

**THE IMPLEMENTATION OF ENGINEERING, PROCUREMENT AND
CONSTRUCTION CONTRACTS IN THE PUBLIC SECTOR.**

By

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MASTER OF SCIENCE IN PROCUREMENT MANAGEMENT

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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 a 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 acknowledgment is made in the thesis.

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ABSTRACT

In most countries across the world, particularly African countries, the public sector is considered the single most important player in terms of promoting socio-economic development. This is because, in almost every country, the public sector is the largest employer providing jobs at central, regional and local levels and at the same time provide high-quality services such as health services, education, transportation, financial, infrastructure and security services to citizens. There is a huge gap between the needed infrastructure and what is provided. The public sector must therefore develop innovative ways of providing the needed infrastructure. The Engineering, Procurement and Construction contracts is one of the methods which the public sector can use to breach the infrastructure gap. The study therefore sought to examine the implementation of Engineering Procurement and Construction contracts as a procurement method in the public sector. The objectives were to identify the types of EPC contracts, the factors considered in adopting EPC contracts and to assess the challenges associated with the implementation of EPC contracts. Using a purposive sampling approach, interview guide and questionnaires were used to interview procurement professionals with the experience in EPC contracts. A narrative analysis technique and descriptive statistics were used to analyse the data obtained from the interview. The results show that, EPC contracts are not popular in the public sector because it usually involves large projects. The research therefore recommends that, government should consider the adoption of EPC in whatever major project it intends to execute, such as roads, hospitals and schools. The researcher proposes that further studies in this area should be carried out to compare the various forms of public procurement methods in Ghana to EPC contracts.

Key words: Contracts, Procurement methods, Infrastructure, Public sector.

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DEDICATION

The work is dedicated to God the Father, the Son and the Holy Ghost.

CHAPTER ONE

GENERAL INTRODUCTION

1.0 BACKGROUND OF THE STUDY

In most countries across the world, particularly African countries, the public sector is considered the single most important player in terms of promoting socio-economic development (Betchoo,2016). This is because, in almost every country, the public sector is the largest employer providing jobs at central, regional and local levels and at the same time provide high-quality services such as health services, education, transportation, financial, infrastructure and security services to citizens (Betchoo,2016). In its broader sense, the public sector is that aspect of a country's economy that provides a range of government-related services to the public.

In Ghana, based on the 1992 Republic Constitution Chapter 14, Article 190(1), the public sector is made up of the civil service along with statutory agencies created by the parliament and other 14 public services (Wereko, 2009). It is the duty of the sector to provide best value services is partly hinged on their capacity to understand and synthesize the information presented in contracts awarded (Horsley, 2018). The ability of government-related institutions, statutory agencies, ministries, commissions and departments to effectively deal with, and manage value and risks arising from contracts goes a long way to ensuring smooth operation and running of daily lives (Smith, 2019). In other words, when contracts are successful and delivered, public sector institutions are able to provide services that are useful and helpful to the public or citizens. That being said, contracts are agreements which are made based on the promises of one party to the other party and are capable of being applied by the law (Crucitti, 2015). When a contract is capable of being applied by the law, this means that the said contract is valid. Although there are many types of

contract forms, the engineering, procurement and construction (EPC) contract are increasingly becoming popular. This is because, with this system of contract, it (EPC contract) points the available association among the principal and contractors for the delivery of technical and specialised facilities to the public (Lieu, 2018). With the EPC contract, the principal or owner enters into an agreement with the contractor, who will, in turn, enter into various sub contracts or agreements with other contractors for the completion of other aspects of the project assigned (Lieu, 2018). This would mean that servicers have total switch over the project and execution of the EPC projects right from beginning to end. Also, the EPC contract affords the owner the opportunity to direct and assess the progress of a project based on the performance of the contractor. On the other hand, the downside of the EPC contract is that while owners get advantage from one contractor for the delivery of the project, the owners usually miss contribution to the project and implementation procedure, totalling to the probable danger of failure of the development.

1.1 PROBLEM STATEMENT

Engaging in EPC contracts in the public sector is one of the ways by which projects are accomplished on time and within budgets yet it has its own downsides. In Ghana, most projects are given to contractors who involve other expertise in executing their jobs but there are no clear lines to how far one's work can go (Arhin,2013) There are cases of shoddy works and low compliance. According to Issaka (2014) when it comes to contract in public sector, most people are willing to cut corners in order to avoid any kind of obligations that ties them down to a project till it ends. This is because most contractors in the public sector always want to go in for more than one contract in order to make more money. The EPC method is unlike the traditional Item Rate Agreements. Practice has made it clear that traditional methods are

disposed to extreme time and cost over runs (Niharbala & Pimplikar, 2017). Most studies have been conducted on contracts in the public sector in Ghana but they are mostly on procurement (Agyapong, 2016; Ameyaw, Mensah & Osei-Tutu, 2012, Issaka, 2014; Arhin, 2013). None of these studies focused on EPC making it one of the grey areas. Based on this, the current study seeks to examine the implementation of EPC as a procurement method in the public sector.

1.2 RESEARCH QUESTIONS

1. What are the types of EPC contracts are used at ministries?
2. What are the roles of the implementation of EPC contracts?
3. What are the difficulties associated with the execution of (EPC) contracts?

1.3 AIM

The aim of the study is to examine the implementation of engineering, procurement and construction contracts as a procurement method in the public sector.

1.4 OBJECTIVES

To discourse the aim, the following objectives were considered:

1. To identify the types of EPC contracts used in the public sector.
2. To identify the factors considered in adopting EPC for infrastructure procurement.
3. To determine the challenges associated with the implementation of EPC contracts.

1.5 SIGNIFICANCE OF THE STUDY

The current study will dig into how institutions in the public sector, and in this case, the ministries, make use of or apply engineering, procurement and construction

(EPC) contract to the execution of projects meant to provide technical and professional services to the public. The findings of this current study will be useful in providing an insight into the available types of EPC contracts used in the public sector, the role of the implementation of these types of EPC contracts and the challenges associated with implementing these types of EPC contracts in the public sector.

1.6 RESEARCH METHODOLOGY

The study adopted qualitative study design. According to Myers, M. D. (1997), the qualitative research method gathers qualitative information through meetings, comments, opinions and letters to analyse the behaviour of people. The population for the study was workers of the selected ministries. The study made use of purposive and simple random sampling method. The simple random sampling method is a sampling method which allows participant in a populace the likely opportunity of being part of the study (Creswell, 2007). The study also adopted a simple random sampling method in selecting the ministries. Simple random sampling method will be used in selecting the ministries because it gives each ministry the opportunity of being part of the study. Also, the study made use of a purposive sampling method. According to Babbie (2007), a purposive sampling method is the sampling technique that helps a researcher select a group of subjects that are related to a topic. The purposive sampling method will be used in selecting the workers who have knowledge on EPC contracts in the selected ministries. Information will be collected using an interview guide.

1.7 SCOPE OF THE REPORT

The aim of the study is to examine the implementation of EPC contracts as a procurement method in the public sector. Therefore, the study will be delimited to only identifying the types of EPC contracts, the role of the execution of EPC and the challenges associated with the application of EPC contracts used in the ministries. Based on the objectives the study will adopt only qualitative study design where interview guide will be used in collecting data. Also, the study will use purposive sampling method in selecting the respondents whereas a simple random sampling method will be used in selecting the ministries.

1.8 STRUCTURE OF THE REPORT

The report is separated into five chapters. Chapter one entails background of the study, problem statement, research objectives and questions, significance of the study, the scope of the report and the structure of the study. Chapter two addresses the review of literature that is related to the study as well as theories and conceptual framework. In chapter three, the study presents the methods adopted in collecting and analysing data. Chapter four discusses the results obtained from the study, summary, conclusion and commendations made based on the results from the data collected.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This is a review of selected books, journals, reports, cases, etc that cover the subject of contracts in the public sector with particular concentration on engineering, procurement and construction contracts. The review adopts a narrative approach where the researcher analyses the literature. Dudovskiy (2019) explains that narrative review also draws deductions about the topic and recognizes gaps in a body of knowledge.

2.2 THE CONCEPT OF ENGINEERING PROCUREMENT AND CONSTRUCTION (EPC) CONTRACTS

2.2.1 DEFINING ENGINEERING, PROCUREMENT AND CONSTRUCTION (EPC) CONTRACT

McNair (2011) asserted that EPC contract is common kind of contract for infrastructure and power projects. It is also innovative method of contracting arrangement used in both public and private sector. The study explained that under an EPC contract a contractor must provide a design of the facility, carry out all procurement process and deliver the project in terms of construction and commissioning within a certain time frame and cost. Niharbala & Pimplikar (2017) mentioned that, EPC contracts are one of the forms of contracting arrangement mostly used in the construction industry. The EPC contractor prepares the designs of the structure, procure all materials and equipment needed for the execution of the project and builds the projects directly or with the help of subcontractors. At times, based on the approved scope of work, the contractor may convey the project risk for a schedule and also project the budget for a fixed price, known as lump sum or lump

sum turnkey. According to Lieu (2017), an important advantage of EPC contracts is that the owner has the opportunity to engage only one EPC contractor, who manages the entire project with subcontractors.

2.2.2 TYPICAL PHASES OF EPC CONTRACT

2.2.2.1 Design and Engineering

Design and engineering - the EPC Contractor's appointment could begin as soon as the feasibility phase of the project. That is, it may be engaged analyse high level technical aspects and prepare a report on the likely timing and cost, proposed procurement arrangements for long-lead items, local project considerations and other aspects of the proposed project

Following the feasibility study, the EPC contractor will undertake the Front-End Engineering and Design (FEED) for the project. Broadly, the FEED phase covers the basic engineering and design for the project and also the development of preliminary project schedules, budgets and work packages. Following the FEED stage, the EPC Contractor will work the basic engineering and design into the complete detailed engineering package McNair (2011)

2.2.2.2 Procurement

Procurement In addition to undertaking the design and engineering for the project, the EPC Contractor is usually required to procure, on behalf of the Owner, all of the materials, equipment and construction works necessary for the proper completion of the project. To this end, the EPC Contractor is required to establish a system or follow procedures for implementing such procurement arrangements. This may be a significant task if the project is broken down into many components and involves the EPC Contractor preparing a suite of standard form procurement and construction

contracts for the project establishing a tender process suitable for the commercial terms McNair (2011)

2.2.2.3 Construction

The contractor is responsible for the performance of all construction services and activities required for the timely scheduled completion of the project including furnishing the management, qualified and skilled labor, equipment, tools, consumables, spare parts, temporary facilities and necessary utilities.

A significant benefit of EPC contracts is that it allows the owner to engage with just one contractor, who will, in turn, manage all the relationships with subcontractors. For owners of projects, such arrangements allow them to manage risk more effectively while allowing contractors to allocate and specialize in the work they undertake. McNair (2011)

2.2.3 THE NEED FOR EPC

Niharbala & Pimplikar (2017) stated the need for EPC contracts as follows.

- ❖ Fixed contract price – The contract price for EPC contract is fixed and secured. There is no room for changes and variations.
- ❖ Fixed completion date – There is a guaranteed completion date in EPC contracts. Failure by an EPC contractor to meet the deadline will attract penalties.
- ❖ Very high performance – The performance standards are very high for EPC contractor to deliver.
- ❖ Sole responsibility from the contractor – The entire project from inception to commissioning is depended on the EPC contractor.

- ❖ After commissioning services – It is the duty of the EPC contractor to service and maintain the facility even after it has been commissioned.
- ❖ Flexibility and certainty – The clients dealing with one contractor makes the entire contract flexible and certain.
- ❖ Advanced management and control – These are contractors which are well structured to deliver EPC projects. Therefore, their management and control tend to be classic compared to other contractors in the industry.

2.2.4 PRINCIPAL ELEMENTS OF EPC

Niharbala & Pimplikar (2017) stated the major elements of EPC contracts as follows.

- ❖ Cost, time and quality – The cost of the project, the duration and the quality to be delivered are one of the major items to be considered in EPC contracts.
- ❖ Sole point of accountability – The client wants to be sure the contractor has the capacity to handle such project.
- ❖ Fixed handing over date – No time overruns during the contract period.
- ❖ Performance specifications – The contracts strict compliance to the specifications is a must.
- ❖ Financial consequence for delay/defaulting – Failure by the contractor to meet the deadline attracts huge financial penalty

Wadedwer & Darade (2016) included the following in the elements of EPC contracts

- ❖ Sole point of responsibility - The entire project from inception to commissioning is depended on the EPC contractor.

- ❖ Fixed time and quality - The duration and the quality to be delivered are fixed and guaranteed.
- ❖ Fixed cost – The cost of the project is fixed and guaranteed. No cost overruns.
- ❖ High degree of risk for contractor – Very high degree of risk for the contractor due to unforeseen circumstances.
- ❖ No possibility of cost variation – No variation allowed under EPC contracts.
- ❖ Risk for client is minimized – The client has all his risk push to the contractor.
- ❖ Better performance – High level of performance as compared to other types of contracts in the industry.

2.2.5 TYPES OF EPC CONTRACTS

According to Wadedwer & Darade (2016), the types of EPC contracts are EPC, lump-sum turnkey (LSTK), turnkey projects and item rate contracts. Solabannavar & Jamadar (2017) also mentioned sole document, confidentially negotiated, tendered out, issued under nomination basis, multiple documents, lumpsum price and fixed price as types of EPC contracts.

2.2.6 ADVANTAGES & DISADVANTAGES OF EPC CONTRACTS

Wadedwer & Darade (2016) declared the following advantages and disadvantages of EPC contracts.

Advantages

- EPC is the most suited method for mega projects delivery.
- EPC is also innovative approach in contracting

- EPC decreases the owner / client risk
- EPC projects has a fixed completion date.

Disadvantages

- Cost – Increase in contract sum to cater for risk and unforeseen circumstances.
- Control – the entire process from design to commissioning is under the control of the contractor.
- Quality – if the scope is not well spelt out, the contractor might not achieve the maximum standard required.
- Duration – total duration of project could be lengthy due to FEED - EPC process.

2.3 THE CONCEPT OF PROCUREMENT

2.3.1 DEFINING PROCUREMENT

Procurement has defined by different institutions in different ways. However, some of the definitions presenting the fundamental idea of procurement are presented here. Procurement simply refers to the process of purchasing goods, services and goods, casing couple of purchases from stakeholder. This includes choices appraisal and a vigorous “make or buy” choice that could end up in the delivery of services and goods in suitable conditions (PPB, 2007). Also, Webster (2014) defined procurement as the procedure for obtaining goods, works and services from external sources or suppliers. Again, the Ghana Integrity Initiative (2009) has described procurement in the public sector as the purchase of services, goods and works through the most minimal cost of proprietorship, in the appropriate quality and quantity, at the appropriate defined time, in the appropriate place for the uninterrupted value or use

of government institutions, companies, or individual persons, commonly through a contract. Simply, procurement can be referred to as the acquisition of public properties, and public works by governmental and public organizations. Procurement plays an important role on the economy of any nation. It is through this process that public principles are introduced (GIL, 2009). This is also recognized by Basheka (2009), who argued that “public procurement has increasingly become one of the dominant fertile grounds for corruption”. Procurement is now accepted to be an ‘integral part’ of every organizations. Because of this, laws have been enacted to govern how procurement of public contracts are carried out in Ghana.

2.3.2 PROCUREMENT METHODS

The law that regulates the procurement in Ghana has clearly stated the procurement procedures and methods. This section states this method.

Section 34A of Act 914 (2016) stated the following methods of procurement and conditions of use, including framework contracting.

34A. (1) the procurement entity may conduct procurement by means of the following methods as from time to time determine by regulations:

- a. competitive tendering that includes
 - i. international competitive tendering
 - ii. national competitive tendering
 - iii. request for quotations and
 - iv. restricted tendering

(b) single source procurement

(c) selection of consultants determined by

- i. quality and cost-based selection,
- ii. quality base selection,
- iii. selection based on consultant's qualification
- iv. least cost selection,
- v. fixed budget selection and

(d) framework contracting.

Other innovative methods of procurement according to Niharbala & Pimplikar (2017) are:

- Build-Own- Operate (BOO)
- Buy-Build-Operate (BBO)
- Build-Own-Operate-Transfer (BOOT)
- Build-Operate-Transfer (BOT)
- Build-Lease-Operate-Transfer (BLOT)
- Design- Build- Finance-Operate (DBFO)
- Engineering Procurement and Construction Contracts (EPC)
- Engineering Procurement and Construction Management (EPCM)

2.4 EPC AND PROCUREMENT

2.4.1 EPC PROCUREMENT PROCESS

Solabannavar & Jamadar (2017) stated five stages of EPC procurement process

- i. Preparation of tender documents.

- ii. Announcement and invitation to participate.
- iii. Receiving application for participation.
- iv. Sending tender documents, receipt and inspection of proposals.
- v. Notification of decision, grace time of 10 days and signing of agreement.

2.4.2 EPC PROJECTS AND PROCUREMENT

Experience in the EPC domain shows that, throughout project implementation, substantial nonconformities could happen amid the actual presentation and the intentional one. The courses of these nonconformities are very flexible and could depend on both outside sources, of which the firm has virtually no control, and internal sources. Procurement, to be specific, has the highest influence on the project delivery. Purchasing could account for up to 80% of the total worth of a project and up to 45% in the case of serious supplies Micheli & Cagno (2016). The high impact of procurement on project performance is just as evident with regard to time: consider the long lead-time item, whose buying process begins even before the actual beginning of the project activity. Finally, the finish quality of the project is exceedingly influenced by the quality of the items purchased; EPC companies act by selecting a supplier capable of assuring an adequate level of quality Micheli & Cagno (2016)

2.5 UNDERSTANDING ENGINEERING CONTRACTS

Ryan (2006) defined a contract as a legally binding agreement which recognises and governs the rights and duties of the parties to the agreement. According to Winter v Nemeth (2018), a contract is legally enforceable because it sees the necessities and endorsement of the law. Business Dictionary (n.d) defines contract as a volunteer, thoughtful, and lawfully requisite agreement among parties. Contracts are generally

printed but may be verbal or indirect, and mostly have to do with engagement, auction or tenancy. Engineering Contract means the contract for professional services between the Company and a qualified third-party firm for the performance of design and engineering services for the Project. Business Dictionary (n.d)

2.6 TYPES OF ENGINEERING - INFRASTRUCTURE CONTRACTS

The Associated Builders and Contractors (2018) enumerated types of construction contracts to include lump sum contract, unit price contract, cost plus contract, incentive contracts, guaranteed maximum price contract, design-build contract, and integrated project delivery contract.

In a paper for the Congressional Research Service, Manuel (2014) explained the following types of contracts: fixed-price contracts, cost-reimbursement contracts, incentive contracts, time-and-materials and labour-hour contracts, indefinite-delivery contracts, letter contracts, and agreements. According to the Australian Department of Industry, Innovation and Science (2018), all of these contract types can either be written contracts, verbal contracts, standard form contracts, or period contracts.

2.7 PROCUREMENT CONTRACTS USED IN THE PUBLIC SECTOR

Mihai-Bogdan & Badia (2013) mentioned three types of procurement contracts used in the public sector. Namely works contracts, supply or goods contracts and service contracts.

A. The works contract – this is execution and design work on activities such as insulation, finishing, plumbing, carpentry (Anexe no.1 GEO. No. 34/2006), or design, execution or performance by any means, of a work corresponding to the need and objectives of the contracting authority.

B. Supply Contract – This is for the supply of one or more products based on purchase, including rates, hiring or leasing, with or without option to buy. This type of contract is the main supply of products and, as a secondary operation / installation work and commissioning them.

C. The service contract - It is that public contract, which is for the provision of one or more services.

2.8 CONSTRUCTION CONTRACTS USED IN THE PUBLIC SECTOR

IPSAS (2001) contended that, construction contracts in the public sector are directly related to the construction of the asset, for example, those for the services of project managers and architects. Construction contracts in the public sector also include all arrangements that are binding on the parties to the arrangement, but which may not take the form of a documented contract

Construction contracts in the public sector are formulated in a number of ways which, for the purposes of this Standard, are classified as fixed price contracts and cost plus or cost based contracts. Some commercial construction contracts in the public sector may contain characteristics of both a fixed price contract and a cost plus or cost based contract, for example in the case of a cost plus or cost based contract with an agreed maximum price.

Cost plus and cost-based contracts encompass both commercial and non-commercial contracts. A commercial contract will specify that revenue to cover the constructor's construction costs as agreed and generate a profit margin will be provided by the other parties to the contract. However, a public sector entity may also enter into a non-commercial contract to construct an asset for another entity in return for full or partial reimbursement of costs from that entity or other parties.

2.9 THE CONCEPT OF EPC CONTRACTS IN THE PUBLIC SECTOR

According to Niharbala & Pimplikar (2017) the Ministry of Road Transport and Highways in India adopted the EPC method of construction for national highways road project that are not engaged on PPP basis for a five-year period. During this period, the ministry constructed 20,000 km of 2-lane national highways roads project by the use of EPC method. The Ministry however explains the rational behind the adoption of the EPC method as follows:

- The Indian government adopted this mode of construction to guarantee the execution of projects to detailed standards with the idea of cost and time in mind.
- EPC method is far different from the traditional item rate contracts. The traditional method is prone time and cost over runs.
- The EPC method also allocates the duty for enquiry, design and building to contractors for a lump sum price.
- This initiative was accepted to solve the difficulties in the construction of national highways on a fast tract route.

Wadedwer & Darade (2016) refers to some of the successful EPC project in India.

Namely

- ❖ Construction of four lane bye pass road at Chittorgrah Rajsthan
- ❖ Westerly bypass road in New Delhi
- ❖ Improvement & maintenance of East coast road in Tamilnadu

Table 2.1 EPC Players in India

Segment	EPC Player
Construction residential / commercial	<ol style="list-style-type: none"> 1 Larsen and Turbo Ltd 2 Shapoorji Pallonji and C. Ltd 3 B.G Shirke Construction Tech Pvt ltd 4 Man Infra Construction Ltd 5 Supreme Infrastructure India ltd
Infrastructure / general contracting	<ol style="list-style-type: none"> 1 Hindustan Construction Co. Ltd 2 Gammon India 3 Simplex Infrastructure Ltd 4 Gayatri Projects Ltd 5 Nagarjuna Construction Ltd

Source: Solabannavar & Jamadar (2017)

2.10 FACTORS TO CONSIDER IN ADOPTING EPC FOR INFRASTRUCTURE PROCUREMENT

Kabirifar & Mojtahedi (2018) enumerated the following fifteen (15) factors that affect EPC for infrastructure project: poor design, poor project planning, poor estimation, design incompleteness, inadequate stakeholder involvement, dispute, reputation loss, long-lead item delivery, poor site supervision, poor project control, change of scope, accidents or incidents, excessive bureaucracy, insufficient or inefficient equipment or machinery, and inclement weather. Niharbala & Pimplikar (2017) considered cost, time and quality as the major factors to be considered.

2.11 CHALLENGES ASSOCIATED WITH THE IMPLEMENTATION OF EPC CONTRACTS

According to (Hwanget al.,2014; Zavadskaset al., 2010; Liaudanskienèet al., 2010) as cited by Sarpong (2016) risk may be defined as been opened to loss over profit or the possibility of incidence of loss over profit multiplied by risks corresponding level. If the occurrence is said to be certain then the probability of it happening is 100%and if it is not occurring then the probability is 0%. Separating these excesses, the improbability varies rather extensively. Nowadays, a lot of information can be used to assess risk. Construction activity is associated with a lot of risk as other economic activities are also exposed to risk. Paslawski (2013) also said, successes and implementation in depends on the level of risk. Nevertheless, construction projects are known to have more inbuilt risks because of the number of people that are involved in the contract or contracting, like contractors, clients, suppliers, designers and subcontractors (PMI, 2004).According to Akintoye and MacLeod (1997), risk is found in every social activity, which includes the activities inside construction and the risk components involved varied. The nature of construction undertakings moves to risk management in the controlling, arranging and planning resources and activities so as to lessen the effect of unreliable activities. Cost and time overruns linked to projects of construction are risk in construction because it has been the object of consideration. Perry and Hayes (1985), Healey (1982) and McKim (1992) defined risk to be an acquaintance to economic gain or loss through the participation in the process of construction;due to this Mason(1973),see risk to be an exposure to loss. McKim (1992) stated that, it is important to know the risk's nature before any idea of managing it can follow. Risks come in various categories and most times the type of risk be contingent of the condition.¹³Toakley and Ling

(1991); Williams and Heims (1989); Raftery (1994); and Akintoye and Macleod (1997) identified the contemporary procedures or techniques for managing risk in the construction industry. They Include discount rate, risk adjusted, decision analysis, sensitivity analysis, subjective probability, risk premium.

According to Wadedwer & Darade (2016), the challenges that confront the implementation EPC Contracts are as follows:

- Cost – Increase in contract sum to cater for risk and unforeseen circumstances.
- Control – the entire process from design to commissioning is under the control of the contractor.
- Quality – if the scope is not well defined, the contractor might not achieve the maximum standard required.
- Duration – total duration of project could be lengthy due to FEED - EPC process.

Table 2.2 Stages of EPC contract at different risk

Risk	Pre-tender stage	Post-tender stage	Execution stage
Political risk	Political solidness of the nation, change in government.	Delay in endorsement and land securing	-
Environmental risk	-	Ecological approvals	Unfavourable climatic and geological conditions
Technical risk	Deficient research on extension, assets, accessibility, innovation pre-requisite prompting of base time and cost	Design challenges, assets accessibility and site conditions	Unfamiliarity with landscape, utility moving, resettlement
Financial risk	Cost estimates and financing assumptions	Liquidity and credit storage	Foreign exchange and interest rate fluctuation
Market risk	-	Economic downturn	Setback in payment as of client
Contractual risk	Unfamiliarity with local laws and regulations	Unfamiliarity with local laws and regulation limited contract negotiations	Unfamiliarity the with local laws, tax and regulations
Force majeure	-	-	Related to external hazards, such as storm, floods, earthquakes, vandalism and sabotage

Source: Solabannavar & Jamadar (2017)

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

The methodology is organised into four parts. The first parts comprise an account of the research design used in this study. The second part comprises the explanation of the population and sample of the report while the third part contains the method and procedures used for data collection. The final part clarifies the procedure of analysing the data.

3.2 RESEARCH DESIGN

This study employs the mixed method, that is quantitative and qualitative approach. The qualitative research technique contains information gathering of individual knowledges, self-examination, stories about life, discussions, remarks, exchanges and visual texts which are significant to people's lifecycle. Qualitative study classically helps to identify these results as shown in Figure 3.1 (Peshkin,1993).

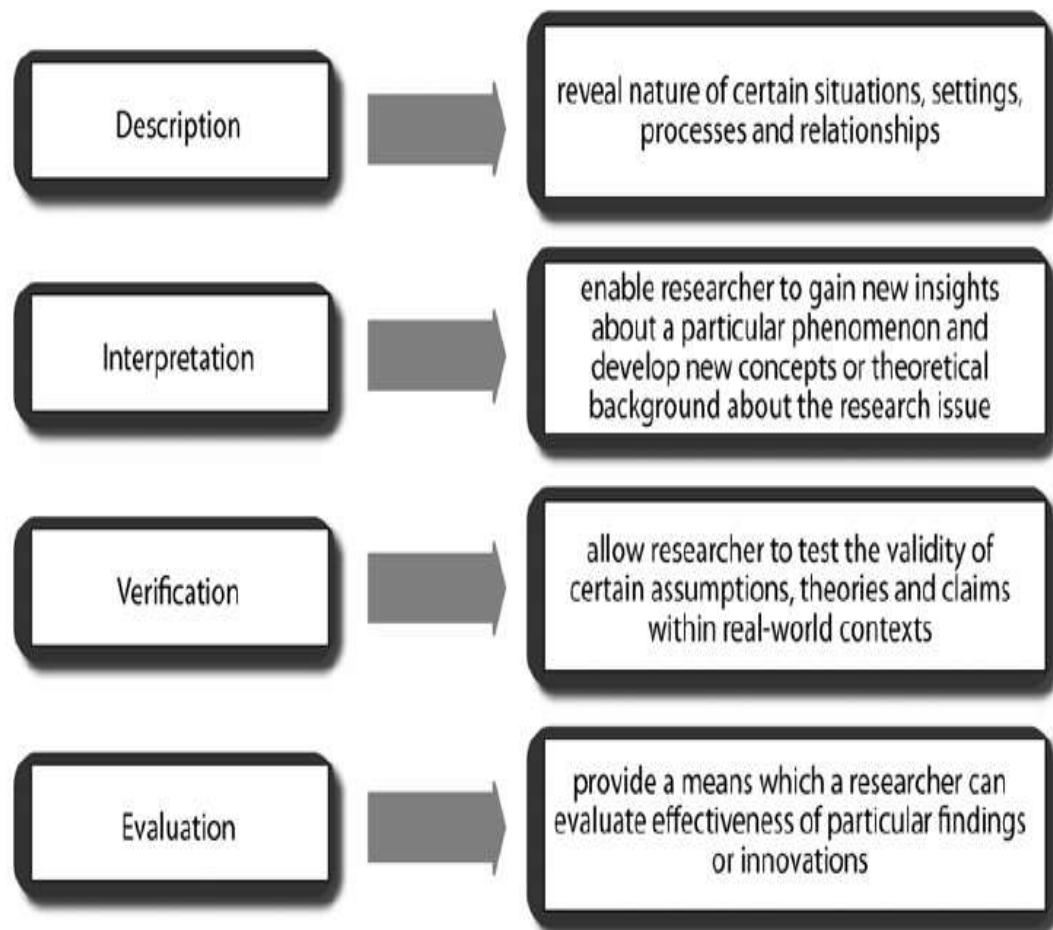


Figure 3.1: Purpose of quality research

Source: Perskin (1993)

3.3 POPULATIONS AND SAMPLE

A population was defined as any set of people or events from which the sample is selected and to which the study results will be generalized. The population of this study consisted of procurement officers in a number of government ministries in Ghana (Ministry of Finance, Interior, Energy and Petroleum, Food and Agriculture, Education, Health, Railway Development, Transport, Youth and Sport, Works and Housing, Roads and Highways and Gender). The above ministries represented one third of the total ministries in Accra selected using purposive sampling due to the nature of the study. The total number of procurement professionals in the selected

ministries was 146 according to data obtained from the various ministries under study.

3.4 SAMPLING TECHNIQUE

The samples of this study were selected using purposive sampling technique. Purposive sampling is a non-probability sampling method and it occurs when “elements selected for the sample are chosen by the judgment of the researcher. Researchers often believe that they can obtain a representative sample by using a sound judgment, which will result in saving time and money” Black (2009).

3.5 SAMPLE SIZE

Usually, researchers cannot make direct observations of the entire population of interest. Therefore, they tend to choose a sample from the population. This sample has to be representative of the entire group. This is important so that conclusions drawn can be used to make some general inference about the whole population. It is therefore important to determine the appropriate number of respondents to be sampled from the entire target population of the study to be representative of it. There are many approaches available for sample size determination of a study population (Israel, 1992). Among these methods are calculating the sample size using a formula, using samples from similar studies and published related research among others. In this study, a formula is employed to determine the sample size needed for the research. The total number of professionals in the ministries is 146 according to data obtained from the various ministries under study. The sample size (n) was then determined using the formula (Kish, 1965).

$$n = \frac{n^*}{1 + \frac{n^*}{N}}$$

where $n^* = \frac{(p(1-p))^2}{SE^2}$, N is the total population = 146, p is the proportion of the population that belongs to the category of interest, that is, p is taken to be 0.5. Finally, SE is the standard of error of the sampling distribution. Let SE=0.05. Using these give the sample size as follows:

$$n^* = \frac{(0.5(1 - 0.5))^2}{0.05^2} = 100$$

$$n = \frac{100}{1 + \frac{100}{146}} = 59.34 \approx 60.$$

Therefore, the sample employed for the research was 60.

3.6 DATA COLLECTION METHOD

The data for this study was collected from the respondents through interview and questionnaire as the research instrument. Kvale (1996) interviews are “conversations, whose purpose is to gather descriptions of the real-world of the interviewee” with the mindset of analysing the result.

For the purpose of this study, the researcher opted to adopt the semi-structured type of interviews. This will allow in-depth to be attained as the researcher has the chance to ask the interviewee more related questions and cover many issues to enhance the study (Rubin & Rubin, 2005: 88).

3.7 METHOD OF DATA ANALYSIS

The methods employed in the data analysis involves descriptive statistics and narrative analysis. However, for this to be achieved, the data has to be initially assigned codes and tags. The descriptive analysis employed involves the use of tables and figures to display and show the variables and information of interest in the study.

CHAPTER FOUR

DATA PRESENTATION AND ANALYSIS

4.1 INTRODUCTION

This chapter presents the analysis of the data collected. It presents the descriptive analysis and some in-depth exploration of the responses from the interviews conducted.

4.2 DEMOGRAPHIC CHARACTERISTICS

This section presents the demographic characteristics of the respondents. This is very important for the understanding of the distribution of respondent across the various ministries. Also, captured under this section is the years of experience of respondents. Table 4.1. It can be observed that the distribution across the various ministries is fairly equal.

Table 4. 1: Distribution of respondents across the various ministries

Ministry	Frequency	Percentage
Education	5	8.3
Energy and Petroleum	5	8.3
Finance	5	8.3
Food and Agriculture	5	8.3
Gender	5	8.3
Health	5	8.3
Highways	4	6.7
Interior	5	8.3
Railway	6	10.0
Transport	4	6.7
WH	6	10.0
Youth and Sport	5	8.3
Total	60	100.0

Source: Field Survey (2019)

Also, it of interest to explore the years of experience of respondents. This is also given in the Table 4.2. It can be observed that most of the respondents, representing 38.3%, have experience between 0 and 5 years. This was followed by those who have had experience for over 20 years in the profession, representing 21.7% of the respondents.

Table 4. 2: Years of Experience of Respondents

Years	Frequency	Percentage
0-5	23	38.3
6-10	5	8.3
11-15	10	16.7
16-20	9	15
Over 20	13	21.7
Total	60	100.0

Source: Field Survey (2019)

The data in Table 4.2 is illustrated in the pie chart in Figure 4.1. The figure clearly confirms the results shown in Table 4.2.

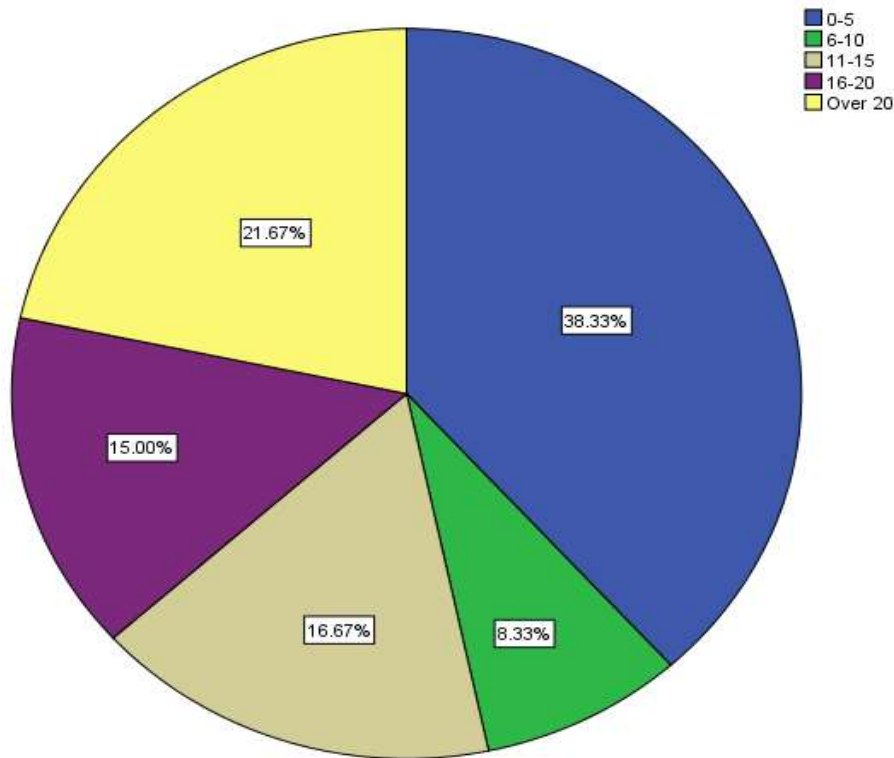


Figure 4. 1: Illustration of Years of experience of respondents

Source: Field Survey (2019)

The educational level of respondents was also explored to help ascertain the quality of information gathered. This is displayed in Table 4.3. From the table, it can be observed that most of the respondents, representing 36.7%, attained either a BSc or B-Tech degree. In all, majority of the respondents attained at least an HND degree. This implies that they have the basic qualification and would be in the position to provide credible information for the study.

Table 4. 3: Educational Level of respondents

Education	Frequency	Percentage
HND	15	25.0
BSc or B Tech	22	36.7
MSc or MPhil	16	26.7
PhD	3	5.0
Others	4	6.7
Total	60	100.0

Source: Field Survey (2019)

4.3 TYPES OF EPC CONTRACT USED IN THE PUBLIC SECTOR

In this section, the results from the data is presented. Table 4.4 shows the types of EPC contracts ascertained from the various ministries under the study. It can be observed that the lump sum contract is frequently used by the respondents in this study. It was mentioned by 45% of the respondents. This was followed by fixed price contracts, representing 31.7% of the respondents and 23.3% mentioned turnkey projects.

Table 4. 4: Types of Contracts

Type of contract	Frequency	Percent
Lump sum	27	45.0
Fixed price	19	31.7
Turnkey project	14	23.3
Total	60	100.0

Source: Field Survey (2019)

The results are illustrated in the bar chart in Figure 4.2.

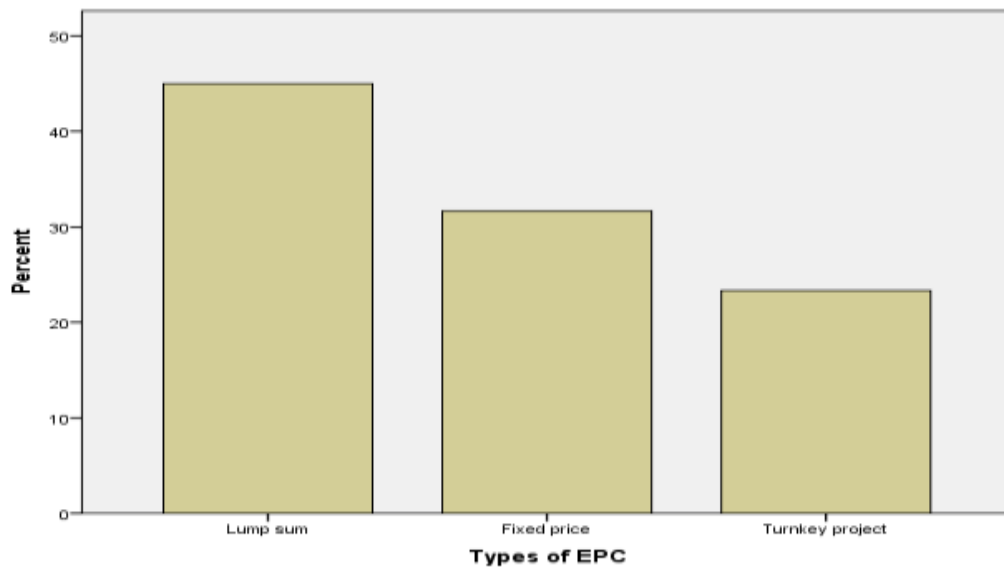


Figure 4. 2: Types of EPC contracts

From the interview conducted with the respondents from the Ministry of Education and Finance, it was realised that three major types of EPC contracts are used in the public sector of Ghana. They are the lump sum contract, fixed price contract, and turnkey projects. This is evident in the statement by Respondent # 1 (refer to Appendix III):

“Lump sum contracts in the sense that the cost is determine and submitted for value for money analysis and then we have a certain approval to do a certain scope of work within a certain amount of money. It becomes very expensive when variations come in. It’s also a high risk for the contractor.”

“...Lump sum price, fixed price and turnkey projects.” (Appendix #2)

Elsewhere, in India for instance, EPC contracts are the type of contracts used to execute construction works and highway road projects. EPC contractor will prepare comprehensive design of the facility, take charge of the entire procurement process required and then build a functioning facility prescribed by the client within stipulated time period. The highway sector in the country has been facing difficulties in the award and implementation of projects particularly through public private partnership mode. This is due to overall economic downturn as well as, specific issues of the sector. In such time public funded or EPC mode of implementation is preferred mode, subject to availability of resources in such cases hybrid (Wadedwer et al, 2016).

4.4 FACTORS TO CONSIDER IN ADOPTING EPC FOR INFRASTRUCTURE PROCUREMENT

A number of factors are considered in adopting EPC for infrastructure. The study revealed that cost and quality are the two topmost factors to be considered. Cost was rank first by the respondents as the priority of the factors to be considered. This was followed by the quality. Also, others to be considered are the performance of the contractor, conflict of interest and delivery time. Among all these, conflict of interest was rank as the lowest factor to be considered.

Table 4. 5: Factors to be considered in adopting EPC for Infrastructure**Procurement**

Factors	1	2	3	4	5	Weights	Rank
Cost	0	0	1	5	54	293	1
Quality	0	0	4	12	45	285	2
Performance of contractor	1	4	8	16	30	247	3
Conflict of interest	8	6	20	18	15	227	5
Delivery time	10	10	22	12	20	244	4
Others	20	12	10	8	18	196	6

(1-strongly disagree, 2-disagree, 3- fairly agree, 4-agree, 5-strongly agree.)

Source: Field Survey (2019)

A number of factors to consider in adopting EPC for infrastructure were identified as themes in the transcribed data. According to Respondent #1, these factors centre on cost and quality:

“...first of all, you look at the project on the countries scale of immediate priorities. Do we really need this? If yes, at what cost. What is the funding available, is it a commercial loan or interest free loan? Do we have the capacity to pay? What does the term sheet say? How many years are they given the country to pay back the loan. Are we able to pay back within our developmental goals? Want to be sure the country is comfortable. It fit into our development plan...Do we have the capacity to supervise what is been done. Do we have the means of knowing that the equipment they are bringing is the latest? Are they not bringing obsolete equipment? There is always this problem of poor supervision. Do we have the capacity to supervise? Who is going to be our eye of the project? Who is going to be the watchman for the government?

Respondents #2 however mentioned more factors in addition to cost:

“...the price of the project, the timeline for completion, level of performance of the EPC contractor, post - commissioning services, and higher supervision and control.”

Although not explicitly stated, the second respondent’s reference to ‘level of performance’ implies quality and speed

4.5 CHALLENGES ASSOCIATED WITH THE IMPLEMENTATION OF EPC CONTRACTS

There are always challenges associated with the implementation of contracts. From the study, some of the challenges associated with EPC contracts were revealed. Table 4.6 shows the results with this regard. It can be observed that cost of contracts is recorded as a major challenge. This was followed by

the quality of the work. Contractors usually end up for the minimum standard thereby reducing the quality of the work itself.

Table 4. 6: Challenges Associated with EPC contracts

Challenge	1	2	3	4	5	Weights	Rank
Cost	0	0	1	8	50	285	1
Control	0	0	8	8	40	256	4
Quality	0	1	6	10	42	270	2
Understanding the scope	2	3	20	16	25	257	3
Capacity to supervise	2	6	18	12	20	216	5

(1-strongly disagree, 2-disagree, 3- fairly agree, 4-agree, 5-strongly agree.)

Source: Field Survey (2019)

From the interviews, the cost is a challenge because contractors always want to add a substantial risk premium to the price of the contract. Another challenge is the control of the contractor with regards to the detailed design and construction process. Again, contractors always aim for the minimum compliant standard. The scope or definition of the contract is a challenge. The respondents also asserted that “one must know exactly what the contractors are bringing. The value for money is key. Value for money is the crack of the problem. If the comparator price from the word go is wrong, the value for money will be wrong. You are not too sure what the actual market price of the projects is. Value for money is very difficult to fine.”

Challenges associated with EPC contracts based on the findings according to Respondent #2 are:

- Cost: “... *contractors will add a substantial risk premium to the price.*”
- Control: “...*the contractor controls the detailed design and construction process.*”
- Quality: “...*the contractor will aim for the minimum compliant standard.*”
- Value for money analysis: “...*you must know exactly what they are bringing. The value for money is key. Value for money is the crack of the problem. If the comparator price from the word go is wrong, the value for money will be wrong. You are not too sure what the actual market price of the projects is. Value for money is very difficult to fine.*”
- Definition of the scope: “...*sometimes the scope is a challenge.*”
- Unavailability of our capacity to supervise: “...*do we have the capacity to supervise what is been done.*”

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter will present the conclusion showing the major findings together with possible recommendations to aid further research in practice and academia. The chapter will propose recommendations based on the outcome of the study. The recommendations from the studies are then stated with a look at the limitations that came with it. The final discussion is in the recommendation for further research.

5.2 SUMMARY OF THE STUDY OBJECTIVES

The study aimed at examining the implementation of Engineering, Procurement and Construction contracts as a procurement method in the public sector. The objectives laid down to help realize the aim of the study were; to identify the types of EPC contracts used in the public sector, to identify the factors considered in adopting EPC for infrastructure procurement and to determine the challenges associated with the implementation of EPC contracts.

The findings are discussed below;

5.2.1 THE FIRST OBJECTIVE

To identify the types of EPC contracts used in the public sector.

Literature was reviewed to gather existing literature on EPC contracts in both private and public sector. An interview guide and questionnaire was used to collect the data from the respondents. The analysis undertaken were narrative analysis and descriptive statistics. From the analysis, it was realised that lump sum, fixed price and turnkey contracts were the common types of EPC contracts used in the public

sector. Meanwhile lump sum contract was highly ranked by the respondents as the most commonly used one.

5.2.2 THE SECOND OBJECTIVE

To identify the factors considered in adopting EPC for infrastructure procurement.

To achieve the objective stated above, existing literatures on the topic were reviewed. Interview guides and questionnaires were developed to enable the researchers gather information from respondents. After the analysis, it was revealed that, cost, quality and time were the most common factors considered during the implementation. Cost however was ranked the highest factor considered in adoption of EPC contracts.

5.2.3 THE THIRD OBJECTIVE

To determine the challenges associated with the implementation of EPC contracts.

Narrative analysis and descriptive statistics were used in analysing the data obtained for this objective. The results showed that, cost, quality and scope were the major challenges confronting the implementation of EPC contracts. Cost was very high because source of funding comes with high cost of capital and the contractor also adding a substantial risk premium to the contract price. The last two ranked were comprising capacity to supervise and control as such does not make them unimportant.

5.3 CONCLUSION

In view of the findings from this study the researcher concludes that:

- EPC is not popular in Ghana because according to Respondent #1, "... a lot of the work is done by the contractor. And it's because the contractor provides the source of funding. Anytime a donor fund is used, people think that implementing something that is not funded from Ghana is free. But it's never free because Government had to pay at the end of the day. It's not very common because funding comes at a very high cost of capital. Secondly the work to be done is only known by the contractor and they try to cut corners. The beneficiary does not take time to ask questions. It is not very common and most people do not like using it." and in the view of Respondent #2, "... it is not popular because it is not mostly used in the public sector and it's a contract that requires large projects."
- Factors to consider in adopting EPC for infrastructure procurement include Cost of project, quality of project, fixed completion date, agreed performance of the EPC contractor and capacity to supervise what is been done.
- The major challenges with the implementation of EPC contracts are cost due to contractors risk premium; control of the detailed design and construction process by the contractors; the contractor's tendency to aim for the minimum compliant standard; value for money analysis; definition of the scope; and, the capacity to supervise what is been done.

5.4 RECOMMENDATIONS

Based on the findings, it is recommended that government should consider the adoption of EPC in whatever major project it intends to execute, such as hospital,

airport, train station among others. The procurement terms should be very clear and should be well advertised. As much as possible, there should be expression of interest that may lead to keen competition to the advantage of all stakeholder in the contract. During the bidding process, instead of focusing on a certain contractor, a number of contractors should be selected and a committee should be formed to look at every body's proposal. And even ask them to do a presentation. The panel will look at each of the presentations and then choose the one appropriate to execute the project.

5.5 AREAS FOR FURTHER STUDY

The researcher proposes that further studies in this area should be carried out to compare the various forms of public procurement methods in Ghana to EPC contracts

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APPENDIX I: INTRODUCTORY LETTER

RESEARCH TOPIC: Engineering, Procurement and Construction Contract.

INTRODUCTION

The researcher is a final year student of Kwame Nkrumah University of Science and Technology-Kumasi and from the Department of Construction Technology and Management. He intends to execute this research as part of the university's academic requirement for the completion of his degree of Masters of Procurement Management. Your objective response to this interview is an invaluable aid to this research work. All information provided would be treated as confidential and for academic purposes only. There are no rights or wrong answers.

In case of any doubt/s or need for clarification, please contact any of the addresses given below.

Thank You.

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APPENDIX II: INTERVIEW QUESTIONS GUIDE

SECTION A: Demographics

Which ministry do you work with?

What is the highest level of education you have attained?

What is your years of experience?

SECTION B: Types of engineering, procurement and construction contract used in the public sector

In your opinion, is EPC a popular type of contract in Ghana?

What type of EPC contracts are predominantly applied in the public service sector?

Mention a few projects that are based on the EPC contract?

SECTION C: Factors to consider in adopting EPC for infrastructure procurement

In your opinion, what factors should be considered in adopting EPC for infrastructure procurement?

Why these factors?

SECTION D: Challenges associated with the implementation of EPC contracts

What are the major challenges with the implementation of EPC contracts for infrastructure procurement?

What accounts for these challenges?

In your opinion, how can these challenges be surmounted?

APPENDIX III: INTERVIEW WITH - RESPONDENT #1

SECTION A: DEMOGRAPHICS

What is your age?

41-50 years

What is the highest level of education you have attained?

MSc

SECTION B: TYPES OF ENGINEERING, PROCUREMENT AND CONSTRUCTION CONTRACT USED IN THE PUBLIC SECTOR

1. In your opinion, is EPC a popular type of contract in Ghana

It is not popular because a lot of the work is done by the contractor. And it's because the contractor provides the funding. Anytime a donor fund is used, people think that implementing something that is not funded from Ghana is free. But it's never free because Government had to pay at the end of the day. It's not very common because funding comes at a very high cost of capital. Secondly the work to be done is only known by the contractor and they try to cut corners. The beneficiary does not take time to ask questions. It is not very common and most people do not like using it.

2. Were you ever engaged in any EPC contract?

Yes, six hundred bed University of Ghana Medical School. Contractor: Engineering and development consultants Limited (EDC)

3. What type of EPC contracts are predominantly used in the public sector (Example of types: Lump sum price, fixed price, turnkey projects, privately negotiated, issued under nomination basis)

Lump sum contracts in the sense that the cost is determine and submitted for value for money analysis and then we have a certain approval to do a certain scope of

work within a certain amount of money. It becomes very expensive when variations come in. It's also a high risk for the contractor.

4. Please mention some projects that EPC contracts are used.

University of Ghana Medical School

SECTION C: Factors to consider in adopting EPC for infrastructure procurement

1. In your opinion, what factors should be considered in adopting EPC for infrastructure project? Is it cost, quality, or time?

Cost – First of all, you look at the project on the countries scale of immediate priorities. Do we really need this? If yes, at what cost. What is the funding available, is it a commercial loan or interest free loan. Do we have the capacity to pay? What does the term sheet says. How many years are they given the country to pay back the loan. Are we able to pay back within our developmental goals? Want to be sure the country is comfortable. It fit into our development plan.

Quality - Do we have the capacity to supervise what is been done. Do we have the means of knowing that the equipment they are bringing is the latest? Are they not bringing obsolete equipment? There is always this problem of poor supervision. Do we have the capacity to supervise? Who is going to be our eye of the project? Who is going to be the watchman for the government?

SECTION D: Challenges associated with the implementation of EPC contracts

1. What are the major challenges with the implementation of EPC contracts?

Cost – contractors will add a substantial risk premium to the price

Control – the contractor controls the detailed design and construction process

Quality – the contractor will aim for the minimum compliant standard

Value for money analysis – You must know exactly what they are bringing. The value money is key. Value for money is the crack of the problem. If the comparator price from the word go is wrong, the value for money will be wrong. You are not too sure what the actual market price of the projects is. Value for money is very difficult to fine

Definition of the scope – Sometimes the scope is a challenge.

Unavailability of our capacity to supervise – Do we have the capacity to supervise what is been done.

2. In your opinion, how can these challenges be surmounted?

Let us advertise what we want. We want a hospital, airport, train station etc. Let's invite expression of interest like a competition. We can shortlist about five contractors. Form a committee to look at every body's proposal. And even ask them to do a presentation. The panel will look at each of the five presentations and then choose the one appropriate to execute the project.

APPENDIX IV: INTERVIEW WITH - RESPONDENT #2

SECTION A: DEMOGRAPHICS-

What is your age?

41 – 50 years

What is the highest level of education you have attained?

MSc

SECTION B: TYPES OF ENGINEERING, PROCUREMENT AND CONSTRUCTION CONTRACT USED IN THE PUBLIC SECTOR

In your opinion, is EPC a popular type of contract in Ghana?

No, it is not popular because it is not mostly used in the public sector and it's a contract that requires large projects.

Were you ever engaged in any EPC contract?

Yes, University of Ghana Medical School

What type of EPC contracts are predominantly used in the public sector? Is it either lump sum price, fixed price, turnkey projects, privately negotiated, issued under nomination basis)

Lump sum price, fixed price and turnkey projects.

Please mention some projects that EPC contracts are used?

SECTION C: FACTORS TO CONSIDER IN ADOPTING EPC FOR INFRASTRUCTURE PROCUREMENT

In your opinion, what factors should be considered in adopting EPC for infrastructure project

The price of the project, the timeline for completion, level of performance of the EPC contractor, post - commissioning services, and higher supervision and control.

SECTION D: CHALLENGES ASSOCIATED WITH THE IMPLEMENTATION OF EPC CONTRACTS

What are the major challenges with the implementation of EPC contracts?

Cost – contractors will add a substantial risk premium to the price

Control – the contractor controls the detailed design and construction process

Quality – the contractor will aim for the minimum compliant standard

Duration – total construction time may be prolonged by required feed to EPC sequence

Capacity / competition – few contractors have the balance sheet capacity to accept (and bond) the risk of large projects on an EPC basis

Claims – Contractors are motivated to make claims to alleviate risk transfer.