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COLLEGE OF TECHNOLOGY EDUCATION, KUMASI

AN ASSESSMENT OF THE EFFECTS OF DELAYS IN HIGHWAY CONSTRUCTION PROJECTS IN GHANA: A CASE STUDY OF THE GREATER ACCRA AND EASTERN REGIONS

WISDOM ADU

JULY, 2014

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AN ASSESSMENT OF THE EFFECTS OF DELAYS IN HIGHWAY CONSTRUCTION PROJECTS IN GHANA: A CASE STUDY OF THE GREATER ACCRA AND EASTERN REGIONS

WISDOM ADU

A Dissertation in the Department of CONSTRUCTION AND WOOD TECHNOLOGY EDUCATION, Faculty of TECHNICAL EDUCATION, submitted to the School of Graduate Studies, University of Education, Winneba in partial fulfillment of the requirements for the award of Master of Technology (Construction) degree.

JULY, 2014

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DECLARATION

STUDENT'S DECLARATION

I, Wisdom Adu, declare that this Dissertation, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for any other degree elsewhere.

SIGNATURE: ……..……

DATE: ……..……

SUPERVISOR'S DECLARATION

I hereby declare that the preparation and presentation of this work was supervised in accordance with guidelines for supervision of Dissertation laid down by the University of Education, Winneba.

NAME OF SUPERVISOR: Prof. N. Kyei-Baffour

SIGNATURE: ……

DATE: ……

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DEDICATION

I dedicate this project to the Almighty God who saw me through this programme and my wife Vida Agyei-Boateng, who supported me throughout the course of the study.

It is also dedicated to my daughter, Nana Afua Amoakoa-Adu, who has brought joy to our marriage.

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LIST OF ABBREVIATIONS

ADB	African Development Bank
BDTP	British Department of Transport
BOG	Bank of Ghana
CCD	Contractor Classification Delay
DBIA	Design-Build Institute of America
DFR	Department of Feeder Roads
DRUC	Calculation of Daily Road User Cost
DUR	Department of Urban Roads
ECD	Compensable Classification Delay
ENCD	Nocompensable Classification Delay
EPC	Engineering, Procurement and Construction
EPD	Estimated project
FIDIC	Federal International Des Ingéniurs Conseils
GHA	Ghana Highway Authority
GNA	Ghana News Agency
GOG	Government of Ghana
I/D	Incentive/Disincentive
LPG	Liquefied Petroleum Gas
NCD	Nonconcurrent Classification Delay
OCD	Owner Classification Delay
TPCD	Third Party Classification Delay
TTV	Total Time Value
UTV	Unit Time Value

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ABSTRACT

The highway system of every country forms an integral part of its development. The construction of this highway poses many challenges to inhabitants. Due to cash flow difficulties and others like Variations/Changes in scope of project, highway construction projects delays have become prevalent in Ghana. The effects of these delays that manifest both directly and indirectly tend to be ignored by the authorities. This research sought to identify the most significant causes and effects of delays and suggests, effective ways to minimize/mitigate them. The study was conducted through questionnaire survey supplemented with interviews among contractors and consultants by assessing the importance they attach to factors causing delays and ways in minimizing them. The research revealed the most significant effects of highway construction delays as high interests paid on delayed claims and compensations for fluctuation, traffic hold-ups and user delays, locked-up goods and services in the communities, health hazards to users in traffic hold-ups for inhaling carbon monoxide, soil erosion and higher labour and material costs. The rest are loss of business to locals in the work zones, locked up capital in plant and equipment as well as degrading landscape and aesthetics of towns and cities. Increased production cost and depreciating incomes result into low quality of work and labour agitations. The study identifies prompt payment, incentives for completion and realistic calculations as the most effective ways of mitigating delays in highway construction and its associated effects. The study also makes some recommendations on training of personnel, well-resourced independent Road Fund and proposes authority for local pressure groups to act as catalyst for early completion of projects and observance of Environmental obligations.

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CHAPTER ONE

INTRODUCTION

1.1 Background

The highway system of a nation is deemed to be the foundation for economic development. It supports sectors such as health, education, agriculture and tourism among others.

Until 1961 when Ghana began to lack funding for the sector, Issah (2002) felt that the country had a relatively sound highway network. In 2001, the national roads network was about 39,000 kilometres but by 2011 it was over 67,000 kilometres (Ghana News Agency (GNA, 2011).

Ghana's investment into the roads sector as mentioned by Issah (2002) accounted for US$ 7.0 billion. It has also been estimated that road transport accounts for about 94% of freight and about 97% of passenger kilometers in the country.

As the user demand of the nation's highway increases, so do the age and deterioration of the infrastructure. While most may recognize that an overhaul of the nation's highways and construction of new ones to make up for any shortfall is needed, the task of completing on-going projects is daunting.

In Ghana, as mentioned earlier, inadequate funding has become the lot of agencies seeing to it that maintenance and new construction are accomplished on time. As if the aforementioned fact is not enough the situation tends to be compounded by adverse international balance of payment with its attendant inflation. Budgets therefore are not met and payments to contractors are always in arrears.

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Delayed payments constitute the most significant factor for incompletion of highway construction projects which bring about numerous effects on the government as a client, the contractors, the users of the highway and the entire nation.

1.2 Statement of the Problem

As the user demand on the nation's highway increases, so do the age and deterioration of these infrastructures. Highway construction and maintenance involve high cost and the contracts require large amount of time to complete. Unfortunately, in Ghana, delays on those projects have become our lot due to delays in payment among so many other factors. The Government of Ghana lost millions of Cedis due to these delays. The Ghana Highway Authority (GHA) and the Department of Urban Roads (DUR) revealed that a contract dated 6th/5/2003 and with Final Certificate dated 24/11/2008 with a part cost of GH₵ 145,223.02 and Euro € 59,939.68 was paid for the "Abuakwa - Bibiani Road Project". This represents 1.64% of the contract price.(Ghana News Agency, 2011)

There are those indirect effects such as traffic delays, extra fuel costs for staying longer in traffic, loss of business to those living in the work zone as well as environmental degradation among many others, which are not given much attention.

Mr George Aidoo, Director of Monitoring and Evaluation at the GHA identified a number of challenges facing the road and transport sector. They included not only inadequate logistics for project supervision but low delivery capacity of the local construction industry, thereby affecting the early completion of road projects and the loss of tax due to conversion of a large number of vehicles from the use of petrol to Liquefied Petroleum Gas (LPG) on which no levy was charged, he stressed. This

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stresses the country financially (GNA, 2011). Government as a client finds itself in this vicious cycle of paying more for fluctuations rather than for kilometres of road done. Indirect effects of delays such as environmental degradation already mentioned also continue to prevail for a long time without any attention and remedy being given. It is therefore necessary to identify all the important effects of delays in highway construction as a means of preventing or mitigating them.

1.3 Aim of the Study

The main aim of this study is to identify the significant effects of delays in highway construction in Ghana so as provide basis for strategies to minimize or control them.

1.4 Specific Objectives

To achieve the aforementioned aim, the following specific objectives were set:

a. To identify the factors that cause delays in highway construction
b. To determine the relative importance that the client which is government (represented by consultants), contractors and users attach to the effects of delays in highway construction projects.
c. To determine whether there is any significant difference between consultants and contractors in the way they assess these effects of delays in highway construction projects and
d. To propose a system to curtail as well as mitigate the effects of delay in highway construction projects.

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1.5 Research Questions

The following research questions guided the study:

1. What factors cause delays in highway construction?
2. What importance do client (government represented by consultants), contractors and users attach to the effects of delays in highway construction projects?
3. Is there any significant difference between consultants and contractors in the way they assess the effects of delays?
4. Identify the system used to curtail as well as mitigate the effects of delays in highway construction?

1.6 Significance of the Study

This work will draw the attention of highway construction stakeholders (government, contractors and all road users) to the factors that cause delays in these projects leading to the associated effects. The study also intends to contribute to the systems that will effectively reduce delay in highway construction. In addition, this study intends to provide some framework for the development of policies and rules in highway construction management.

1.7 Limitations

The study will be limited to the government represented by consultants from the Department of Feeder Roads, Department of Urban Roads, Ghana Highway Authority, contractors and drivers/villages affected by road projects within the Greater Accra and Eastern Regions.

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1.8 Delimitations

This study was narrowed down in scope due to finance and time constraints. The sample size was small due to these factors.

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CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Delays are the most common problems encountered on construction projects and the effects according to Alkass et al. (1995) can be very costly. A lot of studies done in several countries (Sadi and Sadiq, 2006) have establish that because of the difference in the conditions of the economy, environment, labour laws, sociology and level of technology the significant factors that cause delays and the subsequent effects they manifest differ from country to country. The chapter covers a review of the following subtopics:

- Project delays definition and classifications
- (Federal International Des Ingéniurs Conseils) FIDIC condition of contracts
- Major causes of delays
- Effects of delays in highway construction
- Minimizing delays and their effects and
- Innovative methods for shortening contract duration.

The chapter also looks into the contractual environment in which highways are constructed and their repercussions on users, the client, contractors as well as consultants in Ghana.

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2.2 Project delay Definition and Classifications

2.2.1 Definition of delays

In construction, delay could be defined as the time overrun either beyond completion date specified in a contract, or beyond the date that the parties agreed upon for the delivery of a project. It is a project slipping over its planned schedule and is considered as common problem in construction projects (Sadi and Sadiq, 2006). Completing projects on time is an indicator of an efficient construction industry. A project is considered successful if it is completed on time, within budget, without any accidents, to the specified quality standards and overall client satisfaction. Rwelamia and hall (1995) found that the timely completion of a project was frequently seen as major criterion of project success. Usually the vast majority of project delays occur during the construction stage. It is also possible that a non-realistic construction time may have been settled upon in the first place.

2.2.2 Project Delay Classification

According to Antill and Woodhead (1989) construction project delays can be classified according to their origin, compensability and timing.

2.2.2.1*Delay classified by origin*

i. The client or client's representative causes these delays. In this case, the contractor receives a fair reasonable compensation in cost and time.

ii. Delays caused by the contractor, in which case the contractor bears full responsibility.

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iii. A third type is caused by other parties which are not controlled by neither the contract nor the client. No party is given the opportunity for monetary recompense but the completion date can be extended in order to protect the contractor from liquidated damages.

2.2.2.2*Delays Classified by Their Compensability*

Under this category delays may be interpreted as excusable or non-excusable i.e. analyzed on the basis of whether or not the contractor would be entitled to a time extension. Excusable delays can further be broken into excusable /compensable and excusable /non compensable.

i. Excusable delays are not caused by the contractor and he/she is excused from responsibility. In a technical sense, these are delays stated in the conditions of contract for which the contractor is entitled to an extension of time under the contract.

ii. Excusable/Compensable delays may be acts of omission of the owner for example lack of access to site. Contractors may be entitled, depending on the contract condition, to damages for extra cost incurred

iii. Excusable /Non-excusable Compensable delays are caused by neither party. It may be an act of God such as unexpected floods. Time extension is normally the only remedy.

iv. Non-excusable delays are those caused by the contractor. They are compensable to the client in the form of liquidated or actual damage paid by the contractor for late completion, or could be the basis for contract termination by the client or for an order to accelerate work.

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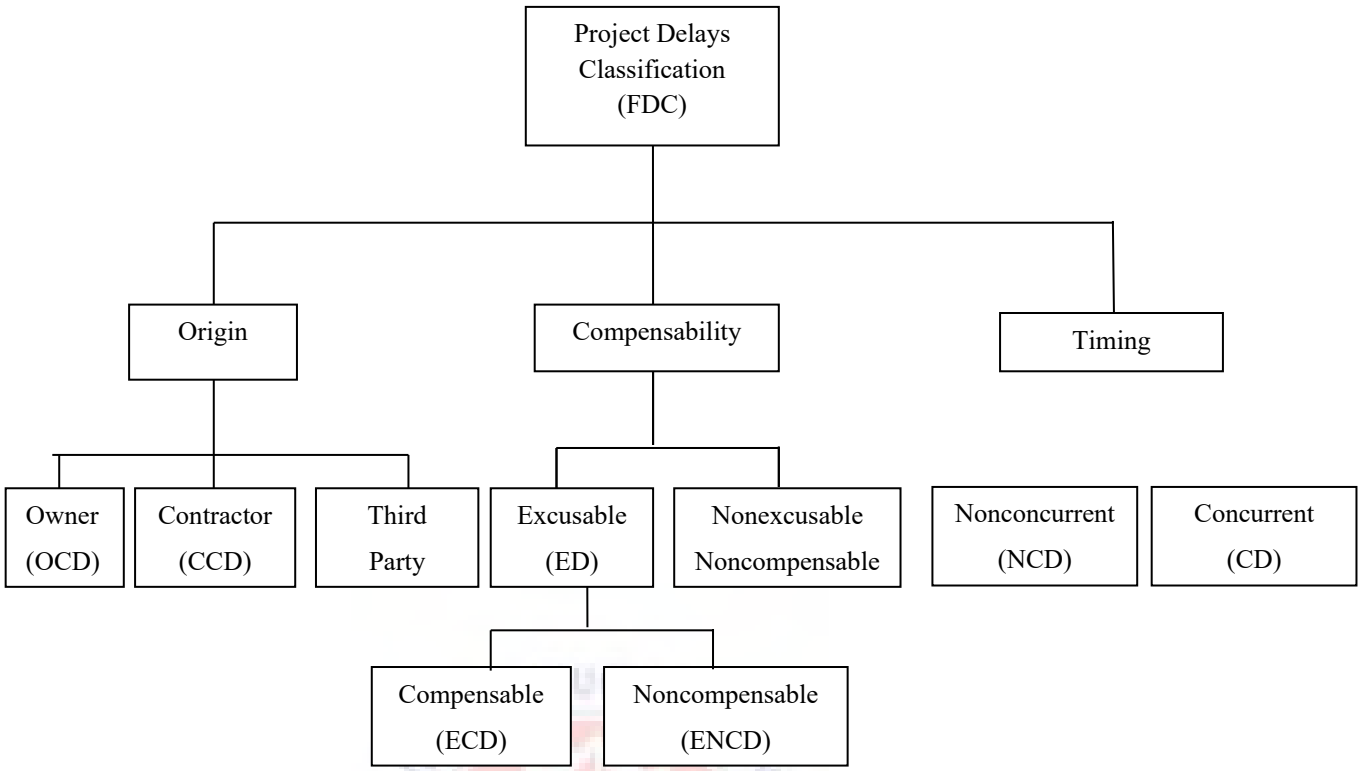

Fig 1.1 Project Delay Classification (Sadi and Sadiq, 2006

2.2.2.3 Delays Classified by their Timing

Delay can be said to occur concurrently or non-concurrently and the timing is crucial to determine whether the delay is compensable or not. Concurrent delays occur when two or more delays occur at the same time (see Fig 1). A crucial path method chart or other visual representation of real progress is essential in analysing overlapping delays. Non-concurrent delays, however, occur alone at the time.

2.3. Fidic Conditions Contract

The main contract documents including the FIDIC (Federal International Des Ingéniurs Conseils) among other issues dealt with commencement and delays, defects liability, alterations, claims and settlement of dispute. The incidence of delays has

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been captured under the foregoing topics and treated in terms of remedies, compensations and other measures to mitigate the effects of delays.

2.3.1 Possession of site and commencement of work

The general condition of contract in the FIDIC, clauses 41.1 and 42.1 emphasise the commencement of wok depending on access to site, which is the responsibility of the client. Extension of time is granted should the client fail to give adequate access at the right time. The FIDIC conditions of contract can be described as a double edge sword. It protects the rights of all parties. Failure to give access for early commencement of work by client would lead to delays and the contractor should not only be excused but be compensated for the loss due to idle construction time. On the other hand, the contractor is penalized should there be delays due to late commencement for no reasons or hindrances.

2.3.2 Extension of time

Clause 44.1 of the FIDIC mentions extension of time being granted in the case of extra work, bad or exceptionally adverse climatic conditions as well as impediments put in the way by the client. The extension of time request must be made, but the reasons must be investigated before being granted by the consultant with the permission of the client.

2.3.3 Liquidated Damages for Delay

In the case of the contractor failing to complete work as pertained in clause 48 of the FIDIC, a pre-determined penalty is to be paid by the contractor not to penalize him but to compensate client for being deprived the use of the project. These monies are

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deducted on daily basis that the delay prevails and taken out of any outstanding monies due to the contractor.

By inserting into contracts the clause for damage, the FIDIC conditions have instituted a situation to safeguard the interest of the client as regards undue delays. Contractors are most sensitive about damages which serve as disincentives to unduly prolong contract durations.

2.3.4 Alteration, Additions and Omissions

The FIDIC provisions emboldened the engineers to grant extra work, which are referred to as variations. Under situations such as already mentioned, this extra pay and extension of time is permitted under clause 44.1 of the FIDIC contract. A contract going beyond its initial duration due to the above mentioned conditions cannot be said to be in delay.

2.3.5 Time for payment

Clause 60.10 of the FIDIC contract sets 28 days as period within which the client must pay the contractor upon submission of interim certificates and 56 days for final certificates. Failure to honour the certificate within this time schedule entitles the contractor to interest on the amount due.

Elsewhere in the FIDIC contract(clause 53.1), however, the contractor must also observe the 28 days notice he should give the engineer to check and evaluate the works prior to raising the certificate.

Here the contractor is being protected from undue delays in payment, which will lead to the devaluation of the contractor's real profits.

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2.3.6 Remedies

Under clause 46.1 of the FIDIC contract, the engineer could accelerate progress of work by issuing instructions. In the case of these being ignored after 28 days, the contractor is said to be defaulting, giving the opportunity to the client to enter site after giving 14 days notice to terminate the contract. Here the FIDIC conditions are seen as a mechanism which foresees delays and attempts to redeem the situation and prevent a contractor from holding onto the project *ad infinitum* resulting in loss of intended profits on the investment.

2.4 Review of Factors Causing Delays from Previous Studies

Gyebi-Ababio (2003) researched on causes and effects of delayed payments to contractors in the Ashanti Region. His focus was on Government of Ghana (GoG) funded projects and he stated the following factors as affecting delayed payments:

1. Inability to provide funds, due to poor budgetary allocation and mismanagement of funds
2. Bureaucratic bottlenecks, due to signatories to certificate
3. Late preparation of certificates
4. Late commencement of work
5. Poor planning and inadequate feasibility studies
6. Shear disregard to the conditions of contract and articles of agreement regarding payment to contractors and
7. Political leanings of the directors of the company.

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2.4.1 Contributors to Construction Delays in Hong Kong

Kumaraswamy and Chan (1998) studied the causes of construction delays in Hong Kong and found that there was a difference in perceptions as to causes of delays by different groups of participants in the building and civil engineering works. The survey covered 83 delay factors, which were grouped into eight major categories.

The following is a brief description of the categories of these factors;

1. Project –related factors

These include causes of delays related to:

- Project characteristics
- Necessary variations
- Communication among the various parties
- Speed of decision making involving all project teams and
- Ground conditions.

2. Client –related factors

These include those concerned with:

- Client Characteristics
- Project financing
- Their variations and requirements and
- Interim payment to contractors.

3. Design team–related factors

These consist of:

- Design team experience
- Project design complexity and
- Mistakes and delays in (producing) design documents

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4. Contractor –related factors

These comprise those related to:

- Contractor experience in planning and controlling the projects
- Site manager and supervision
- Degree of subcontracting and
- Their cash –flow.

5. Material factors

These include causes related to:

- Shortages
- Materials Changes
- Procurement programming and
- Proportion of off-site prefabrication.

6. Labour factor:

These encompass:

- Labour shortage
- Low skill levels
- Weak motivation; and
- Low productivity.

7. Plant /Equipment factors

They include:

- Shortages
- Low efficiency
- Breakdowns and
- Wrong selection.

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8. Extended factors

They comprise those such as:

- Waiting time for approval of drawings and test sample materials, and
- Environmental concerns and restrictions.

The survey of clients, consultants and contractors focused on identifying and ranking in order of importance the main factors causing delays. The main conclusions of the survey were as follows:

1. All three major groups of industry participants felt that "poor site management and supervision," 'unforeseen ground condition', low speed of decision making involving all project teams', client-initiated variation, and 'necessary variations of work' appear to be the five significant sources of construction time overrun of projects.

2. Despite some differing perceptions as to the relative importance of delay factors suggested by each group of respondents, there is general agreement between the clients and the consultants on a further set of 10 principal factors, but contractors only agreed with some of them.

3. The clients and consultants mostly claimed that delays in construction projects are attributed to a lack of contractor experience in planning and monitoring on site but the contractors asserted in general that they are initiated by a lack of design experience of consultants (Engineers).

4. The clients and consultants agree to a large extent on the ranking of the delay factor categories, whereas the client and contractor greed less, and the consultant and contractors agreed the least.

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2.4.2 Factors causing Project Delays in Indonesia

In Indonesia, Kaming et al (1997) listed the factors causing project delays to be:

- Labour shortage/low productivity
- Variations
- Materials shortage/late materials delivery
- Inadequate construction planning; and
- Lack of designer's experience

2.4.3 Organising and Managing a Finance-Design-Build Project in Turkey

The Ezmir Ring Road-Ayin Motorway Project in Turkey exhibited the typical problems and effects that one could observe in a third world. According to Stager (1995), the contracting was not the very normal types as taking portion of the entire road of 144 km was priced to obtained fixed prices which would prevail for totality.

Different portions were given out to different Turkish Companies to collaborate with their foreign partners. Since this was a finance-design-build project, the task of looking for funding was the responsibility of the contractor and this did not come easily.

Estimates made together with designs to arrive at total contract sums for the purpose of seeking a loan did not prevail throughout the project duration and this led to much delays and subsequent effects.

The detailed design had hardly began when there was a change of design team which also came with authority and new ideas which slowed progress of design. The scope of work was varied in terms of maximum grading and number of lanes and

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lane size. Many interchanges were added which led to increase in quantum of work in terms of excavation and other engineering procedures.

Apart from change of scope and subsequent increase in work to be done, there happened to be unforeseen engineering situations notably soil and rock conditions which were not found to be suitable and ought to be circumvented technically. Technical solutions came with time overrun as well as cost overrun in terms of extra cost for design and materials as well as overheads and equipment usage.

Another source of delay was the fact that right of way was not acquired for all portion of the road due to lack of funding. Construction work had to be suspended at certain portions and in other areas a detour had to be made.

Other challenges met on the project had to do with funding. The Turkish lira devalued about 200% and threw budgeting out of gear. The project which began with a contract of sum of $296,000,000 ended up $790,000,000 with all the changes mentioned above. Additional funding had to be sought for (Stager, 1995). This was done with much difficulty leading to delays.

With much escalation over the period change order became necessary increasing the contract amount by 267% which also inturn led to the request for increased performance bond. The surety bond was difficult to come by thus delaying proceedings further.

Another event that took place at that same time was the national elections leading to consultants for no reasons withholding contractors' claims. There was change of government and payment were not forthcoming but the contractors had to continue working until they could not shoulder the burden anymore thus suspending work.

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With the new government came new regulations especially in terms of cash flows. This led to new loans being sought for but this also had to be signed for by every cabinet minister.

In conclusion, finance misfortunes including devaluation and inflation, politics, difficulty in acquiring right of way and variations as well as unforeseen technical difficulties accounted for delays in the Ezmir Ring-Ayidin motorway project. It was the opinion of the author that lengthy arbitration proceedings would follow in order to redeem lost profits.

2.4.5 Internal Causes of Delays in Highway Construction Project in Thailand:

Under AIT extension programme organized by the Asian Institute of Technology, Amorndech (1992) worked on the internal causes of delays on the above mentioned highway with the objective of identifying actual internal causes of delays in a highway construction project. They attempted to understand the problems and classify them. Their study chose the Nontaburi By-Pass as a case study but their scope of analysis extended across Asia. The group talked to owners, consultants and contractors. Most parties blamed the contractor for the delays. The inadequacy in contractor's organization was a major delay factor. Equipment was not only inadequate but they were always breaking down. Subcontractors were changed frequently due to their ineffective work thus disrupting progress of work. Progress also slowed down at harvest seasons as number of workers dwindled and at rainy seasons the work was interrupted.

Table 2.1 illustrates, and classifies their findings.

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Table 2.1 Classifications of internal causes of delay on the Nontaburi By Pass

(Amorndech, 1999)

Parties / Problem description	Causes *
1. Owner	
Delay approval	A,B,L
Unfinished expropriation	C
2. Designers	
• Incomplete drawing	
Inadequate Details	C,J
Inconsistencies in dimensions and drawings	E,F,I
3. Consultants	
Uncompromising	D,E
Delays approval	A,C,D.G,H,N
4. Contractors	
Improper use of equipment	I,K,O,P
Lack of skilled manpower	I,J,K,N
Late submitted of shop drawing	J,L,M,N
Redone	D,H,J,L,M,N
Insufficient workers	Q
Poor management	J

* Causes indicated in capital letters and subsequently explained.

Actual Causes of Delays

A. Possessive decision –making mechanism

B. High bureaucratic organization

C. Insufficient data collection and survey before design

D. Change of site topography after design

E. Lack of coordination at design phase

F. Inadequate review

G. Improper inspection approach

H Different attitude between the consultant and contractors

I. Financial difficulties

J. Inexperienced personnel

K. Insufficient numbers of staff

L. Time spent to find appropriate subcontractors for specific tasks

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N. Often changing subcontractors companies

O. Inadequate and old equipment

P. Lack of high technology equipment and

Q. Harvest time and disruption by rains

2.4.6 Effects of delayed payments on road works

Issah (2000) attributes the delay in paying contractors in Ghana by the government to difficult economic factors, political influences and other technical problems.

By 2000, government's indebtedness to contractors amounted to 595.5 billion cedis, ($85.12 billion dollars at exchange rate of 1 dollar = 7,000 cedis) It was realized that about 48-56% (40-52 million dollars) emanated from:

- Interest on delayed payments
- Currency Fluctuations and
- Extension of time related payments.

Considering the standard cost of 230,000 dollars per kilometre for road construction in Ghana, it could be concluded that between 1880 and 215 kilometres of road are lost a year in real terms of money spent in payment of claims itemized already.

Economic factors

According to Issah (2002) Ghana's Statistical Service indicated that 55-70% depreciation of the Ghanaian cedi against the US dollar was experienced on the average between 1990 and 2000. Thus with the passage of time, prices of items imported for constructional work increased in cedi terms. About 65% of road constructional inputs are imported.

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The FIDIC conditions of contract, provides for adjustment for changes in cost or fluctuation and seeks to compensate the contractor for rising prices of goods and services. Thus for a road contract of 1 year duration, government needs 40% more of the original sum to settle all payments.

Table 2.2 Contract sum Calculations (Before Executive) (Issah, 2002)

Item	Description		Rate	Amount C	Amount in GHC
A	The Works			2,000,000,000.00	
B	Price	15% (A)	0.15	300,000,000.00	2 000 000.00
C	Contingency	10% (A)	0.10	200,000,000.00	300 000.00
	Physical				200 000.00
A	Contract Sum			2,500,000,000.00	2 500 000.00

Table 2.3 Contract Calculations (After Executive)

Item	Description		Rate	Amount C	Amount in GHC
A	The Works			2,000,000,000.00	2 000 000.00
B	Price	65% (A)	0.65	1,300,000,000.00	1 300 000.00
C	Contingency Physical	10% (A)	0.10	200,000,000.00	200 000.00
Final contract sum				3,500,000,000.00	3 500 000.00

Additional funding required before completion is the difference between the initial contract sum and the final contract sum, which is 1,000,000,000.00 cedis (GHC 1 000 000.00) about 40% of the initial contract sum, ((Issah, 2002))

Poor budgeting also accounts for delayed payments because projected funding never materialise. In 2001, 587.25 billion cedis (GHC 5 872 500.00) was projected but ¢541.23 billion (GHC 5 412 300.00) was spent thus recording a shortfall of 8%. Explanation for this is lack of aggression in collecting realistic values, taxes and dwindling revenue from exports.

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Interference by politicians to award road contracts regardless of road development programme made by technocrats thereby scuttling a well laid down cash flow programme leading to honouring of certificates not planned for and delays of those planned for.

Technical inaccuracy by technocrats leads to realization that more work has to be done than envisaged and for that matter more money has to be paid. This disrupts payment schedules and leads to delay in payments for some works.

2.5 Effects of Delays from Previous Studies

2.5.1 Time is money: Innovative Contracting Methods in Highway Construction,

In their study into the use of innovative contracting methods in highway construction, Herbsman, Chen and Epstein (1995) established the factors mentioned the consequences of delays in highway construction. They identified the cost of traffic control while work is in progress. This cost becomes enormous as the project delays. Another cost to the contractor is the lane rentals which goes higher as the project delays. This is applicable with those contracts using innovative contracting conditions. The GHA and DUR reveals the following substantial amounts of money paid for delayed payments:

- GH¢ 145,223.02 and Euro € 59,939.68 - "Abuakwa-Bibiani Road Project"

  (GHA). This represented 1.64% of the contract price. Contract date was 6/5/2003 and Final Certificate date was 24/11/2008

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- GH¢ 964,293.61 and US$ 113,515.13 - " Reconstruction of Mallam-Kasoa Road" (GHA). This represented 4.35% of the contract price. Contract date was 2/2/2004 and Final Certificate date was 21/11/2008

- € 570,168.66 "Road Rehabilitation and Traffic Management Works in Tema and Sekondi-Takoradi" (DUR). This represented 3.29% of the contract price. Contract date was 6/01/2003 and Final Certificate date was 9/03/2007.

Herbsman *et al* (1995) also on the social front identified litigation and marred relationship with clients and contractors as developments coming out of delays on projects.

When it comes to users of the Highways both in transit and living around, the study identified that user's inconvenience of slow traffic and high cost of fuel consumed and time. Disruption of life especially, economic activities constitute indirect costs emanating from highway construction especially when there is a delay. The rate of accidents by contract workers and the public is measured proportionately to delays on the project. Perhaps the most important effects dealt with in the write up are the cost and losses accruing from the inability of contractors to hand over on time in terms of toll collection on the road.

2.5.2 National goals for construction technology

Wright (1995) also identified the effects of delays on highway construction as traffic delays and its associated costs in terms of time and fuel. Accidents and collisions were also mentioned as effects that increase the projects delays. High capital cost was identified to increase as the project delay or take longer duration. Wright also

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mentions community disruption and significant economic losses as factors associated with delays and that they become significant when the project delays.

2.5.3 Cost overrun and time delays at FDOT

In their presentation and assessment of performance of the Florida Department of Transportation (FDOT), Douglas (1997) presented a scenario of cost overrun as effects of delays. Factors accounting for these were changes and variations for works they could not foresee during the design stages. The Florida Transportation Commission reported that between 1996 and 1997 cost overrun of $93 million was realized and $82 million constituted added value such as creation of extra access or improving the works and the remaining $11 million went to correcting unavoidable mistakes and did not add value. The conclusion was made that within 1994-1995 on the average 15% of cost overrun was made with about $450,000 per project and 32% more time duration spent with 2.5 months delay project.

2.5.4 Causes of delay in large construction projects

Sadiand Sadiq (2006) conducted a field survey in Saudi Arabia to determine the causes of delays and their importance according to each of the project participants, i.e., the owner, consultant and the contractor. 73 causes of delays were identified and combined into nine groups. The field survey included 23 contractors, 19 consultants and 15 owners.

76% of the contractors indicated an average time overrun of between 10% and 30% of the original duration, while about 56% of the consultants specified the same percentage. 25% of the consultants indicated from 30% to 50% average time overrun. Owners specified that causes of delays are related to contractors and labourers. The

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study indicated that owners and consultants realize that awarding to the lowest bidder is the highest frequent factor of delay, while, contractors considered severe causes of delay were related to owners.

Only one cause of delay was common to all parties, which is ‘‘change orders by owners during construction’’. Many causes are common between two parties, such as delay in progress payments, ineffective planning and scheduling by contractor, poor site management and supervision by contractor, shortage of labourers and difficulties in financing by contractor. All parties agree that the following causes are the least important: changes in government regulations, traffic control and restrictions at site, effect of social and cultural factors and accidents during construction.

Both owners and consultants specified labour and contractor related causes as the severe and important sources of delay, while, contractors indicated that the important sources of delay in construction projects are owners and consultants.

2.5.5 Effects of delayed payment on Road works in Ghana (Issah, 2002)

- Since the FIDIC condition of contract Clause 14.8 (1st Ed.) allows for contractors to be paid interest on delayed payment based on the prevailing interest rate per month, huge sum of claims due to interests on delayed payments are submitted annually. As a result more money is paid not for more kilometres of road being built on account of the same contracts which are even in delays.

- Under Clause 16.1 and 16.2 of the same FIDIC conditions, the contractor is at liberty to slow down or suspend work when payments have delayed. Works in this way never get completed and delivered for use by the public.

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- Contractors somehow, always end up seeking for extension with cost plus reasonable profit under Clause 8.4 for delay payment.
- Contractors thus take advantage of the clauses to prolong projects and this leads also to extended overhead costs of agencies in supervising the same projects not counting other external costs.

Table 24 Relationship between initial contract sum and the interests paid for delayed payment for a 21.10 Km road (Issah, 2002)

Item	Description	Cost in Cedis	Av. Exch. Rate	Cost in US$	Cost/Km US$	Remarks
A	Initial Contract sum (i.e. including Contingencies)	11,285,235.00	2.230.00	5.060.836.43	251,782.91	
B	Additional fluctuation (for 1 yr extension of time	3,785,262,350.00	4,385.00	863,229.7 3		
C	due to Delayed payment)	875,625,850.00	4,385.00	195,581.72		Initial Cost
D	Contractor's Cost					
E	(for 1 yr extension of time due to Delayed Payment)					
	Cost to Completion (Physical)	15,928,553,435.00	5,958.00	6,119,647.88	304,460.09	20% of Initial cost
	Interest on Delayed payment	29,196,234,645.84		4,900,341.90	243,798.08	100% of Initial Cost
F	Final Initial Cost	45,124,788,080.84		11,019,989.37	548,258.18	

2.5.6 Effects of Delayed in Highway Construction projects on the Environmental

The World Bank's (1996) study on the effects of delays in highway construction (Table 5) identifies major factors of impact within the socio economic and biophysical spheres. These environmental impacts are said to be unavoidable when it comes to several highway projects but their severity or their extreme influences are felt when delays occur and are prolonged.

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Table 2.5: Environmental impacts of Constructional activities

Project type and action affecting the environment	**Environmental effects (negative only)**
Road Rehabilitation Projects	
Construction	
Removal of vegetative cover	• Habitat degradation • Species loss
Exposure of soil to erosion	• Landslides • Waterway blockages • Habitat loss • Species degradation
Poor quality cut and fill operations	• Reduced water supply • Excessive water blockage or drainage
Interference with surface and ground water hydrology	•
Faulty construction materials handling • Bitumen • Aggregate • Concrete	• Degraded air water quality • Increased noise • Increased odours
Work – camp operation • Liquid and solid waste management • Over-use of local servioces	• Degraded water quality • Increase in bacterial disease (for example dysentery)
Construction equipment operation and servicing • Inadequate petroleum product handling • Inappropriate operating schedule	• Water and soil contamination • Tainting of food
Land acquisition and re-settlement • Removal of f private residence • Removal of business	• Property loss • Residence loss • Business loss • Reduced community coheseion
Spoiling of views Road cross landscape Road close to dwelling	• Reduce quality of living conditions • Reduced land values
• Restriction of access	• Increased transportation cost • Increased travel time • Businesses access
Damage to cultural heritage	• Loss of cultural identify
Community disruption (including indigenous people	• Loss of sense of community • Loss of community cohesion
Post- construction stage	
Failure to implement mitigation measures	• Various (as above)
Failure to rehabilitate work-site	• Various (as above)

Adopted from World Bank (1996), Dixon et al (1988), ADB (1988)

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These are described as follows:

1. **Soil Erosion**

To mitigate the impact of construction works, certain precautions are normally put in place at the end of projects such as construction of drains and retainers but in the event of undue delays, when the end delays these measures also delay. As the delay prevails, soils are exposed and erosion as well as other forms of degradation set in.

2. **Water Pollution**

Settling basins, paving, infiltration ditches, water collection and treatment measures may have been put in place to mitigate the effects of tampering with water bodies, as a result of road projects but due to delays, these are not attended to in good time and water pollution become a common reality affecting the target communities.

3. **Air Pollution**

Air mass pollution occur through emissions of dust, fuel containing carbon monoxide, benzene, lead and sulphur as primary pollutants that go to combine with other chemicals into the atmosphere to form secondary pollutants such as acid rains. These are dispersed through the action of the wind and are received by humans, flora and fauna as was well as artefacts. Air pollution has harmful effects on the lungs, plants and causes stain and corrosion on artefacts.

4. **Impacts on Flora and Fauna**

Construction disrupts by damaging the aquatic habitats, fragmenting the ecosystems as well as restricting corroders for Flora and Fauna. Delays aggravate these situations with mitigating efforts such as replanting, provision of water crossing and bridges not forth coming at the right time. The enabling environment or life support is

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destroyed. So long as there is delays, the borrowed pits and quarries remain uncovered or untreated and tend to serve as sources of pollution or poisoning for Flora and Fauna.

5. **Impacts on Communities and their activities**

As long as delays persist, the life of people living alongside the routes are affected. Accesses hitherto used for business purposes are blocked and people suffer deprivation. Bus terminal change and food selling points change with them. As others lose the opportunity to sell, others gain it. Communities hidden in the interior of forests for instance get exposed and have to encounter heavy traffic and large volumes of people all of a sudden as detours pass through the town. This gentrification affects as well as culture shocks continue as long as the delays persist.

6. **Impacts on cultural Heritage**

In the case of roads passing by or through sensitive places of culture, the access to them become hindered. Environmental degradation due to road construction activities also affect artefacts thus in the case of long delays these effects can be most unbearable to the target groups.

7. **Impact on Aesthetics and Landscapes**

Delayed highway construction has great impact on the landscape and the entire aesthetic view of a community as it remains untidy because a project has not come to an end for amends to be made to artefacts and the land and landscape that have been tampered with and degraded.

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8. Noise Pollution

Just as discussed in the case of air pollution where slow moving heavy traffic tends to dissipate much more exhaust within the relatively smaller environment in which it is forced to stagnate so would noise from heavy traffic moving rather slowly in a detour route environment would raise noise decibels for higher than encountered before.

9. Health and safety

The points raised combine to affect the health of people living along a route under construction both directly and indirectly. The probability of accidents occurring is heighted with the increased number of vehicular passage through a hitherto quiet village by means of a detour. Polluted water and air continue to affect the health of the people as long as the impact mitigation stages of the projects delay.

2.6 Minimizing Delays and their Effects

2.6.1 Reducing Highway Construction Project Durations

O'Connor (1998) came out with proposals that would reduce construction times while acknowledging the barriers that can exist and to overcome to mitigate or prevent the effects of delays in highway construction.

Opportunities for reducing project construction times currently exist, are emerging, or need to be developed. Like the barriers and challenges referred to above, these opportunities can be classified as legal/political, organizational and technical. The opportunities can be explored or achieved through research and development of new technology or procedure, implementation of a demonstration project, or training.

A demonstration project is often effective in implementing change within a large, bureaucratic organization such as a public agency. Initially, such projects involve

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selected personnel on a few projects. Treated as experiments, demonstration projects require systematic tracking and documentation of performance outcomes, successes, difficulties and lessons learned.

(i) Legal /Political Opportunities and Barriers

Research is needed on how to estimate user costs associated with construction project delays. Mechanisms are needed for measuring the marginal user costs at different points in the life of a project. Further demonstration of design-build contracting is needed. Information such as process sequences, time savings, benefits, difficulties, and lessons learned need to be documented. Guidance is needed on contract and remuneration issues.

Barriers to these suggestions could be found in procurement regulations which constrain agencies from using innovative contracting approaches such as privatization, fast-track design –build and use of multiple prime contractors. Contractors associations often oppose such practices and generate considerable political support to oppose them.

(ii) Organizational opportunities and barriers

According to O'Connor (1998), research is needed on how time is actually spent on highway construction projects, the causes of delays also suggested methods for reducing times of lengthy activities and methods for avoiding delays. Procedures need to be developed for determining when it is beneficial to divide large projects into multiple contracts with higher levels of concurrent work activity.

Highway agencies need a method for classifying projects based on the level of schedule urgency. For example, projects could be classified as conventional,

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schedule-driven, and urgent/emergency. Research could aid in identifying appropriate schedule management strategies, tactics and implementation tools for each type.

Demonstration projects could be formulated to test a variety of contractor bidding and incentive systems, such as lump-sum bidding, lump –sum cost plus duration bidding, and lump-sum cost plus likely bonus minus likely penalty. Contractual requirements pertaining to schedule performance such as liquidated damages are often locally enforced for a wide variety of reasons.

Support for projects that encourage collaborating between design consultants and construction contractors to promote constructability and achieve project schedule objectives should be continued and expanded if possible.

a) Organizational barriers

Many public projects suffer from lack of continuity in key project management positions during a project because most public agencies separate the management of planning and design from management of construction. Thus, the project is passed from one manager to another. Both responsibility and accountability for overall projects success, including schedule performance, are distributed and diluted to the point of being less effective.

There are no widely accepted methods, or metrics, for measuring schedule performance. Such measures are needed for accountability purposes and would be useful for benchmarking best performance levels and targeting future performance levels. Projects seldom include any schedules performance reporting or accountability to senior agency executives or legislators. In addition, projects are rarely differentiated on the basis of importance of schedule, so that all projects are frequently treated the same in terms of schedule management practices.

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Because compensation is not linked to project schedule performance, there is little incentive for projects administrators to be knowledgeable about historical performance norms and seek to surpass them. Project managers in the public sector are underpaid in comparison with their private sector counterparts, and public agencies have difficulty in attracting and keeping the best and brightest. Efforts aimed at raising project performance levels would certainly have to be accompanied by higher project management salaries.

b) Other issues related to schedule performance include the following:

- Even though implementation of innovative approaches requires some risk taking by project managers, there is often little or no support or incentive to do so.
- Schedule –sensitive issues such as right – of–way acquisition, utility relocation, and other frequent causes of project delays are often assigned a low management priority.
- There is little use of contractor incentives for schedule performance, a practice often employed successfully in the private sector.
- While collaborating is common between contractors and contract administrators, it is rare (and possibly illegal) between design consultants and construction contractors, where it could have a significant impact on constructability and project times.
- There is an industry-wide failure to take advantage of project lessons learned, including those pertaining to effective schedule management practices.

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(iii) Technical opportunities and barriers

The proposals of O'Connors (1989) for reducing contract durations include the following technical approaches through research:

- Benchmark schedule performance for highway construction projects, taking account of type and size of project and associated causal and enabling factors. Information on effects on project on user delays should be included

- Examine the effect on project performance of various approaches to traffic control measures, (e.g. complete closure with short-term detour vs. partial closure with longer duration)

- Develop duration –estimating systems that can provide target durations giving key project characteristics (e.g. project type, location, length, width, bridges)

- Establish effective procedures for screening or prequalifying potential bidder based on past schedule performance and other parameters and

- Develop mechanisms for evaluating projects, the operations plans, addressing such factors as field organization structure; optimal work calendar and day; number of concurrent work locations; number , size, and make-up of crews; and equipment selection.

Demonstration of an integrated traffic control planning/constructability programme, of advanced time-saving technologies and methods, of fast-track multiple-primes contracting, and of risk-containment plans and strategies would be helpful.

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Training activities that would be beneficial include the following:

- A training programme targeted to project administrators and focused on best practices associated with schedule management,
- Training for engineering departments/offices to enable systematic and routine investigations into time-saving technologies
- Training on project schedule performance measures and on how to collect and analyse schedule performance data.

2.6.2 Innovative Techniques in reduction of Contract durations

The following case studies describe the use of design-build and developing alternative construction plans, illustrate how construction times can be reduced by a variety of techniques (O'Connor, 1998):

Design-Build: An opportunity for the public sector to curtail delays

Design-build (also known as "turnkey" of EPC for Engineering, Procurement and Construction) is a project-delivery system in which a single organisation prepares the design and undertakes construction of a project. Design-build is an alternative to the traditional design-bid-build approach, which has been the dominant project-delivery system in the domestic public sector.

Design-build can substantially shorten project times, primarily by overlapping the design and construction phases so that concurrent activity is possible, and construction starts and ends sooner. The overall project schedule is construction-driven, with construction sequencing driving the production of engineering information packages that support construction activities. An additional benefit of the design-build approach is single-source responsibility for design and construction,

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which can result in consolidated risk management; fewer change orders and reduced litigation.

While design-build has been widely used in the private sector for many years, regulatory barriers have prevented public agencies from taking advantage of the approach (USA national Society of Professional Engineers, 1995). Specifically, regulations pertaining to competitive bidding, lump-sum contracts, and professional licensing often limit the application of design-build in the public sector. However, a growing number of public agencies have adopted the design-build approach, including the General Services Administration, the US Postal Service, the Department of Defence, the Federal Transit Administration and several state departments of transportation (most notably those of Florida, Michigan and Utah) (Huffman, 1995).

The Design-Build Institute of America (DBIA), organised in 1993, promotes the use of the design-build approach. Its mission is to improve the professional standard of the design and construction industry. Major DBIA programme elements include development of best practices, monitoring and analysis of successful applications (projects), standardise selection procedures, educational publications, national for a development of model procurement code.

The design-build approach was used successfully in the reconstruction of the Santa Monica Freeway following the January 1994 earthquake in Northridge, California. The reconstruction was predicted to take 5 months to complete, but was accomplished in just 2 months, earning the contractor a $15 million bonus.

The largest and most current domestic transportation design-build project is the $1.32 billion 115 Reconstruction Project in Salt Lake City, Utah. This project involved the complete replacement of 17 miles (27.2 Km) interstate highway in an urban area,

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including widening from six (6) to ten (10) main lanes and the addition of one high occupancy vehicle lane in each direction. A total of 140-bridge structure was replaced and an advanced traffic management system encompassing 550 traffic signals and 350 miles (560 Km) of fibre-optic cable installed.

The Utah Department of Transportation contracted a joint venture involving three contractors (which has a subcontract with a two-party joint venture of engineering consultants). Preparation of detailed technical proposals began in August 1996 and included the development of conceptual traffic control plans and the standardization of many design details. The joint venture team was selected on the basis of both technical and cost proposals, which were evaluated by independent teams. The Notice to proceed was issued on April 15, 1997, and demolition activities began within 2 weeks. As of October 1997, 3000 plan drawings had been released for construction. The contract called for completion by October 2001, approximately 5 months prior to the 2002 Winter Olympics in Salt Lake City.

Is was estimated that the design-build approach reduced the project time from 10 to 4.5 years. Substantial project cost savings were made as a result of schedule driven savings in both project administrative expenses and contractor overheads costs.

2.7 The establishment of Ghana Road Fund and its relevance to affect road procurement system

2.7.1 Early Beginnings and Objectives

The objective for setting the funds was to ensure availability of sustainable resources for financing Ghana's road projects. The initial effort made to establish the Fund dates back to the Provisional National Defence Council era in 1985 under Legislative

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Instrument. After it was realised that budgetary allocation from Central Government was not helping raise adequate funding at the right time to fund the road maintenance programme of the country since government was always defaulting in payment to contractors.

Until 1997, when the Fund was given a streamlined administrative framework, it was managed jointly by the Finance Minister, the Minister for Roads and Highways and Controller and Accountant General who made allocations to the main Agencies of Ghana Highway Authority, Department of Feeder Roads and the Department of Urban Roads.

The gained revenue accrue from Fuel Levy, Tolls from Bridges, Roads and Ferry, Vehicle Registration fees and Road Vehicle user fee among others. In spite of the good intentions, the fund ran into few difficulties listed as follows:

- Revenue received into the fund only covered less than 35% of the total funding needs.
- Lack of suitable financial management
- Inadequate support for the required increases in fuel levy and other rates
- Releases to the road agencies were irregular
- Absence of Road User Participation in the Fund did not help to create confidence and support for the fund
- There was discontent among the Agencies as regards the unequal distribution of funds to them. In 1992, Department of Feeder Roads received 15% of the Fund while Ghana Highway Authority received over 60%.

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- Releases were irregular and inadequate. Contractors never knew when funds would be released to pay them. this resulted in huge arrears of unpaid certificates.
- There was no control over what projects were paid for with the fund's money. A lump sum was released to the agency who then decided which outstanding contract certificate was paid for.
- There were so many problems with banking and accounting. The fund did not have its own account. The Bank of Ghana (BOG) was managing the account and so much money got locked up in transit for a long time. There was also inefficient book keeping and reconciliation was almost impossible for all accounts.

2.7.2 Restructuring of the Fund under the Highway Sector Investment Programme (1996-2000)

Under the Highway Sector Investment Programme (1996-2000) government yielded to pressure to restructure the Fund and the following innovations were made:

- Putting management under a Board which included road users.
- Through road-user charges, increased revenue was paid into the Fund.
- Managing the Fund on sound accounting principles including the disbursement, accounting and auditing of the fund
- Providing a comprehensive legal framework for the management of the Fund by going to parliament

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- Providing a Road Fund Secretariat comprising a Director, an Accountant, Engineer and Planning Staff to manage the day-to-day affairs of the fund.

In addition to the above steps taken by government to demonstrate government commitment, fuel levy was raised in 1996 from US 1.6 cents to US 4.6 cents. Consequently, accruals jumped from less than $ 16.4 million to $ 38.8 million. Table 6 shows the past road fund accruals.

Table 2.6 Road Fund Accruals (compiled by researcher)

Year	2009	2010	2011	2013
Accruals (Million GHC)	136	182	209	126*

* Value up to June 2013

Mr Joe Gidisu, Minister of Roads and Highways explained that the relatively significant upward jump in 2010 was due to the increases in road and bridge tolls, vehicle registration fees, road user fees and International Transit Fees (GNA, 2011). Mr. Isaac Adjei Mensah, Deputy Minister of Roads and Highways in 2013, said 'the Ghana Road Fund has generated GHC 1.21 billion from 2000 to 2011. (GNA, 2013)

2.7.3 Functioning of Newly Structure Fund, Board and Secretariat

- Identifying other sources of funding as well as collecting monies currently assigned to the Fund thereby improving upon the old situation whereby monies got lost into the government system and not getting lodged in the Fund's account.

- Ensuring transparency and efficient management of the funds making sure the money goes to do exactly what it was meant for with physical evidence to

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show at site and in the records. This entails certification and publication of procedures involved in disbursement of the fund.

- Checking on how much of the Funding goes to the Agencies and making judicious efforts that they are well resourced but at the same time ensuring that the roads get the lion share.

- The new Board and Secretariat is focused on details and are time conscious to forestall delays that lead to interest claims. Projections are made prior to the award of contracts and such payments can be scheduled in order to avoid delays.

2.7.4 Monitoring Use of Funds

Strict monitoring is made by the secretariat by visiting sites to check on quantity and quality of work done. Ghana's total Road Fund accrual from January to June 2013, stood at GH¢126 million, representing an increase of about GH¢9 million over the amount recorded during the same period in 2012, the Minister of Roads and Highways, Alhaji Amin Amidu Sulemani, announced. He attributed the increase in the revenue inflow to regular field visits by the ministry to ensure that funds were being collected in conformity with laid down procedures and paid into the designated bank account (Masahudu, 2013).

Progress reports are written monthly as regards the activities and disbursement made. Payment Reports lodged in by Agencies also give very vivid account of who receives the Funding and for what.

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2.7.5 Results and Achievements of the Fund

- There is now increased revenue and the fund can now cover 50% needs of GHC 24,840,000 road maintenance in 2001 from 30% needs of GHC 64 million in 1997.
- There is regular and increased release of funds for works executed. No undue delays in payment.
- Roads are being successfully brought to the market place through commercialisation (Tolling) due to efficient work being done and getting them completed in good time.
- Efficient bookkeeping and accounting have been instituted
- Accelerated road maintenance resulting from increased and sustained flow of funds has positively affected the overall condition of Ghana's road network. GHA report improvements as shown on Table 7.

Table 2.7 GHA Improvement on Road Network (Staff K, 2011)

Agency	Years	Ranking		
		Good %	Fair %	Poor %
Trunk road	2000	30	39	31
	2006	46	29	25
Department of Feeder Roads (DFR)	2000	28	21	51
	2006	46	30	24
Department of Urban Roads (DUR)	2002	27	17	57
	2006	34	15	51

- In the past, the road Agencies have tended to overrun their budgets and thus created very large arrears of maintenance bills. Agencies have been asked to

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draw up these programme to match available funds. The Road Fund Secretariat will only pay for projects budgeted for a computer programmer has been installed to monitor the progress of the projects and manage their budget allocations to ensure that overruns be it time or cost are avoided.

2.8 Innovative Methods for Shortening Contract Duration

Herbsman et al. (1995) studied four major innovative contracting methods used in the United State of America highway construction industry to reduce the duration of highway projects and thereby mitigating its effects.

Contract time as observed by Hancher and Rowings (1995) affects budgeting, resource planning, local economics and claim issues. Reasonably contract time also avoid higher bid cost as well as decrease the possibility of disputes between the contractor and the contracting authority.

The major contracting methods listed below are the most popular methods in use:

- Bidding on Cost/Time
- Incentive/Disincentive (I/D)
- Bidding on Cost/Time combined with Incentive/Disincentive
- Lane rental

2.8.1 Time value and road user cost

Each of the method is principled on cost reimbursement to the contractor for contract time reduction. The owner has to calculate the values of time if a contactor reduces time duration by 40 calendar days there is the need to know the value of that time.

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The Unit Time Value (UTV) represents the value of time unit to the owner, which is expressed in hours/days/weeks.

$$TTV = UTV \times T$$

Where TTV = Total Time Value

T = Time

If the owner determines that the cost reduction of the contract time is $4,000/day (UTV) and if the contractor reduces construction time by 20 days (T),

Total Time Value (TTV) = $4,000/day x 20 days

= $ 80,000.

Calculation of Unit Time Value (UTV)

The UTV represents the cost of delays to the owner, which include both direct and indirect costs. Direct cost includes temporary facilities, costs for moving and other alternative solutions. Overheads and losses to the business communities and reduction of potential profits and even hardship suffered constitute the indirect costs which are not easily calculated.

Calculation of Daily Road User Cost (DRUC)

The UTV calculation in the highway construction industry are expressed as cost per day and referred to as the "daily road-user cost" (DRUC). If a new road has to be built feasibility study will be conducted to determine the economic impact of the new facility. The calculation of the DRUC will be part of this analysis and will include such items as the, travel distance and fuel expense.

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Due to regulatory constraints and hard-to -qualify values the indirect costs are ignored in the calculation of DRUC. Indirect costs can be significant in the case of neighbourhood with high population for example.

2.8.2 Bidding on Cost/Time (A+B)

- The A + B method, has been highly recommended by Federal Highway Agency, and is used all over the United States.
- The first step in this procedure is for the owner to establish the DRUC and incorporate it into the bid documents.
- The next step will require that every contractor who participate in the bidding process calculates two values: A - the estimated construction cost for the project and B - the estimated project duration for the completion. The successful bidder is the contractor who submits the lowest total combined bid (TCB) using the following formula:

$$TCB = ECC + (DRUC \times EPD)$$

Where TCB = total combined bid;

ECC = estimated construction cost for the project the "A" in the (A+B method);

DRUC = daily road – user cost and

EPD = estimated project duration for project completion here is the "B" in the (A+B method).

The competition here is based on time or duration in combination with estimate for the product.

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Advantages and disadvantages of cost/time (A+B) Method

Time reduction is achieved through competition between contractors. It is also noticed that contractors do not raise their unit prices as my be in the case of the traditional method. If the winning bid is necessarily the lowest, in terms of direct costs the public benefits from time reduction.

The disadvantage however lies in contractors eager to win the contract. Try to present a lower time duration, which may not, which may not be realistic and subsequently try to cut corners on the job in order to attempt to limit financial losses when they sense the duration not being met and disincentives fees loom. The contractor will be seeking to change orders and claims as means for recouping losses. Quality of work cam also suffer/ A check to this situation is to insert a clause that rejects a not so realistic time duration buy classifying it as unresponsive bid.

2.8.3 The Incentive /Disincentive (I/D) Method

This method is the commonly used method of all the four methods mentioned earlier. With this method, the contract time is determined by the owner and presented as part of the bid documents. If the contractor complete ahead of time he is entitled to a bonus (incentive fee). If on the other hand he finishes behind schedule, a penalty the owner then assesses (disincentive fee).

Calculation of daily I/D fees

The DRUC is an integral part of the I/D method, which is calculated by method, which is calculated by most Highway Agencies and applied as their daily ID fees. Although most States have their different fees, an average of $5,000/day is commonly used.

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Although most states are using the DRUC as a basis for determining appropriate I/D fees, there are some states using different parameters for establishing I/D fees. One of the alternate parameters is to calculate the I/D fee as a percentage of total projects cost. For projects whose costs are to exceed $500,000,000 for instance the I/D fees will be 0.03% of the total project cost.

Table 2.8 Schedule of daily I/D fees utilized in New Jersey DO1

Total project (in millions of dollar) (!)	Daily I/D (2)
0-0.5	$1,000
0.5-1.5	$2,000
1.5-5.0	$5,000
5.0-10.0	$6,000
10.0-15.0	$8,000
15.0-20.0	$10,000
20.0-30.0	$13,000
30.0-40.0	$16,000
40.0-50.0	$17,000
50.0+	0.03% of total project cost

Maximum I/D fees allowed

Many states have implemented limits to the maximum amount that will be paid out and disincentive that will be assessed to the contractor. These limits are known as "caps" and have been set as percentage of total contract sum. Some have a flat –rate dollar amount such as the New Jersey DOT mandating that total I/D fees on any one project cannot exceed $100, 00.

2.8.3.1 Advantages and disadvantages of the I/D Method

The method led to dramatic reduction of contract time durations when compared to the engineers estimate. Another advantage of the I/D contracting method is its

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flexibility in enabling state Highway Authorities to adjust their financial exposure by utilizing flat-rate or percentage caps for I/D fees. Relationship between contractors and owners using this system tend to be less adversarial, which is apparently related to the fact that the contractors typically received some amount of incentive payments.

The major disadvantage of the I/D method lies in the fact that the fees are based on the engineer's time estimates as established by the Authorities. Today, in the United States, most Transportation Department determines contract time based on the performance (production rate) of the average contractor. This practice of establishing contract time with little or no additional commitment of resources. In other words, the same time reduction could essentially be achieved; free of charge, by reducing the original engineer's time estimates. This opinion is supported in several states (Florida and California, in particular) where, in recent years, original engineer's time estimates have been reduced, and contractors were still able to complete the projects on time. Florida DOT reduced contract time by 20% without witnessing any major delays in project completion dates.

2.8.4 Bidding on Cost/Time Combined with Incentive /Disincentive

This is composite commonly referred to as A+B plus I/D. The low bidder is determined from the results of the A+B bid procedure. Upon selection of the successful bidder, the estimated project duration submitted by the contractor becomes the contractual project duration. Incentive/disincentive fees are then paid or collected with respect to this newly established contract duration (Herbsman et al. Al. (1995)

Data taken out of Kentucky show a successful bidder's estimated project duration as 450 days, which then became the official contract duration. The contractor completed

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in 406 days, 44days ahead of schedule and I/D fee of $5,000/day was specified in contract document. The contractor upon completion was entitled to an incentive of $220,000 (44 days x $5,000/day).

2.8.4.1 Advantages and Disadvantages of A+B Plus ID

This method combines the advantages of the A+B method and I/D. This is typically associated with emergency works such as bridge repair. the advantages associated here lies in the double motivational stimulus encouraging the contractor to reduce time thus a thorough competition low contract time is achieved and additional time reduction are achieved through incentive/disincentive fees.

2.8.5 Lane Rental

This is one method extensively used by the British Department of Transport (BDTp) and is defined as a way of providing financial incentives to general contractors and others to shorten the overall time required for lane closure, Bondar, V.A (1999)

Contract times are set together with determination of cost of lane closures under different conditional by the Awarding Agency.

Each bidder is expected to submit cost estimate of work along with amount of time needed for lane closures during the construction period. The total cost of the project I the sum of cost estimate of work plus cost of all essential lane closures. The successful bidder is determined by the one having the lowest total aggregate cost estimated.

According to Bondar V.A (1999) contractors seen to minimize construction work during peak traffic hours so as not to pay excessive lane closure fees. Material

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deliveries and management of works are better arranged to make optimum use of lane traffic as a result of sensitivity expressed by contractor to the closure of lane because of contractor incurs.

Meggs M.F (1995) stated that "lane-rental for motorway reconstruction and others have been successful in demonstrating the scope for reducing the time needed for completion. According to Bodar V. A (1999) lane rental favors the more efficient firms who are able to provide careful thought for work planning . Analysis of cost benefit of projects that were contracted using the lane-rental method shows these cost savings to be very significant.

2.8.5.1 Advantages and Disadvantages of Lane Rental

Contactors are strongly motivated to reduce the construction time because actually pay our=t real money to the owners for the lane closures. This method allows the freedom as well as challenge the contractor to choose the most innovative patterns for working, (day, night, weekend, one lane closed, two lanes closed, detour and so on). According to Srinivasan et.al (1999) about 25% of construction time reduction was achieved by using this method.

As associated with the A+B method the major disadvantage with the lane rental is the tendency of contractors to cut corners , where face with unanticipated lance closure fees due to construction delays. This situation could lead to poor quality abs strained contractor/owner relationship.

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2.8.6 Innovative Methods of Contract compared with Conventional Contracts

The most conspicuous advantages the innovative methods have over the traditional contracts are the short duration and savings made. According to Herbsman et al (1995), saving account for 20-50% in USA. The systems have woefully exposed the unviability of the engineer's time estimates since contractors are always finishing far ahead of schedules.

The old conventional contracts are not dynamics, innovative and do not induce the contractors to come out with the best managerial approaches and faster work rates but in Innovating contracting methods do.

While the innovative contracting methods are cut out to minimize losses and inconvenience suffered due to delays the conventional method is unresponsive realistically do delays and its effects once the contractor has enough good reasons to litigate and circumvent the contract conditions and punitive measures.

Financing works in Africa is very difficult and it sounds unrealistic for an Africa state to set aside any funds to pay any incentive thus leaving the Third World to no options but the conventional method.

A report from British Department of Transport BDTp (1995) maintained that quality of work is high with innovative contracting methods that the conventional methods since the contractors were well aware of penalties associated with delays due to non-acceptance of substandard.

An innovative contract calls for more responsibilities and need for communication by the consultants as compared to the conventional methods.

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CHAPTER THREE

RESEARCH METHODOLOGY

This research seeks to assess the effects of delays in the constructions of highways in Ghana. The chapter describes how data were gathered and the sequence for analysing these data.

Firstly, a questionnaire was designed to assess a substantial cross section of Ghanaian road consultants, contractors and users. This industry wide assessment was to gather data and opinions relating to the significance that these groups attach to the effects of delays in highway construction.

Finally, statistical analysis of the results of the questionnaire and the results used to assess the effects of delays and propose a system to minimise and mitigate these effects.

3.1 Data Collection

The primary source of data for this research is in the form of a postal questionnaire, designed to gather a large volume of data from the top management of classes, K1 Road Contractors (as well as consultants representing themselves or the Government in all the ten regions of Ghana) within the limited time and financial constraints. The primary function of the survey is to collect information that can be analysed to produce conclusions on the effects of delays in highway construction in Ghana.

3.1.1 Sampling and Sampling Method

The questionnaires were sent to almost all K1 Road Contractors and randomly selected consultants. The samples were selected from 5452 classified contractors' list

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prepared by the Ministry of Roads and Transport and from list of registered engineers/consultants associated with The Ministry of Roads and Transport. Procedures that were followed to ensure the randomness of the consultants are as follows:

1. A list which had all the consultants whose association or registration was valid as at 2012 was sequentially numbered.
2. Random numbers were selected from the statistical table according to a present criteria(i.e. begin from right to left, top to down, take one row and leave the other, etc.).

The random numbers selected were then compared with the number on the list and certain consultants were accordingly selected.

There were 96 class K1 contractors and 446 consultants. Sample sizes were determined using the following formula by Kish, 1965:

$$n = n^1/(1+n^1/N)$$

Where,

n = sample size

$\mathbf{n^1}=S^2/V^2$

N = total population

V = the standard error of sampling distribution =0.05

S = the maximum standard deviation of the population elements

(Total error = 0.1 at a confidence level of 95%)

$\mathbf{S^2}= P (1-P) = 0.5 (1-0.5) = 0.25$

P = the proportion elements that belong to the defined class.

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Considering only class K1 contractors and substituting N = 96 a sample size of 49 was arrived at. However, for both classes K1 and consultants N = 540 and a new sample size of 84 is introduced.

It was assumed that the commercial sensitivity of the required information would discourage many contractors from participating in the study. A response rate of 10% was therefore assumed. The total sample size had to be increased to about 250 to accommodate the anticipated short fall in response. To be able to get statistically acceptable response from the class K1 contractors, it became imperative to reach all the 96 Road contractors in the class K1 category. Due to time and financial constraints only 104 consultants were reached.

3.1.2 Structure of Questionnaire

The questionnaire also was prepared to sample the opinion of the respondents as regards ways and means of curtailing delays and consequently mitigating their effects.

The first part of the questionnaire contains questions about the background of respondents. The second part covers the significance respondents attach to 20 listed potential causes of delays while the third part gathers information on the significance respondents attach to 36 potential effects of delays. In parts, two and three, respondents are to rank according to the level of significance using a scale from 1 to 5. Where '1' means not significant at all and 5 means most significant.

3.1.3 Distribution of Questionnaires

Most of the questionnaires will either be sent by post or email to the consultants and contractors through their respective addresses. Personal follow-up will be done on

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contractors and consultant that time and finance will permit. In order to get high response stamped addressed envelopes for the return of the answered questionnaires will be added to the questionnaires sent by post. The respondents will also asked to remain anonymous.

3.1.4 Data Analysis

The questionnaires filled by consultants and contractors were screened to ensure that they were adequately answered. They were then coded and inputted in the version 17 of the statistical package for social science (SPSS). Tables showing frequencies and percentages were generated and the graphs were done using Microsoft Excel. Some tables (4.7 and 4.8) had their factors coded to make presentation more convenient. Means rankings and relation importance index were generated by the SPSS software.

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CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter analyses and presents data gathered and continues with a discussion of the results. Tables with frequency, percentages, mean and correlation was generated using SPSS version 17 to simplify the data. Discussions of the results were in-line with the objectives of the study.

4.2 Response Rate

Questionnaires, two hundred (200) were sent to various classes of contractors and consultants in the Highway Authority in the Greater Accra and Eastern Regions. Out of these questionnaires, 86 were completed and returned giving 43 per cent response rate as illustrated in Table 4.1.

Table 4.1 Response Rate

Respondents	Number of Questionnaires		Percentage Returned
	Sent out	Returned	
Contractors	96	52	54.2
Consultants	104	34	32.7
Total	200	86	43.0

The low response rate could be associated with most contractors as well as consultants not keeping good records of their work. Those who had records were reluctant and were associated with delays in completing the questionnaires, lest they tarnish the image of their companies, even though they seemed to be a lot of enthusiasm about the research.

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4.3 Background of Respondents

The background characteristics of the respondents captures the contractors and consultants, number of years of experience and compensation payment as illustrated in Table 4.2.

Table 4.2 Background of respondent

Variable	Contractors		Consultant	
	Frequency	Percentage	Frequency	Percentage
Experience				
0 - 5	16	31	9	27
6 – 10	26	50	14	41
11 – 15	7	14	7	21
16 – 20	2	4	2	6
Above 20	1	2	2	6
Payment of compensation				
Yes	42	81	23	68
No	10	19	11	32

4.4 Cost Effects of Delays in Highway Construction

Delays in highway construction are as grievous as in any other area. Delays affect cost of labour, materials and other auxiliary expenses. The purpose of research question two was to find out if clients recognize the cost effects of delays on highway construction projects given a 12-month period of delay under the same prevailing inflationary conditions.

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4.4.1 Cost Effects of Delays on Labour

Table 4.3 shows respondents, view of cost effects of delays on labour. The analysis shows for example that with 35 responses, 67.4% of contractors believe labour cost should increase by 21- 30%. Consultants also believed labour should cost 21- 30% more over the period with a maximum 24 number of responses making 71.6%.

Table 4.3 Cost Effects of Delays on Labour

Percentage Increment	Contractor		Consultant		Overall
	Number of responses	Percentage responses	Number of responses	Percentage responses	Percentage responses
0 – 10	2	4	1	3	4
11 - 20	13	25	8	24	24
21 – 30	35	67	24	71	69
31 – 40	2	4	1	3	4
TOTAL	52	100	34	100	100

There is no significant difference in opinion here with over 69.6% responses agreeing on 21 -30% increments.

The increment of labour cost can be associated with the general rising costs of living prevailing in developing countries like Ghana. As inflation and cost of fuel and utility escalate, so do other goods and services.

The secondary effects of increment in cost of labour can be the following:

- Contractors would lose some skilled workers, as they can no longer pay them.
- Quality of work would suffer, as contractors would turn to alternative cheaper labour.
- Contractors would even try to make up for the short fall in their profits.

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- As labour become relatively more expensive, contractors would try to cut corners in terms of evading taxes through under declaration of labour size as well as failure to pay securities.
- As contractors insist on paying old prices, workers would demonstrate in protest leading to unrests, legal issues and further delays.

4.4.2 Effect of Delays on Cost of Plant and Equipment

The research again recognised the effects of delays on cost of acquiring plants and equipment and other associated problems as illustrated in Table 4.4.

Table 4.4 Cost Effect of Delays on Plant and Equipment

Percentage Increment	Contractor		Consultant		Overall
	Number of responses	Percentage responses	Number of responses	Percentage responses	Percentage responses
41 – 50	3	6	0	0	4
51 – 60	24	46	24	71	56
61 – 70	25	48	10	29	41
TOTAL	52	100	34	100	100

The analysis shows that most contractors agree on a 61 - 70% increment in cost of Plant and Equipment while majority of consultants put the range at 51 - 60%. As shown in Table 4.3 an increment of 51 - 60% over previous prices were envisaged due to delays of 12 months under current inflationary conditions.

Most Plants and Equipment stock, spare parts and fuel cost are influenced by foreign exchange (Dollars) which is always on the higher side of exchange in cedi terms.

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It is significant to note that most contractors hire these machines and therefore should have them at competitive prices. Those who own their own equipment purchased them through loans, which are being serviced with interests, which are not static either. Thus to hire or maintain equipment over a delayed period there is cost to bear. The consequences of having equipment idle due to delays or going to hire them at higher prices than planned for are:

- Accumulating very high leasing costs without corresponding output leading to loss of profits, indebtedness of contractors and strained relations with owners
- Locked-up capital with interests on loans running without corresponding income on the equipment
- Contractors sacrificing parts of their profits to top up for increments
- Inability to lease the same equipment due to higher costs and contractors resorting to other means that do not bring the same results

4.4.3 Effects of Delays on Cost of Materials

The research also sought to determine in percentage terms the cost effects on materials in relation to initial rates as viewed by contractors and consultants given a delay period of 12 months within the current inflationary conditions. Table 4.4 shows the responses of respondents.

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T able 4.4 Cost Effects of Delays on Prices of Materials

Percentage increment	Contractor		Consultant		Overall
	Number of responses	Percentage responses	Number of responses	Percentage responses	Percentage responses
41 – 50	3	6	0	0	4
51 – 60	24	46	24	71	56
61 – 70	25	48	10	29	41
TOTAL	52	100	34	100	100

Table 4.4 shows that contractors envisage material cost increment between 61 to 70% while consultants indicate a range of 51% - 60% within a 12-month delay.

The difference in opinion, though not very significant, can be explained with the fact that contractors in the field are aware of the realities more than consultants who are mostly in the offices.

The cost of materials would rise with the passage of time because of the trend of general rising cost of goods and services in the country.

Most materials, such as mild steel, cement and bitumen are imported and cannot avoid the effects of inflation as well as unfavourable foreign exchange transactions.

Perhaps the most important cost components is the haulage costs. Higher haulage costs are brought about by incessant increases in petroleum products and spare parts. The labour that goes with haulage also keeps rising in tune with rising cost of goods and services or general standard of living.

At the start of a project, the contractor is never capable of stock piling all his materials and when they become expensive in the course of the project due to inflation, the following happen:

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- Specifications suffer in terms of quality and quantity. For example, contractors no longer go by concrete mixture ratios specified in their contracts. In varying the mix to their advantage, the quality of work is compromised.

- Higher material prices would also lead to loss of profit to contractors as they are left with the choice of either compromising quality or sinking in their profits to make up for the shortfall if adequate compensation is not provided especially when the fault of delay is theirs.

- Higher material prices lead contractors to compromise on labour. They fail to revise workers' pay and they go in for cheaper and less skilled labour and sometimes cut down the labour size altogether. These lead to further delays, poor quality of work and unrest or agitation among the workers.

- Higher material prices definitely send contractors borrowing at interest rate higher than planned for midstream during the project especially when the cause of delay comes from the contractor and there is no remedy or compensation to absorb the effects.

4.4.4 Cost Effect of Delays on Overheads

Consultants and Contractors were asked to determine in percentage the effect on cost of overheads due to delays. Table 4.5 shows the respondents opinion of cost effect of delay on overheads.

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Table 4.5 Cost Effects of Delay on Overheads

Percentage increment	Contractor		Consultant		Overall
	Number of responses	Percentage responses	Number of responses	Percentage responses	Percentage responses
0 – 10	-	-	-	-	-
11 - 20	12	23.1	7	20.6	22.1
21 – 30	26	50	27	79.4	61.6
31 – 40	14	26.9	0	0	16.3
TOTAL	52	100	34	100	100

The analysis shows that 50% of contractors, forming the majority put the range of increment on the cost of overheads at 21 - 30% and most consultants (79.4%) agreed with this range. There is no significant difference in their opinion on the rate of escalation of projected allocation made for overheads.

Judging from the rate of inflation and general rise of prices of goods and services a conclusion like this can be said to be normal.

The components of overheads cost such as salary of head office staff are influenced by rising standard of living. The same applies to the cost of fuel and rent. Other receipts reflect the prevailing prices of goods and services, which keep rising.

- Assuming there are no other jobs running concurrently, contractors overhead cost over a prolonged period will be financed from the only project in question. This leads to erosion of profits.

- Head office overhead costs such as rent on office space and salaries run like fixed costs of production unlike the variable cost of labour and materials that can be withheld if a project is on suspension. When costs continue to be

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incurred without corresponding income, the firm runs into deficit and bankruptcy in the end.

- Another implication of rising cost of overheads is the loss of jobs as contractors have no option but to "cut their coat according to their size" by relieving some of their permanent staff.

4.4.5 Effects of Delays on Loans and Insurance

Figure 4.1 illustrates respondents view on the effects of delays on cost of loans and insurance.

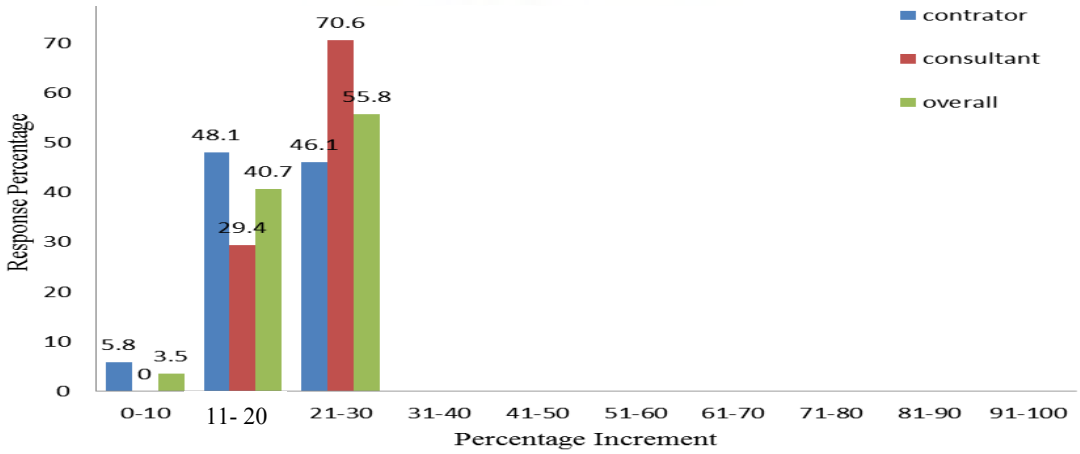

Figure 4.1 Effects of Delays on Loans and Insurance

From Figure 4.1, 48.1% representing the majority of contractor respondents think that delays cost 11 - 20% more on loans and Insurance. Another significant group is 46.1% of contractors indicating that 21 - 30% cost overrun on initial allocation.

Consultant respondents constituting 70.6% majority of their group also believe that, contractors given a 12-month delay on a project are likely to pay 21% - 30% more as cost or interest on loans and Insurance they take.

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The high interest rates reflect a typical uncertain and risky investment environment one experiences in the developing world and Ghana to be specific. Increments are observed all the time as one observes the interest rates change as a result of Central Bank fiscal policies as well as movements at the stock market and inflation.

In Ghana as inflation goes up, the cost of borrowing as well as insurance also rises. When delays occur, companies cannot attain a reasonable payback period on their investments then they have to pays back loans at relatively higher interest rates than planned for.

- The implication of paying higher interest rates on bank loans due to delays and obtaining more bank guarantees at high interest rates to cover the extended period means lower profits.
- The difficulty to pay back in good time of loans obtained due to project delay, leads to loss of credit worthiness of the contractor.
- Default in paying for loans as scheduled leads to one losing properties vested as collateral security.
- Bankruptcy normally results as profits are eroded and credit worthiness is lost. Then contractors have no financial advantage to bid for other contracts.

4.5 Causes of Delays in Highway Construction

Both consultants and contractors were asked to rank the following causes of delays in Highway Construction using 1=not significant at all, 2=not significant, 3=significant, 4=very significant and 5=most significant. Table 4.6 shows their opinions of the causes of Delay in Highway Construction.

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Table 4.6 Causes of Delay in Highway Construction

Code	Causes of Delays	Consultant		Contractor	
		Weighted Mean	Ranking	Weighted Mean	Ranking
A	Variations/Changes in scope	4.00	5	4.31	1
B	Client's slow decision making	3.29	14	3.31	15
C	Client's cash flow problems(Counterpart Funds	4.21	2	4.00	2
D	Lack of proper feasibility studies into the availability of funds to complete a project for the conditions of contract regarding payment	3.41	13	3.56	8
E	The number of signatories that must append to the certificate	3.29	14	3.44	12
F	Delay in work approval	3.79	7	3.46	11
G	Slow coordination and seeking of approval from concerned authorities	3.59	10	3.69	5
H	Inaccurate bills of quantities	3.00	19	3.00	19
I	Late valuation of variation	3.79	7	3.31	15
J	Sheer disregard	2.79	21	3.29	17
K	Late preparation of interim valuation	4.21	2	3.46	9
L	Poor information dissemination	3.29	14	3.44	12
M	Lack of communication	3.50	12	3.46	9
N	Personality clash between contractor agent and resident engineer	4.29	1	3.71	4
O	Test and inspection of works	3.79	7	3.62	7
P	Poor contract management	4.09	4	3.40	14
Q	Lack of skilled technical personnel	3.88	6	2.21	21
R	Liaison problems among the contracting parties	2.79	20	3.13	18
S	Lack of programming for the projects especially using cost-time graph for the client to know his financial commitment	3.29	14	2.63	20
T	Political leanings of the directors of the company	3.29	14	3.67	6
U	Commencement of construction in the rain season	3.59	10	4.00	2

*Key 1=not significant at all, 2=not significant, 3=significant, 4=very significant and 5=most significant

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Consultants rank the causes of delay coded N, C, K, P, A, Q, O, I, F, G, U and M as the very significant causes of delays in highway construction while Contractors rank A, C, U, N, G, T, O and D as the very significant cause of delay in Highway construction.

There are a lot of similarities in the causes of delay ranked by both Consultants and contractors. This is likely because consultants and contractors work together and are faced with similar challenges that delay highway construction. These include. Client's cash flow problems (Counterpart Funds), Variations/Changes in scope, Poor contract management, Slow coordination and seeking of approval from concerned authorities and test and inspection of works.

Generally, the Consultants were of the opinion that the causes of delay in Highway construction outlined are all significant (>2.78) while Contractors on the other hand ranked Q (Lack of skilled technical personnel) as not a significant cause of delays in highway construction (2.21). This is a true picture of the current happening, where management do not see the same problems as seen by work men. The Contractors opinion is likely because there are more graduates various technical skills than the jobs for such graduates.

4.6 Effects of Delays in Highway Construction

Contractors and Consultants were asked to rank a list of various effects of delays in Highway Construction using a scale of 1 to 5; 1=not significant at all, 2=not significant, 3=significant, 4=very significant and 5=most significant. Table 4.6 shows outcomes of the ranking.

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The relative importance indices for the various factors were measured using the following formula:

Relative Importance Index = $\Sigma w/(S \times N)$

Where Σw = the summation of the weighting given to each factor

S = maximum score or ranking

N = total number of respondents in the sample

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Table 4.7 Effects of Delays in Highway Construction: Relative Importance to Contractors and Consultants

Code	Factors	Contractors			Consultants		
		Weighting	Relative Importance Index	Rank	Weighting	Relative Importance Index	Rank
1.0	**DIRECT COST EFFECT**						
1.1	Higher Labour and Material cost	298	0.819	6	196	0.824	6
1.2	Higher cost of overheads	219	0.602	20	133	0.550	28
1.3	Interests on delayed claim fluctuations	334	0.918	1	223	0.937	1
1.4	Inflation and loss of profit	236	0.648	17	108	0.454	32
1.5	Insurance and interest on loans	213	0.585	21	150	0.63	18
1.6	Locked up capital in plant and equipment	278	0.764	8	196	0.824	6
1.7	Cost of litigation	141	0.387	35	88	0.37	36
2.0	**INDIRECT COST EFFECT**						
2.1	Loss of business to locals in work zones	280	0.769	7	192	0.807	8
2.2	Cost of disruption of utilities and fuel usage	235	0.646	18	175	0.735	12
2.3	Cost of accidents in work zones	255	0.701	12	168	0.706	15
2.4	Cost of managing traffic in work zones	165	0.453	32	131	0.55	30

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Table 4.7*Continue*

Code	Factors	Contractors			Consultants		
		Weighting	Relative Importance Index	Rank	Weighting	Relative Importance Index	Rank
3.0	**ENVIRONMENTAL IMPACT ON LOCAL COMMUNITIES**						
3.1	Degrading landscape and aesthetic of town	273	0.75	4	199	0.836	5
3.2	Spread of diseasefrom borrow pits contacts	241	0.662	14	163	0.686	16
3.3	Disruption of drainage in local communities	182	0.5	29	176	0.739	11
3.4	Contamination of soil (bitumen)	202	0.555	24	142	0.597	25
3.5	Environmental pollution, dust and chemicals	237	0.651	10	173	0.727	13
3.6	Soil erosion prolonged	300	0.824	5	200	0.84	4
3.7	Acid rains effect on artefacts	260	0.714	11	181	0.761	10
3.8	Disruption of sources of water streams prolonged	227	0.624	19	171	0.718	14
3.9	Impact on flora and fauna prolonged	241	0.622	14	149	0.626	21
3.10	Disruption of aqua culture(Extinction)	272	0.747	10	133	0.559	28
3.11	Prolong noise pollution in work zone	200	0.549	25	97	0.408	34
3.12	Loss of residence and habitats in settlements	204	0.56	23	96	0.399	35
3.13	Land slides	175	0.481	31	108	0.454	32

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Table 4.7*Continue*

Code	Factors	Contractors			Consultants		
		Weighting	Relative Importance Index	Rank	Weighting	Relative Importance Index	Rank
4.0	**SOCIO- ECONOMICS EFFECTS ON COMMUNITIES**						
4.1	Overall delays in utility services to communities	190	0.552	28	144	0.605	24
4.2	Goods and services locked up in communities	307	0.843	3	209	0.878	2
4.3	Disruption of tourism	195	0.536	26	149	0.626	21
4.4	Split and loss of community cohesion	152	0.418	34	138	0.58	27
4.5	Invasion of community, promiscuity, adulteration	141	0.387	35	130	0.546	31
4.6	Upheavals, revolts by socio-political pressure groups	177	0.486	30	140	0.588	26
5.0	**INCONVENIENCE CAUSED USERS OF HIGHWAY**						
5.1	Traffic holdup and user delays	310	0.852	2	204	0.857	3
5.2	Tear and wear on vehicles	250	0.687	13	155	0.651	17
5.3	Health hazards from dust and carbon monoxide	303	0.852	4	185	0.777	9
5.4	Uncompletion of highway facilities; deprivation of use	194	0.533	27	145	0.609	23
5.5	High fee consumption due to detours and hold ups	208	0.571	22	150	0.63	18
5.6	Use of ambulances become prohibitive	161	0.442	33	150	0.63	18

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Consultants and Contractors ranked the first five (5) top factors or effects listed in the questionnaire to be very similar.

Other factors beyond the fifth to the ninth had almost the same importance indices and have very close rank orders across the two groups of respondents. The most significant effects of delay on Highway construction therefore may be listed as follows:

- Payment of interests on delayed claims/fluctuations
- Traffic hold-ups and user delays
- Locked-up goods and services in communities
- Health Hazards from carbon monoxide to users in long traffic hold-ups
- Soil erosion
- Higher labour and material costs
- Loss of business to locals in the work zones
- Locked up capital in plant and equipment
- Degrading landscape and aesthetics of towns and cities.

4.7 Correlation between Contractor's and Consultant's Assessment of Effects of Delays in Highway Construction

The objective of studying the correlation is to ensure that the factors arrived at can be relied upon as the true effects since the respondent groups may have their own different peculiar filters through which they may view or appreciate the effects of delay. Through this statistical means of evaluation, one may confirm the true, across board effects of delays.

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To study the rank correlation between contractors and consultants, the Spearman rank correlation coefficient, R, between the two groups was measured using the formula:

$R = 1 - \{ 6\Sigma d_i^2 / [n (n^2 - 1)]\}$

$$d_i = (x_i - y_i)$$

$$-1.0 \leq R \leq 1.0$$

Where, n = total number of paired ranks

x_i = rank of contractors

y_i = rank of consultants

D_1 = difference between the ranks

$R = 1- \{6\Sigma D_i^2 / [n(n^2 - 1)]\}$

$= 1 - \{(6 \times 1876)/ [36(36^2 - 1)]\}$

$= 1 - (11256 / 46620)$

$= 1 - 0.241$

$= 0.759 \approx 0.76$

Table 4.7 shows the calculation of R, D_1 and D_1^2. A correlation coefficient of 0.76 was obtained, indicating a monotonically increasing relationship exists between the rankings of the effects of delays as suggested in the two groups.

A further test was made to determine whether or not the correlation found (using the Spearman rank correlation coefficient) justifies a conclusion that there is a non-zero correlation between the rankings by the two groups of respondents.

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Statistically, if the two rankings are independent and if n ≥ 10, the sampling distribution or R can be approximated by a normal probability distribution with mean.

$\mu_R = 0$, and standard deviation

$\sigma_R = \sqrt{\{1(n-1)\}}$

With $\alpha = 0.05$, the decision rule will be to reject the null hypothesis that the two ranking are independent if the observed value of R is:

$> \mu_R + 1.96\sigma_R$ or $< \mu_R - 1.96\sigma_R$

From the data, $\sigma_R = \sqrt{\{1(36-1)\}}$

$= 0.169$

$\mu_R + 1.96\sigma_R = 0 + (1.96 \times 0.169) = 0.33$

$\mu_R - 1.96\sigma_R = 0 - (1.96 \times 0.169) = -0.33$

Since R = 0.76 and $0.33 < 0.76 > -0.33$, the null hypothesis that, contractors and consultants ranking vary.

In conclusion, a significant rank correlation exists between contractors and consultants in ranking the various effects that occur due to delays on highway construction projects.

This relationship of the rankings of Contractors and Consultants being close is explained to be as a result of the similarities in their training and experience on the job. Considering the background and experience of some of the contractors, one realised that they once worked as consultants representing government on various

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jobs. The views of these individuals have not changed drastically as they enter into the private sector.

Most Contractors interviewed are qualified Engineers and Quantity Surveyors and have been in the same classrooms as their counterparts working as Consultants; in fact, one can be sure that they belong to the same professional bodies. The difficulty in securing government white colour jobs with the advent of open market competition and privatisation policies of government, most technocrats have shifted into the private sector where they manage their own construction firms and projects.

Table 4.8 Determination of Rank Correlation

Code	Factors	Contractors Rank (x_i)	Consultants Rank (y_i)	D_1	D_1^2
1.0	**DIRECT COST EFFECT**				
1.1	Higher Labour and Material cost	6	6	0	0
1.2	Higher cost of overheads	20	28	-8	64
1.3	Interests on delayed claim fluctuations	1	1	0	0
1.4	Inflation and loss of profit	17	32	-15	225
1.5	Insurance and interest on loans	21	18	3	9
1.6	Locked up capital in plant and equipment	8	6	-8	64
1.7	Cost of litigation	35	36	-1	1
2.0	**INDIRECT COST EFFECT**				
2.1	Loss of business to locals in work zones	7	8	-1	1
2.2	Cost of disruption of utilities and fuel usage	18	12	6	36
2.3	Cost of accident in work zones	12	15	-3	9
2.4	Cost of managing traffic in work zones	32	30	2	4

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Table 4.8*Continue*

Code	Factors	Contractors Rank (x_i)	Consultants Rank (y_i)	D_1	D_1^2
3.0	**ENVIRONMENTAL IMPACT ON LOCAL COMMUNITIES**				
3.1	Degrading landscape and aesthetic of town	4	5	1	1
3.2	Spread of disease borrow pits contacts	14	16	8	64
3.3	Disruption of drainage in local communities	29	11	18	324
3.4	Contamination of soil (bitumen)	24	25	-1	1
3.5	Environmental pollution, dust, and chemicals	10	13	3	9
3.6	Soil erosion prolonged	5	4	4	16
3.7	Acid rains effect on artefacts	11	10	1	1
3.8	Disruption of sources of water streams prolonged	19	14	5	25
3.9	Impact on flora and fauna prolonged	14	21	-7	49
3.10	Disruption of aqua culture(Extinction)	10	28	-18	324
3.11	Prolong noise pollution in work zone	25	34	-9	81
3.12	Loss of residence and habitats in settlements	23	35	-12	144
3.13	Land slides	31	32	-1	1
4.0	**SOCIO ECONOMICS EFFECTS ON COMMUNITIES**				
4.1	Overall delays in utility services to communities	28	24	4	16
4.2	Goods and services locked up in communities	3	2	1	1
4.3	Disruption of tourism	26	21	8	25
4.4	Split and loss of community cohesion	34	27	7	49
4.5	Invasion of community, promiscuity adulteration	35	31	4	16
4.6	Upheavals, revolts by socio-political pressure groups	30	26	4	16
5.0	**INCONVENIENCE CAUSED USERS OF HIGHWAY**				
5.1	Traffic holdup and user delays	2	3	-1	1
5.2	Tear and wear on vehicles	13	17	-4	16
5.3	Health hazards from dust and carbon monoxide	4	9	-5	25
5.4	Incompletion of highway facilities; deprivation of use	27	23	4	16
5.5	High fee consumption due to detours and hold ups	22	18	4	16
5.6	Use of ambulances become prohibitive	33	18	15	225
					$\Sigma D_1^2 = 1876$

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4.8 Systems used in Mitigating the Effects of Delays in Highway Construction

In finding the systems or ways of mitigating the effect of delay in Highway Construction, respondents were requested to rank the various strategies used to minimise or mitigate highway construction delays.

Table 4.7 illustrates the outcome of responses from Consultants and Contractors on ways of mitigating delays in Highway Construction. Most contractors (36.53%) opined that 'incentives for completion of work' and 'prompt payment' are the first two choices of preventing delays in Highway Construction followed by 'realistic calculation of duration of projects. Only 3.85% of contractors believed either punitive measures or improvements in technical inputs by the Road Agencies could either push them out of delays or help curb delays.

The analysis also shows that 19.24% of Contractors do not believe the duration calculations by the engineers nor the contractors themselves are realistic and that the issues of delays are only perceived.

On the other hand, most Consultants (29.41%) agreed with Contractors that prompt payment for work done limits delays. A significant percentage of Consultant (23.52%) also supported that incentives to complete work on time can limit delays to some point.

The majority of Consultant respondents representing 23.53% suggested that punitive clauses in the FIDIC conditions of contract be used as tools in coercing contractors to complete works as scheduled.

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The overall majority representing 33.72% in the survey agreed to prompt payment followed closely by 31.39% for the fact that incentives be introduced to encourage early completion. About 16.28% still believed that, calculations of contract duration time are incorrect and some delays are only perceived. The suggestions that punitive measures could be used and improvement on technical inputs by Agencies to limit delays were not overwhelming.

Table 4.9 Ways of mitigating delays in Highway Construction projects

Strategies to minimise delays	Contractors		Consultants		Overall
	Number of respondents	Percentage Responses	Number of respondents	Percentage Responses	Percentage Responses
Prompt payment	19	36.53	10	29.41	33.72
Improving upon Technical inputs by Agencies	2	3.85	2	5.9	4.65
Incentives for Completion	19	36.53	8	23.52	31.39
Calculations for more realistic time duration	10	19.24	5	14.70	16.28
Adhering to punitive clauses in contracts	2	3.85	9	26.47	11.63
Total	52	100	34	100	100

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CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Ghana can be said to be suffering under the burden of delays of various highway projects with her people experiencing all the adverse impacts associated with this malaise for a long time. A research to identify these impacts and propose a way forward was thus a useful endeavour.

The chapter summarises the findings of this research, concludes and make recommendations.

5.2 Summary of Findings

5.2.1 Cost Effects of Delays in Highway Construction

Contractors and Consultant estimate increment in the following components of projects for a 12-month delay as shown in Table 5.1.

Table 5.1 Increment on various components of projects

Component of Project	Estimated Increment due to Delay
Labour cost	11 – 30%
Plant and equipment cost	51 – 70%
Material cost	51 – 70%
Overhead cost	11 – 30%
Cost of Loans and Insurance	11 – 30%

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5.2.2 Causes of Delays in Highway Construction

Consultants and contractors listed the following as the first fourteen significant causes of Highway Construction delay.

- Variations/Changes in scope
- Client's cash flow problems
- Personality clash between contractor agent and resident engineer
- Late preparation of interim valuation
- Commencement of construction in the rain season
- Poor contract management
- Political leanings of the directors of the company
- Test and inspection of Works
- Lack of communication
- Poor information dissemination
- Late valuation of variation
- The number of signatories that must append to the certificate
- Lack of proper feasibility studies into the availability of funds to complete a project for the conditions of contract regarding payment
- Client's slow decision making

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5.2.3 Effects of Delays in Highway Construction

Consultants and contractors listed the following as the major effects of Highway Construction delays.

Table 5.2 Effects of delays in Highway Construction

DIRECT COST EFFECT • Interests on delayed claim fluctuations • Higher labour and material cost • Locked up capital in plant and equipment
INCONVENIENCE CAUSED USERS OF HIGHWAY • Traffic holdup and user delays • Health hazards from dust and carbon monoxide • Tear and wear on vehicles
SOCIO ECONOMICS EFFECTS ON COMMUNITIES • Goods and services locked up in communities
INDIRECT COST EFFECT • Loss of business to locals in work zones • Cost of accidents in work zones
ENVIRONMENTAL IMPACT ON LOCAL COMMUNITIES • Soil erosion prolonged • Degrading landscape and aesthetic of town • Acid rains effect on artefacts • Environmental pollution, dust and chemicals • Disruption of sources of water streams prolonged • Spread of disease from borrow pits contacts

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5.2.4 Correlation between Contractor's and Consultant's Assessment of Effects of Delays in Highway Construction

1. A significant correlation exists between contractors and consultants in ranking the various effects that occur due to delays on highway construction projects.

5.2.4 Systems used in mitigating the Effects of Delay in Highway Construction

The systems most effective in mitigating the effects of delays in Highway Construction are:

- Prompt payment
- Incentives for Completion and
- Calculations for more realistic time duration

5.3 Conclusions

Within the analytical framework put forward in this study in investigating the effects of delays in highways construction in Ghana: A case study of Greater Accra and Eastern Region Highway, the following conclusion can be formulated.

5.3.1 Delays Result in Increment in Cost of Production and Other Associated Ripple Effects

The study has shown that delays on projects, lead to increment in the cost of such factors of production as labour, materials, plant and equipment. This is because of the ever increasing cost of those materials purchased with foreign exchange which keeps appreciating in value against the Ghanaian Cedi. Increasing prices of petrol and cement are not the only sources of high cost of production but also the standard of

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living as well as prices of all other goods and services that keep rising influence the cost of labour especially.

The above may be categorised as the primary effects which lead to secondary repercussions including contractors cutting corners to control costs. This they do to limit the extent to which their profits would depreciate. Upheavals from the labour front due to inability of contractors to meet rising cost of their living also occur. The latter also in turn leads to the use of cheaper, less skilled labour to the disadvantage of the project.

Another secondary effect manifest in the locked up capital in plants and equipment that have to stand idle. Interests accumulate on loans used to purchase them while they lie idle and not complementing the daily cost accumulating on them. the contractors definitely absorbs parts of these cost through loss of profit even if compensation for fluctuation or delayed payments are made.

5.3.2 Higher cost of Overheads Experienced due to Delays

The study acknowledges that contractor's overheads are fixed and that in times of delays when work has even been suspended they are maintained. The higher costs for the same reasons of inflation, higher cost of petrol that fuels the vehicles and general higher standard of living that dictates higher salaries and rent constitute significant impact on the contractor.

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5.3.3 Delays result in higher cost of Loans, Depreciation of Profits and Loss of Credit Worthiness

The survey also found that the cost of loans and insurance increase as the project delay beyond completion dates. The implication of this is that more interests accumulate as the delays prolong. Discussants also acknowledge the fact that interest rates are not stable in a chaotic economic environment of a developing country. Higher interest or costs of capital especially if the investment will not pay back the loan early enough. This robs contractors of profit. The study can also conclude that difficulties in paying back higher costs of capital and loss of profits eventually lead to bankruptcy, loss of credit worthiness and sometimes forfeiture of collateral securities due to defaults in paying back loans on time.

5.3.4 Failure of Existing Compensation Packages to Mitigate Effects of Delays

The study debunks the notion that once interest have been calculated and paid to contractors, depreciation of profits are compensated for. The study has sufficiently proved that very few respondents are confident about interest rate calculations since such calculations do not adequately restore the real value of money lost with time. The conclusion is being drawn that for the few that dare to claim for it, compensation packages in the contract fail to mitigate the cost effects of delays so far listed . Even if the shortfall in contractor's income does not manifest so convincingly somehow along the line that 'foreign trip' to upgrade the skills of staff and the envisaged purchase of new equipment would not materialise due to such intangible shortfalls that cannot be accounted for.

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5.3.5 Advocacy for Prompt Payment rather than Compensations

Given the inability of the system or the contract package in existence to adequately compensate for delays in payment and for fluctuations due to inflation, prompt payment for works are more preferred. No need to hang on till later dates only to resort to compensations for delays in payment where contractors' profits get eroded. The conclusion therefore is that contracts should only be signed when funding has already been sourced and there is no misappropriation or diversion of this funding.

5.3.6 Other General Observations and Conclusions

Judging from the inputs and clauses existing in current contract documents for mitigating the effects of delays, the study concluded that, apart from direct cost effects, the system does not seem concerned about indirect cost effects such as loss of business to those living in the work zones when the project delays.

The authorities tend to pay little attention to such environmental effects such as pollution and degradation of towns and cities landscape. Such socio-economic effects as locking up of goods and services in communities due to delays in completion of roads are not looked at critically for any concerted efforts to be made to mitigate them.

The inconvenience of car users face such as traffic hold ups and health hazards from dusts and carbon monoxide due to delays in completion of roads do not seem to be a crucial concern to the authorities left alone to find antidotes to mitigate such causes of delays.

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5.4 Recommendations

1. Government needs to expand the legal framework within which agencies operate to encourage them to be innovative and creative in finding solutions to problems that have affected the sector for a long time.

Public sector procurement regulations are in place to protect public expenditures and achieve fairness in contractor competition and selection. They apply only to cost and not quality or ability resulting in contract award mechanisms that focus on cost only.

Procurement regulations contain agencies from using innovative contracting approaches such as privatization, and fast-tract design-build.

- Innovative contracting methods such as Cost/Time (A+B) and I/D methods would in the shortest time complete projects and thereby curtail the effects of delays mentioned in this work. The influence of incentives can bring the best managerial techniques and technical innovations out of the contractor to complete on time.

- Design-build as an alternative to traditional design-bid-build approach can substantially shorten project times by overlapping the design and construction phases so that concurrent activity is possible. Overall, project schedule is driven with construction sequencing driving the production of engineering information packages that support construction activities.

- Design-build or turnkey is a single source responsibility for design and construction and can result in fewer change orders. Design-build approach will reduce the project time tremendously when schedule milestone, incentives,

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selective use of both double work shifts and 6-day work weeks as well as the extensive use of the critical path scheduling techniques are being used.

In addition to the fact, turnkey projects are innovative, challenging and aggressively managed; they come with financial packages from the private sector to sustain projects from start to end with very effective cash flow programme.

5.4.2 Further Training and Resources to be provided to agencies to enhance their roles

The Ghana Highway Authority needs to be well resourced to be able to improve upon its role through research work and training of engineers.

- Research is needed on how to estimate user costs associated with construction project delays if innovating contracting methods that depend so much on such calculations to determine incentives or disincentives will become meaningful tools in completing projects on schedule.

- Research is needed on how time is actually spent on highway construction projects, the causes of delays, suggested methods for reducing times of lengthy activities (such as right-of-way acquisition, utility relocation, demolition, drainage construction, and intersection reconstruction) and methods for avoiding delays. Procedures need to be developed for determining when it is beneficial to divide large projects into multiple contracts with higher levels of concurrent work activities; with procedures including guidelines for managing interfaces between contracts.

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- The highway industry needs a project lessons-learned database that would allow quick retrieval of best practices associated with project schedule management. Such a database would include successful practices from a wide variety of projects across African countries boundaries.

- The highway needs to develop duration-estimating system that can provide target durations given key characteristics such as project type, location, length, width, bridges, etc.

- There is the need to establish effective procedures for screening or prequalifying potential bidders based on past schedule performance and other parameters. Training is also required to enable engineers to do systematic and routine investigations into time technologies.

- Training is required to improve upon quality assurance methods whereby contractors depending on the agency's drawings, instructions or specifications would get jobs done right at first.

- The agency also needs training in project monitoring that would predict problems far ahead of schedule and provide solutions ahead of schedule.

5.4.3 Provide training programmes for Contractors to improve their Technical and Managerial Skills

- Based on the observations made, the study is recommending that Ghanaian contractors through seminars, short courses and other forms of education be encouraged to improve upon their contract management techniques as well as

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their technical capacities in terms of equipment they use and technical men they employ.

- Through training, contractors should be able to identify and use innovative, time-reducing construction technologies, sequences, automated systems, modularization and pre-assembly methods.

- By virtue of training, they should be able to develop mechanisms for evaluating project site operations plans, addressing such factors as field organisation structure; optimal work calendar and day; number of concurrent work locations; number, size and made-up of crews; and equipment selection.

- Contractors should learn and use techniques in schedule-compression involving schedule milestone incentives; selective use of both double work shift and 6-day workweek and extensive use of the critical path schedule technique.

- If contractors have improved information technology base so as to enhance estimating, project planning and control, cash flow forecasting, cost control, transportation planning and material scheduling via the computer, they will be getting closer to realities on the ground as regards improved productivity and cost minimisation. It the above mentioned environment is backed by some innovative means of funding, direct or indirect such as applying for some tax exemptions, soft loans and accessing stock exchange, Contractors could work continuously without delays even if their client which is usually government default from time to time.

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5.4.4 Ghana Road Fund to be resourced and given the necessary independence to operate

The Road Fund should be restocked with the needed resources to achieve greater outcome.

The fund should truly be independent of Government influences to curtail diversion of funds to politically motivated projects to the neglect of road works programmed and budgeted for. When the Fund hold on to its programme, the vicious cycle of stoppage of works or delays due to default of client in honouring certificates and subsequent effects mentioned earlier in the study would be broken.

5.4.5 Local Pressure Groups to be given the opportunity to act as catalyst for early completion of projects and observance of environmental obligations

The Highway Agency and contractors should not pay lip service to Environmental Impact Assessment. Normally the exercise is merely an academic exercise to fulfil a requirement prior to the start of work.

The people in the work zones have to be consulted and informed about the details of the project and how they will be affected. By consulting the target groups, more realistic inputs could be made as to the measures to be adopted to mitigate the effects. Conscious efforts will have to be made by contractors as the project progresses to mitigate the effects of constructional activities mentioned in this study. The target groups should be given official representations at site meetings to ensure that their interests are protected.

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Such repair works or remedial works to correct environmental disruption shall not be scheduled for the tail end of the projects when damage is beyond repairs which would have occurred most especially when the project has to go through stoppages or delays.

5.5 Recommendation for Further Study

Further study can be done on this same area but with a larger sample size to reflect this finding and many more that have not been captured.

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APPENDICES

Appendix I

UNIVERSITY OF EDUCATION, WINNEBA

COLLEGE OF TECHNOLOGY EDUCATION, KUMASI

SCHOOL OF RESEARCH AND GRADUATE STUDIES

FACULTY OF TECHNICAL EDUCATION

DEPARTMENT OF CONSTRUCTION TECHNOLOGY EDUCATION

QUESTIONNAIRE FOR CONSULTANTS/CONTRACTORS

A. Background of Respondents

1. How do you classify yourself in Road construction Industry?
   Consultant ☐ Contractor ☐

2. If you are a contractor, which class of contractors do you belong?
   A1 ☐ A2 ☐ A3 ☐ A4 ☐
   K1 ☐ K2 ☐ K3 ☐ K4 ☐

3. How many years have you been working as a Contractor/Consultant for Highway Projects?
   0-5 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐ above 20 ☐

4. Are you paid compensation due you when either contractor or consultant delays project? ☐ Yes ☐ No

5. By what percentage would you agree that the cost of labour would have increases over the initial rate if you should experience 12 months delay under the current financial environment?
   0-10 ☐ 11-20 ☐ 21-30 ☐
   31-40 ☐ 41-50 ☐ 5-60 ☐
   61-70 ☐ 71-80 ☐ 81-90 ☐
   91-100 ☐

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6. Given a delay of 12 months on a typical Road Construction project, what are your anticipations on the percentage rise in the cost of plant and equipment usage?

0-10 ☐	11-20 ☐	21-30 ☐
31-40 ☐	41-50 ☐	51-60 ☐
61-70 ☐	71-80 ☐	81-90 ☐
91-100 ☐		

7. By what percentage would you admit the cost of materials would have over a period of twelve months that the project would have suffered delays?

0-10 ☐	11-20 ☐	21-30 ☐
31-40 ☐	41-50 ☐	51-60 ☐
61-70 ☐	71-80 ☐	81-90 ☐
91-100 ☐		

8. By what percentage would you admit the cost of materials would have arisen over a period of twelve months that the project would have suffered delays?

0-10 ☐	11-20 ☐	21-30 ☐
31-40 ☐	41-50 ☐	51-60 ☐
61-70 ☐	71-80 ☐	81-90 ☐
91-100 ☐		

9. When there is a delay of 12 months, what percentage rise do you anticipate in the cost of loans (interest rates) and insurance?

0-10 ☐	11-20 ☐	21-30 ☐
31-40 ☐	41-50 ☐	51-60 ☐
61-70 ☐	71-80 ☐	81-90 ☐
91-100 ☐		

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B. CAUSES OF DELAY IN HIGHWAY CONSTRUCTION

10. The following are factors which causes delay in Highway Construction. Rank them using a scale of 1 to 5; 1=not significant at all, 2=not significant, 3=significant, 4=very significant and 5=most significant

Code	Causes of Delays	Ranking						
		1	2	3	4	5	6	7
A	Variations/Changes in scope							
B	Client's slow decision making							
C	Client's cash flow problems (Counterpart Funds							
D	Lack of proper feasibility studies into the availability of funds to complete a project for the conditions of contract regarding payment							
E	The number of signatories that must be appended to the certificate							
F	Delay in work approval							
G	Slow coordination and seeking of approval from concerned authorities							
H	Inaccurate bills of quantities							
I	Late valuation of variation							
J	Sheer disregard							
K	Late preparation of interim valuation							
L	Poor information dissemination							
M	Lack of communication							
N	Personality clash between contractor agent and Resident Engineer							
O	Test and inspection of works							
P	Poor contract management							
Q	Lack of skilled technical personnel							
R	Liaison problems among the contracting parties							
S	Lack of programming for the projects especially using cost-time graph for the client to know his financial commitment							
T	Political leanings of the directors of the company							
U	Commencement of construction in the rainy season							
Others								

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C. EFFECTS OF DELAYS IN HIGHWAY CONSTRUCTION

11. The following is a list of various effects of delays in Highway Construction. Rank using a scale of 1 to 5; 1=not significant at all, 2=not significant, 3=significant, 4=very significant and 5=most significant

Code	Factors	Ranking				
		1	2	3	4	5
1.0	**DIRECT COST EFFECT**					
1.1	Higher Labour and Material cost					
1.2	Higher cost of overheads					
1.3	Interests on delayed claim fluctuations					
1.4	Inflation and loss of profit					
1.5	Insurance and interest on loans					
1.6	Locked up capital in plant and equipment					
1.7	Cost of litigation					
2.0	**INDIRECT COST EFFECT**					
2.1	Loss of business to locals in work zones					
2.2	Cost of disruption of utilities and fuel usage					
2.3	Cost of accidents in work zones					
2.4	Cost of managing traffic in work zones					
3.0	**ENVIRONMENTAL IMPACT ON LOCAL COMMUNITIES**					
3.1	Degrading landscape and aesthetic of town					
3.2	Spread of disease from borrow pits contacts					
3.3	Disruption of drainage in local communities					
3.4	Contamination of soil (bitumen)					
3.5	Environmental pollution, dust and chemicals					
3.6	Soil erosion prolonged					
3.7	Acid rains effect on artefacts					
3.8	Disruption of sources of water streams prolonged					
3.9	Impact on flora and fauna prolonged					
3.10	Disruption of aqua culture (Extinction)					
3.11	Prolonged noise pollution in work zones					

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3.12	Loss of residence and habitats in settlements					
3.13	Land slides					
4.0	**SOCIO ECONOMICS EFFECTS ON COMMUNITIES**					
4.1	Overall delays in utility services to communities					
4.2	Goods and services locked up in communities					
4.3	Disruption of tourism					
4.4	Split and loss of community cohesion					
4.5	Invasion of community, promiscuity adulteration					
4.6	Upheavals, revolts by socio-political pressure groups					
5.0	**INCONVENIENCE CAUSED USERS OF HIGHWAY**					
5.1	Traffic holdup and user delays					
5.2	Tear and wear on vehicles					
5.3	Health hazards from dust and carbon monoxide					
5.4	Incompletion of highway facilities; deprivation of use					
5.5	High fee consumption due to detours and hold ups					

12. In your opinion, which of the following suggestions mitigate the effects of delays in highway construction project? (*Tick where appropriate*)

☐ Prompt payment

☐ Improving upon technical inputs by Agencies

☐ Incentives for early completion

☐ Calculations for more realistic contract durations

☐ Adhering to punitive clauses in contracts

Thank you for your cooperation.