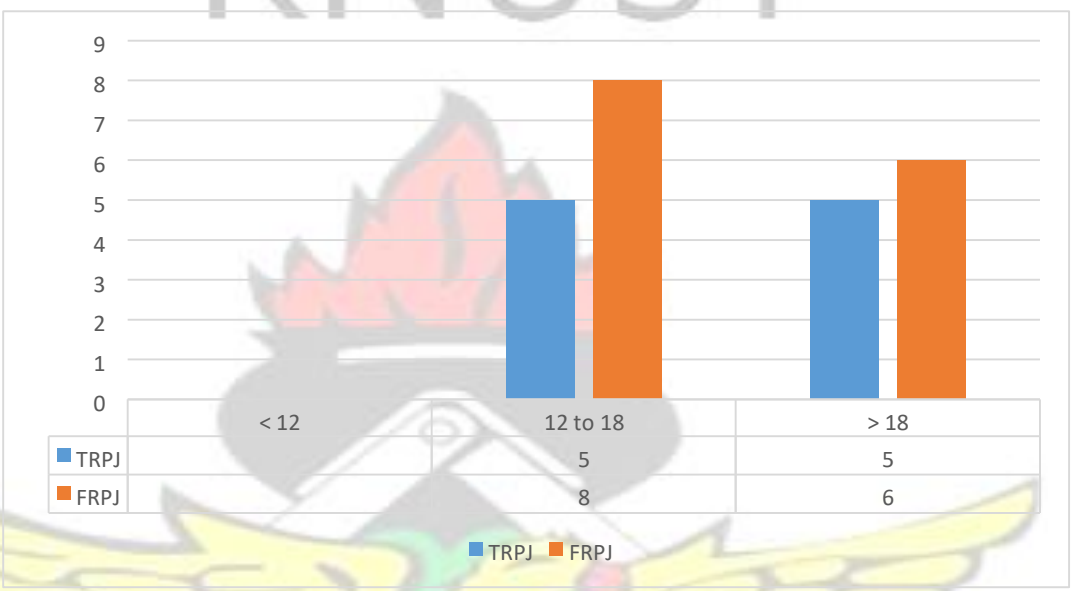
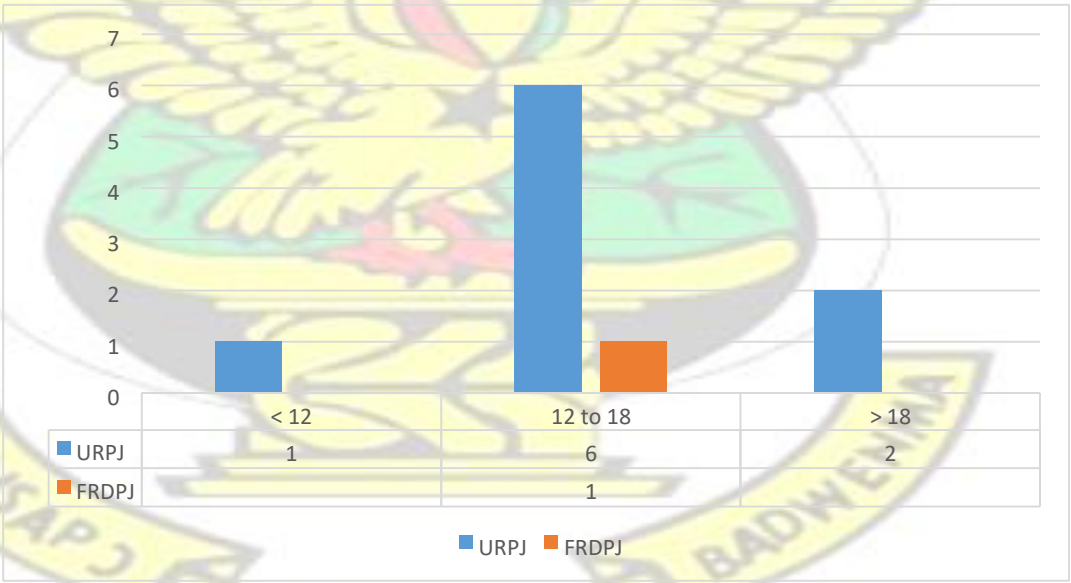


Fig. 4.10 Initial Budgeted Cost of Extraordinary Road Projects

(iv) From Fig. 4.11, the following figures were discovered about the initial budgeted durations of road projects: **20 (58.82%), 13 (38.24%)** and **1 (2.94%)** for 12 to 18 months, above 18 months and below 12 months respectively. These durations depict the time value of money which therefore

meant that should road projects be incurring time overruns it becomes a challenge since an optimum VFM can't be realized. It is clear from these established figures that at least road projects most often than not have enough time for completion and any delay in time affects the value.





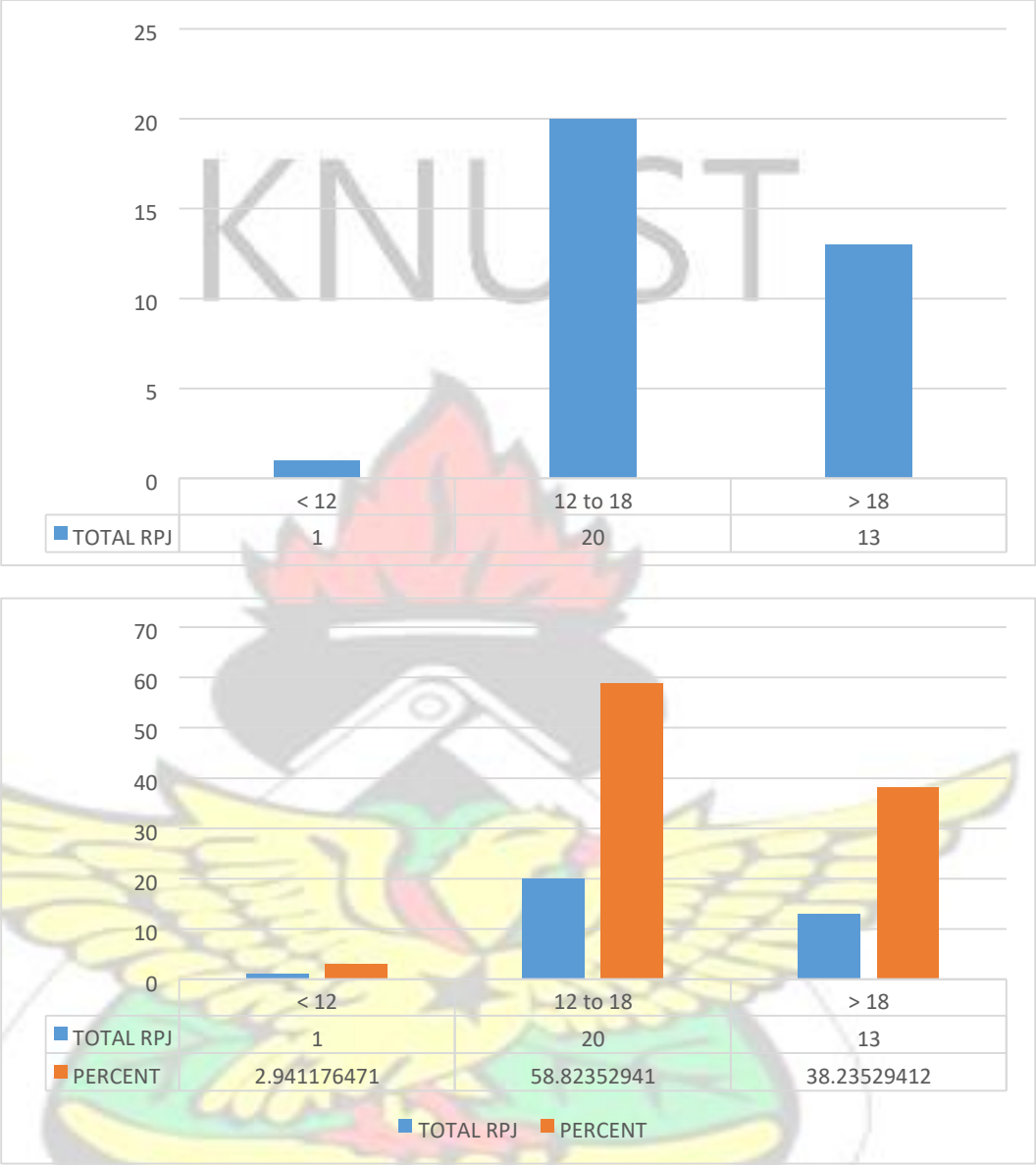
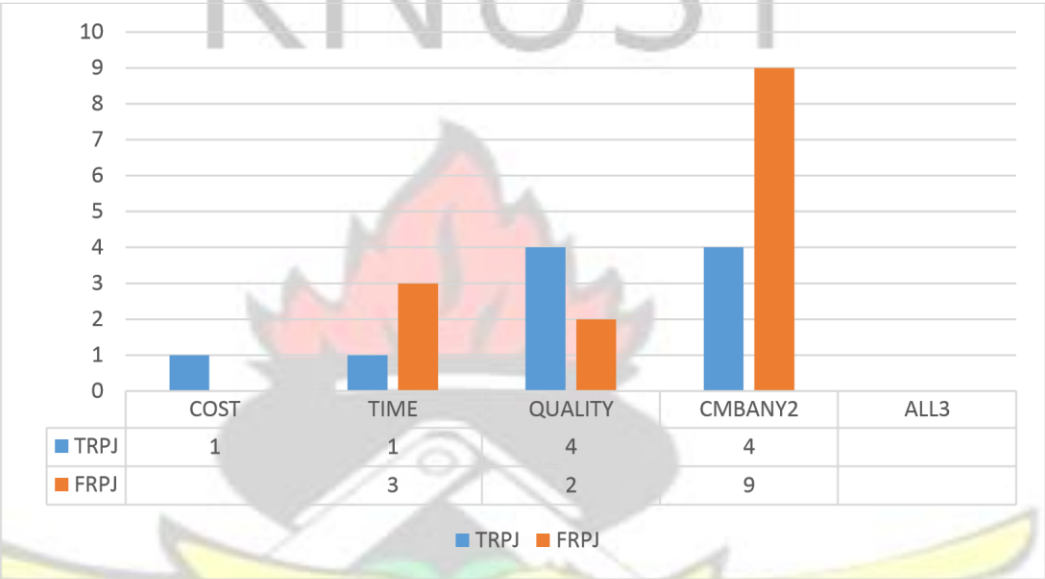
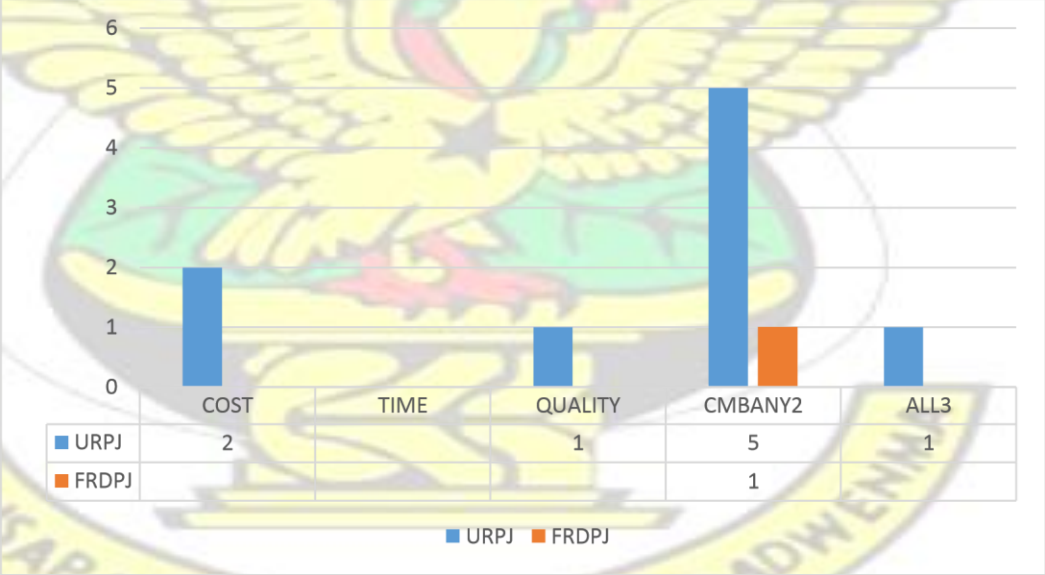


Fig. 4.11 Initial Budgeted Time of Extraordinary Road Projects

(v) From Fig.4.12, one would want to conclude with all confidence that once these are extraordinarily executed road projects, there is absolutely no way for it to incur such cumbersome and severe impacts from respondents, however, cursory look at the figure revealed the following inevitable impacts on these remarkably managed road projects:**19 (55.88%), 7 (20.59%), 4 (11.76%), 3**

(8.82%), and **1 (2.94%)** for a combination of any two impacts, quality, time, cost and all **three (3)** impacts respectively. These associated myriad of impacts has limited and challenged the achievement of an optimum VFM hitherto.





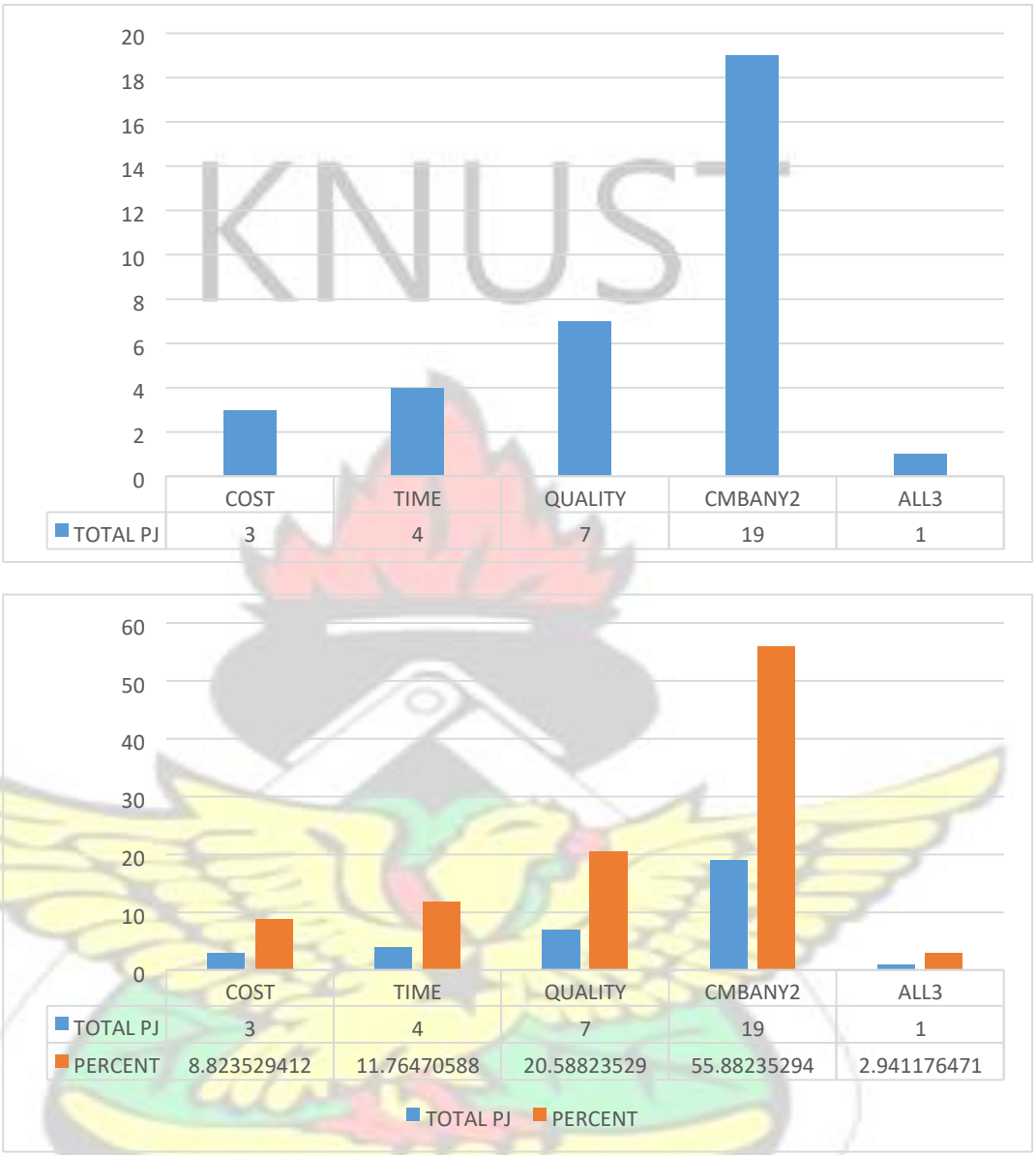
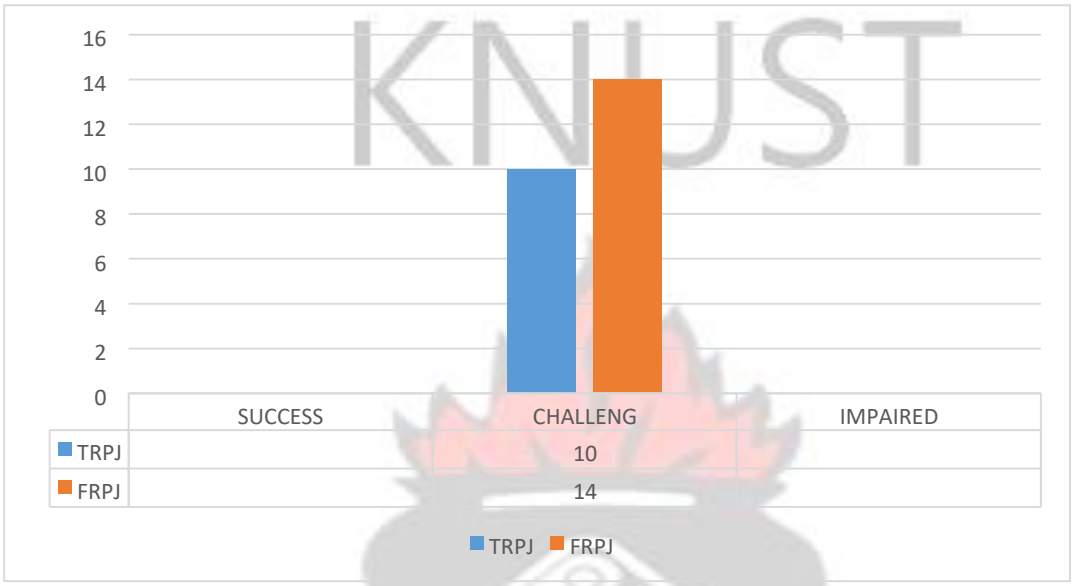
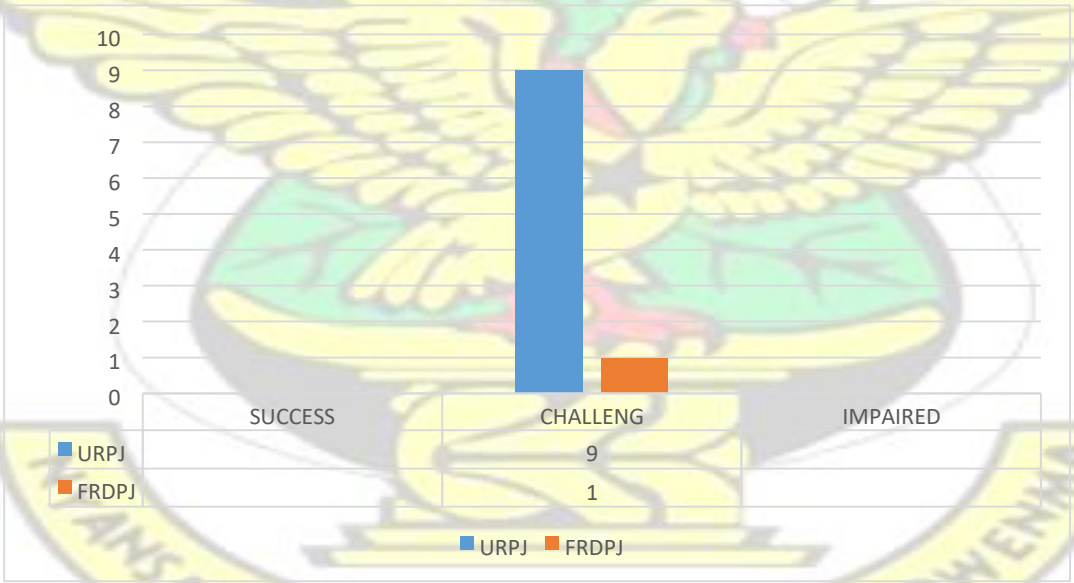


Fig. 4.12 Associated Impacts of Extraordinary Road Projects

(vi) A quick look at Fig. 4.13 was also revealed and concluded by the respondents that truly all road projects executed up till now have been **100%** challenged and thus the associated impacts culminating to these challenges remains inevitable. From this figure, all the **thirty-four (34)** respondents have concluded that all these remarkably executed road projects are challenged

which as well corroborates the serious deficiencies and inadequacies in PM without VE.





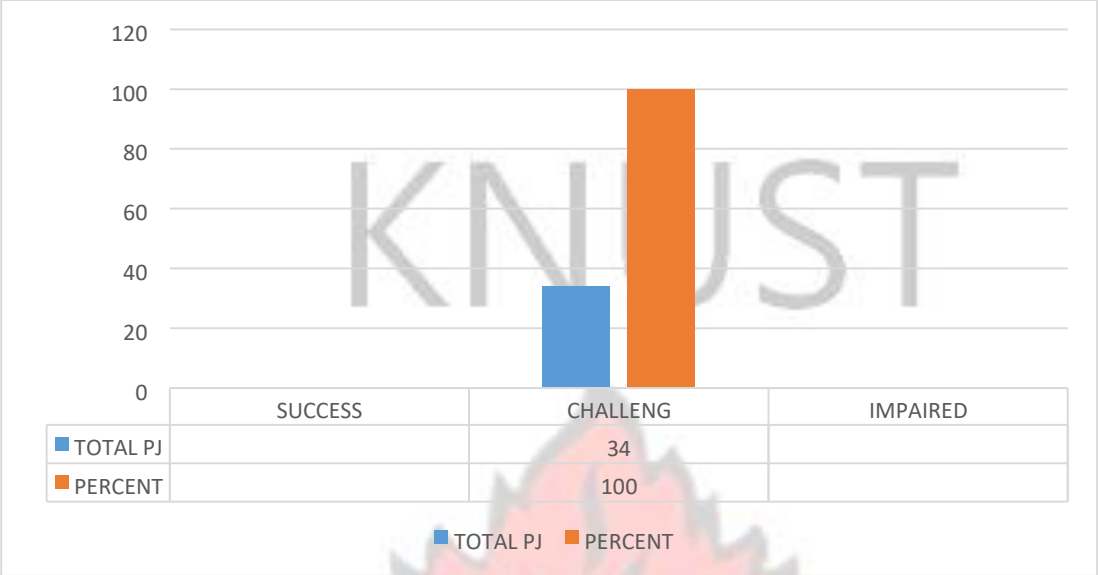


Fig. 4.13 Overall VFM Assessment of Extraordinary Road Projects

VE varying perceptions among RPs in Ghana

Perceptions are opinions of commonality by respondents to concepts which has already received much expectations. Perceptions among respondents will by all means vary since each respondent is unique in technical ideas and there is no one way solution to engineering problems. This was an effort to investigate the varying opinions on VE by these respondents. VE is an advanced VFM tool which originated from the United States (US) and is still being implemented from country to country even in some African countries. It is an essential tool for achieving an optimum VFM which has been tried and tested by a number of countries in the world since it has an inherent propensity to optimize resources in Project Management (PM). As such, there was the need to investigate how convinced these RPs are should VE be implemented on road projects in Ghana since it has already been established by these RPs that VE is not in practice within the RISA of

the MRH. Questions posed were fundamentally precise and concise about the practical application, implementation and usage of VE for road project administration. These questions were derived from literature concerning this concept for optimum VFM on highway projects and as such were to be rated by respondents on a likert scale of 1 to 5 with the following interpretation: 1- Not sure, 2- Quite sure, 3- Moderately sure, 4- Sure, 5- Very Sure. It became necessary to elicit opinions and perceptions from these RPs or TPs about VE usage on road projects to determine the certainty levels of this concept to promote its implementation if it is not being practiced now. A critical look at Table 4.3 revealed that all the **twenty-three (23)** questions had very valid mean scores ranging from

3.5294 to **4.4118** 'sure' mean values. The standard deviations and variances were predominantly less than **one (1)** with only **three (3)** out of **the twenty – three (23)** greater than **one (1).** Those concepts with standard deviations and variances greater than **one (1)** revealed inconsistencies in responses given by the **thirty-four (34)** respondents since it can be clearly inferred that these respondents were seriously not in agreement with those concepts despite their valid 'sure 'mean values. Perhaps, respondents seem not to understand these aspects of the concept, which were equally sound concepts of VE.These anomalies in responses with their corresponding standard deviations and variances were as follows:

(i) VE is the functional analysis of the functional components of all road projects – **(1.08793, 1.184)**

(ii) VE should not disturb the schedule – **(1.05000, 1.102)**

(iii) Understanding VE Job plan is significant for its implementation – **(1.13445,**

1.287)

An attempt to understand the minds of these respondents and how convinced or confident they were should VE be adopted and implemented has been also confirmed by a cursory look at Fig. 4.14, 4.17, 4.20 and 4.23 for DFR, GHA, DUR and KTC respectively, with a summary in Fig. 4.26.These levels of certainty about VE usage on road projects by RPs in the MRH practically depicts the complete consent about the adoption and implementation of VE on road projects in Ghana, meaning that these RPs are very well convinced with 95% confidence.

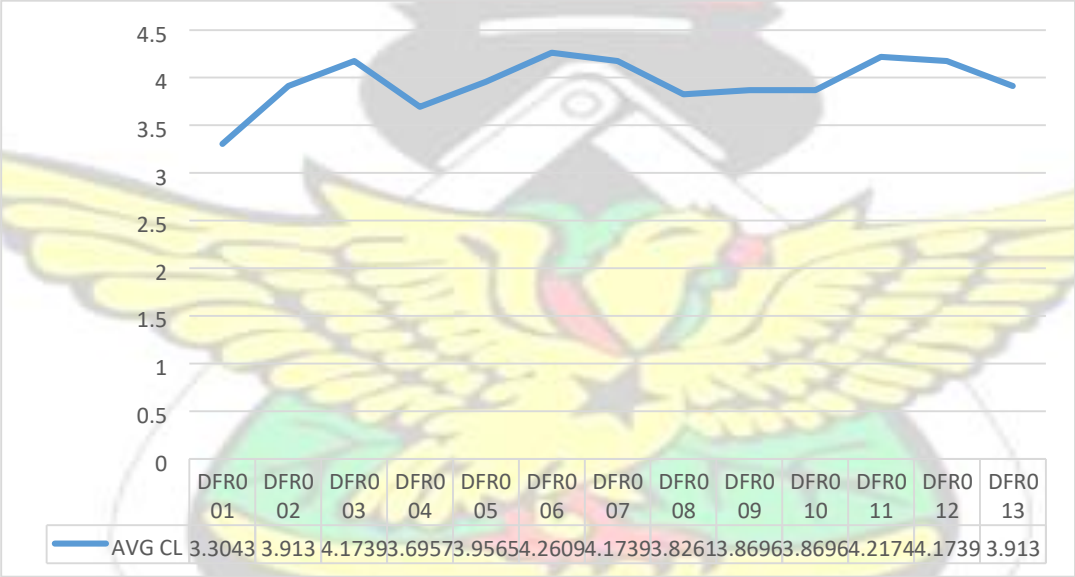


Fig. 4.14 Establishing the VE Certainty Levels on road projects in Ghana among DFR respondents

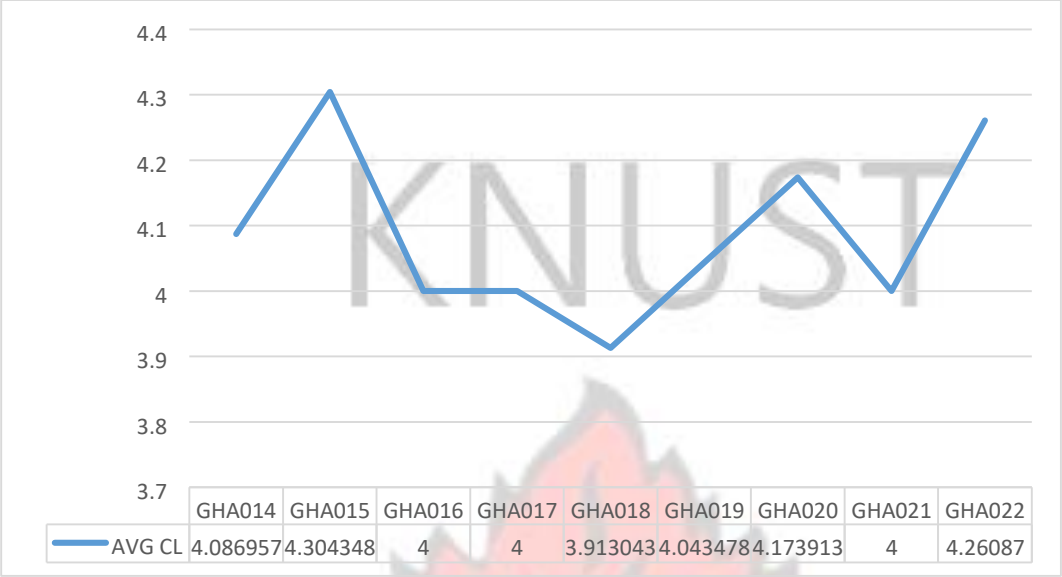


Fig. 4.17 Establishing the VE Certainty Levels on road projects in Ghana among GHA respondents

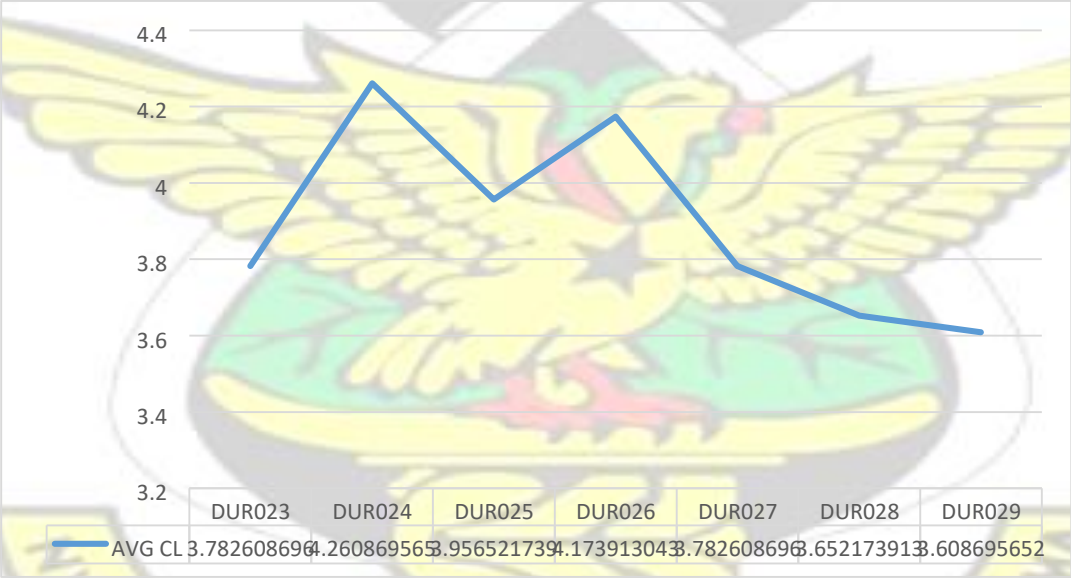


Fig. 4.20 Establishing the VE Certainty Levels on road projects in Ghana among DUR respondents

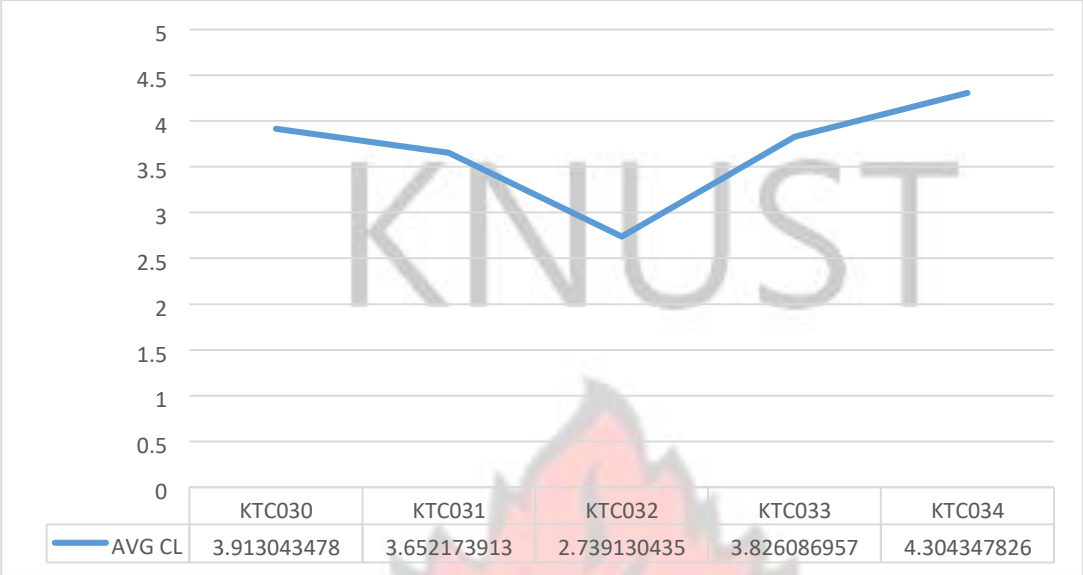


Fig. 4.23 Establishing the VE Certainty Levels on road projects in Ghana among KTC respondents

Advanced VFM practice

VFM adequacy has become so necessary for road projects in Ghana, the reason being that no optimum VFM has been achieved so far by the conventional VFM practice of PM which from literature is limited in adequate VFM unless VE is encapsulated in each of the **nine (9)** knowledge areas of PM. This therefore sets VE far and above PM in terms of optimizing VFM on road projects in Ghana. **Two (2)** questions were posed under this section all in an attempt to understand and establish the potency in using VE to achieve an optimum VFM on road projects in Ghana. These questions in the questionnaire covered VE as an advanced VFM tool and the FAST which sets VE apart from PM or the conventional VFM practice. RPs were thus asked to rate the usage of these concepts on road projects in Ghana on a likert scale of 1 to 5 with the following interpretations: 1- Not Relevant, 2- Quite Relevant, 3- Moderately Relevant, 4- Relevant, 5- Very Relevant.

Now the questions on the VE VFM concepts were fundamentally reflecting VE as an adequate VFM tool to achieve optimum performance of road project components when implemented. Respondents were thus asked to rate the usage of these so as to determine the adequacy of VE for an optimum VFM on road projects in Ghana. Cursory look at Table 4.3 depicted clearly with all confidence and certainty that the responses all had valid means ranging from **3.7941** to **4.0882** of much relevance to the research topic since it all showed that respondents saw all the VE VFM policies as relevant for implementation on road projects in Ghana even though it was not in use. All corresponding standard deviations and variances were also less than **one (1)** which as well portray the consistent nature of all responses given by these TPs respondents. This meant that all the respondents were completely in agreement to the relevance of VE VFM practice for optimum VFM on road projects in Ghana. A very critical look at Fig. 4.15, 4.18, 4.21 and 4.24 for DFR, GHA, DUR and KTC respectively, confirmed the relevance in response given by respondents and the trend or pattern assumed even together with the summary in Fig. 4.26. Respondents therefore saw this VE practice as relevant for the adoption and implementation on road projects in Ghana. Now with respect to questions on the Functional Analysis System Technique (FAST), responses were as well elicited the relevance of the adoption and implementation of VE FAST as a sole means of establishing the ultimate gap between the conventional and the advanced. From Table 4.3 (as in appendix), it has become explicit that all responses have received very valid means ranging from **3.7647** to **3.9706** of much relevance to the research topic since it all showed that respondents saw all the VE FAST policies as relevant for implementation on road projects in Ghana even though it was not in use. All corresponding standard deviations and variances were also less than **one (1)** which as well portrayed the consistent nature

of all responses given by these TPs respondents. This meant that all the respondents were completely in agreement to the relevance of VE FAST practice for optimum VFM on road projects in Ghana. A very critical look at Fig. 4.15, 4.18, 4.21 and 4.24 for DFR, GHA, DUR and KTC respectively, confirmed the relevance in response given by respondents and the trend or pattern assumed even together with the summary in Fig. 4.26. Respondents therefore see this VE practice as relevant for the adoption and implementation on road projects in Ghana.

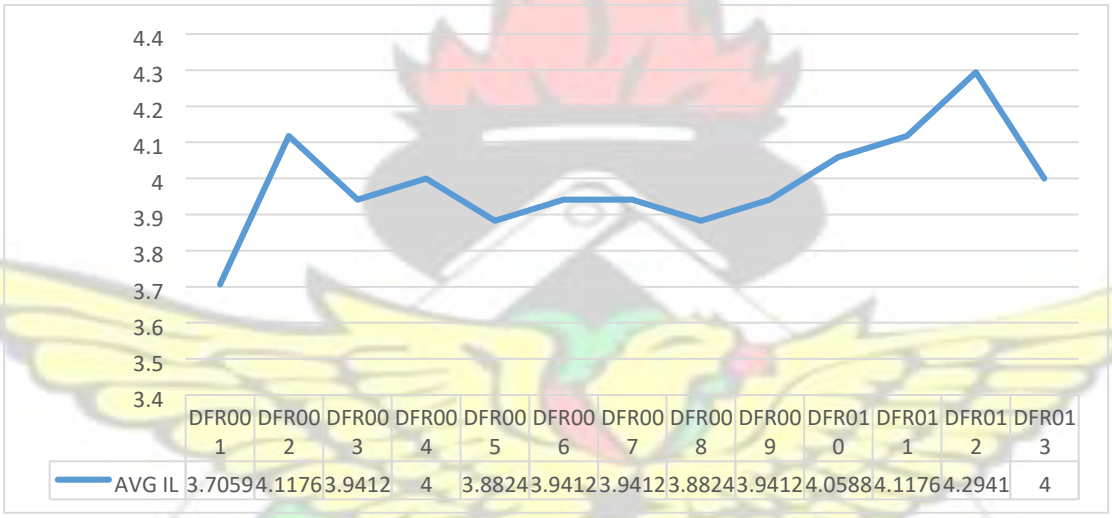
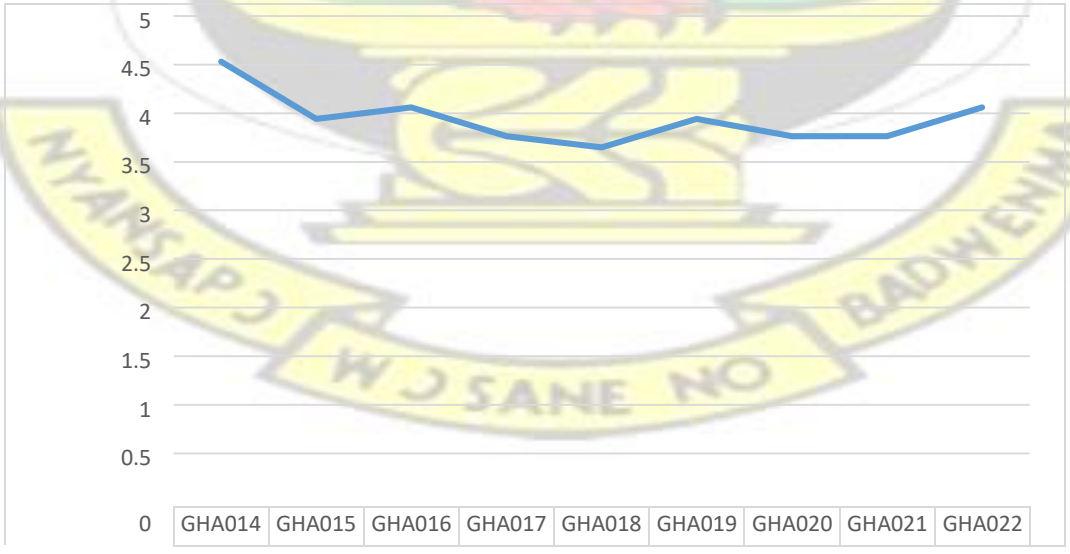


Fig. 4.15 Establishing the VE Implementability on road projects in Ghana among DFR respondents



AVG IL	4.529412	3.941176	4.058824	3.764706	3.647059	3.941176	3.764706	3.764706	4.058824

Fig. 4.18 Establishing the VE Implementability on road projects in Ghana among GHA respondents

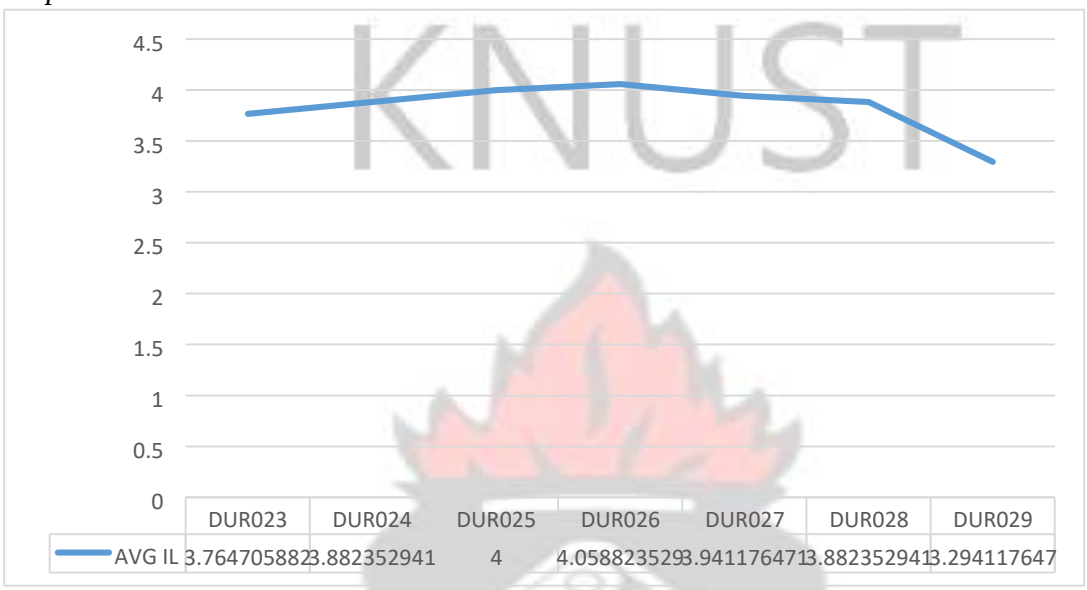


Fig. 4.21 Establishing the VE Implementability on road projects in Ghana among DUR respondents

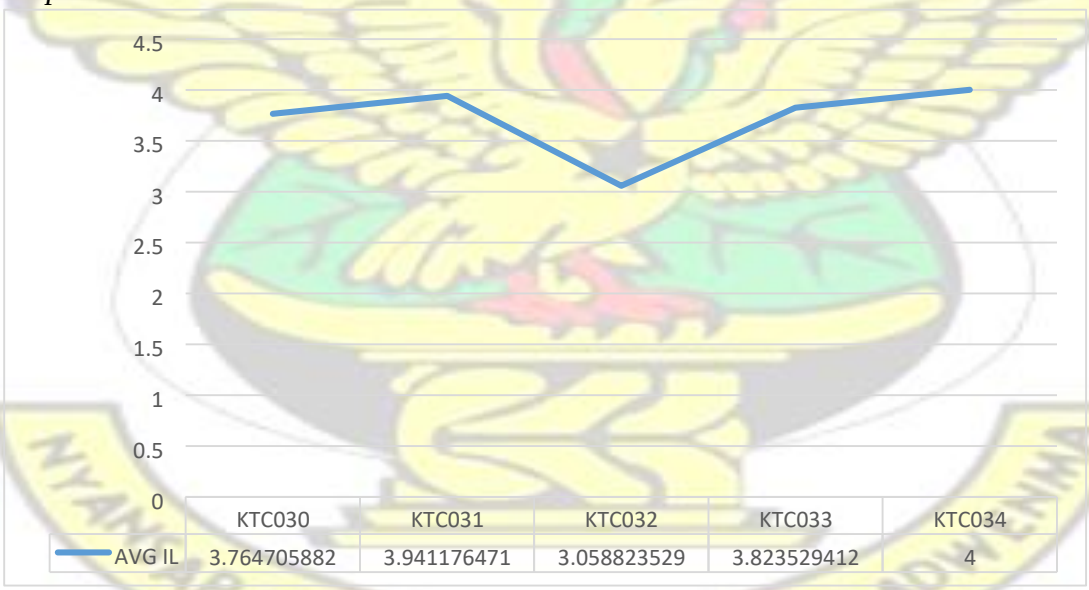


Fig. 4.24 Establishing the VE Implementability on road projects in Ghana among KTC respondents

Usefulness of VE on road projects in Ghana

To be able to encourage or promote the implementation of VE on road projects in Ghana, there was the need to establish its usefulness or effectiveness among these RPs so as to draw a valid conclusion about the VE practice for an optimum VFM on road projects in Ghana. There is a direct correlation of the effectiveness of VE with its implementation. It is of much importance, significance and relevance to note that effectiveness leads to implementation and ineffectiveness also leads to no implementation. Once the usefulness of VE has been established by the responses from respondents, the quicker it becomes for VE to be encouraged and adopted on road projects in Ghana. By so doing the VFM agenda can be enhanced to satisfy the stated and implied needs of the client organization.

PM with its **nine (9)** knowledge areas has for sometime now constituted the brain behind the achievement of VFM on road projects in Ghana. But the only deficiency in this Body of Knowledge in the management of road projects is that it lacks VM/VE in each of the **nine (9)** areas of practice. This section was an attempt to investigate and establish whether each of these knowledge areas can still be treated or exercised solely for an optimum VFM even with its still myriad of VFM deficiencies or it will be necessary to embed or integrate VE/VM practices in each of the **nine (9)** areas of PM for a significant optimum VFM.

The question posed over here was an attempt to bring out responses from these RPs or TPs about whether PM is indeed limited and if it is limited indeed, whether VE integration into each of these **nine (9)** knowledge areas will yield significant or no significant results practically when embedded in road PM practice. This was not an attempt to render PM as obsolete or discredit its practices but responses were to elicit the significance in the integration of VE in these PM areas: Materials, Time, Cost, Quality,

Plant, among other aspects of PM since it was inferred from literature and even realized practically on road projects in Ghana that PM has been limited in terms of its attempt to achieve an optimum VFM. Whether PM is being practiced well by these RPs or there was a need or no practical need to integrate VE was the subject matter and the rationale behind this question. The responses from respondents were to be rated on a likert scale of 1 to 5 with the interpretation: 1- No Value, 2- Low Value, 3- Medium Value, 4- High Value,5- Very High Value.

Cursory look at Fig. 4.16, 4.19, 4.22 and 4.25 for DFR, GHA, DUR and KTC respectively, confirmed the significance in responses given by respondents and the trends or patterns assumed even together with the summary in Fig. 4.26. Respondents therefore saw the integration of VE practice in PM as useful and effective for its adoption and implementation on road projects in Ghana since the responses given were to elicit the effect of PM with VM/VE which almost all responses depicted scores ranging from **four (4)** to **five (5)** ' high value' mean scores with standard deviations and variances all less than **one (1)** signifying consistencies in responses given with complete agreement of responses by respondents in each case on the 'high value' nature of road projects and thus PM can only be effectively applied on road projects if each of its **nine (9)** knowledge areas have VE integrated into them, otherwise, PM still is rendered deficient in optimizing

VFM. Notwithstanding the best PM practices implemented, it will yield 'low value' without VE/VM integration. Thus, PM less VE/VM = low value but PM plus VE/VM = high value.

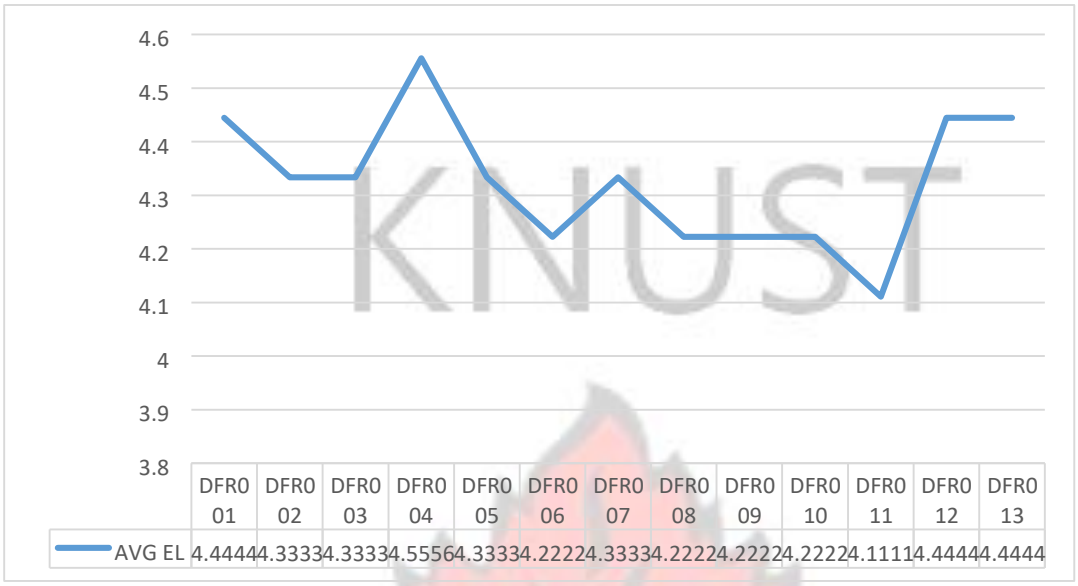


Fig. 4.16 Establishing the VE Effectiveness in VFM on road projects in Ghana among DFR respondents

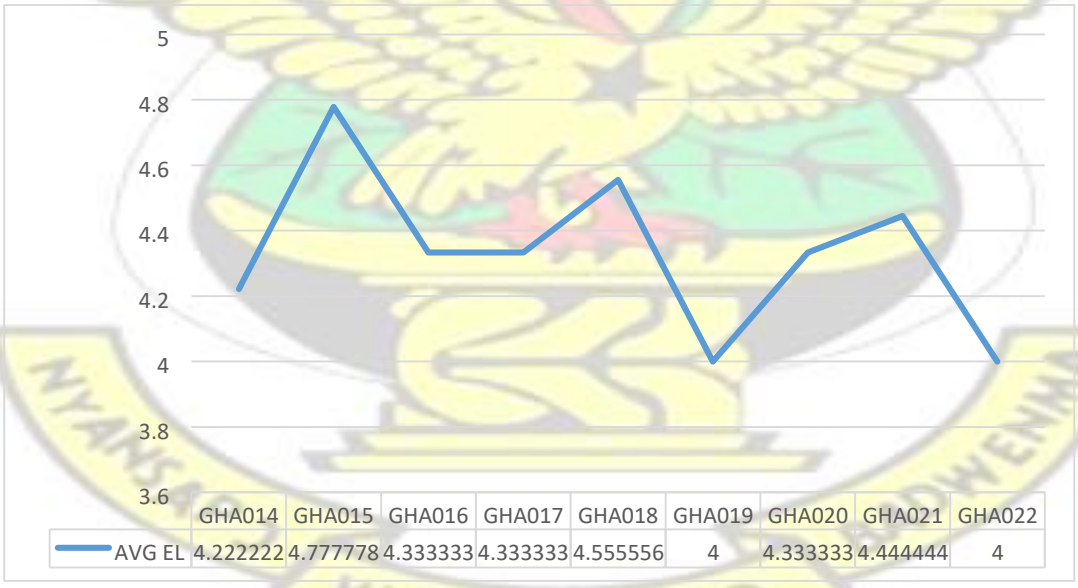


Fig. 4.19 Establishing the VE Effectiveness in VFM on road projects in Ghana among GHA respondents

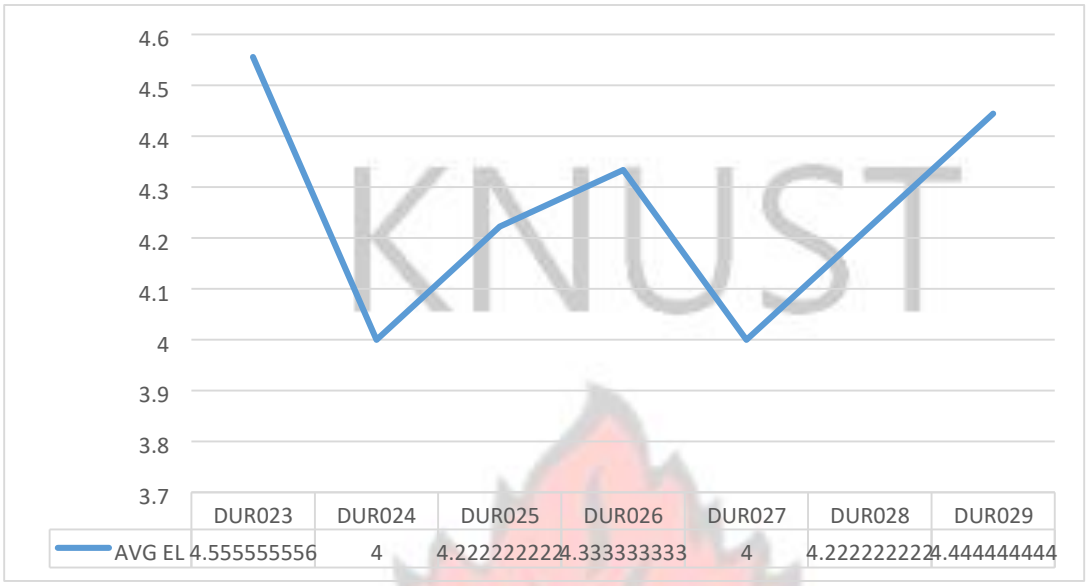


Fig. 4.22 Establishing the VE Effectiveness in VFM on road projects in Ghana among DUR respondents

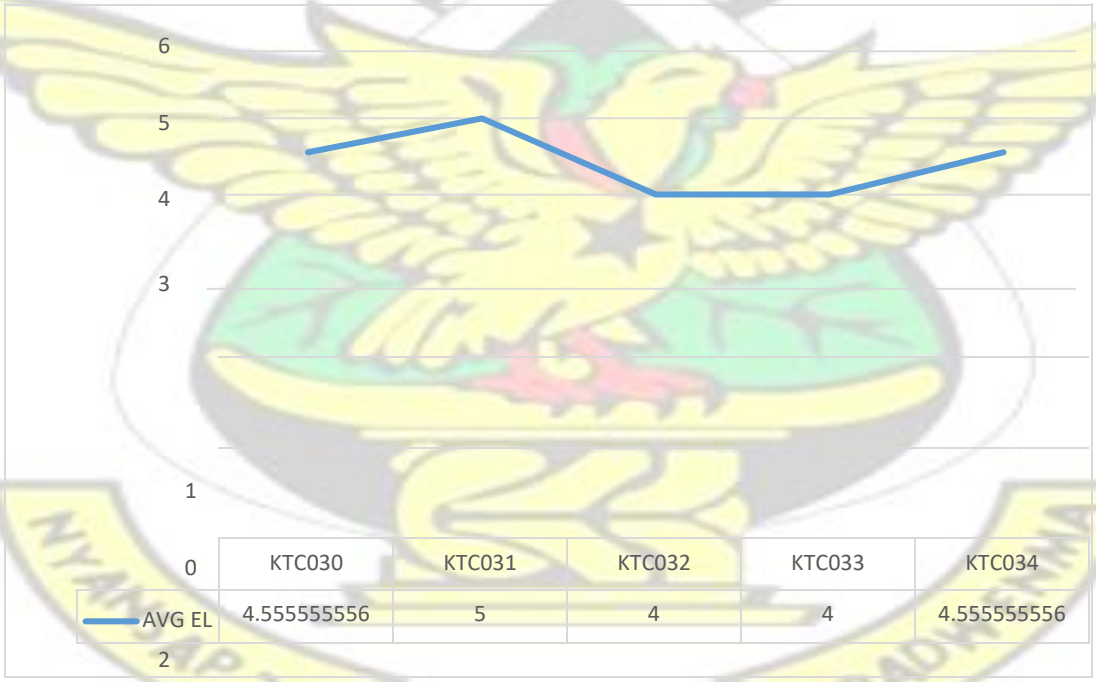


Fig. 4.25 Establishing the VE Effectiveness in VFM on road projects in Ghana among KTC respondents

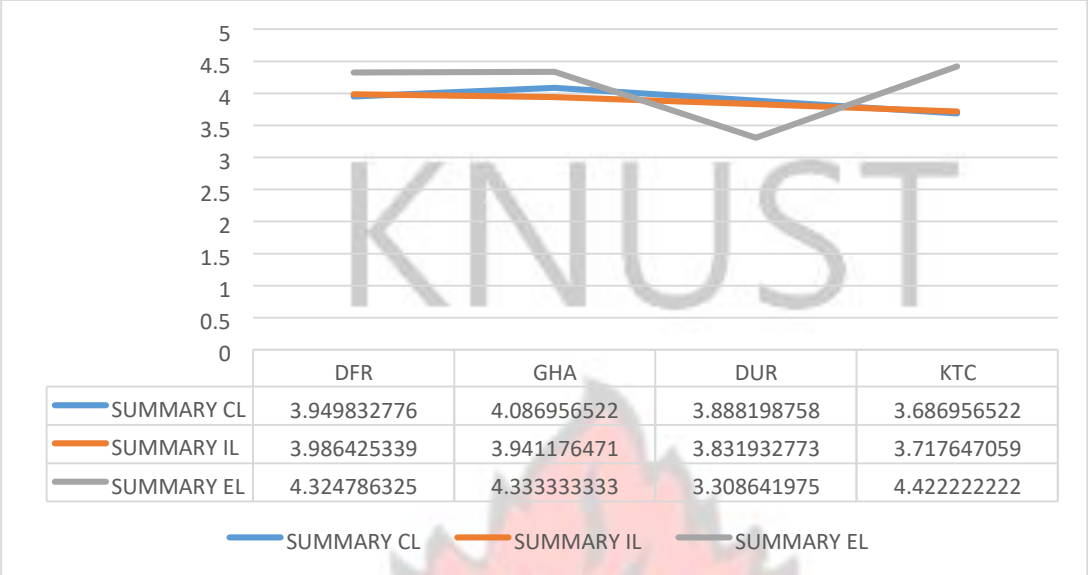


Fig. 4.26 Establishing the overall VE objectives to promote the implementation of VE on road projects in Ghana among the RISA of MRH

4.3.2 INFERENTIALS

The practical implication of the descriptives for these dependent variables has been achieved completely through relevant and sound inferential (hypothetical) statistical tests.

These statistical tests have been based on the fact that the data sets from this section are **75%** continuous and **25%** nominal. The hypothetical tests for these questions were the chi-square tests for the nominal datasets and the parametric tests (Non-parametric: Chisquare for the nominal data sets, Parametric: Pearson Correlation tests and ANOVA tests for the continuous data sets).

Chi-square Tests for the Nominal Data sets

The **four (4)** out of the six (6) multiple-choice questions that this chi-square tests tested were questions presented on:

(v) The type of remarkably managed road projects;

(vi) Their initial budgeted costs; (vii) Their initial budgeted durations; and

(viii) Their associated impacts.

Cursory Look at Tables 4.30, 4.31, 4.32, 4.33 and the corresponding test statistics (refer to table 4.34);

Let H_O = Null Hypothesis and H_A = Alternative Hypothesis Now

test hypotheses based on the following assumptions:

H_O : Variable X and Variable Y are Independent

H_A : Variable X and Variable Y are not Independent

But for $p < 0.05$ reject null hypothesis (that is, Variable X and Variable Y are not independent since the variability of responses is significantly different, there is statistical significance and the corresponding number of responses are rendered invalid or insignificant for consideration here since their p-value has violated and defied the set significance level of 0.05) and for $p > 0.05$ accept null hypothesis (thus, Variable X and Variable Y are independent since the variability of responses is not significantly different among respondents, there is no statistical significance and as such corresponding hypothetical responses are accommodated);

The type of remarkably managed road projects

From table 4.30 and the corresponding test statistics (refer to table 4.34), $p < 0.05$ since p is seen as 0.015 from the table. This, therefore, meant that the individual respondents were related (not independent) in terms of the type of remarkably managed road projects

in their respective Road Agencies since their respective expected frequencies were not almost the same as their observed frequencies. Thus variability in their frequencies were significantly different. The frequencies collated are therefore invalid, unreliable, insignificant, inconsistent, not in agreement and not in harmony since the number of remarkably managed road projects in DFR, GHA and DUR appeared related with KTC. Thus the absence of respondents from KTC as Support Agencies could have validated the null hypothesis since KTC is only a Support Agency and a Training Centre for DFR, GHA and DUR and thus RPs there in as much render training services to them as well partner with them on their numerous road projects. Thus, perhaps, the questionnaire alternative responses needed to have been stated with additional specfics, say, KTC partnered urban road projects, KTC partnered feeder road projects, KTC partnered trunk road projects, in that wise, which could have rendered the remarkably managed road projects unique and independent in each Agency.

Table 4.34 Test Statistics

	TYPERPJ	INCOST	INTIME	IMPACT
Chi-Square	10.471[a]	7.529[b]	16.294[c]	30.118[d]
df	3	1	2	4
Asymp. Sig.	.015	.006	.000	.000

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 8.5.

b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 17.0.

c. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 11.3.

d. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 6.8.

Initial Budgeted Costs

From table 4.31 and the corresponding test statistics (refer to table 4.34), $p < 0.05$ since p is seen as 0.006 from the table. This, therefore, meant that the individual road projects were related (not independent) in terms of their initially budgeted costs since their respective expected frequencies were not almost the same as their observed frequencies. Thus variability in their frequencies were significantly different. The frequencies collated are therefore invalid, unreliable, insignificant, inconsistent, not in agreement and not in harmony since their initial costs are not independent for the respective road projects remarkably managed. Thus, perhaps, there was the need to have invited verbal responses or qualitative responses from respondents and analysed accordingly; or the response intervals needed to have been reduced to say, < 1million Ghana cedis, < 2million Ghana cedis;, and/ or perhaps exhaustive responses could have been integrated into the response structure, for instance, others (please specify), to enable respondents quote specific initial costs.

Initial Budgeted Time

From table 4.32 and the corresponding test statistics (refer to table 4.34), $p < 0.05$ since p is seen as 0.000 from the table. This, therefore, meant that the individual road projects were related (not independent) in terms of their initially budgeted times since their respective expected frequencies were not almost the same as their observed frequencies. Thus variability in their frequencies were significantly different. The frequencies collated

are therefore invalid, unreliable, insignificant, inconsistent, not in agreement and not in harmony since their initial costs are not independent for the respective road projects remarkably managed. Thus, perhaps, there was the need to have invited verbal responses or qualitative responses from respondents and analysed accordingly; or the alternative responses ought to have been stated in acceptable specifics, say 6months, 8months, 12 months, 18months, 24months; and/ or perhaps exhaustive responses could have been integrated into the response structure, for instance, others (please specify), to enable respondents quote specific initial project durations.

Associated Impacts

From table 4.33 and the corresponding test statistics (refer to table 4.34), $p < 0.05$ since p is seen as 0.000 from the table. This, therefore, meant that the individual road projects were related (not independent) in terms of their associated impacts since their respective expected frequencies were not almost the same as their observed frequencies. Thus variability in their frequencies were significantly different. The frequencies collated are therefore invalid, unreliable, insignificant, inconsistent, not in agreement and not in harmony since their associated impacts are not independent for the respective road projects remarkably managed. Thus, perhaps, there was the need to have disintegrated the alternative response: 'combination of any two (2) impacts' into 'time and cost overruns', 'time overruns and poor quality', 'cost overruns and poor quality'; and/or invited verbal responses or qualitative responses from respondents from the different RISA and analysed accordingly; and/ or perhaps exhaustive responses could have been integrated into the response structure, for instance, others (please specify) and accordingly omitted these alternative responses: 'combination of any two (2) impacts'

and ‘all three (3) impacts’, to enable respondents quote specifics.. The reason being that the null hypothesis stems from the premise that, for any **two (2)** road projects, its associated impacts should be independent of each other.

Pearson Correlation Tests for the Continuous Data sets

The **four (4)** rating questions that this Pearson Correlation tests tested were questions presented on:

(i) VE usage on road projects;

(ii) VE for an optimum VFM on road projects in Ghana;

(iii) The FAST on road projects; and

(iv) PM knowledge areas (each with VE integrated) for an optimum VFM on road projects in Ghana.

All these **four (4)** rating questions, thus, fell under the following **three (3)** dependent variables:

(i) VE varying opinions among RPs – (i) ; (ii) Advanced VFM practice – (ii) and (iii); and

(iii) VE usefulness. - (iv).

It is of great importance to note that each of these **three (3)** dependent variables were perfectly correlated correspondingly with same variables and imperfectly correlated with opposite variable (Refer to Table 4.4), that is, (i) is perfectly correlated to (i), (ii) is perfectly correlated to (ii), and (iii) is perfectly correlated to (iii).

Cursory Look at Tables 4.4;

Let H_O = Null Hypothesis and H_A = Alternative Hypothesis Now

test hypotheses based on the following assumptions:

H_O : Variables are related

H_A : Variables are not related

But for $p < 0.01$ reject null hypothesis (that is, Variable X and Variable Y are not related since the variability of responses is significantly different, there is statistical significance and the corresponding number of responses are rendered invalid or insignificant for consideration here since their p-value has violated and defied the set significance level of 0.01) and for $p > 0.01$ accept null hypothesis (thus, Variable X and Variable Y are related since the variability of responses is not significantly different among respondents, there is no statistical significance and as such corresponding hypothetical responses are accommodated);

Now let these **three (3)** dependent variables be denoted by VAR, AVFM, and VEUSE for (i), (ii) and (iii), respectively.

VE varying opinions among RPs (VAR) vrs. Advanced VFM practice (AVFM)

From Table 4.4, $p < 0.01$ since p is 0.000 for the Pearson 'r' of VAR and AVFM. This meant that VAR and AVFM were not related since the variability of responses is significantly different, there is statistical significance and the corresponding number of responses are rendered invalid or insignificant for consideration here since their p-value has violated and defied the set significance level of 0.01, disproving the null hypothesis. Thus, perhaps, it could be that questions asked were not properly understood since it

stands out clearly that once their responses showed that they were confident and convinced about VE usage on road projects (VAR), they should have also seen its implementation on road projects in Ghana as relevant (AVFM).

Advanced VFM practice (AVFM) vrs. VE usefulness (VEUSE)

From Table 4.4, $p > 0.01$ since p is 0.989 for the Pearson 'r' of AVFM and VEUSE. This meant that VFM and VEUSE were related since the variability of responses given was not significantly different, there was no statistical significance and the corresponding number of responses are rendered valid or significant for consideration here since their p-value is greater than 0.01; validating the null hypothesis. Thus, there was coherence, evenness, consistency, and harmony of responses by respondents in terms of these **two (2)** dependent variables.

Table 4.4 Pearson Correlation test of the three (3) dependent variables

		VARVEOPINIONS	AVFMPRT	VEUSEFULNESS
VARVEOPINIONS	Pearson Correlation	1	.654**	.024
	Sig. (2-tailed)		.000	.891
	N	34	34	34
AVFMPRT	Pearson Correlation	.654**	1	.002
	Sig. (2-tailed)	.000		.989
	N	34	34	34
VEUSEFULNESS	Pearson Correlation	.024	.002	1
	Sig. (2-tailed)	.891	.989	
	N	34	34	34

**. Correlation is significant at the 0.01 level (2-tailed).

VE usefulness (VEUSE) vrs. VE varying opinions among RPs (VAR)

From Table 4.4, $p > 0.01$ since p is 0.891 for the Pearson 'r' of VEUSE and VAR. This meant that VEUSE and VAR were related since the variability of responses given was not significantly different, there was no statistical significance and the corresponding number of responses are, therefore, rendered valid or significant for consideration here since their p-value is greater than 0.01; validating the null hypothesis. Thus, there was coherence, evenness, consistency, and harmony of responses by respondents in terms of these **two (2)** dependent variables.

In a nutshell:

VAR ≠ AVFM = VEUSE = VAR.

Analysis of Variance (ANOVA) Tests for the Continuous Data sets

The **four (4)** rating questions that this One-Way ANOVA tests tested were questions presented on:

(v) VE usage on road projects;

(vi) VE for an optimum VFM on road projects in Ghana;

(vii) The FAST on road projects; and

(viii) PM knowledge areas (each without VE) for an optimum VFM on road projects in Ghana.

All these **four (4)** rating questions, thus, fell under the following **three (3)** dependent variables:

(iv) VE varying opinions among RPs – (i) ;

(v) Advanced VFM practice – (ii) and (iii);

and (vi) VE usefulness. - (iv).

Cursory Look at Tables 4.5, 4.6, 4.7, 4.8, 4.9, 4.10; Let H_O = Null Hypothesis and H_A = Alternative Hypothesis Now test hypotheses based on the following assumptions:

H_O : Mean differences between and within groupings are the same

H_A : Mean differences between and within groupings are not the same

But for $p < 0.05$ reject null hypothesis (that is, Mean differences between and within groupings are not the same since the variability of responses is significantly different, there is statistical significance and the corresponding number of responses are rendered invalid or insignificant for consideration here since their p-value has violated and defied the set significance level of 0.05) and for $p > 0.05$ accept null hypothesis (thus, Mean differences between and within groupings are the same since the variability of responses is not significantly different among respondents, there is no statistical significance and as such corresponding hypothetical responses are accommodated);

Now let these **three (3)** dependent variables be denoted by VAR, AVFM, and VEUSE for (i), (ii) and (iii), respectively.

VE varying opinions among RPs (VAR)

Consider the likert scale of 1 to 5 with the following interpretations: 1-Not sure; 2-Quite sure; 3-Moderately sure; 4- Sure; 5-Very sure

From Tables 4.5, the descriptives table, >3.5 mean values, <1 standard deviations and <1 standard error of means all represent significant responses across each of the **four (4)** RISA groups (DFR, GHA, DUR, and KTC). The mean scores of responses given by each groups of respondents together with their corresponding standard deviation and standard error of means are therefore valid, reliable, significant, consistent, in agreement and in harmony. Thus, there is coherence, evenness, consistency, and harmony of responses by respondents. This validates how convinced respondents are should VE be implemented on road projects in Ghana.

From Table 4.6, the ANOVA table, $p > 0.05$ since p is 0.139 from table. Thus, mean differences between and within groupings are the same since the variability of responses is not significantly different among respondents, there is no statistical significance and as such corresponding hypothetical responses are accommodated. Thus, there is coherence, evenness, consistency, and harmony of responses by respondents.

From Table 4.7, Post Hoc (Multiple Comparison table), Mean differences between any **two (2)** of the RISA are not significantly different from each other, thus, there is no statistical significance, since mean differences are almost the same across board, which validates the null hypothesis. All standard errors are less than **one (1)** which shows that variability is also not significantly different among responses from respondents. Thus, there is coherence, evenness, consistency, and harmony of responses by respondents.

From Table 4.8, Homogeneous subset of group means table, $p > 0.05$ since p is 0.067 from table. This meant that means within each RISA are significant but are not significantly different from each other, thus, there is no statistical significance since mean

differences are almost the same, which validates the null hypothesis. Thus, there is coherence, evenness, consistency, and harmony of responses by respondents.

Advanced VFM practice (AVFM)

Consider the likert scale of 1 to 5 with the following interpretations: 1-Not relevant; 2-Quite relevant; 3-Moderately relevant; 4- Relevant; 5-Very relevant

From Tables 4.5, the descriptives table, >3.5 mean values, <1 standard deviations and <1 standard error of means all represent significant responses across each of the **four (4)** RISA groups (DFR, GHA, DUR, and KTC). The mean scores of responses given by each group of respondents together with their corresponding standard deviation and standard error of means are therefore valid, reliable, significant, consistent, in agreement and in harmony. Thus, there is coherence, evenness, consistency, and harmony of responses by respondents. This validates how convinced respondents are should VE be implemented on road projects in Ghana.

From Table 4.6, the ANOVA table, $p > 0.05$ since p is 0.176 from table. Thus, mean differences between and within groupings are the same since the variability of responses is not significantly different among respondents, there is no statistical significance and as such corresponding hypothetical responses are accommodated. Thus, there is coherence, evenness, consistency, and harmony of responses by respondents.

From Table 4.7, Post Hoc (Multiple Comparison table), Mean differences between any **two (2)** of the RISA are not significantly different from each other, thus, there is no statistical significance, since mean differences are almost the same across board, which validates the null hypothesis. All standard errors are less than **one (1)** which shows that

variability is also not significantly different among responses from respondents. Thus, there is coherence, evenness, consistency, and harmony of responses by respondents.

From Table 4.9, Homogeneous subset of group means table, $p > 0.05$ since p is 0.160 from table. This meant that means within each RISA are significant but are not significantly different from each other, thus, there is no statistical significance since mean differences are almost the same, which validates the null hypothesis. Thus, there is coherence, evenness, consistency, and harmony of responses by respondents.

VE usefulness (VEUSE)

Consider the likert scale of 1 to 5 with the following interpretations: 1-No value; 2-Low value; 3-Medium value; 4- High value; 5-Very high value.

From Tables 4.5, the descriptives table, >3.5 mean values, <1 standard deviations and <1 standard error of mean all represent significant responses across each of the **four (4)** RISA groups (DFR, GHA, DUR, and KTC) to establish the VFM inadequacy of PM without VE embedded, which in the long run leads to the establishment of the effectiveness or usefulness of VE on road projects in Ghana. The mean scores of responses given by each group of respondents together with their corresponding standard deviation and standard error of means are therefore valid, reliable, significant, consistent, in agreement and in harmony. Thus, there is coherence, evenness, consistency, and harmony of responses by respondents. This validates how convinced respondents are should VE be implemented on road projects in Ghana.

From Table 4.6, the ANOVA table, $p > 0.05$ since p is 0.686 from table. Thus, mean differences between and within groupings are almost the same since the variability of

responses is not significantly different among respondents, there is no statistical significance of the mean differences and as such corresponding hypothetical responses are valid and in harmony. Thus, there is coherence, evenness, consistency, and harmony of responses by respondents.

From Table 4.7, Post Hoc (Multiple Comparison table), Thus, it is the mean difference between the RISA groups are almost the same that is, there is no statistical significance. All standard deviations and standard errors are less than **one (1)** which shows that variability is not significantly different among responses from respondents. Thus, there is coherence, evenness, consistency, and harmony of responses by respondents.

From Table 4.10, Homogeneous subset of group means table, $p > 0.05$ for all variables since p is 0.518 from the table. This meant that means within each these groups are significant and are not significantly different from each other, thus, there is no statistical significance since mean differences are almost the same, which validates the null hypothesis. Thus, there is coherence, evenness, consistency, and harmony of responses by respondents.

Table 4.5 One-way ANOVA test: Descriptives Table

		N	Mean	Std. Deviation	Std. Error
VARVEOPINIONS	1	13	3.9498	.26318	.07299
	2	9	4.0870	.13223	.04408
	3	7	3.8882	.25210	.09528
	4	5	3.6870	.58121	.25993

	Total	34	3.9348	.31321	.05371
AVFMPRT	1	13	3.9864	.14238	.03949
	2	9	3.9412	.26307	.08769
	3	7	3.8319	.25512	.09643
	4	5	3.7176	.37986	.16988
	Total	34	3.9031	.25078	.04301
VEUSEFULNESS	1	13	4.3248	.12391	.03437
	2	9	4.3333	.24845	.08282
	3	7	4.2540	.20998	.07937
	4	5	4.4222	.42601	.19052
	Total	34	4.3268	.23039	.03951

Table 4.6 ANOVA Table

		Sum of Squares	df	Mean Square	F	Sig.
VARVEOPINIONS	Between Groups	.534	3	.178	1.974	.139
	Within Groups	2.704	30	.090		
	Total	3.237	33			
AVFMPRT	Between Groups	.311	3	.104	1.761	.176
	Within Groups	1.765	30	.059		

	Total	2.075	33			
VEUSEFULNESS	Between Groups	.083	3	.028	.498	.686
	Within Groups	1.669	30	.056		
	Total	1.752	33			

Table 4.7 POST HOC: Multiple Comparisons

			Tukey HSD		
Dependent Variable	(I) RISAindpv	(J) RISAindpv	Mean Difference (IJ)	Std. Error	Sig.
VARVEOPINIONS	1	2	-.13712	.13018	.720
		3	.06163	.14074	.971
		4	.26288	.15798	.360
	2	1	.13712	.13018	.720
		3	.19876	.15129	.562

		4	.40000	.16744	.101
	3	1	-.06163	.14074	.971
		2	-.19876	.15129	.562
		4	.20124	.17578	.665
	4	1	-.26288	.15798	.360
		2	-.40000	.16744	.101
		3	-.20124	.17578	.665
AVFMPRT	1	2	.04525	.10517	.973
		3	.15449	.11370	.534
		4	.26878	.12763	.174
	2	1	-.04525	.10517	.973
		3	.10924	.12222	.808
		4	.22353	.13528	.366
	3	1	-.15449	.11370	.534
		2	-.10924	.12222	.808
		4	.11429	.14201	.852
	4	1	-.26878	.12763	.174
		2	-.22353	.13528	.366
		3	-.11429	.14201	.852
	1	2	-.00855	.10226	1.000
VEUSEFULNESS		3	.07082	.11056	.918
		4	-.09744	.12410	.861
	2	1	.00855	.10226	1.000
		3	.07937	.11885	.908
		4	-.08889	.13154	.905
	3	1	-.07082	.11056	.918

		2	-.07937	.11885	.908
		4	-.16825	.13809	.620
	4	1	.09744	.12410	.861
		2	.08889	.13154	.905
		3	.16825	.13809	.620

Table 4.8 HOMOGENEOUS : VARVEOPINIONS

Tukey HSD

		Subset for alpha = 0.05
RISAindpv	N	1
4	5	3.6870
3	7	3.8882
1	13	3.9498
2	9	4.0870
Sig.		.067

Means for groups in homogeneous subsets are displayed.

1. DFR 2. GHA 3. DUR 4. KTC

Table 4.9 HOMOGENEOUS : AVFMPRT

Tukey HSD

		Subset for alpha = 0.05
RISAindpv	N	1
4	5	3.7176
3	7	3.8319
2	9	3.9412
1	13	3.9864

Sig.		.160

Means for groups in homogeneous subsets are displayed.

Table 4.10 HOMOGENEOUS : VEUSEFULNESS

Tukey HSD

		Subset for alpha = 0.05
RISAindpv	N	1
3	7	4.2540
1	13	4.3248
2	9	4.3333
4	5	4.4222
Sig.		.518

Means for groups in homogeneous subsets are displayed.

4.4 CHAPTER SUMMARY

This chapter focused on the processing, presentation, statistical analysis and discussions of all the results of the data collected from the field survey. It initiated with a concise discussion of the survey questionnaires, data processing procedure and statistical data analysis techniques. This chapter focused on all the presentation of data from both nominal and continuous data used in the questionnaire. It as well tackled the statistical analysis tests for these categorical (nominal) and continuous (ratio) data. The chapter also employed descriptive statistical analysis tests for both data as modes (frequencies) and means, standard deviations, variances - for the nominal and continuous data, respectively. Inferential (hypothetical) statistical tests used were the parametric tests (Pearson Correlation and ANOVA tests) and non-parametric tests (Binomial and Chi-square tests) for the continuous and nominal data sets, respectively, to determine the validity of the

pvalue ($p>0.05$; $p>0.01$) and as well set limitations for future research. ($p<0.05$; $p<0.01$) **Three (3)** of the dependent variables received the parametric statistical tests, whiles the remaining **one (1)** received the non-parametric Chi-square tests. The independent variable received the non-parametric Chi-square tests for the multi-choice questions and the nonparametric Binomial tests for the dichotomous questions in the questionnaire. It is of much relevance to note that variables were analysed by recalling research objectives.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

The inadequate and unsatisfactory VFM achieved on road projects in Ghana has been so pervasive and still remains an inevitable issue and a canker. Road Infrastructure and Support Agencies (RISA) under the MRH with its experienced and expert Road Professionals (RPs) or Technical Professionals (TPs) still continue to be confronted with VFM issues even though almost all road projects in Ghana are believed to have a VFM agenda. The capital intensive nature of road projects in Ghana coupled with its inevitable myriad of challenges still poses so much threat to road project administration in the

country both now and even in the future. The attempt to achieve an optimum VFM remains the only solution to remedying these problems or challenges that have bedeviled this unrealized VFM agenda. This research sought to establish the usefulness of Value Engineering (VE) on road projects in Ghana to promote its implementation. Through the critical review of germane literature, the conventional VFM practice (through PM) and the advanced VFM practice (by the integration of VE into PM) have been explicitly explored and distinguished to establishing the VFM limitation of PM and the VFM adequacy of VE integration into PM. By way of adopting the quantitative research strategy, a questionnaire survey was employed to determine first and foremost how convinced respondents of these RISA were towards the usage of VE on road projects, questions were then also posed on VE FAST for an optimum VFM implementation on road projects in Ghana and finally there was the need to establish the potency of PM without VE on road projects in Ghana, all geared towards establishing how useful or effective VE will be on road projects in Ghana to encourage its implementation, henceforth. The previous chapters highlighted on the background to the research, the review of extant literature, research design and methodology and the data analysis and discussions of results from the questionnaire administered. Finally, this chapter outlines the findings of the study in line with the laid down objectives of this study. Recommendations from the study are as well put forth and the study limitations are presented together with directives for future research.

5.2 SUMMARY OF FINDINGS

Table 5.1 Validity of Responses by Respondents

RESPONSES	Sample size	Mean	Standard Deviation	Variance	ACTION

VE is not only about cost management	34	3.9706	.90404	.817	Valid
VE is so important to meet the stated and implied needs of the client	34	4.2941	.57889	.335	Valid
VE decreases Life Cycle Costs (LCC)	34	3.9412	.73613	.542	Valid
VE decreases timelines of road projects	34	3.8824	.64030	.410	Valid
VE is an optimum VFM intervention for road projects	34	3.8529	.82139	.675	Valid
VE improves quality performances of road projects	34	3.8529	.55772	.311	Valid
VE is the functional analysis of the functional components of road projects	34	3.7059	1.08793	1.184	Invalid
VE is an attempt to break down the high-costs and low efficiencies on road projects	34	3.8824	.94595	.895	Valid
Value Management (VM) is a tool to obtaining innovative solutions	34	4.0000	.81650	.667	Valid
Added value analysis identifies the strengths and weaknesses of road projects	34	4.1176	.80772	.652	Valid
Road projects in Ghana mostly have value in not equal to value out.	34	4.4118	.49955	.250	Valid
Non-Value Adding Activities (NVAAs) negatively impact project performance	34	4.2353	.60597	.367	Valid
VE is not a major cause of variations	34	3.9118	.90009	.810	Valid

Project values influence project quality expectations	34	4.1176	.53737	.289	Valid
VE is achieving quality at an optimum cost and performance	34	4.0588	.64860	.421	Valid
VE team is better when it is multidisciplinary in nature	34	4.0588	.60006	.360	Valid
VE can be implemented at all stages of construction	34	3.9118	.90009	.810	Valid
VE should not disturb the schedule.	34	3.5588	1.05000	1.102	Invalid
VE job plan is significant for the implementation of VE methodology.	34	3.5294	1.13445	1.287	Invalid
During the VE workshop, the VE team first absorbs the background issues.	34	3.8529	.95766	.917	Valid
Secondly, they define and classify the project functions.	34	3.7647	.69887	.488	Valid
They identify creative approaches to provide the functions.	34	3.9412	.85071	.724	Valid
Finally, they evaluate and present the VE proposals	34	3.6471	.84861	.720	Valid

Human (process) values should precede product (project) values	34	3.8824	.80772	.652	Valid
Adequate management is based on a value practice	34	3.7941	.76986	.593	Valid
The difference between VM and VBM is in the definition of value	34	3.8529	.55772	.311	Valid

In general the idea of VM is to increase the VFM relationship	34	3.8824	.59108	.349	Valid
Value in VM is measured by a VFM relationship	34	3.8529	.70205	.493	Valid
Value is not equal to money	34	3.9706	.45960	.211	Valid
Value is associated with the project and its components	34	3.8529	.55772	.311	Valid
The perception about VE is the delivery of value to the client	34	4.0882	.37881	.143	Valid
Value is achieved when the project has a high performance	34	3.9706	.62694	.393	Valid
VFM is an avenue to address quality	34	4.0588	.54723	.299	Valid
FA guarantees an understanding of what a road component does.	34	3.7647	.74096	.549	Valid
The centre of VE is in the FA of the road components	34	3.8235	.67288	.453	Valid
FA moves the team better value.	34	3.9706	.62694	.393	Valid
FA is concerned with specific road project requirements	34	3.9118	.66822	.447	Valid
It is important to spend a significant amount of time on FA	34	3.9706	.71712	.514	Valid
The purpose of FAST is to build consensus in the road VE team	34	3.7647	.55371	.307	Valid
The main goal of FA is an understanding of the road project's purpose.	34	3.9412	.64860	.421	Valid
Project Integration Management with VE	34	4.2647	.44781	.201	Valid

Project Scope Management with VE	34	4.2647	.44781	.201	Valid
Project Time Management with VE	34	4.3529	.48507	.235	Valid
Project Cost Management with VE	34	4.2353	.43056	.185	Valid
Project Quality Management with VE	34	4.3824	.49327	.243	Valid
Project Human Resource Management with VE	34	4.4412	.50399	.254	Valid
Project Communications Management with VE	34	4.3235	.47486	.225	Valid
Project Risk Management with VE	34	4.2941	.46250	.214	Valid
Project Procurement Management with VE	34	4.3824	.49327	.243	Valid

As already established, the research aim was to establish the usefulness and the effectiveness of VE on road projects in Ghana to promote its implementation. Accordingly, research objectives were set in order to accomplish the above aim. In this subsection, the research objectives are being revisited to consider how they were attained through the various phases of the study. The study utilized descriptive statistical analysis tests as well as inferential statistical analysis tests in the analysis of these set of measurable and testable objectives.

Assessing the VFM limitations of the conventional VFM practice

In an attempt to establish the usefulness of VE in Ghana to promote its implementation, the first objective was to examine how the conventional VFM practice is being administered on road projects in Ghana to be able to assess its VFM limitation. It is of great importance to note that this conventional VFM practice is the normal road PM with only **three (3)** major controls in road contracts, namely time, cost and quality, all as an

attempt to achieve a VFM agenda on road projects in Ghana by the RISA under the MRH. To be able to achieve this objective, **six (6)** questions were posed in the questionnaire under section **two (2)** which covered the following: type of most remarkably managed road project, year of execution, its initial budgeted cost, its initial estimated time, associated impacts and overall assessment. Out of these **six (6)** nominal multiple-choice questions, only **four (4)** were subjected to non-parametric chi-square tests as a result of the multiple responses collated in each case: type of most remarkably managed road project, its initial budgeted cost, its initial estimated time, and its associated impacts.

Descriptively, these road projects which were deemed as being remarkably managed all from year 2000 were all challenged road projects, which therefore meant that those projects deemed as remarkably managed were all completed over time, over budget and not meeting all the requirement as was originally specified.

Inferentially and from the chi-square tests subjected to this, it was conclusively deduced that all the remarkably managed road projects were not independent to their associated impacts, since the p-value associated with this sub-variable was 0.000. ($p < 0.05$). Now as a result of the fact that all these remarkably managed road projects were not independent of their associated impacts, it sets a limitation in the VFM agenda of this conventional VFM practice.

Discovering how convinced RPs are about the advanced VFM practice.

Another attempt was also made in the form of rating questions posed to these TP respondents. These rating questions were engulfed around the usage of VE on road projects. Respondents were thus asked to assess how convinced they were about the

application of VE varied practices and techniques on road projects. This was an effort to determine and affirm their certainty levels even though their awareness levels were low. A 5-point likert scale was employed here with the following interpretations: 1- Not sure, 2- Quite sure, 3- Moderately sure, 4- Sure, 5- Very sure.

Descriptively, it was realized that the mean scores of all responses were all significant mean values greater than 3.5.Means were therefore not significantly different. Thus there was significance and coherence of responses given. Standard deviations , variances and standard errors of means among the **twenty-three (23)** rating questions were all less than **one (1)** within and for all these RISA under the MRH. Thus, variability and consistency was not significantly different on the whole, which also depicted the evenness and agreement of responses given.

Inferentially, Pearson correlation and ANOVA tests were used to establish the p-value, which is the significance value. Pearson correlation tests established a significant and a perfect relationship with the VAR variables and the One-way ANOVA tests also received significant mean values (> 3.5) for each group of unique respondents. It was realized from the One-way ANOVA tests that the mean differences between and within the various groupings were not significantly different ($p>0.05$ and p is 0.139). Thus, responses received from each group clearly showed the agreement, coherence and consistency of responses by respondents. Accordingly the certainty and surety levels of these RPs respondents within these RISA under the MRH on the usage of VE practices and techniques on these road projects was affirmed from the harmony in responses from respondents.

Evaluating the VFM adequacy of VE.

In an attempt to achieve this objective an effort was also made over here in the form of rating questions posed to these TP respondents. These rating questions were engulfed around VE for an optimum VFM on road projects in Ghana and the FAST on road projects. Respondents were thus asked to assess the implementability or the applicability of VE FAST for an optimum VFM on these road projects as an effort to evaluate the VFM adequacy of VE practices and techniques. **Seventeen (17)** practices and techniques were thus asked over here and responses were accordingly invited from respondents. A 5-point likert scale was employed here with the following interpretations: 1- Not relevant, 2- Quite relevant, 3- Moderately relevant, 4- Relevant, 5- Very Relevant.

Descriptively, it was ascertained that the mean scores of all responses were all significant mean values greater than 3.5.Means were therefore not significantly different. Thus there was significance and coherence of responses given. Standard deviations , variances and standard errors of means among the **seventeen (17)** rating questions were all less than **one (1)** within and for all these RISA under MRH. Thus, variability and consistency was not significantly different on the whole, which also depicted the evenness and agreement of responses given by respondents confirming and affirming the implementability and applicability of VE FAST for an optimum VFM on road projects in Ghana.

Inferentially, Pearson correlation and ANOVA tests were used to establish the p-value, which is the significance value. Pearson correlation tests established a significant and perfect relationship within the AVFM variables and the One-way ANOVA tests also received significant mean values (> 3.5) for each group of unique respondents. It was realized from the One-way ANOVA tests that the mean differences between and within the various RISA groupings were almost the same and as such were not significantly

different (p>0.05 and p is 0.176). Thus, responses received from each group clearly showed the agreement, coherence and consistency of responses by respondents. Accordingly, the VFM adequacy of the VE FAST for road projects in Ghana was consistent and in harmony with responses from these TPs respondents within the RISA under the MRH.

Promoting the implementation of VE.

Finally, another effort was made to realise the fourth objective of establishing the usefulness of VE on road projects in Ghana to encourage its practical applications. This was in consonance with the attempt to conclusively accomplish the aim of the study. As such, rating questions were posed to ascertain the potency of VE in an implied way by eliciting responses from respondents about the effectiveness levels in the application of each of the **nine (9)** PM knowledge areas (with VE integrated) on road projects in Ghana. A 5-point likert scale was employed here with the following interpretations: 1- No value, 2- Low value, 3- Medium value, 4- High value, 5- Very high value.

Descriptively, it was ascertained that the mean scores of all responses were all significant mean values greater than 3.5, depicting the high value of the PM (with VE integration) on road projects in Ghana. .Means were therefore not significantly different. Thus there was significance and coherence of responses given. Standard deviations, variances and standard errors of means among the **nine (9)** rating questions were all less than **one (1)** within and for all these RISA under MRH. Thus, variability and consistency was not significantly different on the whole, which also depicted the evenness and agreement of responses given by respondents confirming and affirming the integration of VE into each of the **nine (9)** PM knowledge areas for an optimum VFM on road projects in Ghana.

Inferentially, Pearson correlation and ANOVA tests were used to establish the p-value, which is the significance value. Pearson correlation tests established a significant and perfect relationship within the VEUSE variables and the One-way ANOVA tests also received significant mean values (> 3.5) for each group of unique respondents. It was realized from the One-way ANOVA tests that the mean differences between and within the various RISA groupings were almost the same and as such were not significantly different (p>0.05 and p is 0.686). Thus, responses received from each group clearly showed the agreement, coherence and consistency of responses by respondents. Accordingly, the VFM adequacy of the VE FAST for road projects in Ghana was consistent and in harmony with responses from these TPs respondents within the RISA under the MRH.

5.3 CONCLUSION

The study to establish the usefulness of VE on road projects in Ghana to promote its implementation, realized the following:

(i) Conventional VFM practice being administered on road projects now is deficient, limited, unsatisfactory and inadequate in VFM.

(ii) RPs are highly convinced about the potency of the Advanced VFM practice on road projects.

(iii) VE is an adequate, satisfactory and an advanced VFM tool for an optimum VFM implementation on road projects.

(iv) Finally, VE integration into PM is to promote an optimum VFM on road projects.

5.4 RECOMMENDATIONS

The recent state of the VFM agenda of road projects is alarming. Adequacy in VFM seems to be still limited and deficient as far road project administration by the RISA under the MRH of Ghana is concerned. This underlying problem on our road projects today has challenged the execution of almost all our road projects with myriad of associated impacts, even though its being administered by experienced and expert TPs within the RISA under the MRH of Ghana. This current strain on our road projects makes it very significant to evaluate the effectiveness of VE on road projects in Ghana to promote its implementation and application. This formed the basis for this study.

Accordingly, the findings from the study informed the following recommendations to be put forward. These recommendations included:

(i) It was discovered in the process of this study that respondents within the RISA were not aware about the practices and techniques of VE for an optimum VFM on road projects in Ghana. They absolutely did not have any knowledge in this VE practice and technique. Accordingly, it is recommended for an intensive training on VE practices on road projects in Ghana for all RPs within the MRH at the Koforidua Training Centre (KTC), hereinafter termed as 'Equipping the TPs or the RPs'.

(ii) It was also realised that the conventional method of achieving VFM (which is PM without VE integration) by these RPs for road projects in Ghana was limited and deficient in its FM agenda. Accordingly, it is recommended for the integration of VE/VM in each of the **nine (9)** PM knowledge areas as an advanced method and system for an optimum VFM on road projects in Ghana, termed as 'Road PM-VE Integration'.

(iii) It was as well found that all the remarkably managed road projects by these experienced professionals were bedeviled with inevitable associated impacts. Accordingly, it is recommended for the introduction of a VE practice at all phases of the road project in Ghana, most especially, at the planning and design phase. This becomes the VE Initiation phase of road PM, VE Planning phase of road PM, VE Executing phase of road PM, VE Monitoring phase of road PM, and the VE Controlling phase of road PM, all geared towards achieving an optimum VFM on road projects in Ghana.

(iv) There was also an established fact that the VE FAST is a potent tool for achieving an optimum VFM on road projects in Ghana since it does not only look at the mere resources or components of the road project and determines its optimum value but rather the functional aspects of the resources or components as well. Accordingly, it is recommended for the appointment of a Road Value Analyst or a Road Value Engineer on all road projects in Ghana to partner with the Professional team. This becomes the Road VE team which will now replace the Road Professional team.

(v) It was also discovered that the **three (3)** major controls in the conventional VFM practice which were time, cost and quality controls in road contract documents needed some augmentation. Accordingly, it is recommended for the integration of a Road VE control to make the achievement of an optimum VFM exhaustive, hereinafter, termed as the 'VE Control clause' in road project contract documents.

(vi) It was also found that almost all the remarkably managed road projects were bedeviled with inevitable associated impacts (time overruns, cost overruns and poor quality). Accordingly, it is recommended for the appointment of a Road VE Scheduler in addition to the Value Analyst on the Road VE team.

5.5 DIRECTIONS FOR FUTURE STUDY

The study limitation opens way for new areas to be explored. These areas need further research attentions. The following areas have been suggested for future studies:

(i) The study was limited to only Koforidua in the Eastern Region. Research should be conducted to include all the regions in Ghana.

(ii) The research approach adopted was quantitative. A qualitative approach must be adopted for future research on the same topic

(iii) The study only invited responses from the RPs or the TPs in the RISA under the MRH. Future research should be conducted to include the road contractors under the MRH.

(iv) The research only tested hypotheses up to a 95% confidence level with a complement significance value of p = 0.05. Future research should be conducted with other p-values of 0.01, 0.001, and 0.0001.

(v) The study only established the effectiveness of VE on road projects in Ghana. Future research can be achieved by developing a VE road model and testing it for an optimum VFM on road projects in Ghana.

(vi) The study employed multiple-choice questions with interval alternative responses for one of the dependent variable. Future research can be conducted

with either ranking responses or specific responses for all the dependent variables

REFERENCES AND BIBLIOGRAPHY

Ajay, S. and Micah, B. (2014) Sampling Techniques and Determination of Sample size in Applied Statistics Research: An Overview. International Journal of Economics, Commerce and Management, Vol. 2 Iss. 11, Pp. 001-022.

Alabi, G. and Alabi, J. (2012) A new functional management model in perspective: building on Deming's system of profound knowledge and Dewey's quest for certainty. IPS-Legon, Accra-Ghana, September, 2012. Vol. 1 Iss. 1, Pp. 001-015.

Albrecht, J.C. and Spang, K. (2014) Linking the benefits of Project management maturity to project complexity. International Journal of managing projects in Business, Vol. 7 Iss. 2, Pp. 285-301.

Alvarado, C.M., Silverman, R.P. and Wilson, D.S. (2005) Assessing the performance of Construction Projects: Implementing Earned Value Management at the General Services Administration. Journal Facilities Management, Vol. 3 Iss. 1, Pp. 92105.

American Society for Testing and Materials (ASTM E1699-10) The standard practice for performing value analysis (VA) of buildings and building systems.

American Society for Testing and Materials (ASTM E2013-12) The standard practice for constructing FAST diagrams and performing function analysis during value analysis study.

Annappa, C. and Panditrao, K. (2012) Application of value engineering for cost reduction-A case study of universal testing machine. International Journal of Advances in Engineering & Technology, Vol. 4 Iss. 1, Pp. 618-629.

Ayyash, M. M., Ahmad, K. and Singh, D. (2011). A Questionnaire Approach for User Trust Adoption in Palestinian E-Government Initiative, American Journal of Applied Sciences, Vol. 8, No. 11, Pp. 1202-1208

Baiden, B. K. (2006). Framework for the Integration of the Project Delivery Team.Unpublished Thesis (PhD), Loughborough University, United Kingdom.

Benstin, M., Benston, D. and Haraburda, S. (2011) Using value engineering to reduce life cycle cost. Defense AT&L: January-February 2011.

Boock, M. and Chau, M. (2007) The use of value engineering in the evaluation and selection of digitization projects. Journal of Evidence Based Library and Information Practice, Vol. 2 Iss. 3, Pp.76-86.

Borza, J. (2011) FAST diagrams: The foundation for creating effective function models.

Bowen, P., Catell, K., Jay, I and Edwards, P. (2009a) Value management practice in South Africa: the built environment professions compared. Construction Management and Economics Journal, Vol. 27, Pp. 1039-1057.

Bowen, P., Catell, K., Jay, I and Edwards, P. (2009b) The awareness and practice of value management by South African consulting engineers: Preliminary research survey findings. International Journal of Project Management, Vol.28, Pp. 285295.

Bowen, P., Catell, K., Jay, I and Edwards, P. (2010a) Value management awareness and practice by South African architects: an empirical study. Construction Innovation Journal, Vol. 10 Iss. 2, Pp. 203-222.

Bowen, P., Catell, K., Jay, I. and Edwards, P. (2010b) Value Management Practice by South African Quantity Surveyors. Facilities Journal, Vol. 28 Iss. 1/2, Pp. 46-63.

Bowen, P., Catell, K., Jay, I. and Edwards, P. (2011) Value Management in the South African Manufacturing Industry: Exploratory Findings. Management Decision Journal, Vol. 49 Iss. 1, Pp. 6-28.

Bremmer Consulting Llc (2010) Why Use SAVE International value engineering methodology?

Bresnen, M., Edelman, L., Newell, S., Scarbrough, H. and Swan, J. (2003) Social Practices and the management of knowledge in project environments. International Journal of Project Management, Vol. 21, Pp. 157-166.

Bryman, A. (1992). Quantitative and Qualitative Research: Further Reflections on Their Integration, In Brannen, J.(ed.) Mixing methods: Qualitative Research, Aldershot, UK: Avebury. pp. 57-78

Buchko, A.A. (2007) The effect of Leadership on Values-Based Management. Leadership and Organisation Development Journal, Vol. 28 Iss. 1, Pp. 36-50.

Bytheway, C. (2007) FAST creativity and innovation: Rapidly improving processes, product development and solving complex problems.

Cavaleri, S., Firestone, J. and Reed, F. (2012) Managing the project problem-solving patterns. International Journal of managing projects in Business, Vol. 5 Iss. 1, Pp. 125-145.

Chan, I.Y.S., Leung, M. and Yuan, T. (2014) Structural Relationships between Cultural Values and Coping Behaviours of Professionals in the stressful Construction Industry. Engineering Construction and Construction Management Journal, Vol. 21 Iss. 2, Pp. 133-151.

Chen, W., Chang, P. and Huang, Y. (2010) Assessing the overall performance of value engineering workshops for construction projects. International Journal of Project Management, Vol.28, Pp. 514-527.

Chung, B., Syachrani, S., Jeong, H. and Kwak, Y. (2009) Applying process simulation technique to value engineering model: A case study of hospital building project. Journal of IEEE Transactions on Engineering Management, Vol. 56 Issue 3, Pp.549-559.

Clark, J.A. (1999) Value Engineering for Small Transportation Projects. Thesis (MSc), Worcester Polytechnic Institute.

Cochran, W.G. (1963) *Sampling Techniques*, 2nd Ed. New York: John Wiley and Sons, Inc.

Czuchry, A.J. and Yasin, M.M. (2003) Managing the Project Management Process. Industrial Management and Data system Journal, Vol. 103 Iss. 1, Pp. 39-46.

De Marco, A. and Narbaev, T. (2013) Earned Value-based performance monitoring of Facility construction projects. Journal of Facilities Management, Vol. 11 Iss. 1, Pp. 69-80.

Dell'isola, A.J. (1982) Value Engineering in the Construction Industry. Van Inc.

Dlugatch, I. (1973) Methodology for value engineering. Journal of IEEE Transactions on Reliability, Vol. 22 Iss. 1, Pp. 20-23.

Dzah, B.D. (2005) The Potential of Value Engineering in the Ghanaian Construction Industry. Thesis (MSc), Department of Building Technology, KNUST-Kumasi, Ghana.

Emuze, F., Smallwood, J. and Han, S. (2014) Factors contributing to non-value adding activities in South African Construction. Journal of Engineering Design and Technology, Vol. 12 Iss. 2, Pp. 223-243.

Fellows, R. and Liu, A. (2008) Research methods for construction. 3rd Edition. UK: Blackwell Publishing Limited.

Fisher, C. (2010) Researching and writing a dissertation: An essential guide for Business students. 3rd Edition. Harlow, England: Pearson Education Limited.

Ford, D.N. and Bhargav, S. (2006) Project Management Quality and the Value of Flexible Strategies. Engineering Construction and Architectural Management Journal, Vol.13 Iss. 3, Pp. 275-289.

Fortune, J., White, D., Jugdey, K. and Walker, D. (2011) Looking again at current practice in project management. International Journal of managing projects in Business, Vol. 4 Iss. 4, Pp. 553-572.

Ghana News Agency (2011) Government Sourcing for funds to Suhum-Nsawam road, General News, Thursday; 27th October, 2011. [Accessed May 2015]

Gibbons, P.M., Kennedy, C., Burgess, S.C. and Godfrey, P. (2012) Developing an Asset Management Value Improvement Model [a-VIM] approach for an airport operational engineering environment. International of Journal of Quality and Reliability Management, Vol. 29 Iss. 7, Pp. 797-819.

Harrison, F.L. (1985) Advanced Project Management. 2nd Edition. Worcester: Billing and Sons ltd.

Heggade, V. (2002) IT propelled value engineering in construction. Indian Concrete Journal, Pp. 222-226.

Huber, K. (2012) Value engineering in projects. Engineering Council of South Africa.

Ibbs, C.W., Wong, C.K. and Kwak, Y.H. (2001) Project Change Management System. Journal of management in engineering.in China. Journal of Engineering,Construction and Architectural Management, Vol. 11 Iss. 1, Pp. 9-19.

Jaapar, A. (2000) The Case for Value Management to Be Included in Every Construction Project Design Process. Thesis (MSc), Universiti Teknologi Mara.

Jallow, A.K., Demian, P., Baldwin, A.N. and Anumba, C. (2014) An empirical study of the complexity of requirements management in construction projects.

Engineering Construction and Architectural Management Journal, Vol. 21 Iss. 5, Pp. 505-531.

Janes, J. (1999). Survey Construction, Library Hi Tech, Vol. 17, No. 3, pp. 321-325

Jay, C.I. and Bowen, P.A. (2015) Value Management and Innovation: A historical perspective and review of the evidence. Journal of Engineering, Design and Technology, Vol. 13 Iss. 1, Pp. 123-143.

Jessup, S. and Mitchell, C. (2013) Developing a Standard Approach to the Value Engineering Process for the Civil Engineering Industry: a Theoretical, Case Study and Industry Perspective. Conference papers, Dublin Institute of Technology, CEEC General Assemblies Brussels, Pp. 025-027.

Ji, S. (2002) Design Value Engineering in Korea. Journal of Construction Management and Engineering, JSCE, Vol. 55 No. 707, Pp. 225-230.

Kashiwagi, D. and Savicky, J. (2003) The cost of 'best value' construction. Journal of Facilities Management, Vol. 2 Iss. 3, Pp. 285-297.

Kasi, M. (2009) Function approach to transportation projects, a value engineering guide. IUNIVERSE Inc. New York, Bloomington.

Kelly, J., Male, S. and Graham, D. (2004) Value Management of Construction Projects. UK: Blackwell Science Publishing Company ltd.

Kerzner, H. (2009) Project Management: A systems approach to planning, scheduling, and controlling. 10th Edition. Hoboken, New Jersey: John Wiley & Sons Inc.

Kmetty, G. (2013) How the functional analysis discipline works. SAVE International Interactions, Vol. 36 Iss. 1, p. 7.

Koskela, L. and Howell, G. (2002) The underlying theory of Project Management is obsolete. Finland: Proceedings of PMI Research Conference, Pp. 293-302.

Kothari, A. and Lackner, J. (2006) A Value Based Approach to Management. Journal of Business and Industrial Marketing, Vol. 1 Iss. 4, Pp. 243-249.

Kwak, Y.H. and Ibbs, C.W. (n.d.) Assessing Project management maturity, University of California.

Leung, M. and Yu, J. (2014) Value methodology in public engagement for construction development projects. Built Environment Project and Asset Management, Vol.4 Iss. 1, Pp. 55-70.

Liu, G. and Shen, Q. (2005) Value Management in China: Current State and future prospect. Management Decision Journal, Vol. 43 Iss. 4, Pp. 603-610.

Long, G.W. (1989) Developing and Implementing a Value Engineering Program in a Federal Agency, paper presented to the SAVE International Conference, 1989.

Loosemore, M. and Richard, J. (2015) Valuing Innovation in Construction and Infrastructure. Journal of Engineering, Construction and Architectural Management, Vol. 22 Iss. 1, Pp. 38-53.

Macdonald, C., Walker, D.H.T. and Moussa, N. (2013) Towards a project alliance Value for money framework. Facilities Journal, Vol. 31 Iss. 5/6, Pp. 279-309.

Male, S., Kelly, J., Frenie, S., Gronqvist, M. and Boyles, G. (1998). Value management: the value management benchmark: a good practice framework for clients and practioners. London: Thomas Telford Publishing.

Male, S., Kelly, J., Gronqvist, M. and Graham, D. (2006) Managing Value as a Management Style for Projects. Value Solutions Ltd.

Male, S., Kelly, J., Gronqvist, M. and Graham, D. (2007). Managing value as a management style for projects. International Journal of Project Management, Vol.

25, Pp.107-114.

Mangan, J., Lalwani, C. and Gardner, B. (2004). Combining quantitative and qualitative methodologies in logistics research, International Journal of Physical Distribution & Logistics Management, Vol. 34 No. 7, pp. 565-578.

Mansour, D.M., Rashid, I.A. and Arafat, H. (2013) Value Engineering Analysis in the Construction of Box-Girder Bridges. International Journal of Latest Trends in Engineering and Technology (IJLTET), Vol. 2 Issue 4.

Maykut, P. and Morehouse, R. (1999). Beginning Qualitative research: A philosophic and Practical Guide, Psychology Press. 1994

Miles, L. (1962) Technology of Value Analysis and Engineering. Proceedings of the 6th Annual Inland Empire Quality Control Conference, San Bernardino Section, American Society for Quality Control.

Miles, L. D. (1961) Techniques of Value Analysis and Engineering, McGraw-Hill Book Company, New York NY.

Miles, L.D. (1962) Value Analysis and Engineering. Manager-Value Service, General Electric Company, June 1962.

Miles, L.D. (1972) Techniques of Value Analysis and Engineering. McGraw-Hill Inc.

Ministry of Roads and Highways-MRH (2012) Pilot Program Based Project (PBB), final draft. Republic of Ghana, November 2012.

Ministry Of Transportation (2007) Standard Specification for Road and Bridge works. Republic of Ghana, July 2007.

Morris, P.W.G. (2004) Science, objective knowledge and the theory of Project Management. ICE James Forrest Lecture, Pp. 001-022. [Accessed on May 2015]

Morris, P.W.G. (2010) Research and the future of Project management. International Journal of managing projects in Business, Vol. 3 Iss. 1, Pp. 139-146.

Mosweu, C. (2006) Assessment of value added to engineering projects. Thesis (MSc), University of Johannesburg.

Naoum, S.G. (1998) Dissertation Research and Writing for Construction Students. Oxford: Bultermouth-Heinemom Taylor-Powell, E. (1998). Sampling, Program Development and Evaluation, G3568-3, University of Wisconsin-Extension.

Naoum, S.G. (2002) *Dissertation Research and writing for construction students*. Elsevier Butterworth-Heinemann.

Narh, A.K. (2014) Innovative Financing of Road Projects in the Ghanaian Construction Industry. Thesis (MSc), Department of Building Technology, KNUST-Kumasi, Ghana, November 2014.

Nenty, H. J. (2009). Writing a Quantitative Research Thesis, Int J Edu Sci, vol. 1, issue 1, pp. 19-32.

Neville, C. (2007). Introduction to Research and Research Methods, Effective Learning Service, Bradford University School of Management

Nick, R., Matthias, H. and Wirtschaftsing, H. (2000) Value engineering: dissemination of innovation and knowledge management techniques.

O'Farrell, P.K. (2010) Value Engineering: An opportunity for Consulting Engineers to redefine their role. Thesis (MSc), Waterford Institute of Technology, August 2010.

Perera, S., Davis, S. and Marosszeky, M. (2011a) Head Contractor role in construction value-based management. Journal of Financial Management of Property and

Construction, Vol. 16 Iss. 1, Pp. 31-41.

Perera, S., Hayles, C.S. and Kerlin, S. (2011b) An analysis of value management in practice: the case of Northern Ireland's construction industry. Journal of Financial Management and Construction, Vol. 16 Iss. 2, Pp. 94-110.

PMBOK Guide (2008) A Guide to Project Management Body of Knowledge. 4th Edition.

Rabbi, M. (2012) Value analysis for excellence in managing projects.

Road Talk (2000) The value engineering. Ontario Transportation Technology Transfer digest, Vol. 5 Iss. (2), Pp.1-6.

Rohn, N. (2004) Wisconsin Department of Transportation. Facility Development Manual Section15: Value engineering.

Sadawi, U.E. (2008) A Value Engineering Methodology for Low Income Housing Projects in Gaza Strip. Thesis (MSc), The Islamic University of Gaza.

Salvatierra-Garrido, J. and Pasquire, C. (2011) Value Theory in Lean Construction. Journal of Financial Management of Property and Construction, Vol. 16 Iss. 1, Pp. 8-18.

Sharma, A. and Srivastava, H. (2011) A case study analysis through the implementation of value engineering. International Journal of Engineering Science and Technology, Vol. 3 Iss. 3, Pp. 2204-2213.

Shen, Q. and Liu, G. (2004) Applications of value management in the construction Industry in China. Engineering, Construction and Architectural management, Vol.

11 Iss. 1, Pp. 009-019.

Shen, Q.G. and Yu, A.T.W. (2012) Value management: recent developments and way forward. Construction Innovation Journal, Vol. 12 Iss. 3, Pp. 264-271.

Smith, K. (1999) Applying value analysis to value engineering program. Proceedings for AAHSTO VE Conference.

Society Of American Value Engineers (SAVE)-International (1998, 2007 & 2012).

Soderlund, J. and Geraldi, J. (2012) Classics in Project management: Revisiting the past, creating the future. International Journal of managing projects in Business, Vol. 5 Iss. 4, Pp. 559-577.

Taylor-Powell, E. and Steele, S. (1996). Collecting Evaluation Data: An Overview of sources and methods, Program Development and Evaluation, G3568-4, University of Wisconsin-Extension

The Presidency State of the Nation Address (2015) Republic of Ghana. February 26, 2015. [Accessed May 2015]

Thomson, D.S., Austin, S.A., Root, D.S., Thorpe, A. and Hammond, J.W. (2006) A Problem-Solving Approach to Value-Adding Decision in Construction Design. Engineering, Construction and Architectural Management Journal, Vol. 13 Iss. 1, Pp. 43-61.

Tohidi, H. (2011) Review the benefits of using value engineering in information technology project management. Journal of Procedia Computer Science, Vol. 3, Pp. 917-924.

U.S. News and World Report (1988) The Leading Light, Vol. 105 No. 2, Pp.53-55.

Van Zyl, G.J. (1999) Value Engineering for Improvement of Capital Projects. Thesis (MPhil), Rand Afrikaans University.

Wandahi, S. (2005) Value in Building. Published thesis (PhD), Aalborg University of Denmark.

Wao, J.O. (2014) Value Engineering Methodology to improve Building Sustainability outcomes. Thesis (PhD), University of Florida.

Waroonkun, T. and Stewart, R.A. (2008) Pathways to Enhanced Value Creation from the International Construction technology transfer process in Thai Construction projects. Construction Innovation Journal, Vol. 8 Iss. 4, Pp. 299-317.

Whitty, S.J. (2011) On a new philosophy of managing projects in Business. Vol. 4 Iss. 3, Pp. 524-533.

Wilkinson, S. (2001) An analysis of the problems faced by project management companies managing construction projects. Journal of Engineering, Construction and Architectural Management, Vol. 8 Iss. 3, Pp. 160-170.

Wilson, D.C. (2005) Value Engineering Applications in Transportation: A Synthesis of Highway Practice, NCHRP 352, NCE limited, Markham, Ontario, Canada.

Wixson, J. (2004). Value analysis/value engineering: The forgotten lean technique.

Younker, D. (2003). Value Engineering: Analysis and Methodology (Cost engineering). New York: Marcel Dekker.

Yu, A.T.W., Shen, Q., Kelly, J. and Hunter, K. (2005) Application of value management in project briefing. Facilities Journal, Vol. 23 Iss. 7/8, Pp. 330-342.

Zou, P.X.W., Fang, D., Wang, S.Q. and Loosemore, M. (2007) An overview of the Chinese construction market and construction management practice. Journal of Technology Management in China, Vol. 2 Iss. 2, Pp. 163-176.

APPENDIX A: SURVEY QUESTIONNAIRE

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY COLLEGE OF ART AND BUILT ENVIRONMENT DEPARTMENT OF BUILDING TECHNOLOGY

SURVEY QUESTIONNAIRE

Research Topic: **IMPLEMENTING VALUE ENGINEERING ON ROAD PROJECTS IN GHANA**

INTRODUCTION

Value Engineering (VE) is an advanced Value for Money (VFM) management system and decision making tool which involves the logical methodology to obtain value of a project and its components by ensuring that their necessary functions are provided at the optimum cost.VE can also be expressed as Value Analysis (VA), Value Planning (VP), Value Management (VM), and Value Based Management (VBM) depending on its area of application.

This research is conducted as part of the requirement for the award of a Master's degree in Construction Management at KNUST. At the end of this research, it is my hope that the effectiveness of VE will be established to promote its implementation on road projects in Ghana for an optimum VFM.

Kindly complete this questionnaire and return to the researcher via this email: phillippantwi56@yahoo.com in a matter of 48 hours upon receipt, please. In the interim, all responses by respondents will be held secret, reserved and anonymous. Acknowledgements in advance for your contribution to completing this questionnaire.

(Please respond to the following questions by either ticking (√), writing or highlighting your responses as appropriately as possible)

(SECTION ONE): BACKGROUND INFORMATION OF RESPONDENTS

1.1 Which Road Infrastructure and Support Agency (RISA) under the Ministry of Roads and Highways (MRH) do you work with?

a) Department of Feeder Roads ☐ b) Department of Urban Roads ☐

c) Ghana Highway Authority ☐ d) Ghana Road Fund Secretariat ☐

e) Koforidua Training Centre ☐ e) Others (please specify) ……

1.2 What is your current position?

a) Regional Manager ☐ b) Maintenance Manager ☐

c) Operations Manager ☐ d) Contracts Manager ☐

e) Quantity Surveyor ☐ f) Land Surveyor ☐

g) Materials ☐ Engineer h) Technician Engineer ☐

i) Others (please specify) ……

1.3 What is your minimum level of education?

a) HND ☐ b) BSc ☐ c) MSc ☐ d) PhD ☐

e) Others (please specify) ……

1.4 Do you belong to any professional body? a) Yes ☐ b) No ☐

1.5 How many years of experience on road projects do you have?

a) 1-5 years ☐ b) 6-10 years ☐ c) 11-15 years ☐

d) Above 15 years ☐

1.6 Are you privy to the concept of Value Engineering (VE) for optimum Value for Money (VFM) on road projects? a) Yes ☐ b) No ☐

1.7 Do you think Value Engineering (VE) is practiced in your Agency?

a) Yes ☐ b) No ☐

(SECTION TWO): CONVENTIONAL VALUE FOR MONEY (VFM) PRACTICE

2.1 Identify the category of the most remarkable road project you have managed so far?

a) Trunk road project ☐ b) Feeder road project ☐ c) Urban road project ☐

d) Cocoa road project ☐ e) Donor funded project ☐

f) Others (please specify) ……..

2.2 Within which of the following years was that project executed?

a) Before 1990 ☐ b) Between 1990 and 2000 ☐ c) 2000 to date ☐ 2.3 What was the initial budgeted cost?

a) Below 1,000,000 ghc ☐ b) 1,000,000 ghc – 10,000,000 ghc ☐

c) Above 10,000,000 ghc ☐

2.4 What was the initial estimated time?

a) Below 12 months ☐ b) Between 12 to 18 months ☐

c) Above 18 months ☐

2.5 What were the impacts of this road project upon handing over?

a) Cost overruns alone ☐ b) Time overruns alone ☐

c) Poor Quality alone ☐ d) A combination of any two of the above ☐

e) Time overruns, Cost overruns and poor quality all together ☐

2.6 How will you assess this road project today?

a) Successful project ☐ b) Challenged project ☐ c) Impaired project ☐

(SECTION THREE): VARYING OPINIONS OF VALUE ENGINEERING (VE)

3.1 Value Engineering (VE) is an advanced Value for Money (VFM) tool. Below are important concepts of VE. How convinced are you about using VE on road projects? (Kindly use this 5point likert scale to address the following by ticking (√) the cells corresponding to your responses: 1- Not sure, 2- Quite sure, 3- Moderately sure, 4- Sure, 5- Very sure)

	Value Engineering (VE) Usage on road projects	**Certainty Levels**				
		1	**2**	**3**	**4**	**5**
A.	VE is not only about cost management					
B.	VE is so important to meet the stated and implied needs of the client					
C.	VE decreases Life Cycle Costs (LCC)					
D.	VE decreases timelines of road projects					
E	VE is an optimum VFM intervention for road projects					

.						
F.	VE improves quality performances of road projects					
G.	VE is the functional analysis of the functional components of road projects					
H.	VE is an attempt to break down the high-costs and low efficiencies on road projects					
I.	Value Management (VM) is a tool to obtaining innovative solutions					
J.	Added value analysis identifies the strengths and weaknesses of road projects					
K.	Road projects in Ghana mostly have value in not equal to value out.					
L.	Non-Value Adding Activities (NVAAs) negatively impact project performance					
M.	VE is not a major cause of variations					
N.	Project values influence project quality expectations					
O.	VE is achieving quality at an optimum cost and performance					
P	VE team is better when it is multidisciplinary in nature					
Q.	VE can be implemented at all stages of construction					
R.	VE should not disturb the schedule.					
S.	VE job plan is significant for the implementation of VE methodology.					
T.	During the VE workshop, the VE team first absorbs the background issues.					
U.	Secondly, they define and classify the project functions.					
V.	They identify creative approaches to provide the functions.					
W.	Finally, they evaluate and present the VE proposals					

(SECTION FOUR): ADVANCED VALUE FOR MONEY (VFM) PRACTICE

4.1 Below are important Value Engineering (VE) Value for Money (VFM) concepts. How do you assess each of the following for an optimum VFM on road projects in Ghana? (Kindly use this 5point likert scale to address the following by ticking (√) the cells corresponding to your responses: 1- Not relevant, 2- Quite relevant, 3- Moderately relevant, 4- Relevant, 5- Very relevant)

Value Engineering (VE) for an optimum Value for Money (VFM) on road projects in Ghana		**Applicability Levels**				
		1	**2**	**3**	**4**	**5**
A.	Human (process) values should precede product (project) values					
B.	Adequate management is based on a value practice					
C.	The difference between VM and VBM is in the definition of value					
D.	In general the idea of VM is to increase the VFM relationship					
E.	Value in VM is measured by a VFM relationship					
F	Value is not equal to money					
G.	Value is associated with the project and its components					
H.	The perception about VE is the delivery of value to the client					
I	Value is achieved when the project has a high performance					
J	VFM is an avenue to address quality					

4.2 The only difference between the conventional Value for Money (VFM) Practice and the advanced Value For Money (VFM) Practice lies in the element of Functional Analysis (FA) or the Functional Analysis System Technique (FAST). How do you assess each of the following on road projects? (Kindly use this 5-point likert scale to address the following by ticking (√) the cells corresponding to your responses: 1- Not relevant, 2- Quite relevant, 3- Moderately relevant, 4- Relevant, 5- Very relevant)

The Functional Analysis System Technique (FAST) on road projects		**Applicability Levels**				
		1	**2**	**3**	**4**	**5**
A.	FA guarantees an understanding of what a road component does.					

B.	The centre of VE is in the FA of the road components					
C.	FA moves the team better value.					
D.	FA is concerned with specific road project requirements					
E.	It is important to spend a significant amount of time on FA					
F.	The purpose of FAST is to build consensus in the road VE team					
G.	The main goal of FA is an understanding of the road project's purpose.					

(SECTION FIVE): USEFULNESS OF VALUE ENGINEERING (VE)

5.1 Below are the nine (9) Project Management (PM) Knowledge areas. Assess the usefulness in the integration of VE in each of the following for an optimum VFM on road projects in Ghana? (Kindly use this 5-point likert scale to address the following by ticking (√) the cells corresponding to your responses: 1- No Value, 2- Low Value, 3- Medium Value, 4- High Value, 5- Very High Value)

Project Management (PM) knowledge areas (with VE integrated) for an optimum Value For Money (VFM) on road projects in Ghana		**Effectiveness Levels**				
		1	**2**	**3**	**4**	**5**
A	Project Integration Management					
B	Project Scope Management					
C	Project Time Management					
D	Project Cost Management					
E	Project Quality Management					
F	Project Human Resource Management					
G	Project Communications Management					
H	Project Risk Management					
I	Project Procurement Management					

Thanks once again!

APPENDIX B: STATISTICAL ANALYSIS TEST RESULTS

CONTINUOUS (RATIO) DATA

DESCRIPTIVE (EXPLORATORY) STATISTICAL ANALYSIS TEST RESULTS

Table 4.1 Case Processing Summary of Dependent Variables to the independent variable

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
CVFMPRT * RESPROFILE (RISA)	34	100.0%	0	.0%	34	100.0%
VARVEOPINIONS * RESPROFILE (RISA)	34	100.0%	0	.0%	34	100.0%
AVFMPRT * RESPROFILE (RISA)	34	100.0%	0	.0%	34	100.0%
VEUSEFULNESS * RESPROFILE (RISA)	34	100.0%	0	.0%	34	100.0%

Limited to first 100 cases

RISA – Road Infrastructure and Support Agencies

Table 4.2 General Report on Dependent Variables

RISA	CVFMPRT	VARVEOPINIONS	AVFMPRT	VEUSEFULNESS
N	34	34	34	34
Mean		3.9348	3.9031	3.8562
Std. Deviation		.31321	.25078	.30647
N	34	34	34	34
Mean		3.9348	3.9031	4.3268

Std. Deviation		.31321	.25078	.23039

Limited to first 100 cases

Table 4.3 Descriptive Statistics of the individual responses

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
VENOTCOSTMANAGEMENT	34	1.00	5.00	3.9706	.90404	.817
VEMEETCLIENTNEEDS	34	3.00	5.00	4.2941	.57889	.335
VEDECREASESLCC	34	1.00	5.00	3.9412	.73613	.542
VEDECREASESTIMELINES	34	2.00	5.00	3.8824	.64030	.410
VEANOPTIMUMVFM	34	1.00	5.00	3.8529	.82139	.675
VEQUALITYENHANCER	34	2.00	5.00	3.8529	.55772	.311
VEFAST	34	1.00	5.00	3.7059	1.08793	1.184
VECOSTEFFICIENCY	34	1.00	5.00	3.8824	.94595	.895
VMINNOVATIVESOLUTIONS	34	2.00	5.00	4.0000	.81650	.667
ADDEDVASWOTANALYZER	34	1.00	5.00	4.1176	.80772	.652
RPJSSELDOMREALISEVFM	34	4.00	5.00	4.4118	.49955	.250
NVAASTIMECOSTOVERRUNS	34	3.00	5.00	4.2353	.60597	.367
VECAUSEOFVARIATIONS	34	1.00	5.00	3.9118	.90009	.810
RPJVALUEINFLUENCEQUALITY	34	3.00	5.00	4.1176	.53737	.289
VEQUALITYATOPTCOSTPERF	34	2.00	5.00	4.0588	.64860	.421
MULTIDISCPLINARYVETEAM	34	3.00	5.00	4.0588	.60006	.360
VEBESTATPLANNINGDESIGNSTAGE	34	1.00	5.00	3.9118	.90009	.810

VESHOULDNOTDISTURBSCHEDULE	34	1.00	5.00	3.5588	1.05000	1.102
WELLUNDERSTOODVEJOBPLAN	34	1.00	5.00	3.5294	1.13445	1.287
VETEAMFSTABSORBSBACKGROUNDISSUES	34	1.00	5.00	3.8529	.95766	.917
DEFINEPROJECTFUNCTIONS	34	3.00	5.00	3.7647	.69887	.488
IDENTIFYCREATIVEAPPROACHES	34	2.00	5.00	3.9412	.85071	.724
EVALUATEVEPROPOSALS	34	1.00	5.00	3.6471	.84861	.720
HUMANVALUESBFPROJECTVALUES	34	1.00	5.00	3.8824	.80772	.652
VALUEASANADEQMANAGCONCEPT	34	2.00	5.00	3.7941	.76986	.593
VMMINUSVBMISVALUE	34	3.00	5.00	3.8529	.55772	.311
VMIDEAINCREASESVFM	34	3.00	5.00	3.8824	.59108	.349
VALUEINVMBYVFM	34	1.00	5.00	3.8529	.70205	.493
VALUENOTMONEY	34	3.00	5.00	3.9706	.45960	.211
VALUERELATIONS	34	3.00	5.00	3.8529	.55772	.311
VALUEDELIVERYTOCLIENT	34	3.00	5.00	4.0882	.37881	.143
VALUEHIGHPROJPERF	34	3.00	5.00	3.9706	.62694	.393
VFMTOQUALITY	34	3.00	5.00	4.0588	.54723	.299
FAWHATROADCOMPDOES	34	2.00	5.00	3.7647	.74096	.549
VEFAOFROADCOMP	34	2.00	5.00	3.8235	.67288	.453
VETEAMBETTERVALUE	34	3.00	5.00	3.9706	.62694	.393
FASPECIFROADPROJREQ	34	3.00	5.00	3.9118	.66822	.447

BESTFAADEQTIMESPENT	34	3.00	5.00	3.9706	.71712	.514
FASTCONSENSUSINVETEAM	34	3.00	5.00	3.7647	.55371	.307
FAROADPRJPURPOSE	34	3.00	5.00	3.9412	.64860	.421
PIM	34	4.00	5.00	4.2647	.44781	.201
PSM	34	4.00	5.00	4.2647	.44781	.201
PTM	34	4.00	5.00	4.3529	.48507	.235
PCM	34	4.00	5.00	4.2353	.43056	.185
PQM	34	4.00	5.00	4.3824	.49327	.243
PHRM	34	4.00	5.00	4.4412	.50399	.254
PComM	34	4.00	5.00	4.3235	.47486	.225
PRM	34	4.00	5.00	4.2941	.46250	.214
PPM	34	4.00	5.00	4.3824	.49327	.243
Valid N (listwise)	34					

INFERENTIAL (HYPOTHETICAL) STATISTICAL ANALYSIS TEST RESULTS

Table 4.5 One-way ANOVA test : Descriptives Table

						95% Confidence Interval for Mean			
		N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
VARVEOPINIONS	1	13	3.9498	.26318	.07299	3.7908	4.1089	3.30	4.26
	2	9	4.0870	.13223	.04408	3.9853	4.1886	3.91	4.30
	3	7	3.8882	.25210	.09528	3.6550	4.1213	3.61	4.26
	4	5	3.6870	.58121	.25993	2.9653	4.4086	2.74	4.30
	Total	34	3.9348	.31321	.05371	3.8255	4.0441	2.74	4.30
AVFMPRT	1	13	3.9864	.14238	.03949	3.9004	4.0725	3.71	4.29
	2	9	3.9412	.26307	.08769	3.7390	4.1434	3.65	4.53
	3	7	3.8319	.25512	.09643	3.5960	4.0679	3.29	4.06
	4	5	3.7176	.37986	.16988	3.2460	4.1893	3.06	4.00
	Total	34	3.9031	.25078	.04301	3.8156	3.9906	3.06	4.53
VEUSEFULNESS	1	13	4.3248	.12391	.03437	4.2499	4.3997	4.11	4.56
	2	9	4.3333	.24845	.08282	4.1424	4.5243	4.00	4.78

	3	7	4.2540	.20998	.07937	4.0598	4.4482	4.00	4.56
	4	5	4.4222	.42601	.19052	3.8933	4.9512	4.00	5.00
	Total	34	4.3268	.23039	.03951	4.2464	4.4072	4.00	5.00

Table 4.7 POST HOC :Multiple Comparisons

Tukey HSD

Dependent Variable	(I) RISAindpv	(J) RISAindpv	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
VARVEOPINIONS	1	2	-.13712	.13018	.720	-.4911	.2168
		3	.06163	.14074	.971	-.3210	.4443
		4	.26288	.15798	.360	-.1667	.6924
	2	1	.13712	.13018	.720	-.2168	.4911
		3	.19876	.15129	.562	-.2126	.6101
		4	.40000	.16744	.101	-.0553	.8553
	3	1	-.06163	.14074	.971	-.4443	.3210
		2	-.19876	.15129	.562	-.6101	.2126

		4	.20124	.17578	.665	-.2767	.6792
	4	1	-.26288	.15798	.360	-.6924	.1667
		2	-.40000	.16744	.101	-.8553	.0553
		3	-.20124	.17578	.665	-.6792	.2767
AVFMPRT	1	2	.04525	.10517	.973	-.2407	.3312
		3	.15449	.11370	.534	-.1547	.4637
		4	.26878	.12763	.174	-.0783	.6158
	2	1	-.04525	.10517	.973	-.3312	.2407
		3	.10924	.12222	.808	-.2231	.4416
		4	.22353	.13528	.366	-.1443	.5914
	3	1	-.15449	.11370	.534	-.4637	.1547
		2	-.10924	.12222	.808	-.4416	.2231
		4	.11429	.14201	.852	-.2719	.5004
	4	1	-.26878	.12763	.174	-.6158	.0783
		2 3	-.22353	.13528	.366	-.5914	.1443 .2719
			-.11429	.14201	.852	-.5004	

VEUSEFULNESS	1	2	-.00855	.10226	1.000	-.2866	.2695
		3	.07082	.11056	.918	-.2298	.3714
		4	-.09744	.12410	.861	-.4349	.2400
	2	1	.00855	.10226	1.000	-.2695	.2866
		3	.07937	.11885	.908	-.2438	.4025
		4	-.08889	.13154	.905	-.4466	.2688
	3	1	-.07082	.11056	.918	-.3714	.2298
		2	-.07937	.11885	.908	-.4025	.2438
		4	-.16825	.13809	.620	-.5437	.2072
	4	1	.09744	.12410	.861	-.2400	.4349
		2	.08889	.13154	.905	-.2688	.4466
		3	.16825	.13809	.620	-.2072	.5437

CATEGORICAL (NOMINAL) DATA

DESCRIPTIVE (EXPLORATORY) STATISTICAL ANALYSIS TEST RESULTS

Table 4.11 Descriptive Statistical Analysis of Categorical (Nominal) Data of one independent (RESPROFILE) and one dependent (CVFMPRT) variable

		RISA	POSITION	EDUCA	PBOD	JBEXP	VEKNWL	VENRISA	TYPERPJ	YREXECT	INCOST	INTIME	IMPACT	ASSESSM
N	Valid	34	34	34	34	34	34	34	34	34	34	34	3.E1	34
	Missing	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 4.13 POSITION

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	ASTENG	2	5.9	5.9	5.9
	ENG	4	11.8	11.8	17.6
	LS	5	14.7	14.7	32.4
	MAINTE	1	2.9	2.9	35.3
	MATE	6	17.6	17.6	52.9
	OPM	3	8.8	8.8	61.8
	QS	10	29.4	29.4	91.2
	RM	3	8.8	8.8	100.0
	Total	34	100.0	100.0	

Table 4.14 EDUCATION

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	BSc	12	35.3	35.3	35.3
	BTECH	2	5.9	5.9	41.2
	HND	11	32.4	32.4	73.5
	MSc	9	26.5	26.5	100.0
	Total	34	100.0	100.0	

Table 4.15 PBODY

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	N	12	35.3	35.3	35.3
	Y	22	64.7	64.7	100.0
	Total	34	100.0	100.0	

1. N – no
2. Y - yes

Table 4.16 JBEXP

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	11TO15		20.6		20.6

	1TO5	7	5.9	20.6	26.5
	6TO10	2	44.1	5.9	70.6
	ABV15	15	29.4	44.1	100.0
	Total	10	100.0	29.4	
		34		100.0	

Table 4.17 VEKNWLEG

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	N	32	94.1	94.1	94.1
	Y	2	5.9	5.9	100.0
	Total	34	100.0	100.0	

Table 418 VEINRISA

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	N	34	100.0	100.0	100.0

Table 4.19 TYPERPJ

	Frequency	Percent	Valid Percent	Cumulative Percent
	1	2.9	2.9	2.9
	14	41.2	41.2	44.1

Valid	FDR/DONR	10	29.4	29.4	73.5
	FEEDER	9	26.5	26.5	100.0
	TRUNK	34	100.0	100.0	
	URBAN				
	Total				

Table 4.20 YREXECT

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2000TDAT	34	100.0	100.0	100.0

Table 4.21 INCOST

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1TO10M	25	73.5	73.5	73.5
	ABV10M	9	26.5	26.5	100.0
	Total	34	100.0	100.0	

Table 4.22 INTIME

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	ABV18MTS	13	38.2		38.2

	BLW12MTS	1	2.9	38.2	41.2
	BTN12&18	20	58.8	2.9	100.0
	Total	34	100.0	58.8 100.0	

Table 4.23 IMPACT

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	ALL3	1	2.9	2.9	2.9
	CMBANY2	19	55.9	55.9	58.8
	COST	3	8.8	8.8	67.6
	QUALITY	7	20.6	20.6	88.2
	TIME	4	11.8	11.8	100.0
	Total	34	100.0	100.0	

Table 4.24 Overall Assessment Of Remarkable Road Project

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	CHALLENG	34	100.0	100.0	100.0

INFERENTIAL (HYPOTHETICAL OR BIVARIATE) STATISTICAL ANALYSIS TEST RESULTS

Table 4.25 CHI-SQUARE TEST : RISA

	Observed N	Expected N	Residual
1	13	8.5	4.5
2	9	8.5	.5
3	7	8.5	-1.5
4	5	8.5	-3.5
Total	34		

RISA – Road Infrastructure and Support Agencies

1. Department of Feeder Roads (DFR)
2. Ghana Highway Authority (GHA)
3. Department of Urban Roads (DUR)
4. Koforidua Training Centre (KT)

Table 4.26 POSITION

	Observed N	Expected N	Residual
1	3	4.2	-1.2
2	1	4.2	-3.2
3	3	4.2	-1.2
4	6	4.2	1.8
5	10	4.2	5.8
6	5	4.2	.8
7	4	4.2	-.2
8	2	4.2	-2.2
Total	34		

1. Regional Manager (RM) 2. Maintenance Manager (MAINTE) 3. Operations Manager (OPM) 4. Materials Engineer (MATE) 5. Quantity Surveyor (QS)

6. Land Surveyor (LS) 7. Engineer (ENG) 8. Assistant Engineer (AENG)

Table 4.27 EDUCATION

	Observed N	Expected N	Residual
1	11	8.5	2.5
2	2	8.5	-6.5
3	12	8.5	3.5
4	9	8.5	.5
Total	34		

1. HND 2. BTECH 3. BSc 4. MSc

Table 4.28 JOB EXPERIENCE

	Observed N	Expected N	Residual
1	2	8.5	-6.5
2	15	8.5	6.5
3	7	8.5	-1.5
4	10	8.5	1.5
Total	34		

1. 1 to 5years
2. 6 to 10years
3. 11 to 15 years
4. Above 15years

Table 4.30 TYPE OF ROAD PROJECT

	Observed N	Expected N	Residual
1	10	8.5	1.5
2	14	8.5	5.5
3	9	8.5	.5
4	1	8.5	-7.5
Total	34		

1. Trunk
2. Feeder
3. Urban
4. Feeder/Donor

Table 4.31 INITIAL COST

	Observed N	Expected N	Residual
1	25	17.0	8.0
2	9	17.0	-8.0
Total	34		

1. 1 to 10 million Ghana cedis
2. Above 10 million Ghana cedis

Table 4.32 INITIAL TIME

	Observed N	Expected N	Residual
1	1	11.3	-10.3
2	20	11.3	8.7
3	13	11.3	1.7

Total	34		

1. Below 12months
2. Between 12 and 18months
3. Above 18months

Table 4.33 IMPACT

	Observed N	Expected N	Residual
1	4	6.8	-2.8
2	3	6.8	-3.8
3	7	6.8	.2
4	19	6.8	12.2
5	1	6.8	-5.8
Total	34		

1. Time
2. Cost
3. Quality
4. Combination of any two (1,2), (1,3), (2,3)
5. All three (1,2,3)