ASSESSMENT OF COST AND TIME IMPACTS OF PUBLIC SECTOR CONSTRUCTION PROJECTS IN GHANA

by

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DECLARATION

CANDIDATE'S DECLARATION

I hereby declare that this submission is my own work towards the Executive Masters of Business Administration and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where the acknowledgement has been made in the text.

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DEDICATION

This work is dedicated to:

Delali my precious wife and life partner, for her understanding and continual support,

My children, Kofi Eli, Korku Sefa and Keziah Akosua Fafa TAMAKLOE, for their patience and support,

The indigenous Ghanaian Contractors who continue to suffer for the inadequacies of their employers.

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ABSTRACT

This thesis assesses cost and time impacts of construction projects in Ghana. It is a key issue, because many project managers of construction industries have recently started to utilize innovative cost and time impact assessment methods that provide new incentives for improving construction quality. These emerging strategies place an increasing pressure on decision makers in the construction industry to search for an optimal resource utilization plan that minimizes construction cost and time while maximizing its quality. Thirty (30) selected project supervisors of LESTAKO Company Limited and BEROCK VENTURES in the Greater Accra Region were interviewed with a well detailed questionnaire to elicit responses on the cost and time impacts on construction of projects. The research study revealed that cost and time impacts are inevitable on construction projects such that they are inherent in all of project construction’s undertakings. Additionally, the paper revealed that the issue of cost and time impacts on project construction could be managed by using construction recognized and accepted methodologies which identifies and quantifies the overall impact to the project. The research concludes that, on accounting for each of the strategies explained in the survey, it is clear that there is still a need for innovative research in the area of forecasting systems in project construction with regards to cost and time. Again, there is the lacking of many aspects in forecasting methods implemented by today’s Project Managers in Ghana. In a challenging construction industry nowadays, to have accurate forecasting methods require an approach that would gather subjective data and consider experts’ experience and knowledge. In this regard the paper recommends that an effective and efficient procurement system should be established within projects. Procurement has the potential to cause major delays to construction projects. Therefore, procurement process should be improved in order to avoid supply delays and chaos in the construction delivery process in Ghana.

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CHAPTER ONE

INTRODUCTION

1.1.1 BACKGROUND TO THE STUDY

Cost and time impacts are inevitable on construction projects, primarily because of the uniqueness of each project and the limited resources of time and money that can be spent on planning, executing and delivering the project.

Cost and time factors are inherent in all of project construction's undertakings. Construction projects have long been recognized as particularly cost, time and risk-laden. Some of the time and cost factors associated with the construction process are fairly predictable or identifiable; others may be totally unforeseen. The constructed project may not perform as anticipated because the owner may have unrealistic expectations regarding the time and cost of construction forcing contractors into unrealistic gambles, corner-cutting or commitments that may not be realistic (Frimpong 2003).

Project success can be defined as meeting goals and objectives as prescribed in the project plan. A successful project means that the project has accomplished its technical performance, maintained its schedule, and remained within budgetary costs. Project management tools and techniques play an important role in the effective management of a project. Therefore, a good project management lies in the management tools and techniques used to manage the project. Project management involves managing the resources—workers, machines, money, materials and methods used. Some projects are effectively and efficiently managed while others are mismanaged, incurring much delay and cost overruns (Frimpong 2003).

Assessing both construction projects' cost and time is critical in today's market-driven economy.

This relationship between construction projects' time and cost is called time-cost trade-off decisions, which has been investigated extensively in the construction management literature. Time-cost trade-off decisions are complex and require selection of appropriate construction method for each project task. Time-cost trade-off, in fact, is an important management tool for overcoming one of the critical path method limitations of being unable to bring the project schedule to a specified duration.

To maximize long-term return on this public investment, government agencies have recently started utilizing new types of contracting methods that are designed to achieve multiple project objectives, including minimizing construction cost and duration, while maximizing its quality.

In recent years, many departments of transportation, in various states have started to apply new highway contracting methods, including: Bidding on cost/time i.e., to encourage competition among contractors to minimize project duration (Herbsman 1995), Incentive/ disincentive contract clauses that provide financial incentives to reduce construction duration, Nighttime construction that seeks to cut service disruption and project time by requiring contractors to work during off-peak nighttime hours, Warranty contracting that attempts to improve construction quality by making contractors liable for the performance of the facility after project completion.

These new and emerging contracts place an increasing pressure on decision makers in the construction industry to search for an optimal/near-optimal resource utilization plan that minimizes construction cost and time while maximizing its quality. This creates new and pressing needs for advanced resource utilization models that are capable of optimizing the multiple and conflicting objectives of construction time, cost, and quality.

Significant research advancements have been made in the area of optimizing construction resource utilization. This led to a number of optimization models. These models can be classified according to their optimization objectives into models that attempted to:

- *Minimize project time and/or improve resource utilization*;
- *minimize time and cost for nonrepetitive construction using time-cost trade-off analysis*
- *minimize time and/or cost for repetitive construction*

While the above research study seeks to provide significant contributions to the area of optimizing construction resource utilization, there has been little or no reported research focusing on multi objective models for optimizing construction time, cost, and quality.

1.1.2 COST AND TIME IMPACT

The objective of the cost and time analysis in any construction project is to reduce the original project duration, determined form the critical path analysis, to meet a specific deadline, with the least cost. In addition to that it might be necessary to finish the project in a specific time to:

- Finish the project in a predefined deadline date.

- Recover early delays.

- Avoid liquidated damages.
- Free key resources early for other projects.
- Avoid adverse weather conditions that might affect productivity.
- Receive an early completion-bonus.
- Improve project cash flow

Reducing project duration can be done by adjusting overlaps between activities or by reducing activities' duration. What is the reason for an increase in direct cost as the activity duration is reduced? A simple case arises in the use of overtime work. By scheduling weekend or evening work, the completion time for an activity as measured in calendar days will be reduced. However, extra wages must be paid for such overtime work, so the cost will increase. Also, overtime work is more prone to accidents and quality problems that must be corrected, so costs may increase. The activity duration can be reduced by one of the following actions:

- Applying multiple-shifts work.
- Working extended hours (over time).
- Offering incentive payments to increase the productivity.
- Working on weekends and holidays.
- Using additional resources.
- Using materials with faster installation methods.
- Using alternate construction methods or sequence.

1.2 STATEMENT OF THE PROBLEM

Misallocation and misperception of time factor in construction projects have resulted in the Public Sector paying more than necessary for many projects. Improper time assessment can also cause additional costs in the form of delays which result in poor utilization, increasing social and economic costs.

Are contractors using the most appropriate resources to execute projects in Ghana? Do they mobilize the needed resources within the approved time frame allotted to their contracts? What effects do short time periods and/ or extended time periods have on their project costs? Are there remedies to these situations?

These are some of the situations that have prompted the researcher to go deep into the assessment of the cost and time impacts of public sector construction projects in Ghana.

1.3 OBJECTIVES OF THE STUDY

The study had the main objective of assessing the cost and time impacts of public sector construction in Ghana but specifically it had the following objectives.

1. To establish the extent to which cost and time factors have impacted on construction of projects in the public sector in Ghana.
2. To find out the change in the perception of contractors on cost and time effects public sector construction in Ghana.
3. To find out the relationship between construction projects cost and time in Ghana.

1.4 RESEARCH QUESTIONS

In order to achieve a practical and credible conclusion, the research study was guided by the following questions:

i. What effect does cost and time factors have on construction of projects in Ghana?
ii. Has the perception of contractors on cost and time factors in projects construction changed in recent years?
iii. What relationship exists between cost and time in construction of projects in Ghana?

1.5 SIGNIFICANCE OF THE STUDY

All construction contracts allocate time and cost between owners and contractors. Hence the significance of this study would better inform improved project relationships and communications and enhance construction administration practices between owners and contractors.

The findings would also enhance and broaden cost and time of wide range of risks that could materialize during the design, and construction phases of a project which would subsequently result in better and more prudent designs specifications.

1.7 SCOPE AND LIMITATIONS OF THE STUDY

Construction of projects in the public sector has assumed significant functions, hence the need for assessment on the cost and time impacts of construction of projects in order to achieve overall project objectives. Historical cost data is almost non existent hence getting data for this study was very difficult. Data collection and analysis was therefore limited to the data received from project supervisors in the field of project construction.

1.7 BRIEF METHODOLOGY

Both primary and secondary data was used. The primary data for the study was obtained through distribution of questionnaires as well as direct personal interviews with people involved in project construction. In order to enrich the questionnaire for the research, a review of text books and journals were used to identify the various efforts that have been made in the past to evaluate and examine the effects of cost and time schedules on project construction. Simple statistical analysis involving tables graphs and percentages were used in analyzing the results from the questionnaire. Descriptive explanations were also employed in making the analysis more meaningful. Secondary sources of data were obtained from relevant literature that covered research and publication on the subject matter.

1.8 ORGANIZATION OF THE STUDY

The study comprises five chapters of which the current chapter is one which involves, background, cost and time impact, statement of the problem, objectives of the study, research questions, significance of the study, methodology, limitations of the study and organization of the study; chapter two is the literature review, chapter three is methodology, chapter four presents' results and analysis and the final chapter is the summary, conclusions and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Continual advances in construction of projects provide contractors and owners the opportunity to manage the impact of cost and time of all projects. Insurance provides financial protection against a loss arising out of happening of an uncertain event. The construction time, in particular the critical path method (CPM) schedule has become the most significant tool available for projects stakeholders to understand the status of a project – whether a project is on, ahead, or behind the agreed upon completion date. In situations where a project falls behind schedule or time and the completion date becomes less achievable, typically a time impact claim is prepared to prove how and why an impact event(s) delayed the project.

2.2 Cost and Time Growth of Project Construction

Construction projects are notorious for running over budget and time Hester et al. 1991; Zeitoun and Oberlander 1993; Ibbs and Allen 1995. Change orders have been found to be a major contributor to time and cost overruns Jahren and Ashe 1990, yet the impact that rework has on the cost and time performance of projects remains unexplored in the construction management literature. Hence, supervisors always learn details of projects so that cost and schedule growth could be calculated for each project.

2.3 Forecasting Cost and Time in Construction Industry

The nature of construction industry is to be profitable in extremely competitive environment.

More specifically, the construction environment is continuously changing and resulted to uncertain variable in project data. As a consequence, Project Manager faced with performance problem in determining the accurate project performance. In attempting to gain better profits, Project Manager needs to make timely and informed decision. However, today's deficiencies in monitoring and control of project operation unable Project Manager to manage project effectively and resulted to major cause of project failure (Al-Tabtabai 1996).

When controlling project performance, Project Manager should not only monitor cost and time variances for actual project progress, but also to properly establish the actual project status based on objective predictions of final project performance. At completion project performance can be predicted by comparing estimates of planned total budget and final duration with their respective most likely forecasted values (Ahuja et al. 1994). This, however, are necessary for Project Manager to determine if corrective actions are required to minimize the expected variances from planned performance Thus, forecasting is needed to predict the project performance at completion based on current performance.

2.4 Significance of Cost and Time Forecasting in the Construction Industry

In reality, the original estimates may be considered the first project forecast and, at the point of project completion, the latest updated estimate (last forecast) and the actual amount of what is being expended should be the same (Barazza et al 2004). In controlling a construction project, Project Manager should understand the importance of using project baselines which serves as a benchmark. This is to ensure the project is running smoothly and early indication on deficiencies of project can be identified. Thus, necessary corrective action can be made in due time.

In current practice, project baselines or planned S-Curves is used to determine variances in cost or schedule and to measure the earned value. In this context, it explains why this method is widely used in construction industry to measure the performance of projects. One of the advantages of this method is that it can identify any cost and schedule variances at the end of the project. However, there is still lacked within this method of providing corrective action plans if negative variances is identified. Therefore, the needs of forecasting performance variances at completion is necessary to Project Manager in order to decide the suitable corrective action plans and the effect on final project performance (Crandall et al 1982).

2.5 Activity Time-Cost Relationship

In general, there is a trade-off between the time and the direct cost to complete an activity; the less expensive the resources, the larger duration they take to complete an activity. Shortening the duration on an activity will normally increase its direct cost which comprises: the cost of labor, equipment, and material. It should never be assumed that the quantity of resources deployed and the task duration are inversely related. Thus one should never automatically assume that the work that can be done by one man in 16 weeks can actually be done by 16 men in one week. A simple representation of the possible relationship between the duration of an activity and its direct costs appears in. Considering only this activity in isolation and without reference to the project completion deadline, a manager would choose a duration which implies minimum direct cost, called the normal duration. At the other extreme, a manager might choose to complete the activity in the minimum possible time, called crashed duration, but at a maximum cost (Christensen, David 1992).

2.6 Project Time-Cost Relationship

Total project costs include both direct costs and indirect costs of performing the activities of the project. Direct costs for the project include the costs of materials, labor, equipment, and subcontractors. Indirect costs, on the other hand, are the necessary costs of doing work which cannot be related to a particular activity, and in some cases cannot be related to a specific project (Davison 2003).

If each activity was scheduled for the duration that resulted in the minimum direct cost in this way, the time to complete the entire project might be too long and substantial penalties associated with the late project completion might be incurred (Dlakwa 1990). Thus, planners perform what is called time-cost trade-off analysis to shorten the project duration. This can be done by selecting some activities on the critical path to shorten their duration.

As the direct cost for the project equals the sum of the direct costs of its activities, then the project direct cost will increase by decreasing its duration. On the other hand, the indirect cost will decrease by decreasing the project duration, as the indirect cost are almost a linear function with the project duration (Khalil et al 1999).

2.7 Shortening Project Duration

The minimum time to complete a project is called the project-crash time. This minimum completion time can be found by applying critical path scheduling with all activity durations set to their minimum values. This minimum completion time for the project can then be used to determine the project-crash cost. Since there are some activities not on the critical path that can be assigned longer duration without delaying the project, it is advantageous to change the all crash schedule and thereby reduce costs (Diekmann et al 1992).

Heuristic approaches are used to solve the time/cost tradeoff problem such as the cost-lope method used in this chapter. In particular, a simple approach is to first apply critical path scheduling with all activity durations assumed to be at minimum cost. Next, the planner can examine activities on the critical path and reduce the scheduled duration of activities which have the lowest resulting increase in costs. In essence, the planner develops a list of activities on the critical path ranked with their cost slopes. The heuristic solution proceeds by shortening activities in the order of their lowest cost slopes (Dawood et al 1997).

According to Frimpong, (2000) as the duration of activities on the shortest path are shortened, the project duration is also reduced. Eventually, another path becomes critical, and a new list of activities on the critical path must be prepared. Using this way, good but not necessarily optimal schedules can be identified.

The procedure for shortening project duration can be summarized in the following steps:

1. Draw the project network.

2. Perform CPM calculations and identify the critical path, use normal durations and costs for all activities.

3. Compute the cost slope for each activity from the following equation: cost slope = crash cost – normal cost / normal duration – crash duration

4. Start by shortening the activity duration on the critical path which has the least cost slope and not been shortened to its crash duration.

5. Reduce the duration of the critical activities with least cost slope until its crash duration is reached or until the critical path changes.

6. When multiple critical paths are involved, the activity(ies) to shorten is determined by comparing the cost slope of the activity which lies on all critical paths (if any), with the sum of cost slope for a group of activities, each one of them lies on one of the critical paths.

7. Having shortened a critical path, you should adjust activities timings, and floats.

8. The cost increase due to activity shortening is calculated as the cost slope multiplied by the time of time units shortened.

9. Continue until no further shortening is possible, and then the crash point is reached.

10. The results may be represented graphically by plotting project completion time against cumulative cost increase. This is the project direct-cost / time relationship. By adding the project indirect cost to this curve to obtain the project time / cost curve. This curve gives the optimum duration and the corresponding minimum cost (Frimpong 2000).

2.8 CPM Cost Loading

Cost-loading a schedule requires each of the construction activities to contain a cost or budget amount to reflect the cost of the activity's scope of work. The cost of each construction activity should "roll up" to the contract's total schedule of values by the use of a work breakdown structure. This feature is usually found in government or public sector contracts, requires additional maintenance and allows an owner to make payments to a contractor based on the amount of progress earned for each activity. It should be noted that using the CPM schedule as a payment tool as opposed to solely a construction-activity forecasting tool, may skew forecasts of the project's completion date if the activity's percent complete is tied to both the cost amount and remaining duration. Inaccurate forecasts occur when the remaining duration of an activity is not adjusted to reflect actual conditions (Fleming 1999).

2.9 Proof of Delay Methodology

Many construction contracts, especially government contracts, for large construction projects now contain schedule specification sections which set forth a specific methodology the contractor must follow to prove its request for a schedule time extension and related monetary damages. The analysis implementing this contractual methodology is usually called a time impact analysis of time impact evaluation. The basic concept in the time impact analysis is to evaluate delays on a chronological and cumulative basis (Okpala 1986).

The chronological and cumulative approach allows the executor of the schedule as well as any finders of fact to take into account a number of key concepts:

- The schedule is dynamic and the critical path can change from month to month
- Time is a resource to the executor of the schedule as well as to the schedule stakeholders.
- One corollary of this concept is delay to a time extension request effectively acts as a denial

The significant advantage of the chronological and cumulative approach is that it looks at the status of the project at the time of the delay. In this manner all the parties to the project live with the events of the delay. Thus the parties take the "victim" or "project" as they find it at the time of any delay (Okpala et al 1988).

2.10 Causes of Delay and Cost Overruns in Construction of Projects in Ghana

Project success can be defined as meeting goals and objectives as prescribed in the project plan. A successful project means that the project has accomplished its technical performance, maintained its schedule, and remained within budgetary costs (Frimpong et al 2003). Project management tools and techniques play an important role in the effective management of a project.

Therefore, a good project management lies in the management tools and techniques used to manage the project. Project management involves managing the resources—workers, machines, money, materials and methods used. Some projects are effectively and efficiently managed while others are mismanaged, incurring much delay and cost overruns (Ministry of Finance Government Budget Statement 1999 Ghana: Accra).

A construction project such as groundwater comprises two distinct phases: the preconstruction phase, (the period between the initial conception of the project and signing of the contract; and the construction phase which is the period after award of the contract when the actual construction is going on). Delay and cost overruns occur in both phases however, major causes of project overruns usually take place in the construction phase. Previous studies show extensive information on project schedule delays and cost overruns (Frimpong et al 2003). According to his paper, he identifies and examines the causes of delay and cost overruns in the construction of groundwater projects. The study is based on data relating to groundwater construction projects in Ghana. There are many factors that can cause delay and cost overruns in groundwater drilling projects. These range from factors inherent in the technology and its management, to those resulting from the physical, social and financial environment.

In a preliminary survey conducted in water drilling projects in Ghana, for the purpose of this research, it was found that 33 out of a total of 47 projects completed between 1970 and 1999 were delayed while 38 projects were overruns. The data indicated that 75% of the projects exceeded the original project schedule and cost whereas only 25% were completed within the budget and on time. The survey revealed that delay and cost overruns occur frequently in construction of groundwater projects in Ghana and developing countries in general, especially in long-duration projects. It is therefore important that thorough analysis be carried out to help in efficient project management, to reduce delay, and cost overruns (Frimpong 2000).

2.11 Time Impact Analysis

According to Anbari 2003, Time Impact Analysis (TIA) is a simplified analysis procedure typically specified on construction projects to facilitate the award of excusable days to project completion due to delays that were not the responsibility of the General Contractor (contractor.)

Time Impact Analysis is typically associated with the modeling of the effects of a single delay. It requires a CPM schedule that is able to show the pure CPM calculation differences between a schedule that does not include a delay and one that does include an activity modeling a delay. The difference for project completion between the non-impacted schedule and that of the schedule with the impact is considered to be the impact of the delay for time duration considerations.

TIA is more useable as a forward-looking took than as a backward-looking tool. This is partially due to the ability of the Owner to respond to the results of the analysis and optimize the cost of a delay. Never the less, TIA is an acceptable and useable tool for the determination of the effects of a past delay. Other analysis techniques such as Windows Analysis and As-Built Analysis are generally more accurate and reliable, but at the expense of more research and time required to complete (Winter 2004).

As a general guideline, TIA is more or less acceptable and useable for the

More Useable:

- Frozen work plan. If the Contractor has not been given remediation direction and is not able to redeploy his work force in order to keep it in readiness for resumption of work, then the work plan is said to be ‘frozen’ and the assumptions inherent in a TIA remain valid.
- Forward looking. Delays planned to occur or occurring at the present time are better subjects for a TIA then those that have already finished.
- Short duration of delay. In general, TIAs are intended to model delays of less than one month. If longer periods are considered, then Optional Step 3b must be considered.

Less Useable:

- The less linear (or serial in nature) the work plan. Work plans based upon resource considerations are more easily adjusted without detriment to the project completion or planned expenses than those based upon physical constraints.
- The more mitigation was accomplished during the delay. This can be the opposite of a ‘frozen’ work plan. The more work that was performed ‘outof- sequence’, the more construction restrictions waved, the more effort that is performed by either the Owner or contractor on behalf of reducing the effects of a delay upon project completion, the less effective a TIA is in modeling the effects of a delay.
- The longer the time period between the schedule update and the start of the delay, the more conditions will have changed between the planned work schedule and the actual work schedule before the time of the delay.

2.12 Earned-Value Based Methods in Project Construction

Earned value is a method for managing projects based on the regular comparison of actual project costs to planned cost and to completed work. This method analyse completed works to determine the cost to date and compare with the revenue to date (Fleming et al 1994). The advantage of this method is where corrective action can be implemented at early stage if the figures are found not promising to deliver successful project. These forecasting techniques, based on linear trend analysis, are very popular in the industry and are being used by many construction organizations. Indeed, the forecasting techniques employed in current project management systems, such as Primavera and Artemis applying simple regression analysis to forecast cost and schedule performance. Previous study on earned value based method is briefly discussed as follows:

Seiler (1983) recommended forecast techniques for predicting cost and schedule performance. The estimate at completion is assumed to be the same level of cost efficiency experienced to-date continues in the future. The study argues that at later stages of progress the future cost and schedule performance efficiency need to be modified based upon known conditions being experimented by the project. He suggested modifying the CPI and/or the SPI by estimating a line of "best fit" through the monthly data points on the trend line.;

Eldin and Hughes (1992) presented a detailed discussion of the use of unit costs to forecast the final cost. The study stated that an accurate forecast of final cost is based on applying unit costs to quantities using two approaches. The first approach is using the cumulative to-date unit cost to estimate future unit costs. The second approach is assuming that the current-period unit cost is the best available estimate for future unit costs;

Christensen et al (1992) and Christensen et al. (1995) provided a comprehensive review of 25 studies that dealt with estimate at completion (EAC) formulas and models. The EAC formulas were classified into three categories: index, regression, and other (e.g. formulas based on heuristics). The study briefly reviewed comparative and non-comparative EAC research conducted over a period of sixteen years and made the following conclusions: (1) the study showed that no one formula or model is always best. Attempting to generalize from a large and diverse set of EAC formulas is dangerous, (2) the study did not establish the accuracy of regression-based models over index-based formulas. Additional research with regression models is needed, (3) the study concluded that the accuracy of index-based formulas is a function of the system, and the stage and phase of the project. In addition, averaging over short periods (e.g., 3 months) is more accurate than averaging over longer periods (e.g., 6-12 months), especially during the mid stage of the project when costs are often accelerating;

Brown (1996) slightly modified the EAC proposed in Christensen et. al. (1992) to correct for variance in future cost performance rates by introducing Forecasted Cost Performance Index for the remainder of the budgeted work to be performed; Fleming and Koppelman (1994) proposed a constant budget model. The model assumes that all cost overruns can be absorbed through corrective action by the project end date and that the final cost will be equal to the original budget. The major drawback is that the assumption implied by the model could apply to a very small number of projects and in most cases the actual cost at completion will differ from the budgeted cost; Shtub et al. (1994) developed the constant performance efficiency model, which assumed that the cumulative cost and schedule performance indices (CPI and SPI) remain unchanged or constant throughout the remaining project duration. Fleming and Koppelman (1999) and Zwikael et al. (2000) suggested that this model is better that the other earned-value based models;

Al-Tabtabai (1996) forecasted the performance at completion by considering eight influencing factors to impact the project performance index. The factors are performance of productivity, weather and other environment influences, amount of rework, extra-work, and work difficulty, percentage of work completed, past project's performance trend. Since the index contains many subjective factors, its accuracy is highly dependent the quality of judgments and the ability to capture project specific data. This limitation can be overcome to a certain extent by selecting well-experienced professionals in the construction industry as domain experts for knowledge representation;

Fleming and Koppelman (1999) proposed the schedule performance efficiency model that assumed that the forecasted final cost (EAC) is a function of both the Cost Performance Index (CPI), and the Schedule Performance Index (SPI). However, research carried out by Zwikael et al. (2000) showed that this model is inferior to the model where EAC is function of the CPI only.

Anbari (2003) proposed three (3) different scenarios in developing EAC as follows:

• when current analysis shows that the assumption underlying the original estimate are flawed, or no longer applicable due to changed conditions affecting the activity, work package, or project;

• when current analysis shows that past performance is not a good prediction of future performance; and

• when current analysis shows that past performance is a good predictor of future performance.

2.13 Project Risk Identification

Davison (2003) points out that the cause of many claims and disputes over additional payments under construction contracts is the failure to place risk plainly on one party or the other and the failure to record and detail the consequences of risks when they do arise. The employer or project sponsor is the best equipped to undertake a comprehensive risk analysis as the contractors risk assessment will be limited to consideration of the risks within their own scope of work and contractual arrangements.

Bad planning where limited attention is given to the project scope management processes and unseemingly haste in starting work which has not been properly planned can cause variations, cost overruns, delay and disputes. A poorly defined scope of work must therefore be identified as a project risk in the very early stages of the project lifecycle (Oglesby 1986).

2.14 Delay Classification

Sanders and Eagles (2001) define a delay as an event that causes extended time to complete all or part of a project. Halvorson (1995) points out that the contractor's right to recover increased performance costs, as a result of acceleration, depends on the type of delay that reduces the performance period.

He classifies delays as follows:

• Nonexcusable delay,

• Excusable delay,

• Compensable delay, suspension and disruption,

• Imposed milestone, and

• Concurrent delay.

2.15 Rework Costs

Various interpretations of rework can be found in the construction management literature. For example, terms such as quality deviations Burati et al. 1992, nonconformances Abdul-Rahman 1995, defects Josephson and Hammarlund 1999!, and quality failures Barber et al. 2000 are often used, though these definitions vary. Ashford 1992 defines rework as ‘‘the process by which an item is made to conform to the original requirement by completion or correction.’’ The Construction Industry Development Agency 1995, however, defined rework as ‘‘doing something at least one extra time due to nonconformance to requirements.’’ Essentially, rework can result from errors, omissions, failures, damage, and change orders throughout the procurement process Love et al. 1999; Love and Li 2000.

Josephson and Hammarlund 1999 reported that the costs of residential, industrial, and commercial building projects range from 2 to 6% of their contract values. Similarly, Love and Li 2000 in their study of rework costs for a residential and industrial building found the costs of rework to be 3.15 and 2.40% of contract value, respectively. In addition, Love and Li 2000 found that when a contractor implemented a quality assurance system in conjunction with an effective continuous improvement strategy, rework costs were found to be less than 1% of the contract value.

The costs of quality deviations in civil and heavy industrial engineering projects, however, have been found to be significantly higher. Burati et al. 1992 studied nine major engineering projects to determine the cost associated with correcting deviations to meet specified requirements. The results of their study indicated that, for all nine projects, quality deviations accounted for an average of 12.4% of the contract value. A significantly lower figure was reported by Abdul-Rahman 1995, who found nonconformance costs excluding material wastage and head office overheads! in a highway project to be 5% of the contract value. Abdul-Rahman 1995 specifically makes the point that the nonconformance costs may be significantly higher in projects where poor quality management is implemented.

Notably, Nyle´n 1996 found that when poor quality management practices were implemented in a railway project, quality failures were found to be 10% of the contract value. Nyle´n 1996 further found that 10% of the quality failures experienced accounted for 90% of their total cost. Here, significant proportions 76% of the quality failures were attributable to design-related issues, such as erroneous documentation and poor communication between project team members.

As mentioned above, rework can also originate from change orders Knocke 1993; Love and Li 2000. However, the extent to which change orders contribute to rework costs remains relatively unexplored. Research undertaken by Zeitoun and Oberlander 1993 found that the median costs of change orders for 71 fixed price projects were 5.3% of the contract value and 6.8% for 35 cost reimbursable projects. Similarly, research undertaken by Cox et al.1999 in the U.K. revealed that the costs of design-related change orders could range from 5 to 8% of the contract value, even when projects are managed effectively, as most of the changes are initiated by clients. The costs of change orders in the research reported by Zeitoun and Oberlander 1993 and Cox et al. 1999 are similar to the rework costs previously reported. A degree of change can be, and to a certain extent, should be expected in construction, as it is difficult for clients to visualize the end product that they procure. However, almost all forms of rework with the exception of that caused by weather are preventable, since poor management of the design and construction process typically causes such costs to occur.

2.16 Time Impact Analysis Specification

According to FIDIC 1999 Conditions of Contract for Construction for Building and Engineering Time Impact Analysis is performed by following the following steps,

STEP 1: Model the Impact with a Fragnet. The fragnet should consist of a subset of the activities in the project schedules that were involved directly with the delay. The delay should be described as simply as possible with the fewest number of activities and relationships added in order to substantially reflect the impact of the delay to the schedule.

Existing relationships and activities should be left intact wherever passable. It is expected that the added relationships will cause some of the existing relationships to become redundant to the CPM calculation but relationships should only be deleted where the retention of that relationship would negate the actual work restraints on the project (Wahab 1997).

It is acceptable to add a delay as a successor to an activity when in fact, that delay occurred during the activity and delayed its completion. It is also acceptable to break the existing delayed activity into two activities, with one representing the planned work before the delay and the other the planned work after the delay as long as the combined durations of the split activities equals the original duration of that activity. The Owner should review, negotiate (if necessary,) and approve the fragnet before proceeding with the further steps. It is acceptable to combine all of the following steps into one, buy the Owner still needs to approve the step considerations in order in order to approve the TIA (Farghal et al 1997).

STEP 2: Select the appropriate accepted schedule to impact. The appropriate schedule should be the last accepted schedule update prior to the date of the delay. The baseline schedule should be used if the delay began prior to the first schedule update.

If the date between the start of the delay and the last accepted schedule update is too large (or if significant deviation to the schedule were experienced between the last data date and the start of the delay,) the contractor may elect to first provide a new schedule update with a data date immediately prior to the start of the delay. If this new update schedule is to be used, it must first be submitted to the Owner for review and acceptance just like any other schedule update for that project. The schedule to be impacted will be called, "the original schedule update." The data date may not be altered from that used by the original schedule update and the impacted schedule (Frimpong 2000). Constraints not required by contract must not be included in the analysis. Any constraint that is required by contract must be the least restrictive one that still describes the contractual requirement. The list of constraints from least restrictive to most restrictive is as follows,

·Zero free float

· Zero total float

· Start No Later than

· Finish No Later Than

· Start No Earlier Than

· Finish No Earlier Than

· Start On

· Must Finish

· Must Start

Non-contractual constraints must be removed and contractual constraints must be reduced to the least restrictive before proceeding to the next step. The resultant original schedule update will not be used for any purpose other than the TIA in question (Diekmann et al 1992).

STEP 3a: Insert the fragnet into a copy of the appropriate schedule. Using the approved fragnet as a template, add the impact activities and make the existing activity adjustments as necessary to mirror the fragnet. With the duration of the delay activities set to zero, all computed and actual dates in the original schedule update must match that from the schedule which it was derived from.

OPTIONAL STEP 3b: If the delay time period involved is long or if substantial mitigation of the delay has occurred, then an option step may be made to consider the effects of mitigation (Diekmann et al 1992).

Typical construction law requires that the contractor mitigate the effects of any delay, if that mitigation can be made without additional cost or disruption to the project. If Step 2b is not implemented, a statement must be provided with the TIA to explain why this step was unnecessary. Reasons for not implementing Optional Step 3b include frozen work plan, forward-looking impact analysis, and shortness of duration of the delay (Ahuja et al 1994).

In lieu of actually redesigning the logic that was in effect when the delay occurred to that which was actually used after the delay occurred, the contractor my elect to revise the remaining duration status of every activity in the schedule to the remaining duration status evidenced at the time of the actual end of the delay. This revision of the status to the impacted schedule will reflect the resultant effects of mitigation of the project. Activities performed out-of-sequence will still exist as successors to the impacted activity, but their remaining durations will be reduced to reflect the work performed during the delay period (Arditi et al 1985).

STEP 4: Recompute the CPM and note a change in the project completion date. This analysis is primarily interested in the estimated early completion of the last milestone prior to demobilization (usually substantial completion.) This is due to the consideration of Extended Field Overhead. The delay or acceleration effect to all contractual milestones still outstanding should be noted and documented.

STEP 5: Determine the amount of project delay. If the contract specifies work days, then this measurement is made in work days. If the contract specifies calendar days or lists an absolute date for completion, then the award is made in calendar days.

STEP 6: Determine the actual dates of the delay. Using the original schedule update, determine when the successor activity to the delay impact actually became a project critical activity. On schedules without negative float, the activity will be predicted to become project critical on the computed late start date. The first date of delay due to this impact will be the next day after the activity late start date. Every day after this start of delay will be labeled a delay day (counting work days or calendar days as appropriate) until the number of delay days is exhausted.

Every date determined to be a delay date will be excusable to contractual milestone completion, providing that this date has not already been awarded as a delay date due to a prior TIA or other excusable event such as an adverse weather date. Should the day already be designated as an excusable delay date, then this day will be considered concurrent in terms of a previous delay. No single date will be granted an additional contractual milestone excusable day if it has previously been granted one for any other reason. Excusable deal days will be granted regardless of any contributing contractor concurrent delay on that same date. The issue of compensability of extended field overhead costs is dependent upon the lack of (or contributing factor in) contractor concurrent delays on any given date (Al-Tabtabai 1998).

2.17 Comparison of Calculated Results with Actual Observance

Time Impact Analysis is not an attempt to simulate reality. It is a recognized analysis technique designed to facilitate quick estimation of the time delay to the project caused by a single delay (Barazza et al 2004).

Barazza et al 2004 continues to add that it is not reasonable to require that a delay modeled in a Time Impact Analysis to manifest itself in that exact number of days that a project actually ends up being late. This is partially due to the extenuating effects of acceleration and mitigation. In addition, other delays (including the contractor's own inefficiency) may also contribute to late project completion. In practically all cases, a typical construction project will have enough deviations from the planned baseline schedule as to make the manifestation of any single delay unattributable to any particular day after the planned end of the project.

Awards of time and costs from a TIA are intended to include the compensation for acceleration and disruption in response to a delay. Acceleration and disruption to a project due to a delay may be considered to be incorporated in a TIA and thus may account for the apparent reduction in the actual effects of a delay. While imperfect, the ease and quickness of preparing and reviewing a TIA compensates for the lack of exactness in modeling the exact features of the impacts to a delay (Anbari 2003).

2.18 Forecasting Performance in Project Construction

Forecasting performance is one of the most challenging tasks in predicting whether the project will be successful. In turn, this will depend on the ability of the project manager to predict, well ahead of time. In attempting to establish the reliable forecasting system, it is required to develop a forecasting tools which capable in dealing with variability existing in construction operations. As such, this has still been a burden to project manager to determine the accurate data as early as possible where the primary important of forecasting system is, it should be able to predict variance data at any future time and at completion and thus provide an early warning of performance overruns. Often, project variables differ from time to time throughout the construction operation which usually unacceptable to most stakeholder. Thus, a reliable forecasting system should provide project manager an accurate, unbiased, timely and stable system. In essence, however, accurate project performance forecasts are difficult

to produce when considering the impact of some factors such as material delays, scope deviation, poor productivity, unforeseen scope changes, and adverse weather conditions. Most of the current systems are not designed to incorporate this input in the form of a judgmental input from the user and consequently could lead to inaccurate results.

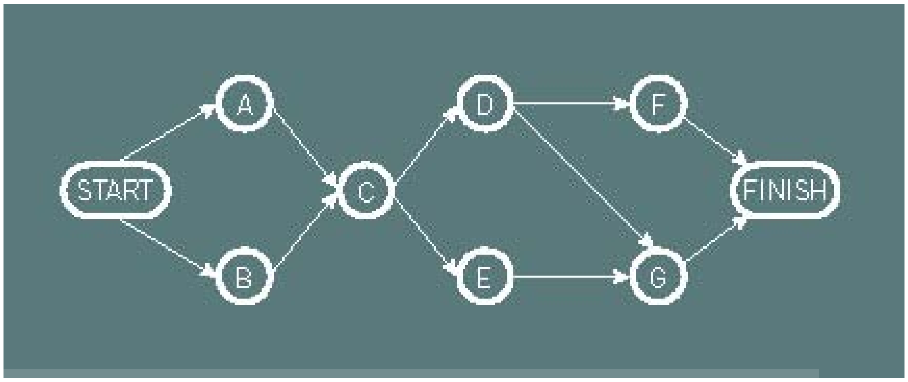
2.19 Project Construction

Construction projects typically involve multiple parties performing their specialized functions in a coordinated effort, which sometimes leads to opportunities for issues to impact the completion of a project. In other cases, projects are impacted by unforeseen conditions discovered during the course of construction or an owner simply needs to initiate a change in the work that causes project delay. When a project is delayed, all parties involved experience some impact whether it can be measured through cost increases or not (Brown 1996).

Christensen 1992 remarked that not all impacts result in a corresponding delay to the project's completion date, therefore, it becomes necessary to determine which delays were critical to the project's overall completion. In order to determine those time impacts, the project must be evaluated using industry recognized and accepted methodologies to identify and quantify the overall impact to the project's completion resulting from those delays that are incurred. Generally, contract time extensions are based upon the contractor's demonstration that a particular delay had a critical impact contributing to the project's overall completion. A non-critical delaying event would not provide a basis for entitlement to an extension of contract time.

According to Anbari 2003, it is important to performs schedule delay analyses in both contemporaneous and "after-the-fact" situations for clients who need to determine what delayed their project and for how long. One must have expertise in either preparing or responding to delay analyses addressing the question of what critically extended the project's completion. Every industry must recognize and accept methodologies to identify and quantify critical impacts that delayed the project's completion.

Fig 1. Project Scheduling Plan



Source: Davidson, 2003

Schedule acceleration typically results from the need to shorten the original planned performance period, to incorporate additional or changed work into the original duration, or to recover lost time that has occurred during the course of construction. Whether the acceleration is directed or constructive, the contractor will attempt to compress the original time period or accelerate down stream activities in the project schedule to absorb additional work or recover lost time. In a directed acceleration effort, the schedule is compressed by shortening activity durations, resequencing activities to allow them to be performed concurrently rather than sequentially, and generally results in reduced efficiency and increased costs caused by the acceleration (Diekmann et al 1992).

According to Frimpong 2000, in the case of constructive acceleration, the contractor typically is required to demonstrate that it previously has incurred delay, and - but for the owner's denial, it would have otherwise been granted an extension of contract time. When that time extension is denied, the contractor is forced to accelerate its performance to overcome prior delays or subject itself to the potential exposure of Liquidated Damages or other owner-related delay costs. In analyzing this risk, the contractor can accelerate its schedule performance or continue to perform against its original plan.

In either situation, directed or constructive acceleration, it is important to establish what the status of the project's completion was before the acceleration begins. This determination allows the parties to quantify exactly how much acceleration is being forecasted in the revised schedule. The accelerated schedule also needs to realistically forecast and quantify what additional efforts the contractor and its subcontractors will perform (Wahab 1997).

2.20 Change Order Evaluation in Project Construction

Cost management in the construction phase is critical to bringing a project in on budget. Cost issues from the point of signing a lump sum or GMP contract arise with the issuance of change orders, or contract modifications, against the contract. These are either initiated by the owner for a change the owner would like to make, are a result of unforeseen conditions such as below-ground obstructions, or are a result of the contractor issuing a Request for Information (RFI), the answer to which results in a change to the contract drawings or specifications (Ahuja et al 1994).

In the public sector, in order to properly prepare an estimate for a change order, the estimator must understand the overall objective, i.e. to reach an agreement with the contractor that is in the best interest of the government. The lowest possible price does not always meet this objective nor would a "generous" price if that price offers more payment than necessary to include sufficient incentive. The negotiation team must strive for some intermediate point, which is generally regarded as the lowest reasonable price- the amount at the bottom of the price range that the negotiator considers to be fair and reasonable (Brown 1996).

To arrive at this price the negotiator must at least partially rely upon an independently prepared government estimate. This estimate must be based on a detailed analysis of the change in requirements and existing job conditions. For the most part, the estimate should be prepared similar to, and take into account, those same conditions and elements occurring in the contract, as each applies to the change order scope. In lieu of better data, the government estimate for bid evaluation may be used for assistance.

It is necessary to fully understand the scope change (by, for example, a meeting with the designer and owner) and then prepare an accurate quantity takeoff for each direct item of change. Then apply a cost to each of the direct items for labor, material, and equipment costs, and sequentially apply appropriate overhead, profit, and bond costs, all in accordance with the terms of the construction contract. This formal, approved government estimate will be used to evaluate the contractor's proposal in determining reasonableness and therefore must be prepared on a comparable and realistic basis. The estimator should become familiar with the modification and claim processes as outlined in the contract (Dlakwa 1990).

2.21 Preparation for Estimation in Project Construction

The estimator must review the change documents received and become thoroughly familiar with the scope and requirements of the changed work. This will perhaps entail detailed comparison, analysis and various discussions with the design team and owner to ensure understanding. The estimator must determine the existing status of construction and how the changed work will fit into the construction schedule. This will require obtaining progress reports, schedules, and discussion with those closest to the work. This often requires a visit to the construction site, and shows why on large projects it is useful to have a cost estimator on site (Farghal et al 1997).

The estimator should become fully aware of the contractor's existing methods, capabilities, and rates of accomplishment. The estimate should not arbitrarily include methods and capabilities different from the way in which the contractor is performing existing work. Unless the Contracting Officer is willing to direct the contractor to another method of performing work and assume the responsibility, the estimator should usually base the change on existing contractor operations for similar work. When work is anticipated to be subcontracted, prepare the estimate to include costs accordingly (Fleming et al1999).

The estimator must obtain valid labor rates that the contractor is incurring. The rates are usually available from labor reports or from the contractor upon request. Contact actual sources of supply for materials for quotes. The price that the contractor is expected to pay should be the basis for estimating material costs. The estimator should obtain a list of equipment on the job. Determine equipment rates by a required methodology, either as specified in the contract. Any other applicable information that the estimator determines necessary should be obtained if available (Mansfield et al 1994). The estimator, through the negotiator, should attempt to agree tentatively with the contractor on scope and format before preparing the independent estimate. The intent of the agreement is not to influence the contents, price or independency of the Government estimate, but only to eliminate unnecessary wasted effort for both parties.

2.22 Preparing the Estimate

Okpala 1988 indicated that after collecting and analyzing all the information, the estimator must decide upon the presentation format unless there has been a prior agreement and discussion. Unless otherwise agreed, the format for the estimate will be MasterFormat with a level of detail as per the available detail on the Construction Documents. General guidance for the calculation of direct costs can be provided as follows:

- For additional work, items and format should be priced similar to a new contract as performed by the known contractor. All new work should be priced at the rates anticipated to be in effect at the time the work will be performed.
- Changed work requires a separate quantity takeoff for each item directly affected for comparable scope both before and after the change. The estimator should price each item at the rates that would

be in effect at the scheduled time of accomplishment. Typically, the estimator quantifies, prices and totals each item of changed original work. Then, price at the applicable rates and total each comparable item of revised work. Obtain the net cost (or credit) by subtracting the total of the original work from the total of the revised work. It is important that the estimator maintain a comparable scope of items throughout both estimates. When an item of work will be performed identically before and after, except for a revision in quantity, the net or differential quantity may be estimated directly for that item. However, if overhead and profit rates vary between the original and revised work, difficulty may occur in application of those same rates to the net quantity.

- For deleted work, the item and format should be priced similar to a new procurement as performed by the known contractor. Rates in effect at the time the work would have occurred should be utilized. In addition to the direct cost of the work, include variable overhead, profit (where the contract allows for recovery of profit on omitted work), and bond costs for credit on the deleted work.
- Impact considerations of cost on the remaining unchanged work will be discussed forward. Clearly and adequately describe and identify impact related costs as a separate part to each estimate (Okpala 1986).

2.23 Impact Cost Considerations

When a modification is directed, the settlement of that modification includes not only the cost and time change of the work directly affected but also the cost and time impact on the unchanged work. The impact portion on unchanged work of a modification is very difficult to determine. The scope of impact is very broad, intangible, and susceptible to a large variety of situations (Ogunlana and Olomolaiye 1989). Both continue to add that by far the greatest portion of impact costs results from acceleration or delays. In general, when delay effect can be minimized, impact costs are reduced. Through the present, at least, impact costs have been determined on a case-by-case basis for each particular situation. Very few claims for impact are denied in their entirety. It is, therefore, necessary that the claim be reviewed for validity by a team involving all-around expertise.

Impact costs are generally first presented by the contractor as "claimed" impact cost as part of the proposal. The support for such “claimed” cost should also be obtained and includes narrative, calculations, and planned rescheduling. To determine the extent of the impact, the existing network schedule furnished by the contractor must be developed to reflect actual construction as accurately as possible. The modification work must be superimposed upon the original network schedule in such a manner to minimize delay under the given requirements. The revised network must then be thoroughly reviewed relative to the existing job plan (Davison 2003).

This comparative review should indicate those areas that have been affected by the modification. Once identified, each construction task must be analyzed for impact and estimated judgmentally considering the influences caused by the change. Each impact cost claimed should be classified as either factual or judgmental. The factual costs are those which are fixed and established and can be determined directly from records. These include rental agreements, wage rate agreements, purchase documents, etc. Once the item has been determined to be valid as a factual impact, the item cost may be directly calculated. The amount of cost change is either stated on the certification document or can be determined from the scheduled time change of the construction progress plan (Christensen et al 1995).

Impact costs considered factual:

- Escalation of material prices
- Escalation of labor wage rates
- Change in equipment rates

- Increase from extending the storage period for materials and equipment
- Increase from extending the contract for labor cost and subsistence
- Increase from a longer period of equipment rentals or use
- Increase from a longer period of utilizing overhead personnel, materials, and utilities
- Increase from a longer period of providing overhead and project office services

Judgmental costs are those that are dependent on variable factors such as performance, efficiency, or methodology and cannot be stated factually prior to actual accomplishment. These must be negotiated and be based upon experienced judgments. Judgment or costs can be challenged but cannot be found erroneous if based on reasonable judgments of the conditions. Since judgmental factors appear in the Government estimate and the contractor's proposal, results of negotiations often depends on credibility and clarity of support documentation. When each impacted activity can be analyzed for cost separately, the estimate of impact should be prepared accordingly. However, sometimes the impact items are so interrelated that it is best to develop a detailed plan for accomplishing the total remaining revised contract work (Davison 2003).

Impact costs considered judgmental:

- Change of efficiency resulting from rescheduling
- Loss of labor efficiency resulting from longer work hours
- Loss of efficiency caused by disruption of the orderly existing processes and procedures
- Inefficiency from tearing out completed work and the associated lowering of morale
- Loss of efficiency during rescheduling of manpower
- Inefficiency incurred from resubmittal of shop drawings, sample materials, etc.
- Additional costs resulting from inability to transfer manpower expertise to other work

Each remaining item in this plan would be costed at the productivity and rate in effect at the time the work is to be accomplished and the cost incurred. The same scope of work under the original plan would also be separately costed at the productivity and rates in effect at the originally scheduled time. The net difference from the totals of these two estimates yields the cost of impact. Whatever the method used, those impacts determined valid must be included and costed by the most accurate method available. The estimator should avoid including questionable impact costs in the initial government estimate unless each has been found to be justifiable (Dawood et al 1997).

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter discusses method adopted in carrying out the data collected for the survey. Specific areas covered are the research design, population, sample and sampling procedure, instruments for data collection and the procedure for analyzing the data. In order to obtain the relevant data both primary and secondary data were used to address the specific details under the study.

The primary data for the study was obtained through distribution of questionnaires as well as direct personal interviews with people involved in project construction. In order to enrich the questionnaire for the research, a review of text books and journals were used to identify the various efforts that have been made in the past to evaluate and examine the effects of cost and time schedules on project construction. Secondary sources of data were obtained from relevant literature that covered research and publication on the subject matter.

The survey method is generally used when the researcher wishes to elicit opinions (Bogman and Biklen, 1998). Since the objective of the study is to assess the cost and time impacts of the public sector construction, the survey method was deemed most appropriate.

The study was fundamentally a descriptive quantitative research. Data collection was done by means of questionnaires which were completed by a selected group of 30 project supervisors. The questionnaires tested respondents' views and knowledge regarding issues relating to cost and time on construction projects in Ghana.

3.2 Research Design

Biklen and Bogman (1998) define research design as the overall plan for collecting and analysing data including measures to enhance both internal and external validity. Research design is the term often used to describe a number of decisions which need to be taken in the data collection process (Durrheim, 1992). The design therefore constitutes the blueprint for the collection, measurement and analysis of data. This study is designed to collect data in order to assess cost and time impacts of project construction at public sector, with a view to generalizing the results and making inferences.

Leedy and Ormrod (2005: 183) define survey research as follows:

- The researcher poses a series of questions to willing participants,
- Summarizes the participants responses with percentages, frequency counts or more sophisticated statistical indexes, and
- Draws inferences about a particular population from the responses of the sample.

The purpose of the descriptive research is to solve the research problems through the interpretation of the data that have been gathered.

3.3 Population and Sample Size

In order to evaluate and assess cost and time impacts of construction projects, a wide range of personnel (project supervisors) involved in construction of projects were targeted. Personnel were randomly selected from Ghanaian construction industries.

This study covered 30 project supervisors of LESTAKO Company and BEROCK VENTURES Company in Industrial Area of the Greater Accra Region. LESTAKO Company and BEROCK VENTURES were selected for data collection for two main reasons: Both are local firms which have several years of project construction in the public sector and finally to enable the researcher obtain differences in perceptions on the topic among the various construction firms thereby increasing the utility of information obtained.

3.4 Sampling Procedure

A simple random sampling was used to select thirty (30) project supervisors each from LESTAKO Company and BEROCK VENTURES out of a total population of hundred (100). The goal of the sampling method used was to obtain a sample that is a representative of the population. That is, apart from random error, the information derived from the sample was expected to be the same and had a complete census of the population being carried out. The techniques used by the researcher to select the sample size required prior knowledge of the target population which allowed a determination of the size of the sample needed to achieve a reasonable estimate with accepted precision and accuracy of the population.

3.5 Data collection Procedure

The researcher personally administered the questionnaire. Respondents were allowed sufficient time of five working days to complete the questionnaire. The questionnaires were series of structured questions which were related to the research work and directed to respondents with the aim of gaining first hand information. The questionnaire consisted of both open ended and close-ended questions. Thus, in some cases, respondents were to choose the option that best reflected their options. Respondents were required to respond to a number of questions.

The project supervisors were asked to respond to fifteen (15) questions. The questionnaire afforded respondents much flexibility and privacy in answering the questions without any undue influence. The questionnaire was in simple and unambiguous language and as such, did not pose any problem as regards interpretation. The researcher personally traveled to LESTAKO Company and BEROCK VENTURES offices in Accra to conduct the interview. The personal interview was a face to face interaction. This method was purposefully selected so that the researcher could interact on a personal level with the project supervisors.

3.6 Data Organisation and Analysis

In order to ensure clarity of expression and accuracy, information gathered was foremost checked. The raw data was then organized considering the issues for which the questionnaire was designed to address. Bogdan and Biklen (1998) indicate that data analysis is a mechanism for reducing and organizing the bulk data to produce findings. These findings ultimately aid researchers in the interpretation of their work. Simple statistical analysis involving tables, graphs and percentages were used in analyzing the responses to the questions on the survey questionnaire. Descriptive explanations were also used to make the findings of the analysis more meaningful.

3.7 Research Constraints and Problems

Several challenges were encountered by the researcher in the administration of the questionnaires which have been outlined following:

- Situations were respondents were not met at all or even those present had misplaced their questionnaires and new ones had to be given them.

- Some respondents having been assured of their anonymity of their personalities declined to offer any assistance to the researcher.

CHAPTER 4

RESEARCH RESULTS AND DATA ANALYSIS

4.1 Introduction

This chapter examines and analyses the data gathered from the questionnaire administered and personal interviews conducted at LESTAKO Company and BEROCK VENTURES. The procedure used in analyzing the results was aimed at establishing the relative importance of the assessment of cost and time impacts of the public sector construction projects with various factors responsible for project delay and cost overruns.

4.2.1 Analysis of findings

The results from the data in the displays, graphs, charts and tables are analyzed and interpreted in order to find answers to the research problems. The numbers are summarized and interpreted by using statistics. The statistics provide a means through which numerical data can be made more meaningful.

An analysis of the summarized research results is done in order to make meaningful conclusions and recommendations. Tables, charts and descriptive explanations have been employed to illustrate data gathered from the field to make the research findings more meaningful. The following analysis shows the responses received from thirty (30) project supervisors each from LESTAKO Company and BEROCK VENTURES.

4.2.2 Findings from Project Supervisors of LESTAKO Company

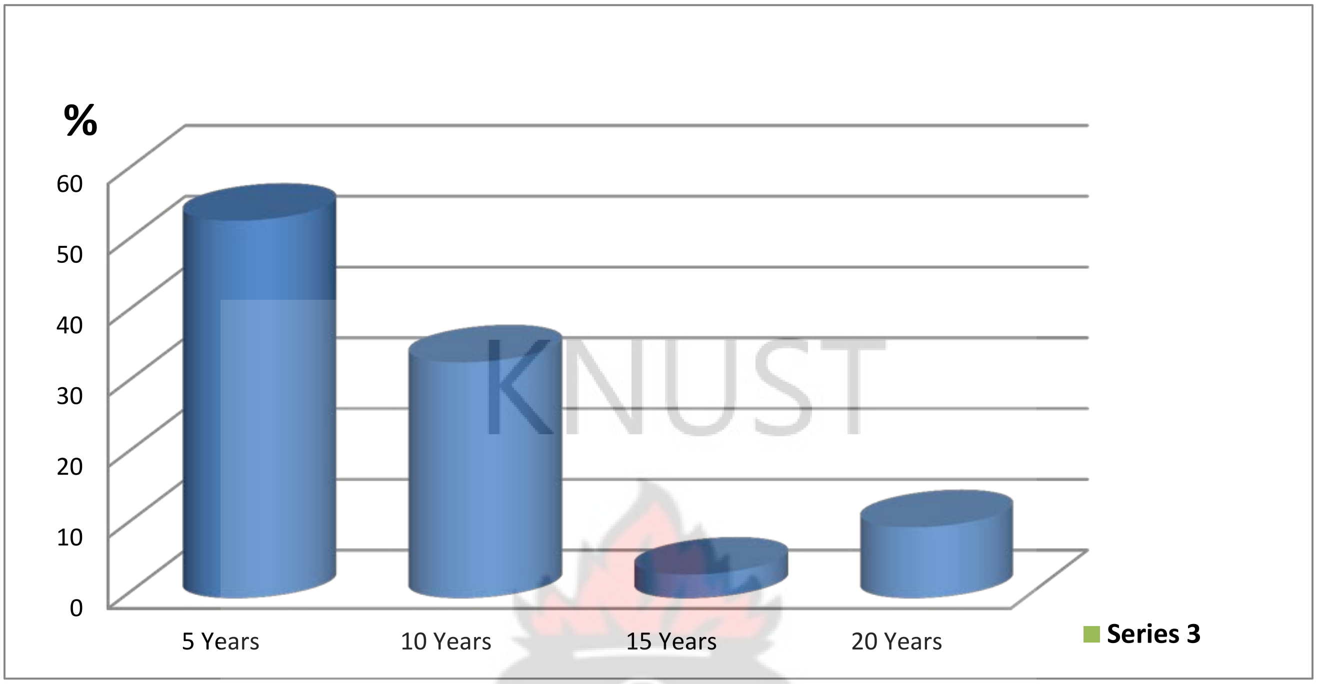
A total number of thirty (30) project supervisors were selected from LESTAKO Company out of a total of hundred (100) to provide answers to the structured questionnaire. The project supervisors were expected to provide reasons for their choice of an answer. Table 4.1 and figure 4.1 gives the responses obtained from the Project Supervisors as shown below.

Table 4.1: Years of Experience in Project Construction

Years of Experience	Frequency	Percentage (%)
5 Years	16	53.3
10 Years	10	33.3
15 Years	1	3.3
20 Years	3	10
Total	**30**	**100**

Source: Field Research, April 2011

Figure 4.1 Years of Experience in Project Construction



Source: Field Research, April 2011

Results on Table 4.1 and figure 4.1 show that 53.3% of the sampled project supervisors of LESTAKO Company and BEROCK VENTURES have 5 years experience in project construction, 33.3% have 10 years, 3.3% have 15 years whilst 10% have 20 years. It could therefore generally be inferred from the foregoing that, the sample population is quite old and could therefore provide reasonably constructive and valid answers.

Table 4.2: How important is cost and time factors to project construction?

Importance	Frequency	Percentage (%)
Very Important	30	100
Fairly Important	0	0
Not Important	0	0

Total	30	100

Source: Field Research, April 2011

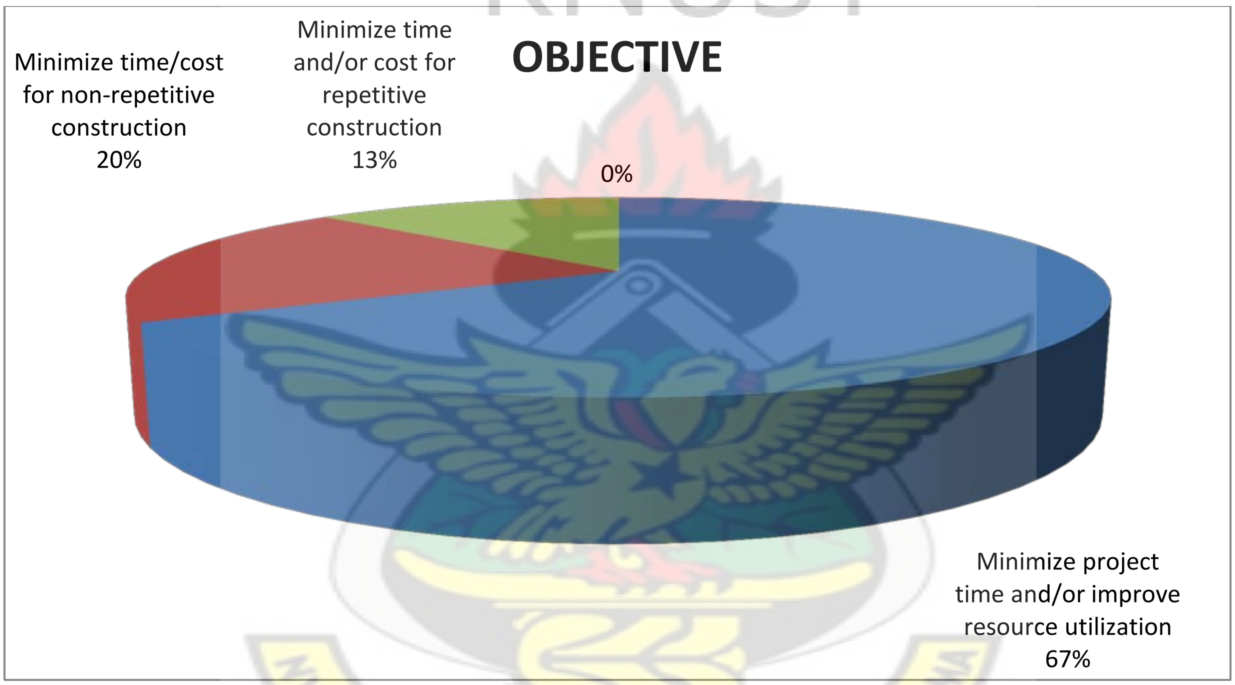
Table 4.2 shows the importance of cost and time to project construction. When questioned about the importance of cost and time factors to project construction, total respondents representing 100% interviewed indicated it was very important. Project supervisors thus consider cost and time factors as singular most important factor in their activities. There should not therefore be any compromises wherever this is considered.

Table 4.3: Which is the key objective of cost and time factors on project construction?

Objective	Frequency	Percentage (%)
Minimize project time and/or improve resource utilization	20	67
Minimize time/cost for non-repetitive construction	6	20
Minimize time and/or cost for repetitive construction	4	13
Total	**30**	**100**

Source: Field Research, April 2011

Figure 4.3: Which is the key objective of cost and time factors on project construction?



Source: Field Research, April 2011

With table 4.3 and figure 4.3, the Project Supervisors were asked to indicate the key objective of cost and time factors on project construction. 67% of total respondents said the key objective was to minimize project time and/or improve resource utilization. 20% of the respondents said the key objective was to minimize time/cost for non-repetitive construction, whilst a minimum of 13% mentioned the key objective as to minimize time and/or cost for repetitive construction. This implies that the key objective of cost and time factors on project construction is to minimize project time and/or improve resource utilization according to project supervisors.

Table 4.4: Unplanned delays due to cost and time factors on construction projects are often regrettable but unavoidable. Do you agree?

Response	Frequency	Percentage (%)
Agree	25	83
Disagree	3	10
Not Sure	2	7
Total	**30**	**100**

Source: Field Research, April 2011

Results from table 4.4 shows that 83% of project supervisors agreed that unplanned delays due to cost and time factors on construction projects were often regrettable but unavoidable. 10% indicated that they disagreed, whilst 7% said they were not sure. This implies that generally construction supervisors would avoid unplanned delays all things being equal. Nobody would intentionally allow delay knowing that the end result would be regrettable.

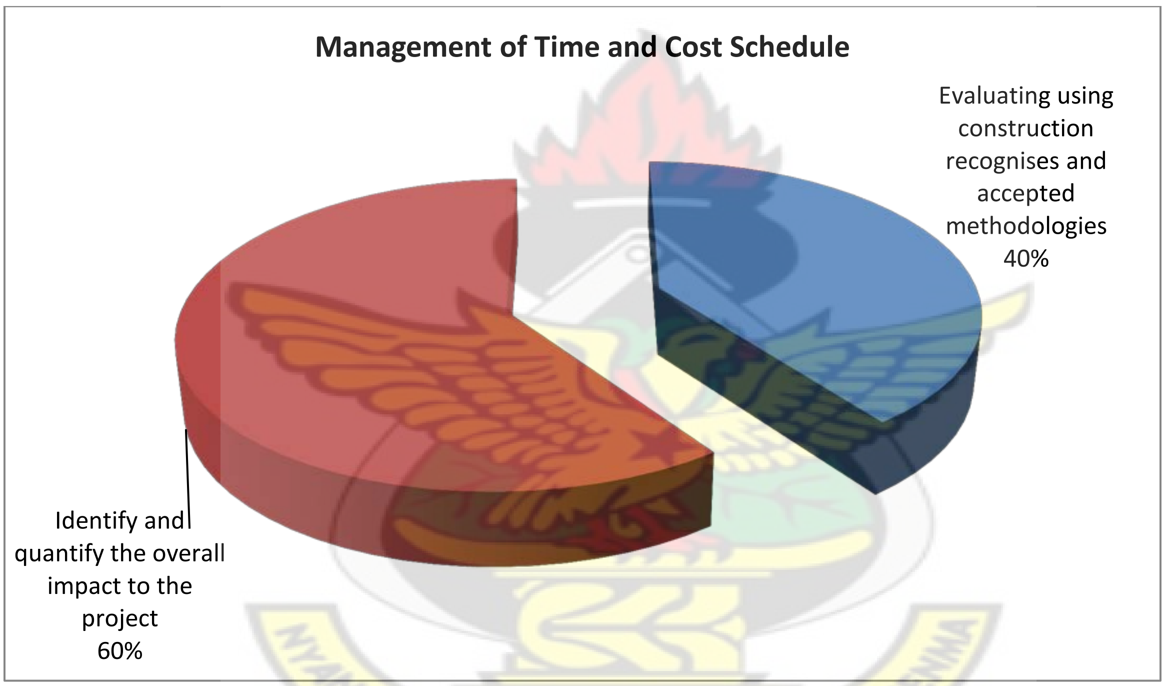
Table 4.5: How do you manage time and cost schedule of project construction?

Management of Time and Cost Schedule	Frequency	Percentage (%)
Evaluating using construction recognized and accepted	12	40

Methodologies		
Identify and quantify the overall impact to the project	18	60
Total	**30**	**100**

Source: Field Research, April 2011

Figure 4.5: How do you manage time and cost schedule of project construction?



Source: Field Research, April 2011

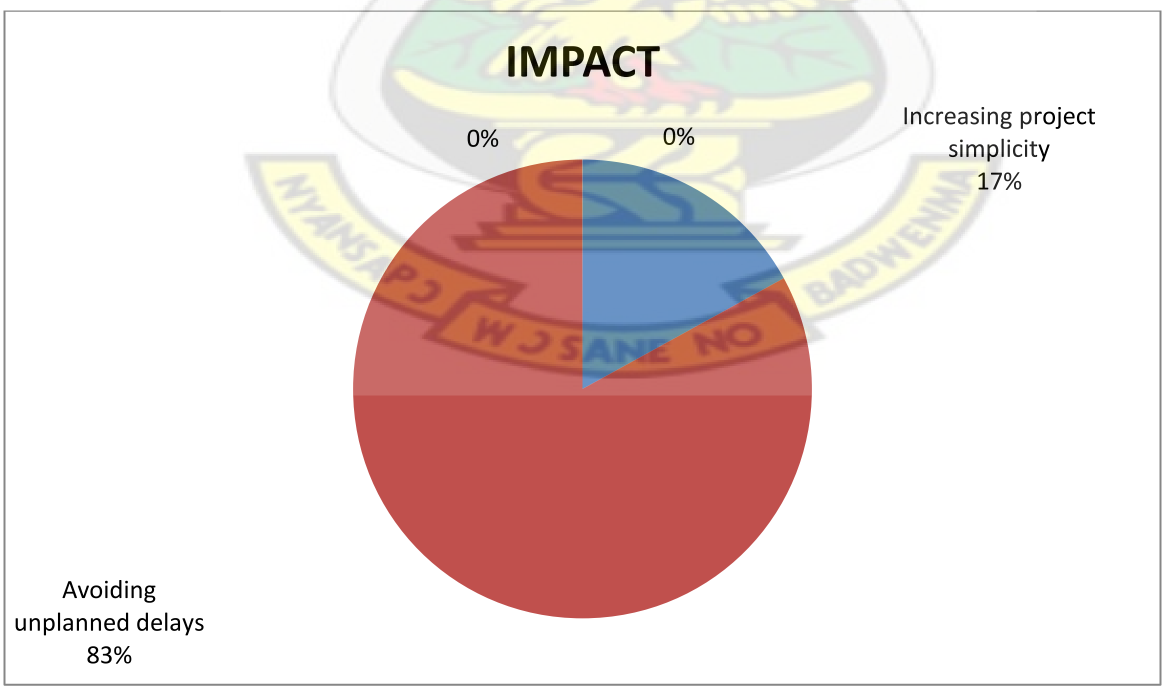
Among the surveyed project supervisors, 60% of total respondents manage time and cost schedule of project construction by evaluating using construction recognized and accepted methodologies whilst 40% indicated that they identify and quantify the overall impact to the project in their efforts to manage time and cost schedule of project construction. This implies that most supervisors are not using the most modern techniques is their evaluation. They are also likely to be not very effective in their results as they would have to wait for the error to have far progressed before being assessed.

Table 4.6: How does cost and time factor impact on your project construction?

Impact	Frequency	Percentage (%)
Increasing project simplicity	5	17
Avoiding unplanned delays	25	83
Total	**30**	**100**

Source: Field Research, April 2011

Figure 4.6: How does cost and time factor impact on your project construction?



Source: Field Research, April 2011

It is clear from table 4.6 and figure 4.6 that majority of the respondents (83%) mentioned that the impact of time and cost on their project construction is avoiding unplanned delays whilst 17% said increasing project simplicity. This implies that progressively, most supervisors see cost and time impacts being ameliorated by avoiding unplanned delays.

Table 4.7: Do you perform Time Impact Analysis?

Response	Frequency	Percentage (%)
Yes	27	90
No	3	10
Total	**30**	**100**

Source: Field Research, April 2011

Results from table 4.7 shows that a majority of 90% of total respondents indicated that they perform time impact analysis, whilst 10% said they do not perform time impact analysis.

Table 4.8: Are you able to complete construction of projects within specified time period?

Response	Frequency	Percentage (%)
Yes	27	90
No	3	10
Total	**30**	**100**

Source: Field Research, April 2011

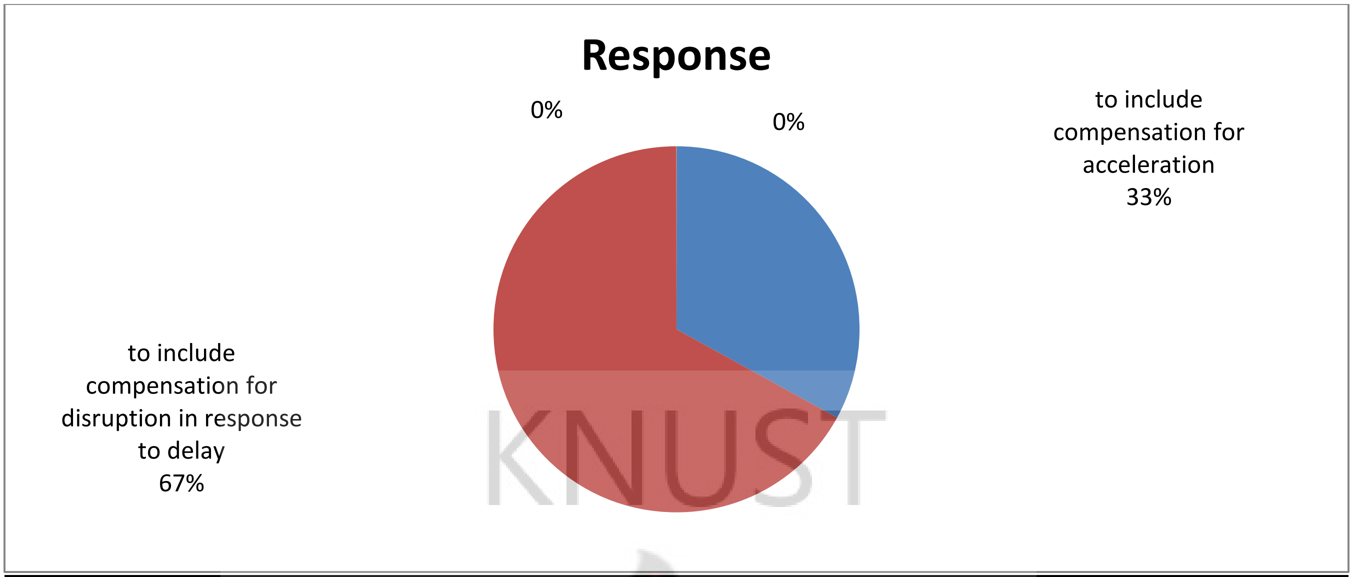
It is obvious from table 4.8 that out of a total sample size of thirty (30), only 10% of the respondents said that they were unable to complete construction of projects within specified time period. Meanwhile, 90% of the respondents said they were able complete construction of projects within specified time period. It can be inferred that to a large extent contractors are not the causers of the many delays at sites I Ghana.

Table 4.9: In your view, what is the essence of the award of time and cost from Time Impact Analysis?

Response	Frequency	Percentage (%)
To include compensation for acceleration	10	33
To include compensation for disruption in response to delay	20	67
Total	**30**	**100**

Source: Field Research, April 2011

Figure 4.9: In your view, what is the essence of the award of time and cost from Time Impact Analysis?



Source: Field Research, April 2011

From table 4.9 and figure 4.9, it is clear that 33% of the respondents indicated that the essence of the award of time and cost from Time Impact Analysis is to include compensation for acceleration whilst 67% indicated that the essence is to include compensation for disruption in response to delay. This implies that most supervisors do not appreciate the essence in acceleration of projects.

Table 4.10: Which of the following activities is important in cost/time assessment on project construction?

Response	Frequency	Percentage (%)
Finish the project in a predefined deadline date	23	76
Recover early delays	3	10
Avoid liquidated damages	2	7
Avoid adverse weather conditions that might affect productivity	2	7
Improve project cash flow	0	0
Total	**30**	**100**

Source: Field Research, April 2011

It is evident from table 4.10 that 76% of responses said finishing the project in a predefined deadline date is important in cost/time assessment on project construction. 10% indicated recovery of early days as the most important activity, whilst 7% each indicated the activity of avoiding liquidated damages and avoiding adverse weather conditions that might affect productivity. There was no response for improving project cash flow. Most supervisors would therefore naturally endeavour to finish their projects on time as a basis for achieving cost /time efficiencies.

Table 4.11: Has your company attempted to deliver a project within a significantly shorter duration than a traditional project?

Responses	Frequency	Percentage (%)
Yes	17	57
No	8	27
Total	**30**	**100**

Source: Field Research, April 2011

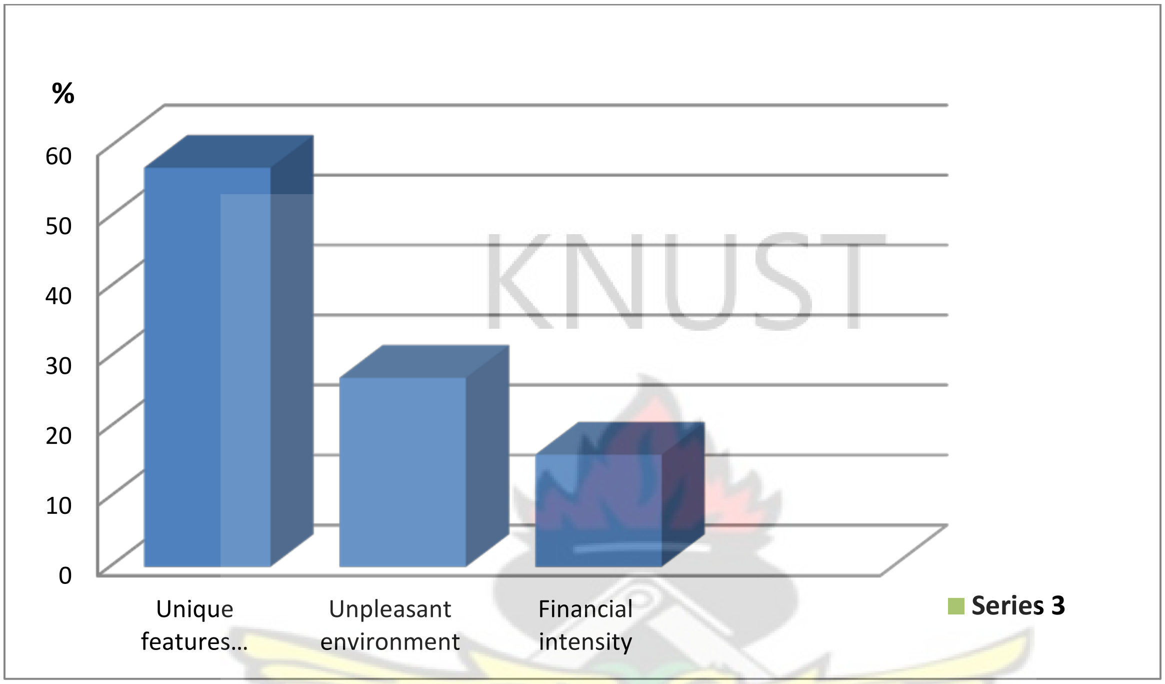
Table 4.11 shows responses on whether their company has attempted to deliver a project within a significantly shorter duration than a traditional project. 57% said they have indeed delivered project within a significantly shorter duration than traditional project whilst 27% said they have not delivered a project within a significantly shorter duration than a traditional project. This implies that it is quite possible for contractors to deliver within project time lags all things being equal.

Table 4.12: Which of the following places your construction industry to more risks regarding cost and time assessment?

Responses	Frequency	Percentage (%)
The unique features of construction activities	17	57
Unpleasant environment	8	27
Financial intensity	5	16
Dynamic organization structures	0	0
Total	**30**	**100**

Source: Field Research, April 2011

Figure 4.12: Which of the following places your construction industry to more risks regarding cost and time assessment



Source: Field Research, April 2011

With table 4.12 and figure 4.12, the project supervisors were asked to indicate which of the following places their construction industry to more risks regarding cost and time assessment. 57% majority of project supervisors indicated that the unique features of construction activities places their construction industry to more risks regarding cost. 27% said unpleasant environment whilst 16% mentioned financial intensity. None indicated dynamic organization structures. The uniqueness of construction thus places it at very great risk.This implies the more simplified the process becomes the less risk it exposes the contractors to.

Table 4.13: The impact of cost and time factors in project construction is to search for an optimal resource utilization plan that minimizes construction cost and time while maximizing its quality. Do you agree?

Response	**Frequency**	**Percentage (%)**
Agree	30	100
Disagree	0	0
Not Sure	0	0
Total	**30**	**100**

Source: Field Research, April 2011

Table 4.13 reveals that total respondents (100%) of project supervisors agreed that the impact of cost and time factors in project construction is to search for an optimal resource utilization plan that minimizes construction cost and time while maximizing its quality.

4.2.3 Findings from Project Supervisors of BEROCK VENTURES

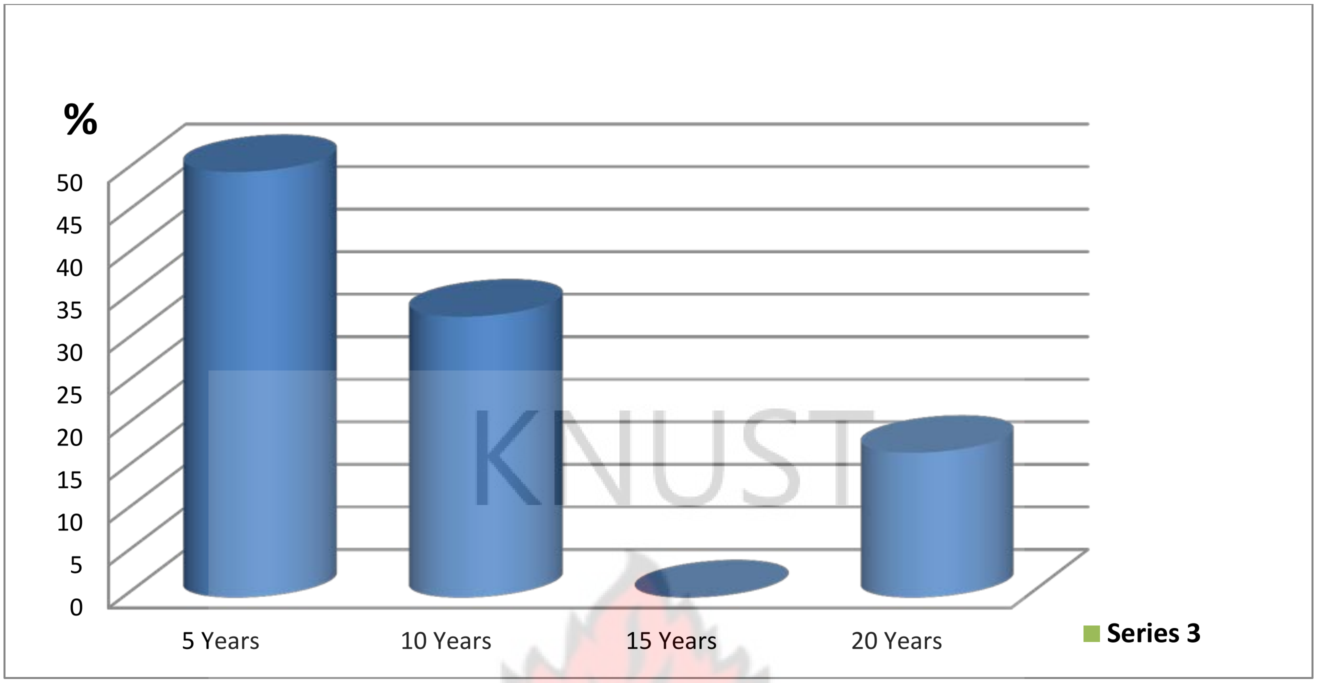
A total number of thirty (30) project supervisors were selected from BEROCK VENTURES out of a total of hundred (100) to in addition provide answers to the structured questionnaire. The project supervisors were expected to provide reasons for their choice of an answer. Table 4.1 and figure 4.1 gives the responses obtained from the Project Supervisors as shown below.

Table 4.2.1: Years of Experience in Project Construction

Years of Experience	Frequency	Percentage (%)
5 Years	15	50
10 Years	10	33
15 Years	0	0
20 Years	5	17
Total	**30**	**100**

Source: Field Research, April 2011

Figure 4.2.2 Years of Experience in Project Construction



Source: Field Research, April 2011

Results on Table 4.2 and figure 4.2 indicate that 50% of the sampled project supervisors of BEROCK VENTURES have 5 years experience in project construction, 33% have 10 years, whilst 17% have 20 years. There was none for 15 years. This is quite an old sample and expected results are supposed to be realistic. They can be presumed to know their work.

Table 4.2.3: How important is cost and time factors to project construction?

Importance	**Frequency**	**Percentage (%)**
Very Important	30	100
Fairly Important	0	0
Not Important	0	0

Total	**30**	**100**

Source: Field Research, April 2011

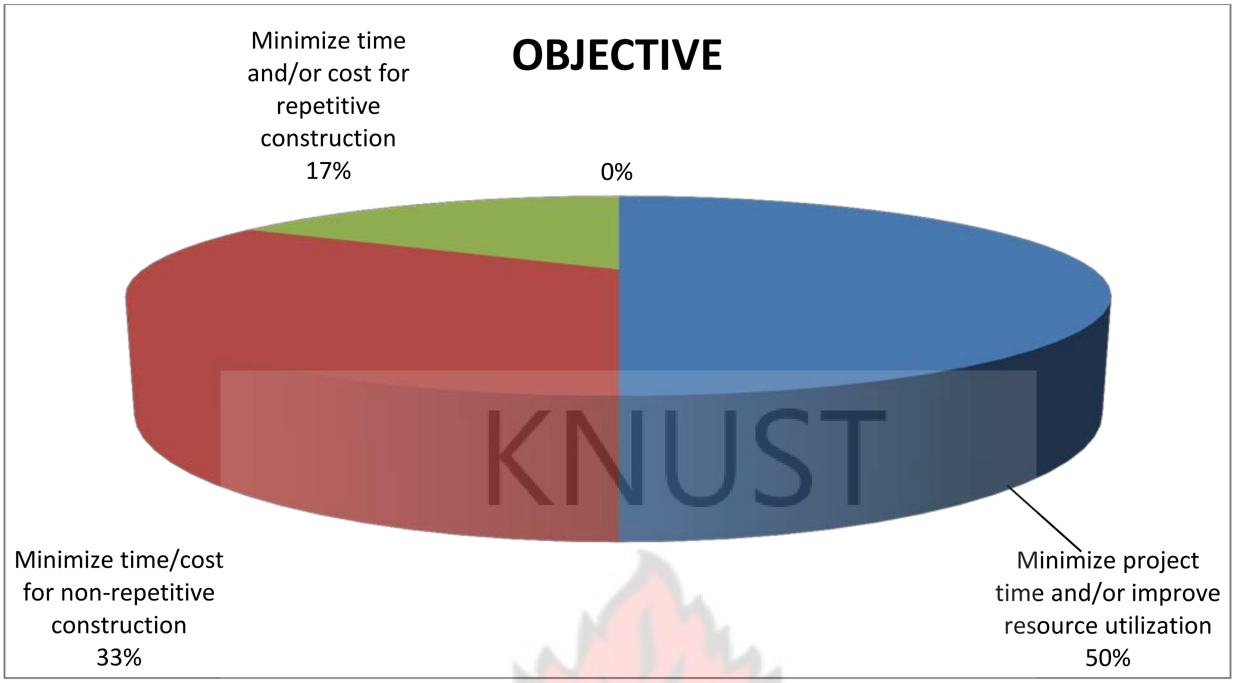
With regards to the importance of cost and time to project construction. Project supervisors at BEROCK VENTURES were questioned about the importance of cost and time factors to project construction. Table 4.2 shows that total respondents representing 100% interviewed indicated that cost and time factors to project construction were very important. Cost/ time considerations are therefore non- negotiable issues within this group of respondents.

Table 4.2.4: Which is the key objective of cost and time factors on project construction?

Objective	Frequency	Percentage (%)
Minimize project time and/or improve resource utilization	15	50
Minimize time/cost for non-repetitive construction	10	33
Minimize time and/or cost for repetitive construction	5	17
Total	**30**	**100**

Source: Field Research, April 2011

Figure 4.2.4: Which is the key objective of cost and time factors on project construction?



Source: Field Research, April 2011

Regarding table 4.3.4 and figure 4.3.4, the Project Supervisors of BEROCK VENTURES were asked to indicate the key objective of cost and time factors on project construction. 50% of total respondents said the key objective was to minimize project time and/or improve resource utilization. 33% of the respondents said the key objective was to minimize time/cost for non-repetitive construction, whilst a minimum of 17% mentioned the key objective as to minimize time and/or cost for repetitive construction. This implies a key issue in dealing with cost/time problems is improving time and resource utilization.

Table 4.2.5: Unplanned delays due to cost and time factors on construction projects are often regrettable but unavoidable. Do you agree?

Response	Frequency	Percentage (%)
Agree	25	83
Disagree	5	17

Not Sure	0	0
Total	**30**	**100**

Source: Field Research, April 2011

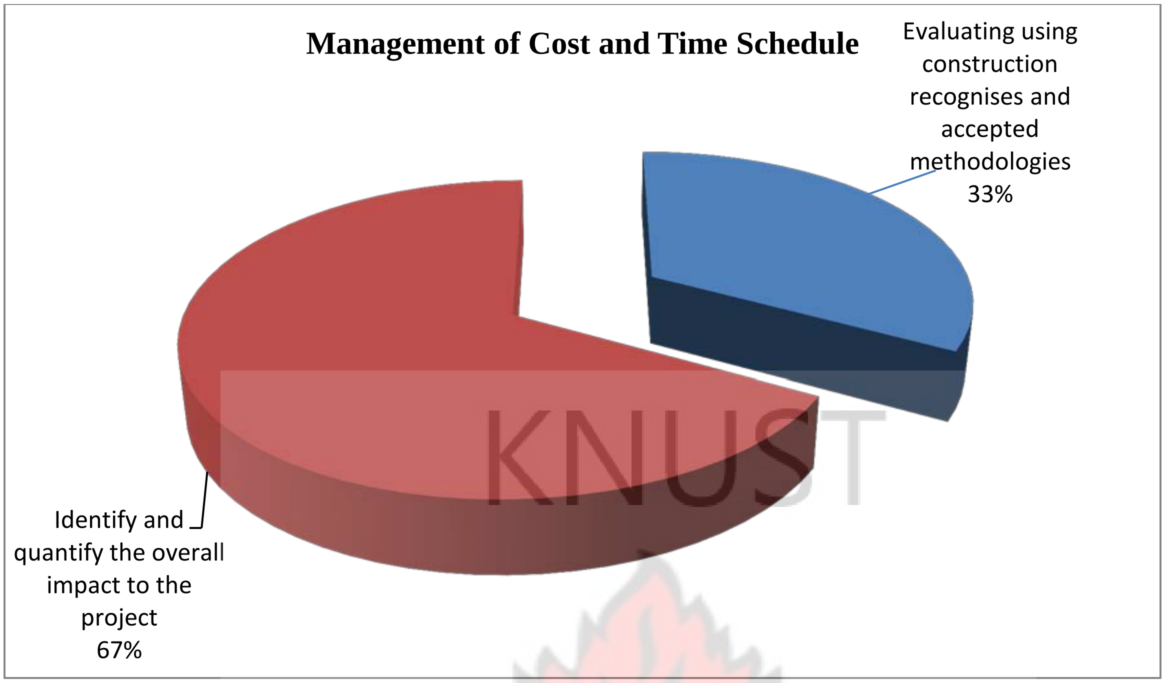
Data collected and showed on table 4.2.5 shows that 83% of project supervisors agreed that unplanned delays due to cost and time factors on construction projects were often regrettable but unavoidable. 17% indicated that they disagreed, whilst none said they were not sure. This implies that contractors left on their own would avoid delays.

Table 4.2.6: How do you manage time and cost schedule of project construction?

Management of Time and Cost Schedule	**Frequency**	**Percentage (%)**
Evaluating using construction recognized and accepted Methodologies	10	33
Identify and quantify the overall impact to the project	20	67
Total	**30**	**100**

Source: Field Research, April 2011

__Figure 4.2.6: How do you manage time and cost schedule of project construction?__



Source: Field Research, April 2011

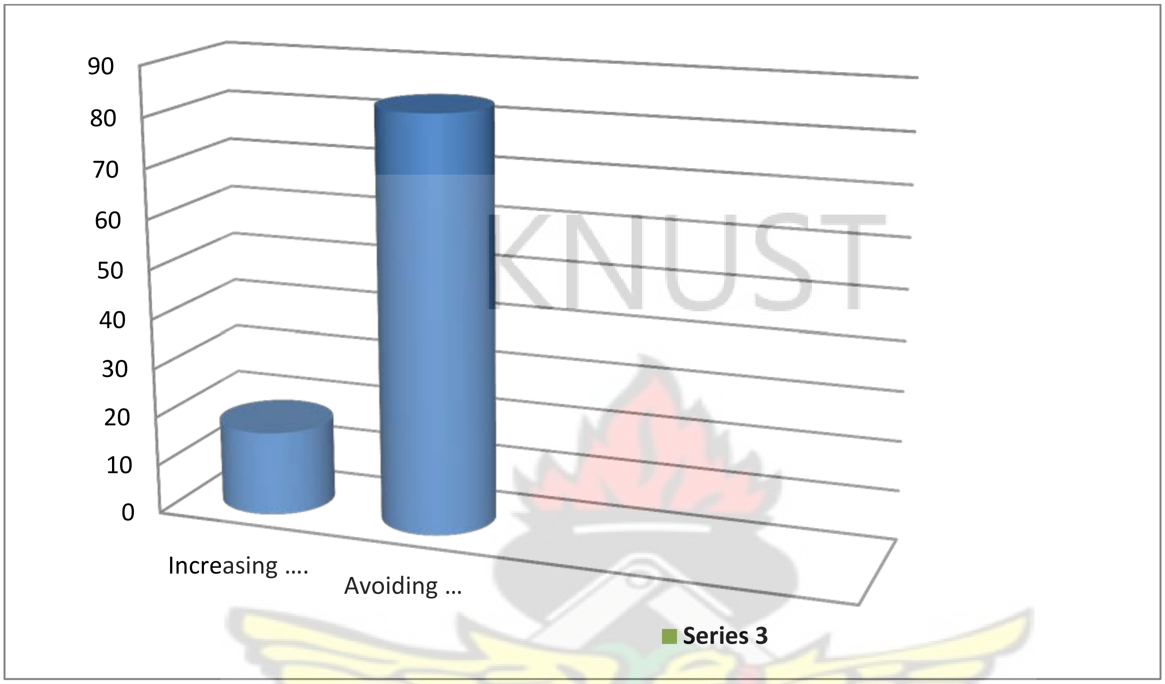
Details from analysis of project supervisors surveyed showed that 67% of total respondents manage time and cost schedule of project construction by evaluating using construction recognized and accepted methodologies whilst 33% indicated that they identify and quantify the overall impact to the project in their efforts to manage time and cost schedule of project construction. Preventive measures are therefore not the norm with this group of supervisors.

Table 4.2.7: How does cost and time factor impact on your project construction?

Impact	Frequency	Percentage (%)
Increasing project simplicity	5	17
Avoiding unplanned delays	25	83
Total	**30**	**100**

Source: Field Research, April 2011

Figure 4.2.7: How does cost and time factor impact on your project construction?



Source: Field Research, April 2011

With table 4.2.7 and figure 4.2.7, majority of the respondents (83%) mentioned that the impact of time and cost on their project construction is avoiding unplanned delays whilst 17% said increasing project simplicity. Avoiding unplanned delays could therefore be effectively used to curb cost / time problems.

Table 4.2.8: Do you perform Time Impact Analysis?

Response	Frequency	Percentage (%)
Yes	27	90
No	3	10
Total	**30**	**100**

Source: Field Research, April 2011

Results from table 4.2.8 shows that a majority of 90% of total respondents at BEROCK VENTURES indicated that they perform time impact analysis, whilst 10% said they do not perform time impact analysis. Lack of project appraisal could not be a source of worry to this people.

Table 4.2.9: Are you able to complete construction of projects within specified time period?

Response	Frequency	Percentage (%)
Yes	27	90
No	3	10
Total	**30**	**100**

Source: Field Research, April 2011

It is obvious from table 4.2.9 that out of a total sample size of thirty (30) project supervisors from BEROCK VENTURES, only 10% of the respondents said that they were unable to complete construction of projects within specified time period. Meanwhile, 90% of the respondents said they were able to complete construction of projects within specified time period. This implies that these supervisors are very conscientious with their planning.

Table 4.2.10: In your view, what is the essence of the award of time and cost from Time Impact Analysis?

Response	Frequency	Percentage (%)
To include compensation for acceleration	12	40
To include compensation for disruption in response to delay	18	60
Total	**30**	**100**

Source: Field Research, April 2011

From table 4.2.10, it is clear that 40% of the respondents indicated that the essence of the award of time and cost from Time Impact Analysis is to include compensation for acceleration whilst 60% indicated that the essence is to include compensation for disruption in response to delay. These project supervisors therefore to a large extent are not mindful to push projects as a panacea for preventing cost/ time negativities.

Table 4.2.11: Which of the following activities is important in cost/time assessment on project construction?

Response	Frequency	Percentage (%)
Finish the project in a predefined deadline date	23	76
Recover early delays	3	10
Avoid liquidated damages	2	7
Avoid adverse weather conditions that might affect productivity	2	7
Improve project cash flow	0	0
Total	**30**	**100**

Source: Field Research, April 2011

Results from table 4.2.11 indicate that 76% of responses said finishing the project in a predefined deadline date is important in cost/time assessment on project construction. 10% indicated recovery of early days as the most important activity, whilst 7% each indicated the activity of avoiding liquidated damages and avoiding adverse weather conditions that might affect productivity. There was no response for improving project cash flow. This implies all things being equal these supervisors would endeavour to finish their projects within agreeable time/ cost framework.

Table 4.2.12: Has your company attempted to deliver a project within a significantly shorter duration than a traditional project?

Responses	Frequency	Percentage (%)
Yes	25	83
No	5	17
Total	**30**	**100**

Source: Field Research, April 2011

Table 4.2.12 shows responses on whether their company has attempted to deliver a project within a significantly shorter duration than a traditional project. 83% said they have indeed delivered project within a significantly shorter duration than traditional project whilst 17% said they have not delivered a project within a significantly shorter duration than a traditional project. These supervisors therefore do not have problem with keeping to deadlines.

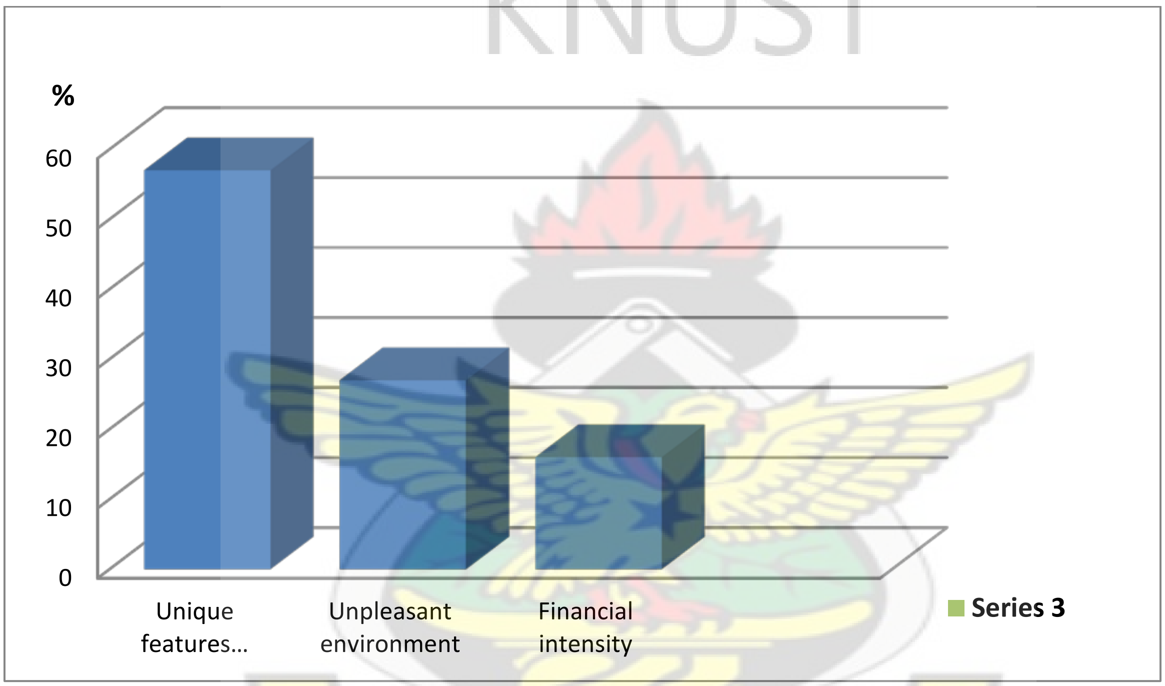
Table 4.2.13: Which of the following places your construction industry to more risks regarding cost and time assessment?

Responses	Frequency	Percentage (%)
The unique features of construction activities	17	57
Unpleasant environment	8	27

Financial intensity	5	16
Dynamic organization structures	0	0
Total	**30**	**100**

Source: Field Research, April 2011

Figure 4.2.13: Which of the following places your construction industry to more risks regarding cost and time assessment?



Source: Field Research, April 2011

With table 4.2.13 and figure 4.2.13, the project supervisors were asked to indicate which of the following places their construction industry to more risks regarding cost and time assessment. 57% majority of project supervisors indicated that the unique features of construction activities places their construction industry to more risks regarding cost. 27% said unpleasant environment whilst 16% mentioned financial intensity. None indicated dynamic organization structures. This implies the less unique the project is the less the cost/time problems.

Table 4.2.14: The impact of cost and time factors in project construction is to search for an optimal resource utilization plan that minimizes construction cost and time while maximizing its quality. Do you agree?

Response	**Frequency**	**Percentage (%)**
Agree	30	100
Disagree	0	0
Not Sure	0	0
Total	**30**	**100**

Source: Field Research, April 2011

Table 4.2.14 reveals that total respondents (100%) of project supervisors at BEROCK VENTURES agreed that the impact of cost and time factors in project construction is to search for an optimal resource utilization plan that minimizes construction cost and time while maximizing its quality. Optimization of resources (time, material, money etc) is key to solving the twin headed problem of cost/time in most construction projects.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF FINDINGS

Many project managers of construction industries have recently started to utilize innovative cost and time impact assessment methods that provide new incentives for improving construction quality. These emerging strategies place an increasing pressure on decision makers in the construction industry to search for an optimal resource utilization plan that minimizes construction cost and time while maximizing its quality (Frimpong 2003).

The main survey of project supervisors as discussed in this research work relates to the construction of projects in Ghana which focuses on assessing the cost and time impacts of construction of projects in the public sector.

In the light of the abovementioned issues, there is the need to consider the following observations:

The issue of cost and time to project construction is very important. Significant research advancements have been made in the area of assessing cost and time with the view of optimizing construction resource utilization.

These emerging contracts place an increasing pressure on decision makers in the construction industry to search for an optimal resource utilization plan that minimizes construction cost and time while maximizing its quality.

Cost and time impacts are inevitable on construction projects such that they are inherent in all of project construction's undertakings.

Construction of projects may not perform as anticipated because the owner may have unrealistic expectations regarding the time and cost of construction forcing contractors into unrealistic gambles, corner-cutting or commitments that may not be realistic.

The key objective of cost and time factors on project construction according to project supervisors is the minimization of project time and improvement of resource utilization.

83% majority of respondents indicated that Unplanned delays due to cost and time factors on construction projects are often regrettable but unavoidable. This may be due to challenges such as weather conditions etc.

It was revealed that the issue of cost and time impacts on project construction could be managed by evaluating using construction recognized and accepted methodologies and identifying and quantifying the overall impact to the project.

It was observed that cost and time factors impact on project construction through avoiding unplanned delays. This was indicated by majority of respondents.

The following activities are important in cost and time assessment on project construction;

- ✓ Finish the project in a predefined deadline date
- ✓ Recover early delays
- ✓ Avoid liquidated damages
- ✓ Avoid adverse weather conditions that might affect productivity

Unique features of construction activities places construction industries to more risks regarding cost and time assessment.

The delay or impact which occurs most frequently or often on construction projects is: A substantial increase in the scope of the work.

5.2 CONCLUSIONS

Traditional methods of procurement have been heavily criticized for their sequential approach to project delivery, as they have contributed to the so-called ‘‘procurement gap’’ whereby design and construction processes are separated from one another (Love et al. 1998). As a result, Love et al. 1998 suggest that behavioral, cultural, and organizational differences between project individuals and groups often prevail. In addition, the procurement gap between design and construction is considered to inhibit communication, coordination, and integration among project team members and can adversely affect project performance (Lahdenpera 1995; Evbuomwan and Anumba 1996).

Nontraditional methods such as design and build and construction management have been advocated as methods for overcoming some of the problems inherent in traditional methods NEDO 1988; Turner 1990; Masterman 1994, yet it would appear from these findings that their use is minimal. Sharif and Morledge 1997 provide a plausible explanation for the ubiquitous use of traditional methods by stating that most construction clients are small and occasional and therefore only ever build once or twice. Thus, an architect is typically the first point of contact for these clients and their advice is heavily relied upon (Mackinder and Marvin 1982; Sharif and Morledge 1997). Consequently, it is often in the interest of the architect to persuade the client to use a traditional method, as they can take a lead role in the project as well as maximize his or her fees. Traditional methods can provide clients with cost certainty, whereas design and build and construct management methods are often used when the pressure of early completion is imposed on the project (Holt et al. 2000).

The main conclusions of the survey are as follows:

Many projects experience extensive delays and thereby exceed initial time and cost estimates. In addition to impairing the economic feasibility of capital projects, extensive delays provide a fertile ground for costly disputes and claims.

According to the contractors and project supervisors, monthly payments difficulties from agencies was the most important delay and cost factor, while owners ranked poor contractor management as the most important factor. Despite some difference in viewpoint held by the project supervisors surveyed, there is a high degree of agreement among them with respect to their placing of the factors. The overall results indicates that the project supervisors felt that the major factors that can cause excessive project delays in developing countries are poor contractor management, monthly payment difficulties from agencies, material procurement, poor technical performances, escalation of material prices according to their degree of influence.

Delay in the delivery of materials and equipment to construction sites is often thought of as a contributory cause of cost overruns in construction projects in developing countries. A cursory examination of the environment in which projects are executed in developing countries appears to support this thinking according to project supervisors.

Construction delay has become endemic in Ghana. It is imperative to create awareness of the extent to which delays can adversely affect project delivery with regards to cost and time.

Forecasting project cost performance is a paramount important to the project controls process in construction industry. In making profits, today's construction organization requires an ability to predict, well ahead of time, project performance. Thus, necessary and timely corrective actions need to be taken if project lagged of time or exceed budget.

Other factors that emerged clearly as not very important, but of interest, are bad weather and unexpected natural events. These are the natural factors. The bad weather and unfavourable geological conditions are most difficult and unknown factors because they cannot be controlled.

The result shows that many of the problems in the construction of projects are originated from poor resources management (human, technical and material). In practice, this phenomenon is expected to continue unless actions are taken to control these causes right away from the planning to the implementation and management stages. Therefore, good practice in planning, coordinating, controlling and monitoring procedures needs to be recognized.

Accounting for each of the strategies explained in the survey, it is clear that there is still a need for innovative research in the area of forecasting systems in project construction with regards to cost and time. There is still lacking of many aspects in forecasting methods implemented by today's Project Managers. In a challenging construction industry nowadays, to have accurate forecasting methods require an approach that would cater subjective data and consider experts' experience and knowledge.

5.3 RECOMMENDATIONS

Based on this study, some recommendations are given as follows:

Appropriate funding levels should always be determined at the planning stage of the project so that regular payment should be paid to contractors for work done.

In order to improve contractors' managerial skills there is need for continuous work-training programs for personnel in the construction industry to update their knowledge and be familiar with project management techniques and processes. Have effective and efficient performances.

Effective and efficient material procurement systems should be established within projects. Material procurement has the potential to cause major delays to construction projects. Therefore, material procurement process should be executed properly by improving procurement process in order to avoid supply delays.

Developing effective and efficient technical performances in project construction through different types of training programs. The training should cover project planning, scheduling, time and cost control, and the information systems.

There should be adequate contingency allowance in order to cover increase in material cost due to inflation.

Employers or owners of projects should allow more time and funds for the study phases of projects.

Contractors should regularly try to identify and to bring to the attention of the client project risks such as an ill defined scope in the early stages (tender clarification meetings) of a project etc.

Project Managers must agree that delays or impacts which cause extension of time and/or increase in cost are a frequent occurrence in project construction.

Regarding cost and time factors in project construction, if the employer intends to gain the most advantage from the programme (optimisation), the cost and time should be prepared jointly by the contractor and consultant and be accepted as the baseline programme

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(APPENDIX A)

<u>QUESTIONNAIRE FOR PROJECT SUPERVISORS OF BOTH LESTAKO AND BEROCK COMPANY LTD</u>

This long essay is assessing the cost and time impacts of public sector construction projects. You are assured of your utmost confidentiality as its only purpose is to help improve and enhance construction of projects in Ghana.

Thank you for your participation.

<u>Please tick (√) where applicable</u>

1. How many years of experience have you gained in project construction?
   a. 5 Years (   )
   b. 10 Years (   )
   c. 15 Years (   )
   e. 20 Years (   )

2. How important is cost and time factors to project construction?
   a. Very Important (   )
   b. Fairly important (   )
   c. Not Important (   )
   Explain your answer……………………………………………………………………
   ……………………………………………………………………………………

3. Which is the key objective of cost and time factors on project construction?
   a. Minimize project time and/or improve resource utilization (   )
   b. Minimize time/cost for non-repetitive construction (   )
   c. Minimize time and/or cost for repetitive construction (   )

4. Unplanned delays due to cost and time factors on construction projects are often regrettable but unavoidable. Do you agree?

   Agree (   )   Disagree (   )   Not Sure (   )

5. What main factors influence causes of delay and cost in project construction?

…………………………………………………………………………………….

…………………………………………………………………………………….

6. How do you manage time and cost schedule of project construction?

   a. Evaluating using construction recognized and accepted methodologies (   )

   b. Identify and quantify the overall impact to the project (   )

   c. Other…………………………………………………………………………………

   Explain your answer……………………………………………………………………

…………………………………………………………………………………….

7. How does cost and time factor impact on your project construction?

   a. Increasing project simplicity (   )

   b. Avoiding unplanned delays (   )

   Explain your answer…………………………………………………………………

   …………………………………………………………………………………….

8. Do you perform Time Impact Analysis?

   a Yes (   )

   b. No (   )

9. Are you able to complete construction of projects within specified time period?

   a Yes (   )

   b. No (   )

10. In your view, what is the essence of the award of time and cost from Time Impact Analysis?

   a. to include compensation for acceleration (   )

   b. to include compensation for disruption in response to delay (   )

   Explain your answer…………………………………………………………………

   ……………………………………………………………………………………..

11. Which of the following activities is important in cost/time assessment on project construction?

   a. Finish the project in a predefined deadline date (   )

   b. Recover early delays (   )

   c. Avoid liquidated damages (   )

   d. Avoid adverse weather conditions that might affect productivity (   )

e. Improve project cash flow ( )

12. Has your company attempted to deliver a project within a significantly shorter duration than a traditional project?

a Yes ( )

b. No ( )

If No, which factors were responsible, Explain your answer……………………….

………………………………………………………………………………………

………………………………………………………………………………………

13. What relationship exists between cost and time in construction of projects?

Explain your answer…………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

14. Which of the following places your construction industry to more risks regarding cost and time assessment?

a. The unique features of construction activities ( )
b. Unpleasant environment ( )
c. Financial intensity ( )
d. Dynamic organization structures ( )

15. The impact of cost and time factors in project construction is to search for an optimal resource utilization plan that minimizes construction cost and time while maximizing its quality. Do you agree?

a. Agree ( )
b. Disagree ( )
c. Not Sure ( )