TIME OVERRUN AND COST EFFECTS OF TAILINGS STORAGE FACILITY (TSF) CONSTRUCTION PROJECTS IN GHANA

By

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DECLARATION

I hereby declare that this submission is my own work and that to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which to substantial extent has been accepted for the award of any other degree or diploma at Kwame Nkrumah University of Science and Technology, Kumasi or any other educational institution, except where due acknowledgement is made in the thesis.

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ABSTRACT

Construction project time overrun is endemic and bears both direct and indirect cost implications to project budgets. This thesis seeks to, by questionnaire measure and through empirical method assess the percentage cost escalation of TSF projects that have overran their agreed upon completion dates. Data was obtained from 56 respondents comprising of contractors (51.8%), consultants (28.6%) and clients (19.6%). Of the total respondents, 23 were project managers, 20 were Civil Engineers, 8 were Quantity Surveyors, 5 belonged to other group of professionals. The study reveals that time overrun is frequent in TSF construction projects which is indicated by 86% of respondents who indicate time overrun was experienced by their projects. 57.1% of respondents asserted that their projects overrun cost by less than 5% of the project budget due to time overrun factor. 25% of surveyed respondents indicated their projects overran cost by 5% of their project budgets, 12.5% overran 10% of their TSF project budgets whiles 3.6% overrun cost at 15% of their project budget. Generating a predictive model for time overrun from the survey data revealed capacity, project duration and project budget as independent variables and time overrun as the dependent variable. The mean variation between time overrun and capacity of TSF, project duration and project budget in relation to construction projects in Ghana are equal hence the acceptance of the null hypothesis. Twenty-one (21) factors were identified by all respondents as cost factors that emanate as a result of poorly managed time overrun causes by industry practitioners. The highest ranked cost effect was identified to be Claims (ranked 8.21) with a standard deviation of 0546. Traditional contracting is ranked the most effective procurement system for time overrun mitigation partly. The use of effective procurement systems and the possible mitigation of time overrun causes be timeously made in order to curtail the effects of cost incurred due to time overrun in TSF construction projects.

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DEDICATION

To my loving and supporting family for their unflinching support and uplifting encouragement.

LIST OF ABBREVIATIONS

ANCOLD	Australian National Committee on Large Dams
BOT	Build, Operate and Transfer
BOO	Build, Own and Operate
BOOT	Build, Own, Operate and Transfer
CM	Construction Management
CPM	Critical Path Method
EVM	Earned Value Management
GDP	Gross Domestic Product
ID	International Development
KNUST	Kwame Nkrumah University of Science and Technology
LADs	Liquidated and Ascertained Damages
PERT	Program Evaluation and Review Technique
PFI	Project Finance Initiative
PM	Project Management
PPP	Public Private Partnership
TSF	Tailings Storage Facility

CHAPTER ONE

INTRODUCTION

1.1 Background

A tailings storage facility (TSF) is a structure generally constructed using earth and assembling other structures that make up a complete facility principally for the motivations behind putting away or seizing the uneconomical mineral (ground shake, sand and residue), water from the processing procedure and harmful synthetics used to separate the profitable materials from the metal. ANCOLD (2012).

Tailings are the materials left over after isolating the important bit of minerals from the metal extricated from the earth. Tailings can be as fluid, strong, or slurry of fine particles. Acheampong (2016).

The capacity and treatment of tailings is an ecological issue around the world. Transfer of mine tailings is generally the greatest natural concern confronting the mining business, and makes extremely long haul ecological liabilities which future ages must contend with. ANCOLD (2012).

Numerous tailings are harmful and must be kept unendingly detached from nature. Size of tailings generation is tremendous, since metal extraction is normally just ounces or pounds, for each ton of metal. Harvey and Plewes (2003).

According to Paull et al. (2006) as cited by Acheampong's 2016 study of harmful synthetic compounds used to extricate the important materials from the mineral, for example, the cyanide utilized in gold mining, stay in the tailings and may filter out into ground water if not appropriately taken care of.

Tailings Storage Facilities are subsequently deliberately built to securely store the tails from mineral preparing. Tailings storage facilities are viewed as the world's biggest man-made structures. Harvey and Plewes (2003).

With the current expanding interest for gold, creation has gone up, along these lines expanding altogether the measure of tailings produced by individual mining ventures and by the mining business overall. Tailings are delivered in enormous amounts every year, and may contain some poisonous synthetic elements that are destructive to the earth. Acheampong (2016). Therefore, Tailings storage facilities ought to thusly give sheltered, steady and prudent stockpiling of tailings so that presents immaterial general wellbeing and dangers and acceptably low social and ecological effects during activity and post-closure. Kurylo, Rykaart and Wade (2013).

Tailings storage facilities construction projects depending on their size usually require some length of time to be constructed. The construction process of these facilities requires expertise from all three project management organizations: Sponsor, Consultancy and Construction organizations. Each of these is distinguished from the other by their contribution towards the success of the TSF project. Sarfo (2007).

A project is termed successful if it has achieved technical performance, stayed within budget and completed within time. Other success factors are unmentioned because of the dire consequences quality, cost and time have on mining projects if poorly managed. Effective project cost and schedule management are essential elements of the success criteria of TSF construction projects considering the limited duration project team members are presented with in most cases. Changes are inevitable in construction processes. However, poorly managed changes may have significant negative effects on cost and schedule successes. Key issues challenging the construction industry are project

delay and cost overrun. Considering contemporary competitive business environment, project completion within budget and time is becoming increasingly important. Senouci, Ismail and Eldin (2016).

1.2 Problem Statement and Relevance of Study

The aspirations of every investor are based on proven strategies for value creation and expect that managers of their investments exploit opportunities that will augment the successes of any ventures and effective time management is no exception in the contribution to value creation.

Introduction of various schedule control software such as Asta Power Project, Microsoft project, Primavera etcetera has increased efficient schedule management increasing success levels of projects. Time and cost control is paramount to successful project delivery, time however in the mining sector time is prime to both investors and employees of mining firms. In the mining sector, efficient management of TSF construction projects plays a major role in boosting investor confidence to a large extent and consequently enhances the economic benefits a nation like Ghana derives from mine operations.

Despite the development of project management tools, large construction projects such as the TSF projects still suffer project time overruns which by extension directly impacts project cost. Othman, Shafiq and Nuruddin (2018).

There have been numerous studies with regards to time and cost overruns of construction projects, however, cost margins of time overran projects give the reason for the study into cost incurred due to time overrun. This will give an understanding to project teams

to enable them adequately manage their projects to stay within schedule, and on budget since time and cost are elementary to project performance measurement.

Ascertaining the significance of time overrun on critical success factors and ranking them will advise project teams on main focus areas in project execution.

Identifying efficient schedule and cost management practices of TSF construction is relevant in informing project team members to better prepare against challenges that may impede project completion timelines during execution to enhance the success of the project which eventually will prudently safe guard jobs for mine workers.

1.3 Aim

The principal aim of this study is to determine the percentage cost escalation of TSF construction projects that have overran their scheduled completion time.

1.4 Objectives

The foregoing objectives will guide in achieving the aim of this study:

- To generate a predictive model for time overrun of TSF construction projects.
- Identify the significance of some critical causes of time overrun in their contribution to time overrun of TSF construction projects.
- Determine the effectiveness of procurement methods used in delivering TSF projects in mitigating time overrun.

1.5 Research Questions

- Can the amount of delay to a project be predicted if the project duration, project budget and the capacity of TSF are known?

- Of the general causes of construction time overrun, are some of them more impactful on time overrun?
- How effective are various procurement methods employed in delivering TSF construction projects in mitigating time overrun?

1.6 Hypotheses

1.6.1 Hypothesis #1

There is increase in project cost of TSF projects that overrun the agreed upon dates by parties.

1.6.2 Hypothesis #2

Time overrun causes vary in their impacts to one another.

1.6.3 Hypothesis #3

Procurement methods vary in their effectiveness towards the mitigation of time overrun of TSF construction projects.

1.7 Justification of Study

With the gap knowledge in desk study and the succeeding review of literature, a predictive determination of the project time extension of TSF projects taking into account originally estimated duration of project and obtained cost variance data from respondents will help in the prediction of time overrun. Independent variables such as cost variance, capacity and project duration will single handedly be analyzed to understand the percentage of project budget that is expended owing to time overrun. Considering the fact that every project is unique, each project with its time overrun may have its

attributable causal factors but will nonetheless fall under either internal or external factors of time overrun.

Of all the causes of project time overrun: Internal and external factors, client, contractor and consultant related causes. There are overlapping causes that cut across most of the group of causes. Similar causes that run through all groups have been considered as one cause in this study to avoid repetitions. The frequently mentioned causes in literature are also considered the most critical causes of time overrun. Some are however critical and more significant in their contribution to time overrun than others. A comprehensive assessment of the causes of time overrun by identifying their significance will well inform industry practitioners to channel their efforts and resources in addressing the most influential causal factors to maximize results.

The inability of some organizations to self-perform certain project activities calls for the acquisition of goods, works and services from outside the performing organization. Failing to procure rightly is in itself a recipe for disaster. Often times, the wrong procurement methods are applied in the execution of projects which also contribute to project time overrun. Understanding the effectiveness of procurement methods will aid in mitigating time overrun.

1.8 Scope of Research

The focus of this research is centered on three objectives: Obtaining cost variances of TSF projects for the generation of a predictive model to determine time overrun, identifying the significance of critical causes of time overrun of TSF construction projects, soliciting views of respondents on ranking the procurement systems in their effectiveness in mitigating time overrun. The aimed at the determination of the margin

of cost with respect to time overran projects considering that cost is a basic component for any project. Of the Ghanaian construction industry, focus is on TSF construction projects owing to their relevance in the mining industry.

1.9 Limitations of Research

- Considering the availability of time to investigate the study area, time constraint was a factor that did not allow deeper examination into this study.
- Respondents targeted are construction professionals involved in TSF construction projects. Questionnaire administered may not be by filled out by target respondents.
- Respondents may not consider how important this exercise may be, hence the likelihood of seeing this exercise as a mere "tick and go".
- Questionnaire administration was characterized by initial unwillingness by respondents but was however overcome by persistence and assurance of utmost confidentiality.

1.10 Benefits of study

- Projects having cost and time as their prime objectives have their performance measured against these as critical success factors. Having all three variables: facility capacity, project duration, project budget can always help in predicting time overrun that will be experienced on projects and inform industry players of the effect of a change in project time, project budget and facility capacity on the project.

- A knowledge of the significance of the critical delay causes would alleviate chronic poor performance of cost and time of the construction industry which ultimately affects project performance.
- Evaluation of procurement methods in time overrun mitigation will well advise project teams of the type of procurement models to consider in their projects delivery.

1.11 Research Methodology

All three methods have been employed in similar studies pertaining to the subject areas, time and cost. However, Qualitative and quantitative methods of research have been employed in conducting this study. In the conduct of this study, a questionnaire was structured in a way to enable proper collection of data advantageous to this study.

Objective one (1) of this study was best addressed using both quantitative and qualitative approaches.

Objectives two (2) and three (3) were addressed by only quantitative method to give a better understanding of the significance of causes of time overrun time overrun and determine the effectiveness of procurement methods in addressing time overrun respectively.

In this, the statistical tool, SPSS was employed in the analysis of data obtained.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview of Time Overrun in the Construction Industry

Auspicious completion of projects is one of the key criteria in measuring the performance of a project irrespective of the industry. The construction industry in Ghana is ever changing and plays a pivotal role in the development of the nation and for this time of the essence. Ghana is a developing country and has construction being one of the consistent contributors to its gross domestic product. Similarly, the construction industry contributes significantly to most economies globally and a clear example is the Malaysian economy as cited by Othman et al (2017) as described in Endut and Keely (2005): The Malaysian construction industry consistently contributes approximately 3% to 5% to the GDP of Malaysia.

Qatar's construction industry is shown to contribute 2.7% to the non-hydrocarbon GDP growth as indicated by in Senouci et al. (2016). Delays consequently were accounted to be 72% in new constructions projects and termed a nightmare for Qatari national economy because of the hold back of the construction industry.

In any construction project, the aim of the project team is to make sure projects are timely completed, within allocated budget, and to the specified and required quality. A successful project is described as one that has achieved its specified requirements, stayed within budget and right within the allotted time. Othman et al (2017). Project schedule is very dire to the success of any construction project as each day of time overrun directly impacts the cost of projects. Aibinu (2002) reports in his study that 7 out of every 10 projects in Nigeria suffered delays, 70% of large construction projects in Saudi Arabia

also experienced time overruns as well and range from 30% to 50% of United Arab Emirates encountered delays.

From Ahsan and Gunawan (2010), International Development (ID) projects were studied and on the average 86% of project are completed behind schedule by almost 2years. International Development projects take approximately 39% more than planned average project time to complete.

Time overrun can be described as an extension of project time beyond the agreed upon duration in a contract. Also defined by Ahsan and Gunawan (2010) and Mukuka et al., (2015) as the "difference between the actual completion time and estimated completion time". Project time overruns which are an extension beyond planned project completion date also impact projects budget. Time overrun causal factors include unavailability of resources, inclement weather delays etc. Generally, project time overrun cause external and internal effects and affect relationships. Battaineh and Odeh (2002). Conclusively, time overrun has debilitating effects on both project owners and contractors which often raises contentious delay responsibilities that provide fertile grounds for claims.

2.1.1 Classifications of Time Overrun (Delay)

Excusable, concurrent and critical delays have both internal and external impacts on project processes. Internal delays arise out of causes that come from the owner, designer, contractor and consultants whiles the external causes emanate from government policies, suppliers, labor unions, nature etc. The figure below is the types of delays identified by Naikwadi and Khare (2007) in one of their studies.

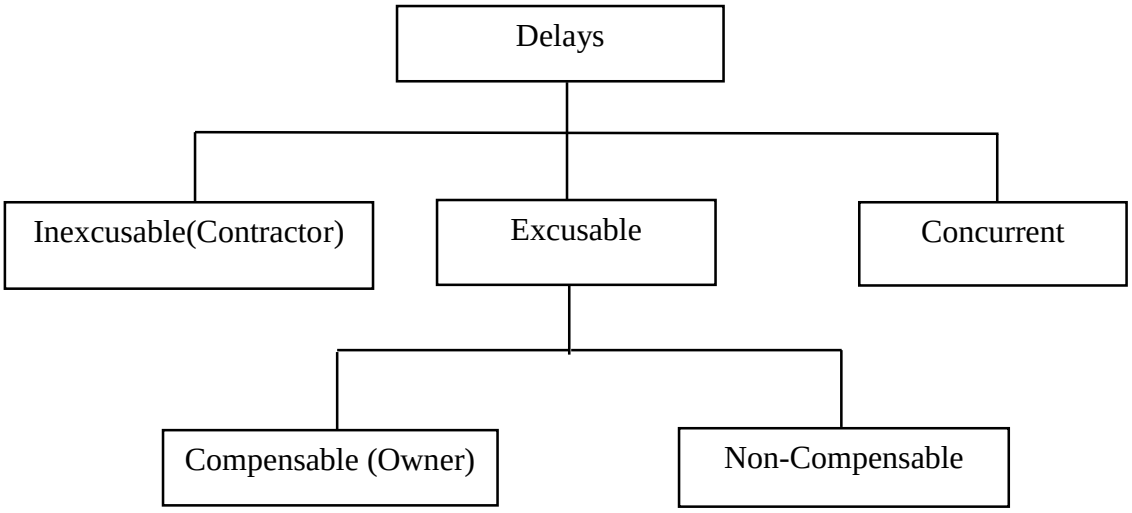

Figure 2.1: Types of delays (Naikwadi and Khare, 2007)

2.1.1.1 Excusable Delays

Excusable delays are unforeseeable events outside anybody's ability to control which are additionally separated into compensable and non-compensable delays. On the off chance that the delay is compensable, the contractor is qualified for extra money related remuneration just as considered for time extension. In instances where the non-compensable excusable delay occurs, the constructing party is considered for project time extension without financial compensation for additional work carried out. Excusable delays also known as “force majeure” delays are delays caused by “acts of God’s and are not the faults of any party. Ahmed et al. (2003). Also identified in their study, is that excusable delay are the most common type of delays. Most agreements permit to obtain a project schedule extension for excusable delays, but with no extra payments. Alaghbari et al. (2007). Owner induced delay however addresses some potential compensable delays and gives some fair modifications. Some compensable delay factors that are addressed in agreements include changing site conditions and suspension of work.

2.1.1.2 Concurrent Delays

Concurrent delays occur when both the contractor and the project owner both contribute inextricably to the delay. A more typical but very complicated situation that results from a single issue. In this kind of situation, it is usually fairly easy to calculate both time and cost resulting from that single issue. More than one factor defers the project simultaneously or in covering time frames. When these type of delays occur neither the contractor can be forced to accelerate the construction schedule nor is held for LAD nor would he be able to recuperate the delay losses from the client. Until the development of a Construction-Procurement-Management schedule analysis, there was no reliable method to differentiate the impact of contractor caused delays from owner caused delays. It has become easy due to sophisticated computerized techniques to reliably separate the impacts of evidently concurrent owner and contractor delays. To analyze a concurrent time overrun claim, the constructing party's approved schedule should be compared with his as-built schedule to distribute legitimate obligation regarding the delay. This is because the critical path may shift as the project progresses. Alwi et al. (2002).

2.1.1.3 Critical delays

Critical delays are delays that affect progress of project time by affecting the completion date of a project. Non-critical delays are those that affect activities that are not in the critical path of the construction programme. This poses setbacks to activities if they do not have slacks. Abdul-Rahman et al. (2006).

2.1.2 Project schedule management tools

Successful projects should be completed before or on project schedule however this limit is often surpassed. There may be significant variance between assumptions and actual

outcomes. Despite the development of project management tools such as Gantt chart, Program Evaluation and Review Technique (PERT) and the Critical Path Method (CPM), large construction projects still suffer project time overruns which by extension directly impact project cost. Othman, Shafiq and Nuruddin (2018). Resource Optimization Techniques involve the scheduling of activities and resources required by those activities taking into account resource availability and project time. Schedule compression deals with either fast tracking or crashing a schedule for the remaining works after an evaluation of the project's performance. For effective schedule management of construction projects, the critical path method is used for all types of projects such as construction, engineering etc. The critical path method is used to determine the time-cost trade off activities that meet given completion times for projects at minimum costs especially where there are similar experiences from previous projects. Jongyul (2010) cited by Deckro et al. (1995) contends that project crashing is not desirable if there is a concern over quality degradation more time should be allowed to finish the project advised.

2.1.3 Causes of Time Overrun of Construction Projects

Consequences of construction time overrun affects all parties coupled with cost issues and usually leads to adverse effects on the growth of national economies. Although various methods have been identified for mitigating this major problem in the construction industry, limitations of using these methods raise concerns that probably do not address the problem adequately.

In a study by Ahmed et al. (2003) two types of delay causes were identified as

i. Internal causes
ii. External causes

These are termed as delays resulting from actions of all parties involved in the construction process and include the contractors, client, designer, and experts. Delays not arising out of these causal factors are described as external causes and may result from national policies and regulations, material suppliers or inclement weather.

Generally, construction time overrun causes were divided into 3 categories namely:

- Those over which none of the parties to an agreement has no control
- Those over which the client has control
- Those over which the contractor can control

Predominantly, factors influencing time overruns have been categorized by various researchers such as Ahmed et al. (2003) and Alaghabri (2007) to fall under four (4) categories:

i. Delay by Contractor's Obligation

Factors that relate to contractor's obligations in the contribution to delays include delay in material delivery, labor shortage or shortage of material on site, defective work, equipment and tool shortages, financial incapability, poor skills and inexperienced labor, low productivity, poor coordination with others, inexperienced subcontractors, lack of site staff, and poor site management.

ii. Delay by Consultant's obligation

These are causes that arise out of consultant's inability to properly manage issues which results in contributing to time overrun of projects. They include slow supervision in decision making, incomplete documents, absence of consultant's site staff, inexperienced consultant's staff and slowness in instructions.

iii. Delay by Client's Obligation

These are factors that are either directly or indirectly attributed to construction time overrun on the part of the client. They have been identified to be poor coordination with contractors lack of working knowledge, modifications in contracts, slow decision making process and financial problems.

iv. External factors

Poor site conditions, transportation delays, lack of materials on the market, poor economic conditions, lack of equipment and tools on the market, poor weather conditions, changes in laws and regulations, and external work due to public agencies are considered as external factors that also contribute to construction project time overrun.

Olawale (2010) identified and discussed top five (5) time overrun inhibiting factors to include; design changes, risks and uncertainties, inaccurate evaluation of project time/duration, complexities and non-performance of subcontractors.

Assaf (2006) and Battaineh (2002) also classified time overrun causal factors into eight groups namely; contractor, contractual relationships, owner, consultant, material, labor and equipment, contract and external factors.

In Mahamid and Ibrahim (2011), major categories that caused time overrun have been identified as

- Poor resource management
- Rework
- Insufficient inspectors
- Delays in commencement
- Poor communication between construction parties

Mahamid and Ibrahim (2011) identified financial factors being the most common causes of delays in Malaysian construction projects whiles coordination problem being the second delay causing factors followed by material problems. Chan et al. as cited by Mahamid and Ibrahim (2011) identifies poor site management, supervision, unforeseen ground conditions, low speed of decision making involving all project teams, variation arising out of client's initiation and necessary variations of works.

Odeh and Battaineh (2002) in their study also acknowledged that time overrun in the construction industry of developing economies are settled mainly into three (3) layers:

- Incompetence of contractors
- Client and consultant induced problems
- Shortages or inadequacies in industry infrastructure, mainly been supply of resources

In this study, time overrun are seen to be extensive and have an average ratio of actual completion time to planned contract time of 160.5%. This indicates the extent of time overrun experienced on construction projects. Consequently, the client's contribution is ranked higher relative to all other factors mainly because the client plays a pivotal role in the construction process. Financing issues and owner interferences are key to both parties; contractor and consultant. The contractors' contribution is as well considered by both contractor and consultant indicating that inadequate experience, poor subcontractor management and improper planning are causal factors to the contractors' contribution to time overrun.

Assaf and Al-Hejji (2006) in their study of large building projects in Saudi Arabia established that the most important time overrun causal factors are:

- Approval of shop drawings
- Delay in contractor's payments
- Design changes
- Subcontractors' work schedule conflicts
- Slow decision making process
- Executive bureaucracy
- Design errors
- Inadequate labor skills and shortage

Mukuka (2015) summarizes time overrun causes in to financial problems, late payments for completed and on-going work, change orders and organizational changes.

Kaliba, Muya and Mumba (2009) in their study of cost escalation and schedule delays in road construction projects in Zambia established that inclement weather due to heavy rains and floods, scope changes, environmental protection, and mitigation costs, schedule delay, technical challenges, inflation and local government pressure as the major causes of cost escalation and on the other hand contract modification, changes in drawings, delayed payments, economic problems, staffing problems, equipment unavailability, materials procurement, poor supervision, construction mistakes, financial processes and difficulties on the part of contractors and clients, poor coordination on site, changes in specifications, labour disputes and strikes were found to be the major causes of schedule delays in road construction projects.

2.1.4 Effects of time overrun

Mukuka (2015) acknowledged extension of project time, cost overrun, loss of profit, disputes and claims, poor quality of work due to hurrying construction processes, stress to owner, acceleration losses, bad reputation with construction team are the major effects of project time overrun. Time overrun effects are most likely experienced when the causes of time overrun are not effectively worked on. In this study, twenty (20) effects were identified to negatively impact project schedule overrun.

Ramanathan (2002) in his study presented effects of time overrun as having a debilitating effect on contractor and consultants in terms of growth in their adversarial relationships, mistrust, arbitration, litigation, cash-flow issues and a general feeling of trepidation towards stakeholders. These effects are said to cut across the global construction industry.

Time overrun causes dissatisfaction to all parties involved in construction projects since every party has a pinch of these effects ranging from cost overrun to the client and stress to contractor in efforts to accelerate project schedule.

2.2 Contribution of Procurement Systems to Time Overrun

Different procurement types have been introduced to the construction industry over the years and have undergone different stages in their evolution. Vast majority of construction projects before Second World War (1939) were procured by conventional methods which remained unchanged for over 150years. Rahman et al. (2017). Management-oriented methods were fully developed in the 1970s in the UK due to economic recession at the time. Consultative design and build also developed in the 1970. Rahman et al. (2017). Relationship-based methods that are centered on the concepts of teamwork, integrated teams and framework arrangements became prominent in the late 1990s and early 2000s. Mc Dermot and Khalfan (2006).

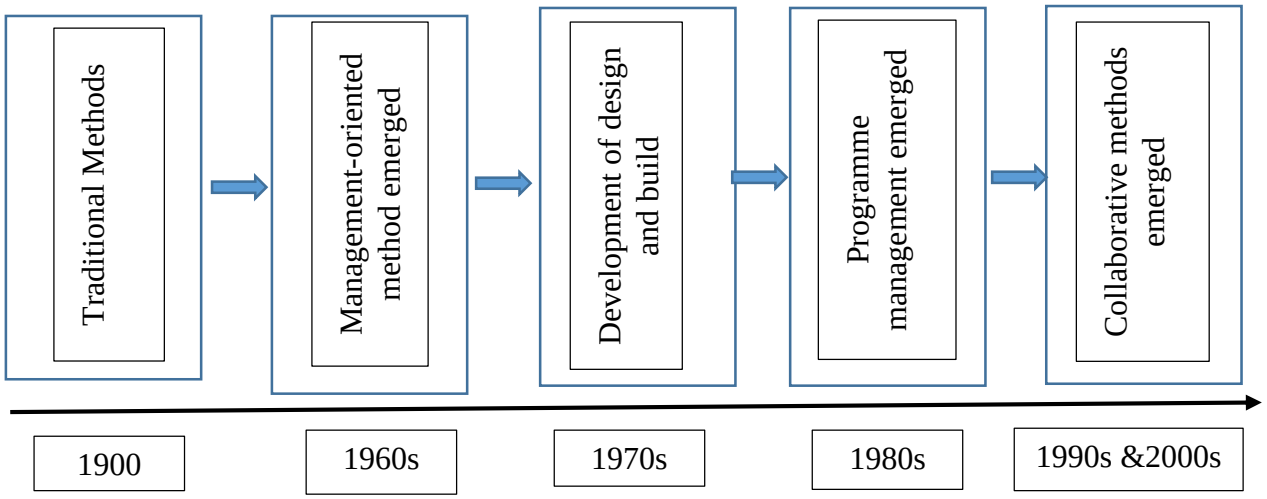

Figure 2.2: Evolution of procurement Methods (Rahman et al.2017)

It is axiomatic referring to a construction projects as successful when measured against schedule budget and quality standard having achieved high level of client satisfaction. The fulfilment of these criteria is increasingly associated with procurement method of construction as the selection of an appropriate method can shape a project's success. Generally, projects are challenged with time overrun factors caused by separation of design from construction, lack of integrity, lack of effective communication, increasing project complexity which has construction professionals and the industry to resort to alternative means of construction procurement methods. Naoum and Egbu (2016). One major reason to construction project failure is attributable to deteriorating relationships amongst project teams perhaps resulting from the conventional approach used in procuring partners using the competitive tendering based contracts with no consideration to relational links in the partner's procurement route.

Naoum (2015) defines procurement as "a mechanism for linking and coordinating members of the build team together throughout the building process in a unique systematic structure, both functionally and contractually. Functionally, via role, authority power and contractually, via responsibilities and risks. The main aim is to deliver a project that meets the objectives and fulfil the client criteria and expectations". Certainly, a proposition that the impact of time overrun causes may vary significantly between procurement options: Traditional procurement, Public Private Partnership (PPP), Design-Bid-Build, Design and Build, Build-Operate and Transfer etcetera may be true and can be confirmed in the conduct of this study.

Masterman (2002) cited by Rahman et al. (2017) classified procurement systems into four broad groups:

- Separated procurement systems
- Integrated procurement systems
- Management-oriented procurement systems
- Discretionary/ Collaborative systems

Under the separated method, the traditional design-bid-build typically should have all designs completed before inviting competitive tenders and main construction contract awarded. Clients have the privilege to influence the development of the design as they have direct contractual relationships with the design team. Assuming no changes are introduced, construction costs can be determined with certainty before the start of construction process. If plans go contrary, the likelihood of post contract changes my cause delays to the progress of works and increase costs. Rahman et al. (2017).

The integrated method sometimes termed “design and build” is described as the use of a single contractor who acts as a sole point of responsibility on lump sum fixed price basis. This contractor is responsible for the design, management and construction project delivery, on time and within budget in accordance with predefined requirements.

Thirdly, the management-oriented method systems described by Rahman et al. emerged owing to the need for developers to take more commercial risks on construction projects than that of the case of general contracting. This type of procurement allows for the owner to contract the design management and consortium to a contractor considering a route where early start and completion is paramount to the client’s requirement. This system has two main categories, namely management contracting and construction contracting. Rahman et al. (2017).

Lastly, the collaborative system as the name suggests requires that all parties involved in the work together for benefit of the project rather their individual interests. The collaborative approach is characterized by an agreement of good faith and aims to achieve an established working relationship between stakeholders which by nature helps mitigate rigid contractual and instrument, and misalignments of project stakeholders. Rahman et al. (2017). It also facilitates team working across contractual boundaries by improving resource optimization by each party through a structured management approach.

2.3 Traditional contracting and its influence on project time

Conventional approach to procurement involves discreet design development, award of contract and construction delivery phases. Traditional procurement systems despite their

long lead-in preparation, pose certain risk factors to project delivery with time overrun not being an exception. Fundamentally, risks are transferred almost completely on the contractor under the various procurement delivery systems embracing the conventional system; traditional lump sum, fixed price, firm fixed price etc. Derek and Keith (2003).

Doloi (2012) describes traditional contracts as being characterized by formal relationships among parties which regularly bring about a distinction of feelings on undertaking issues that grow into disputes and potentially costly legal wrangles. Such conflicts end up contributing to unwarranted delays projects and unnecessary costs which could be avoided.

The traditional procurement method produces a culture of defensiveness with parties spending some amount of time and money to protect their contractual obligations. In the case of a conflict, parties focus on blame gaming than finding workable solutions. Naoum and Egbu (2016).

With traditional procurement process, low tender submissions may result in contractors pursuing claims and inflated measurements to recover losses. Inefficient project time management can result in time extension. Advantageous to the traditional contracting are design certainty, fair or manageable allocation of risks, simplicity and transparency though it is short changed by low speed, design separation from productivity, and inability of profit making. Love et al. (2016).

2.3.1 Total Package Procurement and its influence on Project Time

In this procurement option a client project need is satisfied by an entity that contracts to design, build, operate, own and transfer completed project back to the owner. This type

of package is also classified into Build-Operate-Own- and Transfer (BOOT), Build-Operate-Own (BOO) and Build-Operate and Transfer (BOT). BOOT projects require contracted parties to accept the conventional wisdom that risk should be assumed by the party within while control of the most risk. Derek and Keith (2003).

Design and build system can be wholly completed by at the design and build entity or partly through subcontractor agreements. This system of procurement is critical and can be complex than other delivery systems. Consequently, other researchers have argued that the low bid selection is not the most appropriate approach to procure a design and build team. Elwardani (2006).

Private sector finance procurement methods term public private partnership (PPP), private finance initiative(PFI), design-built-finance-operate and build-own-operate-transfer used interchangeably in different literature but refer to similar forms of project procurement. The underlying principle PPP is the use of private sector finance for design, construct and maintain or operate public projects. The process begins with a project initiator inviting outlined bids from selected organizations that comprise of funder, contractors and operator. The successful tenderer enters an upstream agreement with the owner and a downstream agreement with constructors, suppliers and service providers. Derek and Keith (2003). Patel and Robinson (2010) as cited in Hampton et al. (2016) established that a typical PPP models involve private consortiums constructing and operating the facility for a period of thirty (30) years.

2.3.2 Construction Management (CM) and Project Management (PM) and their influence on Project Time

Under the CM method, the contractor plays the role of a consultant and builder providing significant advice on design practicality and expected construction methods. CM has two forms: Agency and direct. The agency CM applies where a CM undertakes works as a consultant for a fee providing constructability advice and coordination of the works. The second CM form is the direct CM, employed when design is sufficiently advanced to address risk adequately and CM undertakes works for a guaranteed maximum amount or at negotiated price. Derek and Keith (2003). CM has some advantages that help obviate the risk of time overrun of project schedule include:

- Fewer contract variations
- More even development of documentation
- Overlap of design and construction phases
- Early involvement of construction management expertise
- Reduced confrontation between design team and construction team

PM generally assumes responsibility for design coordination and supervision of those undertakings work packages. The PM will use a persuasion power to influence others to carry out their duties of responsibilities are not backed by contract. Major decisions are directed at the owner for formal approval. PM teams have arm's-length relationship with both design and construction teams. Derek and Keith (2003).

2.3.3 Novation and its influence on Time Overrun

RAIA (1991) cited by Chan and Ma (2003) describes Novation contract as a form of Design and Build contract which allows the client to initially employ a consultant's team to execute a design and documentation such that the needs and intent are clearly identified

and documented. On the basis of the design brief, bids are invited for the selection of a contractor where the client novates the consultant agreements to the contractor to take responsibility of the project to completion. Waldron (1993) in Chan and Ma (2003) contends novation process into two distinct stages:

2.3.3.1 Pre-novation stage

There is an established agreement between the client and the consultants after the client initiates the project by commissioning design consultants to develop design brief and start the design work. The design consultant completes the design to a stage meeting all requirements to a level of "legal clarity". 30-80% of the overall design and requirements are normally defined, drawn and specified. After the achievement of "legal clarity stage", the client is poised to call for bids from contractors to undertake the completion the design and construction process. Waldron (1993).

2.3.3.2 Post-novation Stage

After the selection of a successful bidder, the contractor has a direct contractual link with the client and design consultant. At this stage the contractor becomes the designer and is responsible for design works and construction process as well, and is responsible for the payment of the consultant instead of the client. The distinction between a novated contract and a design and build contract is that whiles the contractor in a design and build contract has the luxury of choosing his preferred consultant, the contractor of a novated contract has no choice of choosing but to employ services of the designated consultant. The detailed design phase allows the involvement of the contractor to implement changes to the design that suit material or labor availability. The contractor's

obligation is to keep the client informed of any modifications whiles maintaining the prime responsibility of meeting requirements and performance criteria. Waldron (1993)

2.3.4 Sequential negotiated work packages-On call contracting

The client initially signs a master contract with a consultant and divides the project into manageable task orders released to the consultant in phases based on the premise that the owner has more expertise of the work than the consultant at the commencement stage of the project whiles the consultant also has more expertise of the execution stage. Advantages of this system are that design packages are frozen into discreet task orders. It also allows for sufficient planning and budget controlling of work packages as if it were mini-contracts. If the contractor is not available or cannot meet schedule requirement, a second contractor is given the opportunity to negotiate that task order. Greater detailed planning is effective in this system of procurement and inures to the benefit of considerable time overrun reduction due to the not very high client influence over design and procurement type. Derek and Keith (2003).

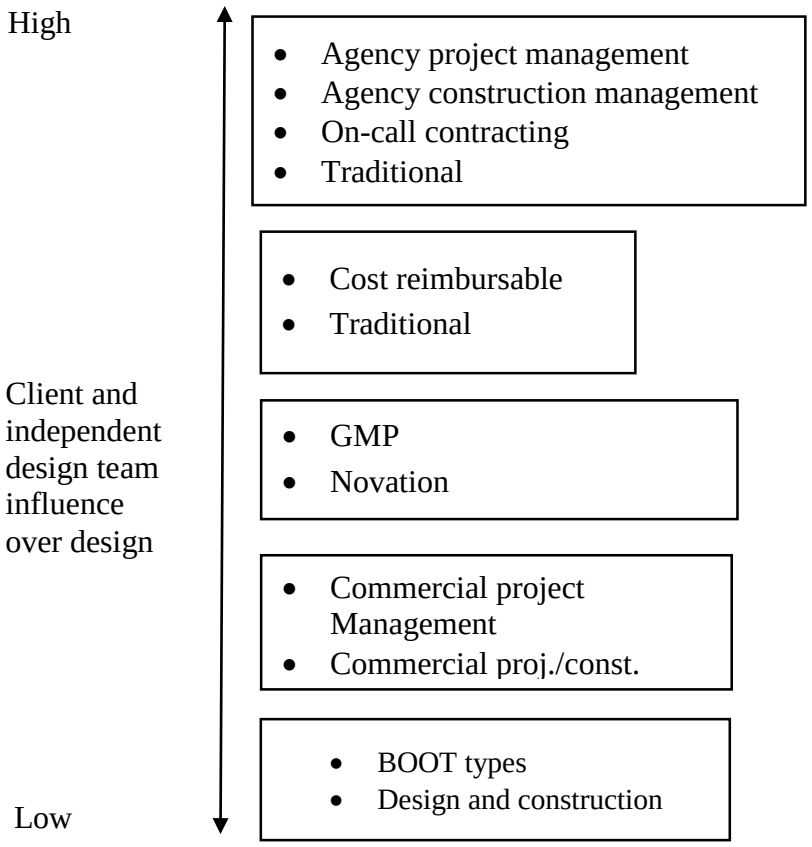

Figure 2.3: Client influence over design and procurement type (Derek and Keith, 2003).

2.4 Project Cost

Cost is considered the most significant success driver of projects. Memon (2011). Direct project costs include labor, material cost, equipment and subcontractor's costs. Indirect costs also termed overhead costs is the cost of doing other works that cannot be directly related to a particular activity of a project. Direct cost equals the sum of direct costs of project activities. Total project cost considers costs of project activities. Notwithstanding proven significance of cost management, most construction projects are faced with poor cost performance when executed resulting in several severe consequences. Reliable estimates are essential for effective project budget control and cash flow management. Memon (2011).

2.4.1 Cost Control Techniques of Construction Projects

Otim, Nakacwa and Kyakula (2012) in their study established that of one hundred and thirty (130) building construction contractors in Nakawa, Kampala city identified cost control techniques being used by developers as seven (7) techniques: schedules, budget, inspections, meetings, reports, records, monitoring and evaluations. It was noted in the study that most project managers do not practice them because of certain difficulties which include delays by clients to release money, delay in decision making, lack of materials and equipment, inclement weather, concurrent activities, ambiguous and incomplete drawings, reworks and poor resource management. Project cost control of bidding processes is implemented at the bidding stage to better improve project success levels. It is done by predicting and controlling the target budget even the construction process commences. The project is decomposed into work packages and down into activities according to construction drawings. There is the high chance of good project beginning with proper prediction to cost making it approximate to practical work. Effective cost control aims to save labor expenditure, estimate cost practically and makes a realistic target. Zhou (2014). Reliable cost estimates are key to effective project control and cash management. Traditional approaches to cost estimates rely on detailed information for a specific project which often results in cost overrun. An understanding and the efficient utilization of various project cost control tools influence the success rate of construction project as it may at early project stages give early warning signs. Otim, Nakacwa and Kyakula (2012).

2.4.1.1 Earned Value Analysis

During project execution phase, earned value management (EVM) provides effective methodology for obtaining forecasts. Actual performance data is obtained and incorporated into a cost management tool together with estimated project cost to determine some effective cost predictions. Batselier and Vanhouke (2015). Out of actual performance data, cost and schedule variances, cost and schedule performance indices are evaluated and used to enable determine many other forecasts to project costs and schedules. Kim and Reinschmidt (2011). The advantage this technique has is that corrective actions can be ensured at early stages of a project if figures tend to be promising to deliver a successful project. Batselier and Vanhouke (2015).

2.4.1.2 Forecasting

Seppanen and Kenley (2005) developed a system known as the location-based method that forecasts cost using practical site management data such as survey quantities and their unit prices as starting data. The location-based model is used in developing a flowline schedule which has a start and a finish date. Cashflow forecasts can be determined accurately using schedule flow lines. Location-based schedule forecasts can be used to forecast overhead costs and to forecast cost interferences.

First time-cost regression model of construction projects, created in 1960s describes a correlation between the actual construction time and actual construction cost. Seppanen and Kenley (2005).

Using the critical path method (CPM), each project activity is loaded on to a scheduling tool. The cost of each project activity rolls up contributing to the contract's total schedule values. In this method of cost control, a work breakdown structure is an essential feature that contributes to budget determination of projects. Tamakloe (2014).

2.4.1.3 Variance Analysis

This type of tool allows the determination of variances by measuring actual work performance data against forecasts (planned) data. It determines degree of variance relative to cost baseline and assess implications of those variances on future work to completion.

2.4.2 Time and Cost Relationship

Cost and time are interrelated concepts as defined by Olawale and Sun (2010). Csordas (2017) convincingly describes cost and time as having a correlation and by developing an algorithm that considers costs starting with zero flow and maximal process times ($0 \leq \tau ij = bij$ and $aij = \tau ij \leq 0$). For any iteration, the algorithm finds a cut which gives a minimum cost rising to get a less project duration. This development however faces some challenges:

- If maximal process times are used in scheduling, the risk of run over T is the highest. In this case, there is not a start scheduling.
- Where calendarized process times are inconstant, the time reduction cannot be uniform after cut.
- Process time reduction can be only on the arcs of critical paths, where the calendarized process time are inconsistent, it effects that critical paths can be changed.

This study targets decreasing cost level with the use of the most effective scheduling method. In testing a critical path determination model developed by Jongyul (2010), it is revealed that overall project duration shortening by crashing also affects direct costs of the project if excessive crashing occurs since quality degradation may occur resulting in rework. Olawale and Sun (2010).

Larsen et al. (2015) in their research aim to present the most negative effects of time, cost and quality, test if a factor affects time, cost and quality significantly different from each other and determine if it affects identify which elements in the iron triangle is affected significantly. Their study evaluated 26 factors on time, cost and quality of public construction projects but response from respondents was contradictory indicating a complex structure between the three iron triangle components for a project manager to understand. Their study recommended however to focus on five (5) related time, cost and quality causes combined with an increase pre-planning effort during the initiations and planning phases of a project to reduce critical project complications.

2.4.3 Cost Implications of Project Time Overrun

Assaf and Al-Hejji (2006) established that eventually, time overrun will have financial consequences on both parties to a construction project in different ways. The owner cannot start operating their delayed facility constructed and will be unable to generate revenue from it. Additionally, loss of income/profit and opportunity, ongoing legal bills and consultant engagement may prevail. To the contractor, there may face the risk of LAD, inflation absorption, unpaid preliminaries associated with ongoing works after contract completion date. Hampton (2012). Given delay-cost relationships, it is not surprising to find out that parties may blame each other for time overrun all in effort to shirk off responsibilities for time overrun with its financial burden. Assaf and Al-Hejji (2006).

2.4.3.1 Schedule Acceleration

It is evident that construction projects are the worst offenders of time overrun worldwide. Consequently, efforts are often made to bring project back on track either by activity

crashing, activity overlapping and/or activity substitution. Activity crashing involves more allocation of resources to an activity than originally planned. Activity overlapping employs starting and before one or more of its predecessors has finished. Activity substitution involves replacing an activity or sequencing activities in series by another activity. Each of these modes of project acceleration always comes with additional costs. In crashing, additional resources imply additional costs. In overlapping, inevitable rework results in additional costs. In activity substitution, the setup of substitute activities necessarily involves unplanned costs of acquisition. Gerk and Qassim (2008).

2.4.3.2 Rework

In civil and heavy industrial projects, the cost of quality has been found to be significantly higher. Love (2002). Several studies have been undertaken by various researchers to determine cost of deviations from quality works: Burati et al. (1992), Abdul-Rahman (1995), Nylen (1996). Love et al. (2006) cites Burati et al. to have studied nine major projects to determine the costs associated with rework from non-conformances. In this study, quality non-conformances from all nine projects accounted for 12.4% of the contract value. Nylen (1996) cited by Love et al. (2006) is said to have further found out in his study that 10% of defects encounted account for 90% of their total cost and a significant proportions of failures are said to be attributable to design-related and poor communication between project team members.

2.4.3.3 Cost of Safety

High accident rates are inherent in construction projects as compared to other sectors. There are associated costs with these accidents which are both human and financial for companies and society. Other indirect costs such as impaired company image or market

loss may arise out of incidents. The acceleration of schedule especially where certain high risk tasks are executed on nightshifts may result in accidents. In efforts to accelerate project schedule due to delays, more resources (human and material) are required and as hypothesized by Monica et al. (2013), the higher the workforce the higher the accident rate. This may contribute to a high cost of safety. In instances where mitigations have to be put in place to mitigate such dangerous occurrences, there is a cost that comes with such interventions. In summary, project schedule overrun may also impact cost of safety negatively due to factors emanating from non-safety costs.

2.4.3.4 Disputes and Claims

Time overrun projects are heavily characterized with unhealthy relationships arising out of determining which party caused the unpleasant situation. Consequently, monetary awards have to be made after eventually addressing how much delay and whose fault it was. Conclusions on the major contributor to time overrun is often a bitter pill to swallow amongst all parties and tends to lead to disputes which if not properly managed can lead to court cases for resolutions especially where large penalties are at stake.

2.4.3.5 Total Project Abandonment

Poorly managed cost elements of time overrun projects whiles executing construction projects can lead to contractors abandoning works outright or suspending sites. To some extent, parties will usually through claims agree upon extra cost and time extension associated with time overrun. Aibinu (2002). Nevertheless, some cases have resulted in heated arguments among contract parties as to whether a particular delay warrants extension of time and extra cost resulting in temporary or permanent project site abandonment. Aibinu (2002).

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This study aims to investigate percentage cost escalation arising out of TSF construction project time overrun. It aims to make a comparison between project budget and expenditure due to time overrun in TSF construction projects in Ghana. From existing literature on time overrun in the construction industry, and based on preliminary investigation conducted at the start of this study, it is possible to establish percentage of project budget expended in projects due to time overrun.

3.2 Research Method

Though all three methods of research been used in the conduct several studies pertaining to the subject area, the qualitative and quantitative methods of research were employed in the conduct of this research. The research was conducted through a literature search of electronic data bases and subsequent analysis of all secondary data sources. Data sources included some well-known texts and cited publications in various referred journals. Other data sources relating to the issues focused on construction schedule and cost management. Literature search was not limited to any group or particular journals. Electronic databases used included Google Scholar, PDF Drive, Science Direct etcetera. The adopted procedure for retrieving papers related to construction time and cost overruns were the scanning of key words. Less and closely related papers on construction time and cost overruns were obtained and reviewed for the purpose of this study.

3.3 Sampling Technique and Sample Size

Census was employed in the collection of data for this study because of the relatively small proportion of construction professionals who are directly involved in the construction of TSFs. This was also chosen to ensure reliable and accurate data for a complete enumeration of the population. A structured questionnaire was distributed to a total of 70 respondents (Project Managers, Engineers and Quantity surveyors). 56 responses were obtained indicating a response rate of 70%.

3.4 Questionnaire Design

In order to conduct the survey, a structured questionnaire was used to elicit perceptions and opinions. Respondents were asked to indicate the percentage of budget expended in their recent projects as a result of Time Overrun. Critical causes of time overrun and procurement methods adopted for project execution were also identified in this study for respondents to rank based on their impact on project time overrun. For the ranking of critical causes, a five (5)-point Likert scale (5) was adopted for this study with the following numerical values assigned to the respondents' rating: Not significant-1, Less significant-2, Neutral-3, Signifcant-4, Very significant-5. Respondents were asked to determine the effectiveness of procurement methods adopted in the execution of their projects by ranking them in an order of effectiveness in mitigating time overrun. Respondents were additional asked to list a number of cost effects occurring as a result of project time overrun. The identified factors and variables have been structured into a questionnaire form and was piloted for modifications to eliminate ambiguities.

The five-point Likert scale, 1-5 was transformed to mean ranks for critical causal factors of time overrun and relative importance indices for effectiveness of procurement methods employed. Sample frame of this study comprised of three groups: Contractors,

Consultants and Clients. Questionnaire comprised the under listed and were aggregated into two sections:

Section 1 comprises:

- Gathering background information on respondents

Section 2 comprises of four (4) parts which are made up of:

- Soliciting project performance information and supplementary information on percentage cost variance.
- Questions in response to the significance of critical causal factors of time overrun on a five-point Likert scale.
- Questions in response to the effectiveness of Procurement methods adopted for project delivery.
- Questions on Cost Effects of Project Time Overrun.

3.5 Data Analysis

The statistical software, SPPSS was used for the analyses of both quantitative and qualitative data obtained. Likert scales were analyzed using the Kendall's mean rank test, Kendall's coefficient of concordance and the relative importance index (RII). Cost variance data obtained was used to generate a predictive model for Time Overrun using the Multiple Linear Regression Analysis. The above statistical tools also aided in the analysis of surveyed data to produce charts and frequency distribution tables.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the socio-demographic characteristics of the respondents and the findings of the study in line with Time Overrun and Cost Effects of Tailings Storage Facility (TSF) Construction Projects in Ghana. It also presents and discusses the findings of the aim and objectives indicated in chapter one (1) as to generating a regression model for time overrun of TSF projects, identifying the significance of some critical causes of time overrun in their contribution to time overrun of TSF construction projects and determining the effectiveness of procurement methods used in delivering TSF projects in mitigating time overrun.

4.2 Socio-Demographic Characteristics of Respondents

The socio-demographic profile of the surveyed respondents is discussed in this section of the research. The major or main socio-demographic characteristics of the surveyed respondents discussed included respondents age groups, gender of respondents, the groups respondents belong to, the role respondents play as team members, the number of years‟ respondents have been involved in TSF construction projects and respondents level of education.

The survey result of the socio-demographic characteristics of the respondents is presented in Table 4.1.

Table 4.1: Socio-Demographic Characteristics of Respondents

A. Industrial Profile	**Frequency**	**Percent**
Age of Respondents		
21 – 30 years	7	12.5
31 – 40 years	17	30.4
41 – 50 years	27	48.2
Above 50 years	5	8.9
Mean	2.54	
Standard Deviation	0.830	
B. Gender of Respondents		
Male	46	82.1
Female	10	17.9
Mean	1.18	
Standard Deviation	0.386	
C. Groups Respondents belong to		
Contractor	29	51.8
Consultant	16	28.6
Client	11	19.6
Mean	1.68	
Standard Deviation	0.789	
D. Role played as team member		
Project Manager	23	41.1
Civil Engineer	20	35.7
Quantity Surveyor	8	14.3
Others	5	8.9
Mean	1.91	8.9
Standard Deviation	0.959	
E. Number of Years respondents have been involved in TSF construction projects		
0 -5 Years	7	12.5
6 – 10 Years	18	32.1
11 – 15 Years	23	41.1
16 – 20 Years	6	10.8
Above 20 Years	2	3.6
Mean	2.59	
Standard Deviation	0.93	
F. Respondents level of education		
PhD	0	0.0
MSc/MPhil/MA	25	44.6
BSc/BA	22	39.3
HND	5	8.9
Others	4	7.1
Mean	2.79	
Standard Deviation	0.889	

Source: Field Survey, 2019

The result of table 4.1 indicates the frequency distribution of the demographic characteristics of the respondents.

From Table (4.1), majority of the respondents were between the ages of 41 to 50 years and are 27 representing 48.2%. Respondents who are between the ages 31 to 40 years are 17 representing 30.4%, 7 of the respondents are between the ages of 21 to 30 years representing 12.5% whereas respondents who are above 50 years are 5 representing 8.9%.

The above result of table 4.1 indicates that majority, forty-six (46) of the respondents were male respondents constituting 82.1% of the total number of respondents whilst 17.9% constitute female respondents which is ten (10) respondents.

The result of the table (4.1) also indicates that the sampling frame for the study were contractors, consultants and clients and it was observed that, there were twenty-nine (29) respondents who were Contractors and constitute approximately 51.8%, sixteen (16) surveyed respondents were Consultants constituting 28.6% whilst eleven (11) surveyed respondents were Clients constituting 19.6%. The high response from contractors can be explained on the premise that contractors' team are often larger than that of clients and consultants in TSF construction project. This may have an influence on the outcome of opinions expressed by respondents in this survey to drift towards contractor perspectives hence perceptions skewing towards contractor oriented submissions can be attributed to the high response rate from contractors.

Table 4.1 indicate that the majority (41.1%) of the surveyed respondents were Project Managers, whiles 35.7% and 14.3% were Civil Engineers and Quantity Surveyors respectively. However, 8.9% were in different (other) roles as (Geological Engineers, Geomatic Engineers and Materials Engineers). The high response rate for project

managers observed from this study may have influence on areas such as objective three of this research since they are mostly involved in decision making process of projects.

Majority (41.1%) of the surveyed respondents who have been involved in TSF construction projects between 11 to 15 years, whereas 32.1% have been involved in TSF construction also been for 6 to 10 years. However, 12.5% and 10.8% of the surveyed respondents have been involved in TSF construction for 0 to 5 years and 16 to 20 years respectively. Lastly, 3.6% of respondents who have been involved in TSF construction were Above 20 years. The output of this group may influence the findings of this research positively as majority (41.1%) of respondents can be said to have some substantial experience in this industry. Quality response may be characterized by the influence of the high levels of TSF construction experience of respondents.

Majority (44.6%) of the respondents had their highest level of education to be Masters in various disciplines. 39.3%, 8.9% and 7.1% of the respondents of the study hold Bachelors, Highest National Diploma and other areas of qualification in academia as their highest level of education respectively. None of the surveyed respondents of the study had PhD. Considering that the majority of respondents hold a Master degree qualification in various disciplines means better quality response may be achieved from the survey.

Figures 4.1 to 4.6 show the graphs for the socio-demographic characteristics of the respondents.

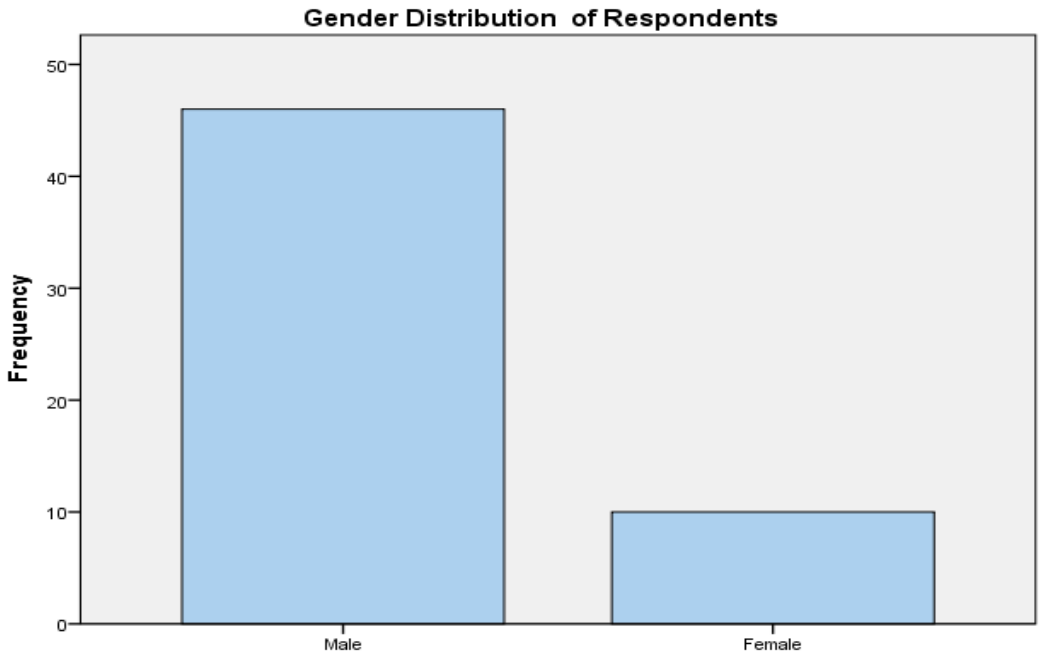

Figure 4.1: Bar chart of Gender Distribution of surveyed respondents

Source: Field Survey, 2019

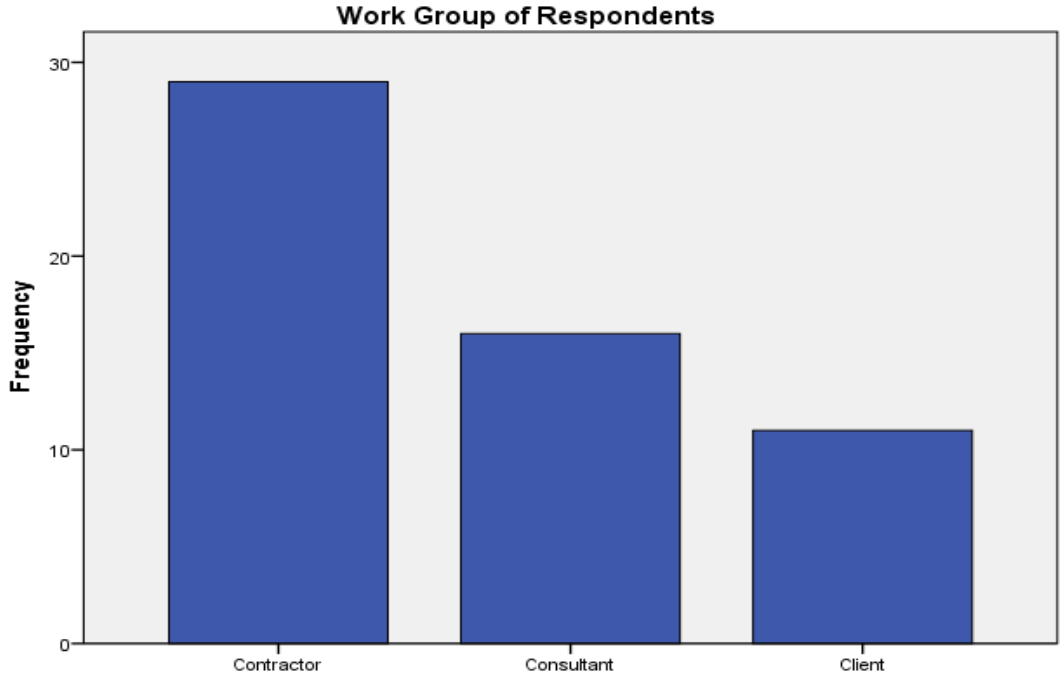

Figure 4.2: Bar chart showing Work Group Respondents belong to

Source: Field Survey, 2019

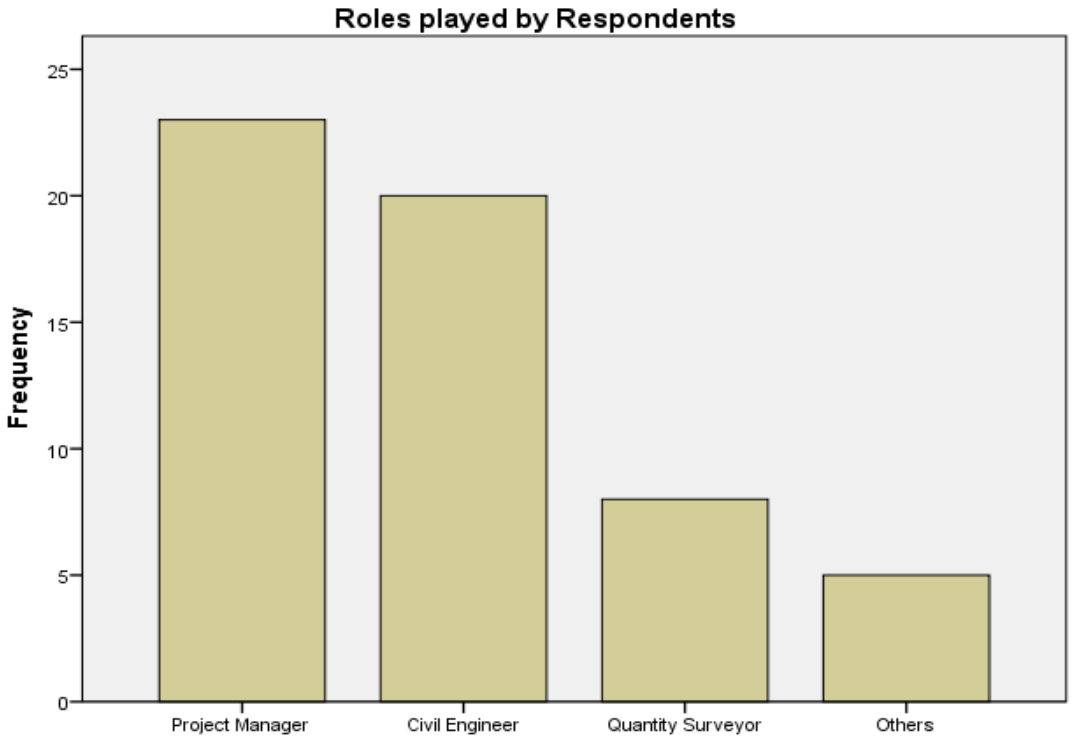

Figure 4.3: Bar chart showing the role respondents played as team members

Source: Field Survey, 2019

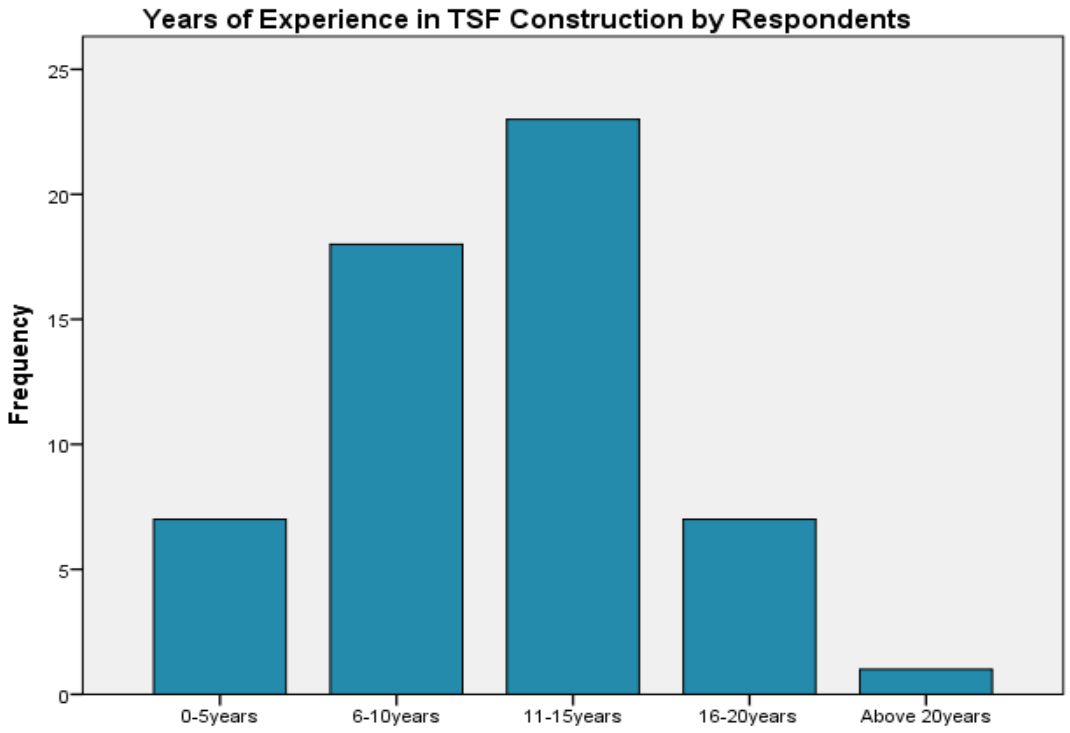

Figure 4.4: Bar chart showing the respondents' years of experience in TSF Construction

Source: Field Survey, 2019

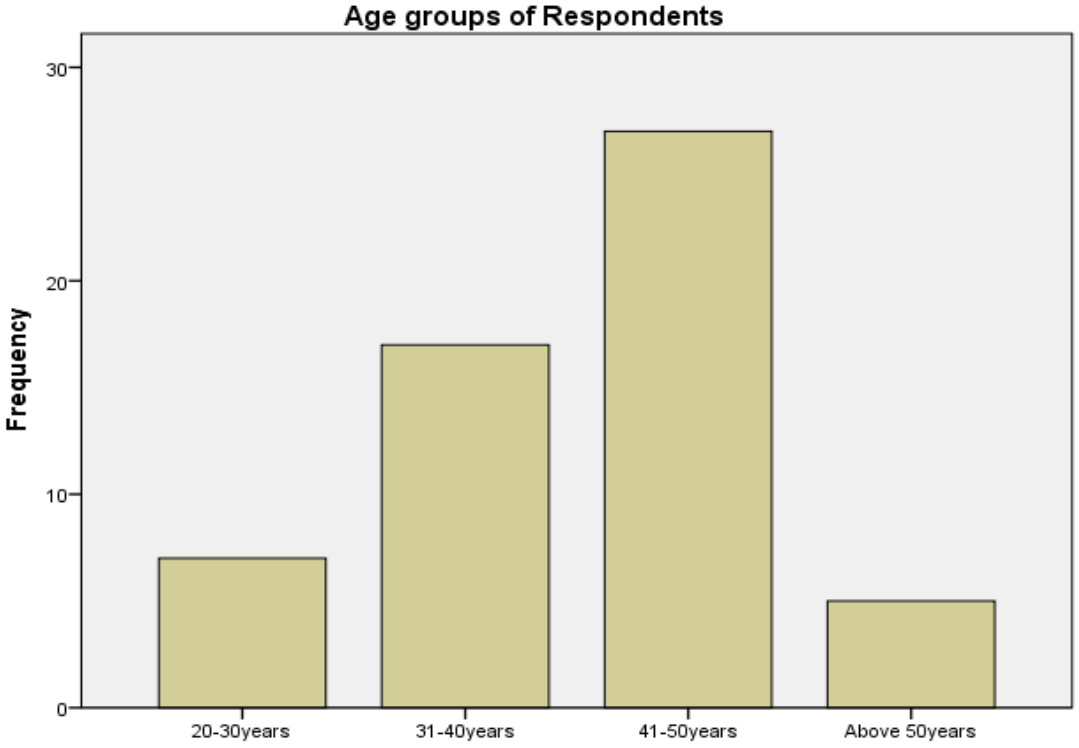

Figure 4.5: Bar chart showing the age distribution of respondents in years

Source: Field Survey, 2019

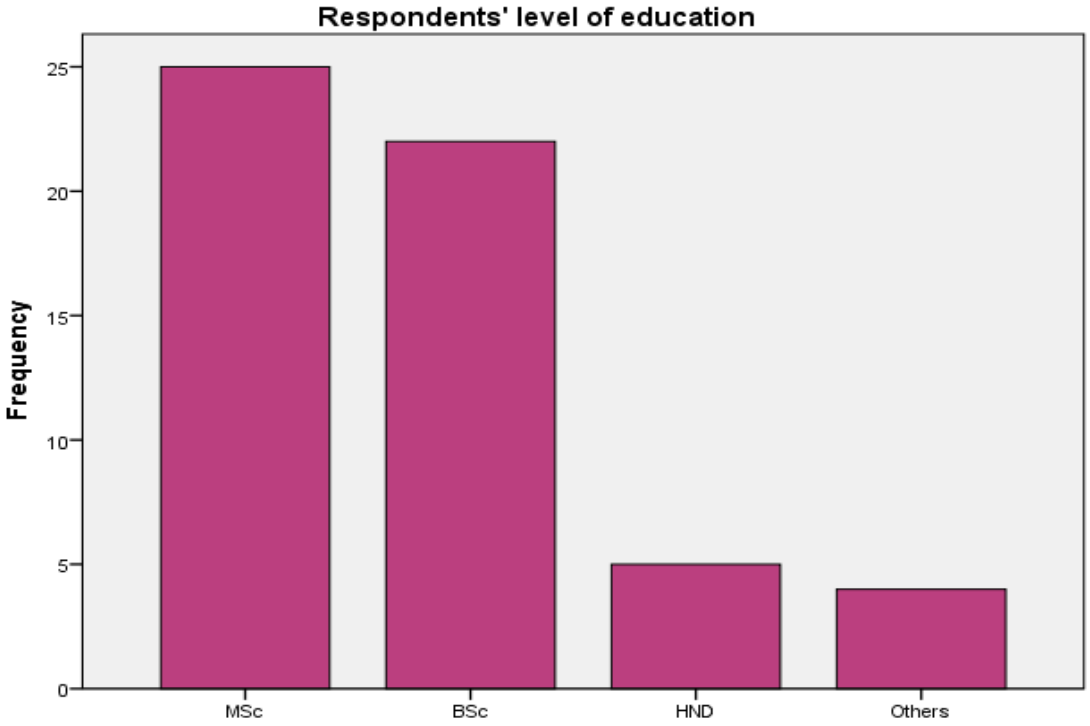

Figure 4.6: Bar chart showing the level of education of respondents

Source: Field Survey, 2019

4.3 Cost Variance of Delayed TSF Projects Due to Time Overrun

In this section, generating a regression model for time overrun of delayed TSF projects as an objective will be achieved by developing a simple linear multiple regression considering time overrun as the dependent variable whilst capacity of TSF, project duration and the budget as the independent variables. A correlation matrix will be generated to determine the measure of association between the dependent and independent variables. Again, an Adjusted R-Square value will be obtained to determine the percentage of dependent variable that is being explained by the independent variables in the regression model developed. Lastly, this section will consider the model diagnostics of the model developed to take care of the assumptions of the model developed.

4.3.1 Cost Variance

To achieve the development of this model, cost variances due to time overrun of the various project sites were obtained from respondents and have been tabulated with literature backing to indicate the amount of project budget that is expended for time overrun of projects.

Table 4.2: Cost Variance-Percentage of project budget expended due to time overrun

Percentage cost variance	Frequency	Percent
Less than 5%	32	57.1
5%	14	25
10%	7	12.5
15%	2	3.6
Total	55	98.2
Missing system	1	1.8
Total	56	100

Source: Field Survey, 2019

The results from table 4.4.1 identifies that 32 respondents (57.1%) indicated the cost variance of their projects to be less than 5% of the project budget, 14 respondents (25%) had 10% of their project expended due to time overrun whiles only 2 respondents (3.6%) recorded 15% cost variance of their project budget expended due to time overrun. In comparison with the outcomes of previous studies: Love, Ahiaga-Dagbui and Irani (2016); Zafar, Yousaf and Ahmed (2016); Al-Hazim, Salem and Ahmad (2017); Derakhshanalavijeh and Teixeira (2017); Durdyev *et al.*, (2017); Famiyeh *et al.*, (2017) and the findings from the 56 respondents nothing new was found from the study except to confirm that cost overrun is prominent in majority of construction projects as identified in most studies. The findings also affirm hypothesis #1 of chapter 1: Every time overrun project has an element of additional cost to its project budget. The 57.1% opined by respondents as to the less than 5% of project budget expended may be due to the good financial systems and supervision most mining companies have instituted at all levels to inure to the benefits of all parties. Most of these organizations have very well laid out procedures for all stages of project management. The list recorded 3.6% as against a 15% budget overrun which can be attributed to the poorly implemented project management policies by industry practioners, time overrun causes: Olawale (2010); Mahamid and Ibrahim (2011) etcetera.

4.3.2 Regression Model Development

Simple Multiple Linear Regression (MLR) is a statistical technique used to analyze the correlation between a single dependent variable and several independent variables. It is the most widely used multivariate technique for analyzing relationships between a dependent variable and several predictive independent variables.

The Multiple Linear Regression is an extension of the simple linear regression model with the view of incorporating two or more independent variables, $x_1, x_2, x_3, \ldots, x_n$ in a predictive equation for a response variable y. It is expressed as $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots + \beta_n x_n + \varepsilon$, where

y is the dependent variable (time overrun), $x_1, x_2, x_3, \ldots, x_n$ (project duration, capacity of TSF and budget) are independent variables, $\beta_1, \beta_2, \beta_3, \ldots, \beta_n$ are the parameter estimates and ε is the error term which is a random variable.

The coefficients of the regression model developed is represented in Table 4.2

Table 4.3: Coefficients of the regression model

Model	Unstandardized coefficients		standardized coefficients	t	sig	Correlations		
		Std. error				Zero-order	partial	part
constant	1.652	0.464		3.558	0.001			
capacity	0.080	0.080	0.433	0.998	0.323	0.072	0.138	0.138
p. duration	-0.078	0.109	-0.282	-0.72	0.478	0.041	-0.10	-0.09
%(p.budget)	-0.190	0.226	-0.154	-0.84	0.406	-0.03	-0.12	-0.12

Source: Field Survey, 2019

The result of the multiple regression model developed with a total number of fifty-six (56) observations in Table 4.1 is given by $TO_p = 1.652 + 0.08 \times capacity - 0.078 \times proj.duration - 0.190 \times proj.budget$

The multiple regression model shows that time overrun (dependent variable) and capacity of TSF, project duration and project budget (independent variables) statistically significantly predicted the time overrun.

4.3.3 Analysis of Variance (ANOVA) Summary

H_0: The mean variation between time overrun and capacity of TSF, project duration and project budget in relation to construction projects in Ghana are equal.

H_1: The mean variation between time overrun and capacity of TSF, project duration and project budget in relation to construction projects in Ghana are not equal.

Table 4.4: Summary of ANOVA result for construction projects in Ghana

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.421	3	0.474	0.419	0.740
	Residual	57.606	51	1.130		
	Total	59.027	54			

a. Dependent Variable: Time Overrun (in Months)

b. Predictors: (Constant), Percentage of project budget expended due to time overrun, Project Duration, Capacity of TSF

The result shows that the calculated p-value (0.740) is greater than the chosen alpha level of 0.05. This signifies that the test is not significant at the 5% level, indicating a sufficient evidence that the mean value of time overrun and capacity of TSF, project duration and project budget in relation to construction projects in Ghana are the same. Therefore, we fail to reject the null hypothesis and conclude that the mean variation between time overrun and capacity of TSF, project duration and project budget in relation to construction projects in Ghana are equal.

4.3.4 Model Summary (Multiple linear regression goodness of fit)

The model summary table provides information about the regression line's ability to account for the total variation in the dependent variable. Thus, the regression model only "explains" a limited proportion of the dependent variable's total variation. The dependent

variable's total variation can be measured by its variance. The part of the variance is measured as the sum of the squared differences between the respondents' predicted dependent variable values and the overall mean divided by the number of respondents. By dividing this explained variance by the total variance of the dependent variable, we arrive at the proportion of the total variance that is accounted for by the regression equation. This proportion varies between 0 and 1 and is symbolized by R^2 (R Square).

Table 4.5: Model Summary of the regression model

Model Summary									
	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df 1	df 2	Sig. F Change
1	0.15	0.024	0.033	1.0628	0.024	0.419	3	51	0.740

a. Predictors: (Constant), Percentage of project budget expended due to time overrun, Project Duration, Capacity of TSF

b. Dependent Variable: Time Overrun(in Months)

As can be seen from Table 4.4, the value of our adjusted R^2 is 0.033, which means that 3.3 percent of the total variance in time overrun is been "explained" by the capacity of TSF, project duration and project budget in relation to construction projects in Ghana. Not very impressive, but not bad either compared with the adjusted R^2 values one tends to get in analyses of questionnaire survey data. The R is the square root of R^2.

4.3.5 Cost Effects of Time Overrun

Effects of schedule overruns are the consequences that will occur when the causes of schedule overruns are not identified and worked on effectively. A compilation of cost effects with their respective mean ranks and standard deviations are outlined in table 4.6:

Table 4.6: Summary of Cost Effects of Time Overrun

Cost Effects	Mean Rank	Standard Deviation	Rank
Claims	8.21	0.546	1
High cost of safety to the contractors, consultant and clients	8.10	0.675	2
Project schedule acceleration	7.99	0.789	3
Defective work	7.78	0.570	4
High Market Risks	7.56	0.990	5
Disagreement amongst all parties with regards to taking responsibility for time overrun	7.44	0.891	6
Financial difficulties due to non-payment of work carried during time overrun period	7.31	0.887	7
Project Abandonment	7.29	1.091	8
Increase in loan interests to contractors	7.23	1.980	9
High Project Cost	7.18	1.102	10
Loss of profit arising from payment liquidated and ascertain damages (LADs)	7.09	1.678	11
Arbitration	7.00	1.996	12
Deteriorated relationship between contractors and client	6.96	2.098	13
Reduction in shareholder confidence	6.87	1.877	14
Poor performance on the part of contractors	6.75	1.546	15
Loss of business opportunities to the contractor	6.54	0.999	16
Deteriorated relationship between contractor and consultant	6.22	1.347	17
Bankruptcy	5.88	1.672	18
Sharing of scarce resources with other projects	5.80	2.091	19
Disputes	5.71	2.549	20
Litigation	5.66	3.011	21

Source: Field Survey, 2019

Table 4.2.5 indicates respondents‟ perception of cost effects identification. The commonest cost effect identified by respondents was claims and has a mean rank of 8.21 as against Litigation with a mean rank of 5.66. High cost of safety was the second highest ranked (8.10) and followed by project schedule acceleration (7.99). In the identification of the cost effects of time overrun from other studies: Ramanathan *et al.*,

(2002); Kaliba, Muya and Mumba (2009); Mukuka, Aigbavboa and Thwala (2015). The above-listed cost effects affirm Ramanathan et al., study of the effects of time overrun: Adversarial relationships, mistrust amongst parties, arbitration, litigation, Cashflow issues and a feeling of trepidation towards stakeholders. Findings from the current study however identified twenty (21) cost effects which have been detailed below:

4.3.5.1 Claims

Claims are considered endemic in the construction industry and often arise out of poorly managed disputes. Ren, Anumba and Ugwu (2001). Several factors account for claims in the construction and time overrun is definitely not out of the list. Impacts of claims are complex to all parties involved in the construction industry. Claims resulting from time overrun may be challenged by agreeing on who to take responsibility for time overrun. This in many instances may result in very heated arguments which may not be properly resolved and lead to claims. Most causes of claims emanate from time overrun.

4.3.5.2 High cost of safety to the contractors, consultant and clients

The type of work, crew size, time of work (day or nightshift) and factors are related to incident rates. Cost of safety is the cost incurred to ensure health and safety at the work place. And can be classified into two group: Safety costs (Prevention costs) and Cost of non-safety (Tangible and intangible costs of accidents). Monica (2013). The health and safety budget is said to increase when project schedules accelerated in order to make-up for lost time. Accident rates tend to increase due to factors such as relaxed supervision, complacency, short-cut to works etc. In efforts to mitigate some of these risks a lot of time is invested in training personnel which in itself is an indirect cost to all parties. The acceleration of schedule especially where certain high risk tasks are executed on nightshifts may result in accidents. In efforts to accelerate project schedule due to delays,

more resources (human and material) are required and as hypothesized by Monica et al. (2013), the higher the workforce the higher the accident rate. This may contribute to a high cost of safety. In instances where mitigations have to be put in place to mitigate such dangerous occurrences, there is a cost that comes with such interventions. summarily, project schedule overrun may also impact cost of safety negatively due to factors emanating from non-safety costs.

4.3.5.3 Project schedule acceleration

It is evident that construction projects are the worst offenders of time overrun worldwide. Consequently, efforts are often made to bring project back on track either by activity crashing, activity overlapping and/or activity substitution. Activity crashing involves more allocation of resources to an activity than originally planned. Activity overlapping employs starting and before one or more of its predecessors has finished. Activity substitution involves replacing an activity or sequencing activities in series by another activity. Each of these modes of project acceleration always comes with additional costs. In schedule crashing, additional resources imply additional costs. In overlapping, inevitable rework results in additional costs. In activity substitution, the setup of susbstitute activities necessarily involves unplanned costs of acquisition. Gerk and Qassim (2008).

4.3.5.4 Defective Work

In civil and heavy industrial projects, the cost of quality has been found to be significantly higher. Love (2002). Several studies have been undertaken by various researchers to determine cost of deviations from quality works: Burati et al. (1992), Abdul-Rahman (1995), Nylen (1996). Nylen (1996) cited by Love et al, is said to have further found out

in his study that 10% of quality failures encounted account for 90% of their total cost and a significant proportions of failures are said to be attributable to design-related and poor communication between project team members.

4.3.5.5 High Market Risks

Fluctuation of prices is on the increase in Ghana. Delayed payments resulting from disagreements from time overrun affects the value of claims paid and this poses a high market risks as the contractor may have long outstanding loans with high interests to settle.

4.3.5.6 Disagreement amongst all parties with regards to taking responsibility for time overrun

Once project duration is exceeded their planned targets, there is usually the compromise of client satisfaction. The budget profile no longer tallies with the requirement which calls for a justification of an overrun by client's representative to their senior management. In order for the client representative to position himself in a comfortable position they often try to ignore contractor's notices of delays. Even if notices are acknowledged by clients, there usually is the high tendency of clients pointing out causes of the time overrun to contractor's contribution only just to brush off concerns by contractors. Back and forth characterizes the onset of identifying responsibility for time overrun. These often have debilitating effects on contractor-consultant and contractor-client relationships and may result in arbitration amongst parties. Arbitration as is very well-known is not friendly to cost as cost incurred are borne by parties involved.

4.3.5.7 Financial difficulties due to non-payment of work carried out during time overrun period

Regular cashflow is often stalled by delay associated problems. Extensive durations involved in the settling of disputes from delays also affect the payment of claims.

4.3.5.8 Project abandonment

Unresolved time overrun problems may escalate into contractor abandoning project site entirely. The abandonment of project has its repercussions and untold hardships to clients. Such instances force clients to take hard decisions in getting different contractors to complete project all at the expense of clients.

4.3.5.9 Increase in loan interests to contractors

The acquisition of funds for the execution of projects is also facilitated by Bank loans for contractor. This enables the early start of construction projects because of the large sums involved which may not be initially financed by contractors. Contractor will require extra funds to make good defective works, acquire extra resources for project schedule acceleration.

4.3.5.10 High Project Cost

Cost is considered to be the most significant element of the construction management life cycle and as one of the main drivers of project success. Durdyev, S. *et al.* (2017). Notwithstanding its proven importance, most cost overrun can be attributed to time overrun since project time extension may call for the payments for time-related costs to contractors.

4.3.5.11 Loss of profit from Liquidated and Ascertained Damages (LAD)

To the client early completion has a profound contribution to the return on their investment however, late completion can be a nightmare for contractors as specified large amounts in their construction agreements are paid the injured party(client) as way of compensation for losses to the client. Tuuli, Baiden and Badu (2007). LAD do not fully compensate the clients for delays but are detrimental to the profit making of contractors. The mean rank of profit loss due to payment of liquidated and ascertained damages as perceived by respondents can be largely be attributed to non- enforceability of the LAD clauses as enshrined in construction agreements.

4.3.5.12 Arbitration

Construction projects globally involves multitude parties in the project execution and often generate large number of expensive disputes. Some of these disputes are resolved through arbitration and according to construction industry arbitration rules of the projects' jurisprudence. Arbitration procedures are lengthy and grind slowly to outcomes with cost implications. A reason the result of this study can be attributed to for the low mean rank of 12 for arbitration.

4.3.5.13 Deteriorated relation between contractor and client

Construction team members with different backgrounds will have differences that will require effective management for a proper team integration. The lack of effectiveness among teams of the contractor and that the client remains a challenge preventing them from achieving their full potential and performance. Confirmed by Demkin (2008) in Titus, Abraham and Isaac (2015); An effective team promotes conducive working environment for the achievement of better results. The result of deteriorated relationship

between contractors and their clients is not encouraging as poor relationships may arise from disputes have debilitating effect on project time overrun, undermining team spirit, increasing project cost and eventually damaging business relationships. The mean rank assumed by this cost effect can be attributed to the possible effective management of disputes, agreements and claims.

4.3.5.14 Reduction in shareholder confidence

Investor confidence defined by Hirschey and Nofsinger (2010) as cited in Bosman (2014) as the "level of the investing public's trust in corporate information and investment advice. Shareholders of mining organizations have high expectations of high returns on their investments. Tailings storage facility construction is one of the basic components and requirements for the survival of gold mining companies. It is indeed a basic requirement a mine cannot do away with. Investors make decisions on project information that is best decided on to make future decisions. Poorly performed TSF projects have an influence on gold production which likely influences the confidence level current invest may have in the organization. Its mean rank obtained from this study may however be a good indication to the low percentage of budget (less than5 %) expended on time overrun as a cost variance. This cost effect may not be too frequent in its occurrence considering the its rank as time overrun experienced by various organizations may still have several other factors such as cash flows achievement despite the high frequency of time overrun experienced from this study since investor confidence is influenced by several factors in the mining industry.

4.3.5.15 Poor performance of contractors

It is widely accepted that projects are said to be successful when they are completed within time, on budget, in accordance with specifications and requirements of stakeholders. Unfortunately, due to the many challenges construction projects are characterized with, high performance of construction projects is not a common place. The poor performance of contractors as a cost effect factor is not surprising and poor performance can be traced to defective works, cost overrun and time overrun of project budget and schedule respectively. It is however impressive to see poor performance of contractors in a lower mean rank and can be related to their ability to accelerate project schedules in order to complete within schedule. Cost overrun of project budget is advantageous to most contractor as they always make efforts to maximize the profitability of projects. From the study it can concluded that the contractor being the majority of respondents may not appraise their own performance to be below standard hence this ranking can be likened to the low response rate observed for consultants and clients.

4.3.5.16 Loss of business opportunities to the contractor

The inability of contractors to perform to expectation, issues lot of claims, have deteriorated relationship with their clients, contribute to loss of investor of confidence, recording high disputes resulting possibly in arbitration may have business of missed. The lower mean rank reported in this study can be asserted to be an influence from well managed relationships with clients, amicable settlement of disagreements and avoidance of litigation.

4.3.5.17 Deteriorated relationships between contractor and client

Contractors organizations often times do not have direct contractual relationships with the client's consultant owing to the predominant procurement system adopted by respondents in this study. Nonetheless construction teams no matter their contractual relationship once located on the same project site will intermingle with their different backgrounds. The interrelated activities carried by both contractor and consultant team sometimes result in heated arguments which need effective management. Ineffectively managing these disagreements and disputes can degenerate the relationship between the contractor's team and that of the consulting team which remains a challenge that prevents both teams from achieving their full potential and performance. An effective team promotes conducive working environment for the achievement of better results and high project success as a whole. The deteriorated relationship has indirect cost implications to the all parties of construction projects. This cost effect is ranked much lower than other cost effects due to low response rate of consultants in this study. A higher response of from consultants could have an equally report of deterioration of contractors and consultants.

4.3.5.18 Bankruptcy

For a company to be solvent, so many factors like profitability, indicators of productivity, indicators of the capital structure, indicators of the liquidity, turnover indicators and other indicators. These above mentioned may be impacted by loss of profit, low productivity, asset wreck etcetera and can result in bankruptcy. The low mean rank perceived by respondents is impressive as this can be attributed to a good financial standing of parties involved in construction.

4.3.5.19 Sharing of scarce resources

The use of same resources by multiple projects due to time overrun can result in poor work output. Especially for equipment and human resources, the apportioned time for equipment may put undue pressure on equipment which can have them wrecked resulting in cost to contractors especially. Human resource use may be over stretched and can have poor work output which will require rework for most projects and a cost to parties.

4.3.5.20 Disputes

With the increasing number of participants in the construction projects, frequent interactions and arguments end up with increasing number of disputes. Sources of disputes are two folds. Chan and Seun (2005). The first set of sources include the parties‟ knowledge and experience in construction law and in management and the second group of sources being the lack of solidarity in project teams, conflicting goals and objectives of contracting parties. The ability of project managers of contracting parties to align and harmonize their differences to work together as a team is a good sign of effective team integration in project management. The findings from this study of the rank of disputes as number 20 can be explained that project teams are working harmoniously towards the delivery of TSF projects. That is not to say all is well with the TSF construction teams but a pointer that they are managing their disagreements and relationships well.

4.3.5.21 Litigation

Miscommunication, poor job specifications, delay or non-payments of claims, rigid contracts, catch up profits, limitations on manpower, improper supervision, constructive modifications not recognized by as such by owner, notice requirements acceleration measures provoke claims which result in disputes. Most litigation process create

unpleasant situations for parties involved because litigation is a cost in itself considering the amount of time and financial investments put into it. The highly low mean rank awarded by respondents indicates how parties avoid litigation entirely by ensuring thriving good relationships and resolution of disagreement not to develop into litigation.

The high frequency of claim in this study can be likened to time overrun. In construction, parties take risks of the unexpected which most times causes loss to parties who have entered into agreements. The least ranked cost effect identified to be litigation can be understood to be that contracting parties ensure the use of standard contract forms which spell out the responsibility of all parties to an agreement. Most contractors are beginning to understand that maintaining good relationships is vital to their survival in the construction industry since most clients avoid engagement with litigious contractors. This high response rate on claim can be said to manifest in the high response rate of contractor respondents as indicated in table 4.1 and figure 4. Clients having the least response frequency and known for generally transferring risks may not identify claims as a cost implication.

Significantly, there is a contribution of knowledge from this study based on the premise that 21 cost effects have been identified as against 14 cost effects identified from literature: Ramanathan *et al.*, (2002); Kaliba, Muya and Mumba (2009); Mukuka, Aigbavboa, Aibinu (2002), Hampton (2012), Gerk and Qassim (2008), Burati et al (1992) and Thwala (2015).

The commonest cost effect of time overrun from this study, can be said to be partly attributable to the inability of industry players to effectively identify the significance of the critical causes of time overrun which is to be discussed in the next objective of this study.

4.4 Significance of Some Critical Causes of Time Overrun in their Contribution to Time Overrun of TSF Construction Projects

This section discusses the significance of critical time overrun causes for TSF construction projects in Ghana. To enable achieve this objective, the respondents were presented with a list of nine (9) Critical Causes of Time Overrun in their Contribution to Time Overrun of TSF Construction Projects usually reported in literature. Respondents were to rank the critical causes using the scale 1 = Not significant, 2 = Less significant, 3 = Neutral, 4 = Significant and 5 = Very Significant. Ranking is in terms of the order of significance of time overrun causes to Time Overrun of TSF Construction Projects. The objective of the section is achieved by employing the Kendall's Mean Rank test and the Kendall's Coefficient of Concordance. Results from the survey are presented in Table 4.5 and Table 4.6 respectively.

Table 4.7: Critical Causes of Time Overrun in their Contribution to Time Overrun of TSF Construction Projects

Causes of Time Overrun	Mean Rank	Rank
Delay/shortage in material delivery	6.80	1
Defective work	6.42	2
Financial incapability	6.29	3
Incomplete documents	6.14	4
Equipment and tool shortage	4.15	5
Slow decision making	4.04	6
Inexperienced site staff	4.01	7
Poor site management	3.97	8
Poor coordination with other team members	3.17	9

Rank: [1 = Not significant, 2 = Less significant, 3 = Neutral, 4 = Significant and 5 = Very Significant]
Source: Field Study, 2019

Results of Table 4.5 was obtained following the non-parametric test for k-related samples in SPSS version 20. The level of significance between the nine (9) variables of Critical Causes of Time Overrun in their Contribution to Time Overrun of TSF Construction Projects from fifty-six (56) surveyed respondents was tested using the Kendall's coefficient of concordance.

Result of table 4.2 shows nine (9) most perceived Critical Causes of Time Overrun in their Contribution to Time Overrun of TSF Construction Projects to the extent of their significance included: (1) Delay/shortage in material delivery (Mean Rank = 6.80); (2) Defective work (Mean Rank = 6.42); (3) Financial incapability (Mean Rank = 6.29); (4) Incomplete documents (Mean Rank = 6.14); (5) Equipment and tool shortage (Mean Rank = 4.15); (6) Slow decision making (Mean Rank = 4.04); (7) Inexperienced site staff (Mean Rank = 4.01); (8) Poor site management (Mean Rank = 3.97) and (9) Poor coordination with other team members (Mean Rank = 3.17).

Table 4.8: Kendall's Coefficient of Concordance

Test Statistics	
Size, N	56
Kendall's Wa	0.312
Chi-square ( )	139.864
Degree of Freedom	8
"P-Value"	<0.000

Source: Field Study, 2019

4.4.1 Hypotheses

H_0: Mean (Delay/shortage in material delivery) = Mean (Defective work) = Mean (Financial incapability) = . . . = Mean (Poor coordination with other team members).

H_1: At least the mean of one critical causes of Time Overrun in their Contribution to Time Overrun of TSF Construction Projects is different.

The use of Kendall's coefficient of concordance (Wa) in testing the null hypothesis that there is no agreement among the respondents with respect to the extent of significance these causes are to project time overrun was rejected at a 0.05% significance level as shown in Table 4.6. The degree of unanimity as measured by the W-statistics is about 31.2% since the score is zero for random ranking and 1 for perfectly unanimous ranking. Respondents of the study can therefore, be said to unanimously agree that, at least the mean of one critical cause of Time Overrun in their Contribution to Time Overrun of TSF Construction Projects is different from Delay/shortage in material delivery to Defective work and so on to Poor coordination with other team members. Each critical cause is unique to its contribution to time overrun. A delay or shortage of material on project site can mean a complete halt of a whole activity for the duration of delay or shortage. In instances where works are mainly dependent on supply of materials, time extension for works completion could be equivalent to the amount of delay caused. Poor coordination with other team members is low ranked indicating the low significance of its contribution to time overrun, however the choice of effective procurement systems may partly help in addressing the impact of material delay or shortage.

4.5 Effectiveness of Procurement Methods used in Delivering TSF Projects in Mitigating Time Overrun

The various Strategies in evaluating the effectiveness of procurement methods used in delivering TSF Projects in Mitigating time overrun are identified in this section of the study. For the achievement of this objective, the study employs the Relative Importance Index (RII) to examine how the surveyed respondents perceived the eight (8) listed items

in Table 4.5 as potential Strategies to evaluating the effectiveness of procurement methods used in delivering TSF Projects in Mitigating time overrun. Each respondent was tasked with ranking the effectiveness of procurement methods used in delivering TSF Projects in Mitigating time overrun using the scale 1. Not Effective 2. Less Effective 3. Neutral 4. Effective 5. Most Effective. This ranking is in terms of their order of effectiveness of procurement methods used in delivering TSF construction projects in the mitigation of time overrun. Table 4.7 shows the perceptions of the respondents, RII values, the weight and by their relative ranks.

Table 4.9: Effectiveness of procurement methods in mitigating time overrun

Procurement methods	**Response**					**RII**		
	1	**2**	**3**	**4**	**5**	**Weight**	**RII**	**Rank**
Traditional contracting	3	1	1	21	30	242	0.864	1
Sequential negotiated work package/On-call contracting.	1	2	8	15	30	240	0.857	2
Construction management/ Project Management	1	4	12	14	25	226	0.807	3
Design and Build	20	6	6	1	23	199	0.711	4
Novation	4	5	14	23	10	198	0.707	5
Build-Own-Operate-Transfer	2	24	18	8	4	156	0.557	6
Build-Own-Operate	19	6	7	21	3	151	0.539	7
Build-Operate-Transfer	18	3	27	5	3	140	0.500	8

Rank: [1=Ineffective, 2=Less Effective, 3=Neutral, 4= Effective, 5=Very Effective]

Source: Field Survey, 2019

Result of the Relative Importance Index (RII) in Table 4.7 indicates that the eight (8) procurement methods used in delivering TSF Projects: (1) Traditional contracting (RII = 0.864); (2) Sequential negotiated work package/On-call contracting (RII = 0.857); (3) Construction management/Project Management (RII = 0.807), (4) Design and Build (RII = 0.711) and (5) Novation (RII = 0.707).

Result of this study indicates that the first five (5) procurement methods are perceived effective in mitigating time overrun in the delivery of TSF Projects based on the reason that their RII values fell above or equal to the minimum importance threshold value of 0.700.

Meanwhile, the result of the Relative Importance Index (RII) indicates that (6) Build-Own-Operate-Transfer (RII = 0.557); (7) Build-Own-Operate (RII = 0.539) and (8) Build-Operate-Transfer (RII = 0.500).

Result of the study also indicates that the last three (3) procurement methods used in delivering TSF Projects to mitigate time overrun are not perceived as effective methods because of the low value of RII values as against 0.700 as the minimum importance threshold value.

4.5.1 Relative Importance Index (RII)

The RII (the relative importance) of each variable according to each responses weight.

$$RII = \frac{\sum W}{A*N}$$

Where; W is the weight of each factor as given by the respondents and ranges from 1 to 5 (where 1 = Not Effective, 2 = Less Effective, 3 = Neutral, 4 = Effective and 5 = More Effective) and A is the highest weight of the scale (5 in this case) and N is the total number of respondents which is fifty-six (56). The choice of respondents in the use of traditional contracting may be favored by the use conventional approaches to procurement which involve discreet design development, award of contract and construction delivery phases owing to the long enough planning phases practiced by most gold mining companies. Traditional procurement systems despite their long

lead-in preparation, pose certain risk factors to project delivery with time overrun not being an exception.

Fundamentally, risks are transferred almost completely on the contractor under the various procurement delivery systems embracing the conventional system; traditional lump sum, fixed price, firm fixed price. The least ranked build-operate-transfer system cannot be practised by gold mining organizations owing to how impracticable such a system can be to mine operations.

CHAPTER FIVE

FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This study was conducted to investigate the percentage of TSF project budget that is expended due to project time overrun leading to other cost effects in Ghana. Majority of the respondents were between the ages of 41 to 50 years and are 27 representing 48.2%. Respondents who are between the ages 31 to 40 years are 17 representing 30.4%, 7 of the surveyed respondents are between the ages of 21 to 30 years representing 12.5% whereas respondents who are above 50 years are 5 representing 8.9%.

The analysis of respondents views and opinions indicate that time overrun is chronic in TSF construction projects similar to other study areas in the construction industry as 89.3% of respondents indicate that time overrun is experienced in TSF construction projects whiles 10.7% of responses indicated that their completion of projects on schedule. 1.7% of responses indicated that their projects were completed ahead of schedule.

Given the economic benefits Ghana derives from the gold mining industry, these time overrun levels are considered undesirable to the mining industry as investors' confidence tends to result in the loss of high proportions of investments to the mining industry and Ghana as a whole. Top ten time overrun cost effects were identified to be claims, high cost of safety, project schedule acceleration, defective work, high market risks, disagreement amongst all parties with regards to taking responsibility for time overrun, financial challenges, project abandonment, increase interests in loans to contractors and reduced shareholder confidence. These above-listed cost effects are likely effects emanating from ineffectively managed likely causes such as delay or shortage in material

delivery, financial incapability, poor site management, inexperienced staff, defective work, poor site coordination, equipment and tool shortage, slow decision making process and incomplete documents which have been ranked in the study. These causes have been evaluated and ranked in their significance to the contribution of time overrun.: (1) Delay/shortage in material delivery (Mean Rank = 6.80); (2) Defective work (Mean Rank = 6.42); (3) Financial incapability (Mean Rank = 6.29); (4) Incomplete documents (Mean Rank = 6.14); (5) Equipment and tool shortage (Mean Rank = 4.15); (6) Slow decision making (Mean Rank = 4.04); (7) Inexperienced site staff (Mean Rank = 4.01); (8) Poor site management (Mean Rank = 3.97) and (9) Poor coordination with other team members (Mean Rank = 3.17). The achievement of mitigating time overrun can easily be addressed by the use of the right procurement system. Respondents were asked to evaluate some procurements based on their effectiveness in curtailing time overrun were identified to be: (1) Traditional contracting (RII = 0.864); (2) Sequential negotiated work package/On-call contracting (RII = 0.857); (3) Construction management/Project Management (RII = 0.807), (4) Design and Build (RII = 0.711) and (5) Novation (RII = 0.707).

5.2 Findings

5.2.1 Objective 1

- Majority of projects are overrunning cost by less than 5% of their project budget with a minimum number of project overrunning cost by 15% of their project budgets.
- From this study it has been observed that the maximum time overrun duration of 4months with a respective project duration of 15 months. By proportion, approximately 27% of the project duration is overran.

- In the application of the Multiple Linear Regression Technique (MLR), time overrun is realized to be influenced by capacity of facility, project duration and project budget which means a change in any of these independent variables (capacity, duration and budget) directly affects the time overrun of TSF projects in Ghana.
- 21 cost effects of time overrun have been identified by survey respondents.
- Claim is identified to be the commonest cost effect of time overrun whiles.
- Litigation is the less common cost effect of TSF projects in this study.
- The top five identified cost effects include claims, high cost of safety, project schedule acceleration and defective work

5.2.2 Objective 2

- The leading cause of time overrun in TSF construction projects identified is delay/shortage in material delivery with a mean rank of 6.80
- The top three causes of time overrun ranked by respondents are delay/shortage in material delivery ranked 6.80, defective work ranked 6.42 and financial incapability ranked 6.27
- The least ranked time overrun cause is poor coordination among other team members ranked 3.17

5.2.3 Objective 3

- The most effective procurement system in mitigate time overrun is identified to be traditional contracting method with a weighting of 242 and ranked 0.8641
- The least effective procurement system for TSF project delivery is Build-Operate-Transfer, weighed 140 and ranked 0.05008.

5.3 Conclusions and Recommendations

- Duration, capacity and project budget have significant effects on time overrun hence predictive model provides a benchmark for future studies.
- Cost effects are influenced by time overrun in TSF construction projects. Can be considered a bench of comparison for other construction disciplines in research.
- Claims arise from poorly managed disputes, unresolved disagreements and use of substandard contract forms. There is the need for engaging claim managers to be part of the construction team. The use of claim managers to reduce claims in the construction industry can be a study area to researched.
- Claims is the commonest effect of TSF construction time overrun.
- Project schedule acceleration to make up for lost time aggravate time overrun effects by the introduction of defective work and reworks of such defective works. Which can be a subject for further research.
- The significance of delay/ shortage in its contribution is a cause for concern and can be addressed by the use of a good procurement model.
- Other procurement methods such as project or construction management, novation, project management among others are other effective procurement systems that can be given a try by industry players.

REFERENCES

Abdul-Rahman, H., Berawi, M.A., Berawi, A.R., Mohamed, O., Othman, M. and Yahya, I.A., (2006) "Delay mitigation in the Malaysian construction industry". *Journal of construction engineering and management*, *132*(2), pp.125-133.

A.S. Ali and S.N. Kamaruzzaman (2010) "Cost Performance for Building Construction Projects in Klang Valley", *Journal of Building Performance*, 1(1), pp. 110–118.

Adjei, K. O., Aigbavboa, C. O. and Thwala, W. D. (2017) "Corrective Measures for Construction Project Cost Control". American Societ of Civil Engineers (ASCE), pp. 31–37.

Aftab Hameed Memon, Ismail Abdul Rahman and Ade Asmi Abdul Azis (2011) "*Preliminary Study on Causative Factors Leading to Construction Cost Overrun*", *International Journal of Sustainable Construction Engineering and Technology*, 2(1), pp. 57–71.

Ahmed, S.M., Azhar, S., Kappagntula, P. and Gollapudil, D. (2003) "Delays in construction: a brief study of the Florida construction industry". In *Proceedings of the 39th Annual ASC Conference, Clemson University, Clemson, SC* (Vol. 257, p. 66).

Ahsan, K. and Gunawan, I. (2010) "Analysis of cost and schedule performance of international development projects", *International Journal of Project Management*. Elsevier Ltd and IPMA, 28(1), pp. 68–78.

Al-Hazim, N., Salem, Z. A. and Ahmad, H. (2017) "Delay and Cost Overrun in Infrastructure Projects in Jordan", in *Procedia Engineering*.

Alwi, S.; Hampson, K. and Mohamed, S. (2002) "*Waste in the Indonesian Construction Project*". Proceedings of the 1st International Conferences of CIB W107 – Creating a Sustainable Construction Industry in Developing Countries, 11-13 November 2002, South Africa, ISBN: 0-7988-5544-4, pp. 305-315.

Alaghbari, W. *et al.* (2007) "The significant factors causing delay of building construction projects in Malaysia", *Engineering, Construction and Architectural Management*, 14(2), pp. 192–206.

Amoatey, C. T. and Ankrah, A. N. O. (2017) "Exploring critical road project delay factors in Ghana", *Journal of Facilities Management*, 15(2).

Assaf, S. A. and Al-Hejji, S. (2006) "Causes of delay in large construction projects", *International Journal of Project Management*, 24(4), pp. 349–357.

Atkinson, R. (1999) "Project management: Cost, time and quality, two best guesses and a phenomenon, it's time to accept other success criteria", *International Journal of Project Management*.

Authors, F. (2016) "International Journal of Managing Projects in Business Article information: Modern selection criteria for procurement methods in construction. A state-of-the-art literature review and a survey Rationale".

Azhar, N., Farooqui, R. and Ahmed, S. (2008) "Cost overrun factors in construction industry of Pakistan". *Conference on Construction.*

Baiden, B. K., Price, A. D. F. and Dainty, A. R. J. (2006) "The extent of team integration within construction projects". *International Journal of Project Management*.

Batselier, J. and Vanhoucke, M. (2015) "Empirical Evaluation of Earned Value Management Forecasting Accuracy for Time and Cost". *Journal of Construction Engineering and Management*. American Society of Civil Engineers (ASCE), 141(11), p. 05015010.

Battaineh, H. T. and Odeh, A. M. (2002) "Causes of construction delay: traditional Contracts", *International Journal of Project Management*.

Baur, D. G. (2014) "Gold mining companies and the price of gold", *Review of Financial Economics*. Elsevier Inc., 23(4), pp. 174–181.

Berger, K. C. (2017) "Study of Tailings Management Technologies", *MEND Report 2.50.1*, (October).

Birch, W. J., Dixon-Hardy, D. W. and Engels, J. M. (2006) "Tailings management facility topography modelling to identify flow accumulations and pond geometry", *Mining Technology*. Informa UK Limited, 115(2), pp. 65–74.

Bojan et al (2014) "Project management cost, time and quality", *8th International Quality Conference*, (May 2013), pp. 345–350.

Bosman, L. (2014) "The relationship between mineral resource reporting, shareholder value and investor confidence". Unpublished thesis (MA), University of Preotoria.

Bs, B.- (2008) "What is Project Success: A Literature Review", pp. 3–10.

Chan, D. W. M. and Kumaraswamy, M. M. (1997) "A comparative study of causes of time overruns in Hong Kong construction projects", *International Journal of Project Management*. Elsevier BV, 15(1), pp. 55–63.

Cindrela Devi, A. and Ananthanarayanan, K. (2017) "Factors influencing cost over-run in Indian construction projects", *MATEC Web of Conferences*, 120.

Chan, E. H. W. and Suen, H. C. H. (2005) "Dispute resolution management for international construction projects in China", *Management Decision*, 43(4), pp. 589–602.

De Cooman, R. *et al.* (2015) "Creating inclusive teams through perceptions of supplementary and complementary person–team fit: Examining the relationship between person–team fit and team effectiveness", *Group and Organization Management*, 41(3), pp. 310–342.

Csordas, H. (2017) "An Overview of the Time-Cost Trade-off Problems of Project Planning", *Procedia Engineering*. The Author(s), 196(June), pp. 323–326.

Czarnigowska, A. and Sobotka, A. (2013) "Time-cost relationship for predicting construction duration", *Archives of Civil and Mechanical Engineering*.

Davis, P., Love, P. and Baccarini, D. (2008) "Building Procurement Methods", *CRC Construction Innovation*.

Derakhshanalavijeh, R. and Teixeira, J. M. C. (2017) "Cost overrun in construction projects in developing countries, Gas-Oil industry of Iran as a case study", *Journal of Civil Engineering and Management*, 23(1).

Doloi, H. (2012) "Empirical Analysis of Traditional Contracting and Relationship Agreements for Procuring Partners in Construction Projects", *Journal of Management in Engineering*, 29(3), pp. 224–235.

Durdyev, S. *et al.* (2017) "Significant contributors to cost overruns in construction projects of Cambodia", *Cogent Engineering*, 4(1).

El-Abbasy, M. S. *et al.* (2015) "A condition assessment model for oil and gas pipelines using integrated simulation and analytic network process", *Structure and Infrastructure Engineering*, 11(3).

Elvis Akwasi Acheampong (2016). "*Assessing the Impact of an Operating TSF on Catchment Surface and Groundwater Quality: A case Study of Adamus Resources Limited (Nzema Gold Mine) in the Ellembelle District of the Western Region of Ghana*". Unpublished thesis (MPhil) submitted to University of Ghana.

El Wardani, M. A., Messner, J. I. and Horman, M. J. (2006) "Comparing Procurement Methods for Design-Build Projects", *Journal of Construction Engineering and Management*.

EY's Global Mining & Metals Center (2016) "*Business risks facing mining and metals 2015–2016, Ernest & Young*. 2016.

Famiyeh, S. *et al. (*2017), "Major causes of construction time and cost overruns: A case of selected educational sector projects in Ghana". *Journal of Engineering, Design and Technology*, 15(2).

Flyvbjerg, B., Holm, M. K. S. and Buhl, S. L. (2003) "How common and how large are cost overruns in transport infrastructure projects?", *Transport Reviews*, 23(1), pp. 71–88.

Gerk, J. E. V. and Qassim, R. Y. (2008) "Project acceleration via activity crashing, overlapping, and substitution", *IEEE Transactions on Engineering Management*.

ANCOLD (2012). "Guidelines On Tailings Dams Guidelines on Planning, Design, Construction, Operation and Closure"

Guo, C., Chu, X. and Wang, F. (2018) "The feasibility of non-water reaction polymer grouting technology application in seepage prevention for tailings reservoirs", *Water Science and Technology: Water Supply*. IWA Publishing, 18(1), pp. 203–213.

Hampton, G., Baldwin, A. N. and Holt, G. (2012) "Project delays and cost: stakeholder perceptions of traditional v. PPP procurement", 17(1), pp. 73–91.

Harvey, M. and Plewes, H. (2003), "*Can Tailings Dams be Socially Acceptable", Symposium on Major Challenges in Tailings Dam*, pp.1-8.

Hughes, W. *et al.* (2006) *Procurement in the construction industry: The impact and cost of alternative market and supply processes*, *Procurement in the Construction Industry: The Impact and Cost of Alternative Market and Supply Processes*.

Hughes, W. (2014) *Procurement in the Construction Industry, Procurement in the Construction Industry*.

Idiake, J. E. *et al.* (2015) "A Comparative Analysis of Traditional and Design & Build Methods of Procurement in the Nigerian Construction Industry", *International Journal of Construction Engineering and Management*.

Jj, B. P. D. J. (no date). "Tailings Management", s.n

Kaliba, C., Muya, M. and Mumba, K. (2009) "Cost escalation and schedule delays in road construction projects in Zambia", *International Journal of Project Management*.

Kheng, O. C. (2003) "Extension of Time and Liquidated Damages in Construction Contracts", *Construction Contracts and Arbitration*.

Kim, B.-C. and Reinschmidt, K. F. (2011) "„Combination of Project Cost Forecasts in Earned Value Management", *Journal of Construction Engineering and Management*. American Society of Civil Engineers (ASCE), 137(11), pp. 958–966.

Kwofie, T. E. *et al.* (2015) "Factors contributing towards the effectiveness of construction project teams", *International Journal of Construction Management*. Taylor & Francis, 15(2), pp. 170–178.

Kurylo, J., Rykaart, M. and Wade, L. (2013) "*Engineering challenges for tailings management facilities in permafrost regions, Tailings 2013" - First International Seminar on Tailings Management*. Edited by S. Barrera et al. Santiago, Chile: Gecamin.

Lam, E. W., Chan, A. P. and Chan, D. W. (2008) "Determinants of Successful Design-Build Projects" *Journal of Construction Engineering and Management*.

Larsen, J. K. *et al.* (2015) "Factors Affecting Schedule Delay, Cost Overrun, and Quality Level in Public Construction Projects", *Journal of Management in Engineering*, 32(1), p. 04015032.

Lighthall, P. C. *et al.* (2002) "Design of Tailings Dams and Impoundments", *Keynote Address Tailings and Mine Waste Practices SME*, pp. 1–18. Long, D. L. and Love, H. G. (1982) "Time management 1", pp. 54–56.

Love, P. E. D. (2002) "Influence of Project Type and Procurement Method on Rework Costs in Building Construction Projects", (February), pp. 18–29.

Love, P. E. D. *et al.* (2015) "Understanding the landscape of overruns in transport infrastructure projects", *Environment and Planning B: Planning and Design*, 42(3).

Love, P. E. D., Ahiaga-Dagbui, D. D. and Irani, Z. (2016) "Cost overruns in transportation infrastructure projects: Sowing the seeds for a probabilistic theory of causation", *Transportation Research Part A: Policy and Practice*, 92, pp. 184–194.

Love, P. E. D., Skitmore, M. and Earl, G. (1998) "Selecting a suitable procurement method for a building project", *Construction Management and Economics*.

Ma, G., Gu, L. and Li, N. (2015) "Scenario-Based Proactive Robust Optimization for Critical-Chain Project Scheduling", *Journal of Construction Engineering and Management*, 141(10).

Mahamid, I. and Arabia, S. (2011) "Common Risks Affecting Time Overrun in Road Construction Projects in Palestine: Contractors' Perspective", *Australasian Journal of Construction Economics and Building this*, 13(2), pp. 45–53.

Memon, A. H., Abdul Rahman, I. and Abdul Azis, A. A. (2011) "Preliminary Study on Causative Factors Leading to Construction Cost Overrun", *International Journal of Sustainable Construction Engineering and Technology*, 2(1).

Monica, L., Maria P.I., Maria C.B. and Teresa G.M (2013) "The impact of health and safety investment on construction company costs" (2013) *Safety Science*, 60, pp. 151–159.

Mukuka, M., Aigbavboa, C. and Thwala, W. (2015) "Effects of Construction Projects Schedule Overruns: A Case of the Gauteng Province, South Africa", *Procedia Manufacturing*, 3.

Naoum, S. and Egbu, C. (2015) "Critical Review of Procurement Method Research in Construction Journals", *Procedia Economics and Finance*.

Naoum, S. G. and Egbu, C. (2016) "Modern selection criteria for procurement methods in construction", *International Journal of Managing Projects in Business*.

Ofosu, J. A. (2014) "Cost Overruns in the Delivery of Highway Construction Projects in Ghana". Unpublished thesis (MSc), Kwame Nkrumah University of Science and Technology.

Olanrewaju, A. L. and Abdul-Aziz, A. R. (2015) "*Building maintenance processes and practices: The case of a fast developing country*, *Building Maintenance Processes and Practices: The Case of a Fast Developing Country"*.

Olawale, Y. A. and Sun, M. (2010) "Cost and time control of construction projects: Inhibiting factors and mitigating in practice", *Construction Management and Economics*.

Othman, I., Shafiq, N. and Nuruddin, M. F. (2018) "Time Overrun in Construction Project", in *IOP Conference Series: Materials Science and Engineering*. Institute of Physics Publishing.

Otim, G., Nakacwa, F. and Kyakula, M. (2012) "Cost Control Techniques Used On Building Construction Sites in Uganda", *Second Conference on Advances in Engineering and Technology*, pp. 367–373.

Oyegoke, A. S. *et al.* (2009) "Construction project procurement routes: An in-depth Critique", *International Journal of Managing Projects in Business*.

Rahmani, F., Maqsood, T. and Khalfan, M. (2017) "An overview of construction procurement methods in Australia", *Engineering, Construction and Architectural Management*.

Raju, M. V. *et al.* (2017) "Evaluation of cost and time impacts to overruns in construction industry", *International Journal of Civil Engineering and Technology*, 8(4).

Ramanathan, C. *et al.* (2002a) "Construction Delays Causing Risks on Time and Cost – a Critical Review".

Ramanathan, C. *et al.* (2002b) "Construction Delays Causing Risks on Time and Cost – a Critical Review".

Rauzana, A. (2016) "Analysis of Causes of Delay and Time Performance in Construction Projects", *IOSR Journal of Mechanical and Civil Engineering*, 13(05).

Ren, Z., Anumba, G. J. and Ugwu, O. O. (2001) "Construction claims management: Towards an agent-based approach", *Engineering, Construction and Architectural Management*, 8(3), pp. 185–197.

R, Naikwadi Sumaya. and R, Khare Pranay. (2016) "Causes of Delays in any Construction Project", *International Journal of Science and Research (IJSR)*, 5(1), pp. 59–61.

Roslan, N., Zainun, N. Y. and Memon, A. H. (2015) "Relevancy of Factors and Mitigation Measures in Controlling Time and, *Applied Mechanics and Materials*, 773–774(July), pp. 1007–1011.

Sarfo, M. (2007) "The Effect of Project Management Practices On Buildings" Unpublished thesis (MSc), Kwame Nkrumah University of Science and Technology.

Senouci, A., Ismail, A. and Eldin, N. (2016) "Time Delay and Cost Overrun in Qatari Public Construction Projects", *Procedia Engineering*. The Author(s), 164(June), pp. 368–375.

Seppänen, O. and Kenley, R. (2005) "Using location-based techniques for cost control", *Iglc-13*, 4321(7374), pp. 253–261.

Simon, M. K. & and Goes, J. (2013) "Scope, limitations, and delimitations", in *Dissertation and Scholarly Research: recipes for Success*, pp. 2000–2002.

Sinesilassie, E. G., Tabish, S. Z. S. and Jha, K. N. (2018) "Critical factors affecting cost performance: a case of Ethiopian public construction projects", *International Journal of Construction Management*, 18(2).

Song, J., Haas, C. T. and Caldas, C. H. (2006) "Tracking the location of materials on construction job sites", *Journal of Construction Engineering and Management*, 132(9), pp. 911–918.

Thomson, D. B. (1994) "Arbitration Theory and Practice: A Survey of AAA Construction Arbitrators", 23(1).

Tuuli, M. M., Baiden, B. K. and Badu, E. (2007) "Assessment and enforcement of liquidated damages in construction contracts in Ghana", *Structural Survey*, 25(3–4), pp. 204–219.

Turina, N., RadujkoviÄ‡, M. and Car-PušiÄ‡, D. (2008) "Design and build" in comparison with the traditional procurement method and the possibility of its application in the Croatian construction industry", *8th International Conference:*

Vanden Berghe, J. F. *et al.* (2009) "Importance of shear stress anisotropy and bottom drainage on tailings dam stability: A case history", in *Proceedings of the 17th International Conference on Soil Mechanics and Geotechnical Engineering: The Academia and Practice of Geotechnical Engineering*.

Venkateswaran, C. B. and Murugasan, R. (2017) "Time delay and cost overrun of road over bridge (ROB) construction projects in India", *Journal of Construction in Developing Countries*, 22.

Walker, D.H., 2012. "Innovation and value delivery through supply chain management". *Construction Innovation and Process Improvement*, *125*.

Wels, C., Robertson, A. M. and Jakubick, A. T. (2000) "A review of dry cover placement on extremely weak, compressible tailings", *CIM Bulletin*, 93(1043), pp. 111–118.

Yazici Julie, H. (2009) "The Role of Project Management Maturity and Organizational Culture", *Project Management Journal*, 40(3), pp. 14–33.

Zafar, I., Yousaf, T. and Ahmed, D. S. (2016) "Evaluation of risk factors causing cost overrun in road projects in terrorism affected areas Pakistan – a case study", *KSCE Journal of Civil Engineering*, 20(5).

Zaghloul, R. and Hartman, F. (2003) "Construction contracts: The cost of mistrust", *International Journal of Project Management*, 21(6), pp. 419–424.

Zhou, X. (2014) "Cost Control Method and Software in Bidding Process Based on Gray System Forecast", 2014.

APPENDICES

APPENDIX A-QUESTIONNAIRE

KWAME NKRUMAH UIVERSITY OF SCIENCE AND TECHNOLOGY,

KUMASI GHANA

COLLEGE OF ARTS AND BUILT ENVIRONMENT

DEPARTMENT OF BUILDING TECHNOLOGY

Introduction

QUESTIONNAIRE

The researcher is pursuing MSc. Project Management at the Kwame Nkrumah University of Science and Technology, Kumasi. This research questionnaire has been designed to solicit your view and information regarding the topic **"Time Overrun and Cost Effects of Tailings Storage Facility (TSF) Construction Projects in Ghana".** This information is intended for only academic purposes and all information provided will be treated confidential.

This study aims at establishing percentage cost escalation of TSF construction projects in Ghana.

The objectives of the study are as follows:

- To generate a predictive model for time overrun of delayed TSF projects
- Identify the significance of some critical causes of time overrun of TSF construction projects
- Determine the effectiveness of procurement methods in mitigating time overrun in the delivery of TSF construction projects.

The questionnaire is in two (2) sections:

- Section 1-Respondents details
- Section 2-Cost Effects of Time Overrun, Cost Variance, Critical Causes of Time Overrun and Procurement methods adopted in the administration of TSF projects.
- You may contact me on 0209106836 or triopt12@yahoo.com

SECTION 1: SOCIO-DEMOGRAPHIC CHARACTERISTICS

Respondent Details

Please read through the following questions, mark [x] and or provide answers where applicable or appropriate.

1. Gender: a. Male [ ] b. Female [ ]

2. Which of the following groups do you belong?

a. Contractor [ ] b. Consultant [ ] c. Client [ ]

3. Please indicate the role you play as a team member

a. Project Manager [ ] b. Civil Engineer [ ] c. Quantity Surveyor [ ] d. Others [ ]

4. How many years have you been involved in TSF construction projects?

a. 0-5years [ ] b. 6-10years [ ] c. 11-15years [ ] d. 16-20years [ ] e. Above 20years [ ]

5. What is your age group?

a. 20-30years [ ] b. 31-40years [ ] c.41-50years [ ] d. Above 50years

6. Please indicate your level of education

a. PhD [ ] b. MSc [ ] c. BSc [ ] d. HND [ ] e. Others [ ]

SECTION 2

Part A: Cost Effects of Time Overrun

7. List at least five (5) Cost Effects of Time Overrun

i…….....

ii……...

iii…….

iv……..

v……

vi……

vii……

viii……...

Part B: Cost Variance of Delayed TSF projects

8. Please provide answers to the most recent TSF project you have undertaken:

a. Capacity of TSF (in m^3 or tonnes) ……...

b. Project duration……

c. Time overrun (in months) ……....

9. Indicate the percentage of your project budget that is expended due to time overrun a. Less than 5% [ ] b. 5 %[ ] c. 10% [ ] d. 15% [ ] e. Above 15%[ ]

Part C: Critical Causes of Time Overrun of TSF Projects

10. Below are causes of time overrun in TSF projects. Indicate how significant these causes are to project time overrun on a scale of 1-5 by ticking the respective check boxes.

Scale: 1. Not Significant 2. Less Significant 3. Neutral 4. Significant 6. Very Significant

Causes of time overrun:	**Scale**				
	1	2	3	4	5
i. Delay/shortage in material delivery					
ii. Defective work					
iii. Financial incapability					
iv. Poor coordination with other team members					
v. Poor site management					
vii. Equipment and tool shortage					
vii. Inexperienced site staff					
viii. Slow decision making					
ix. Incomplete documents					

Part D: Procurement Methods used in administering TSF projects

11. Below are procurements methods adopted for TSF project delivery. Please indicate how effective they contribute in mitigating time on a scale of 1-5 by ticking respective check boxes.

1.Not Effective 2. Less Effective 3. Neutral 4. Effective 5. Most Effective

Procurement Methods used in Administering TSF Projects	**Scale**				
	1	2	3	4	5
Traditional contracting					
Total package					
i. Design and Build					
ii. Build-Operate-Transfer					
iii. Build-Own-Operate					
iv. Build-Own-Operate-Transfer					
Construction management/Project Management					
Novation					
Sequential negotiated work package/On-call contracting.					