UNIVERSITY OF EDUCATION, WINNEBA

COLLEGE OF TECHNOLOGY EDUCATION

KUMASI

A STUDY INTO THE POSSIBILITY OF USING ELECTRONIC TENDERING IN THE GHANAIAN CONSTRUCTION INDUSTRY

SOLOMON AHENGUA ANOKYE

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

AUGUST, 2016

DECLARATION

STUDENTS' DECLARATION

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

....

SIGNATURE DATE

SUPERVISOR'S DECLARATION

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

Supervisor:……. Date .....

DR. WILLIAM GYADU - ASIEDU

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DEDICATION

This project work is wholeheartedly dedicated to God Almighty and my family.

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ABSTRACT

Computerized systems are gradually overtaking manually driven systems. This move has been highly motivated by efficiency and convenience. The traditional system of tendering is time consuming and has cost implications. In the traditional system, the buyer as well as the seller has to go through manual system of tendering. This exposes the system to unfairness and as a result affects the construction industry in Ghana. The main aim of this research was to explore the benefits of electronic tendering over the traditional method of tendering and recommend the best practices for its implementation in Ghana. A literature review was undertaken which covered the inefficiencies in the traditional tendering process in the construction industry and the benefits of e-tendering. The survey approach was used in the investigation using questionnaires as the main tool of data collection. Focusing on the Kumasi Metropolis as the case study area, fifty four questionnaires were retrieved out of sixty distributed representing a ninety percent response rate. The data were analyzed and presented using descriptive statistics only. *High levels of risk, abuse of tendering process, increased errors, low involvement of contractor at design stage, lack of adoption of new tendering methods* and *low level of professionalism* were ranked to be the most severe challenges of traditional tendering. Furthermore, the findings also pointed out that *potential for time saving; better financial control; reduced administrative costs; reduced manpower required* and *greater efficiency of activities* were the most important benefits of e-tendering. The findings from the study are useful for construction stakeholders, helping them to know the benefits of electronic tendering over the traditional method of tendering and the best practices for its implementation in Ghana. In spite of the significance of these findings, there are unavoidable limitations and shortcomings due to the scope and manner in which it was undertaken. These limitations are intended to be the basis for recommendations for future research works. It is recommended that there is the need to develop a capacity building knowledge backbone to drive the adoption of e-tendering.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND TO THE STUDY

Computerized systems are gradually overtaken manually driven systems (Thorpe and Bailey, 1996). Computer through software does most of the work in many working environments. Many businesses conduct transactions using the internet. This move has been highly motivated by efficiency and convenience (Thorpe and Bailey, 1996). As a result, many avenues for business processes have been established, this includes electronic tendering systems, which are gradually replacing the traditional tendering processes (Gunnigan, 2004). The traditional system of tendering is time consuming and has cost implications. In the traditional system, the buyer as well as the seller both have to go through manual system of tendering. This exposes the system to unfairness and as a result affects the construction industry in Ghana (GSS, 2008). As regards the traditional system of tendering the client first prepares the tender document and invites tenders through advertisement in the newspapers. If the contractor after seeing the advert is interested, he or she goes through registering and buys the document from the company. The contractor then submits the tender proposal to the company within a given period for submission. The tender is then opened, which is eventually evaluated by the company. The company then notifies the winner of the bid and awards the contract (Gunnigan, 2004).

Globally, construction industries have established the need to improve service delivery to handle issues promptly and acceptably. The introduction of information technology has made it possible for construction industries to change from the traditional system of tendering to electronic tendering (Hughes, 2003). Tendering, which is a method of entering into a sales contract is viewed by many as an effective contracting method to achieve an outcome which would favor both public and private sectors of the economy. According to Thorpe and Bailey (1996), the tendering process is complex such that it comprises a series of contractually interrelated legal obligations. It is well-thought-out as one of the reasonable means of giving government contracts and the method most likely to secure a satisfactory outcome for government in its spending of public money (Thomas, 1999).

There have been widespread reports by many authorities that traditional paper-based collaborative exchange of data between construction project participants is not efficient and that an effective use of ICT enhances productivity (Thomas, 1999 and Gunnigan, 2004). Hore and West (2005) have subsequently concluded that, electronic transmission of business documents offers savings in time, paper and postage.

In addition, Hore (2007) found that firms can make significant monetary savings, in addition to direct process gains, through direct links between company's technological infrastructures. However, one of the core processes firms in the Ghanaian construction industry complete manually “tendering”. Tendering can therefore be described as a process of entering into a sales contract. It has been viewed as an effective contracting method to achieve favorable outcomes for both public and private organizations. Large construction and engineering contracts are entered into through the tendering process.

Tendering costs have been found to account for up to 6% of the total value of a project cost to a client on a typical construction project (Hughes, 2003 and Canadian Construction Documents Commission, 2005). Hughes' percentage was calculated through a survey of construction companies, while the Canadian Construction Documents Commission (CCDC) completed a review of the work undertaken during the tendering process.

Moreover, an additional review of the documents that were exchanged between parties involved in the process was undertaken. It was established that the tender participants exchanged many standard tender documents, such as, drawings, project specifications and Bills of Quantities (BOQ). In the majority of cases it was reported that each of these documents were reproduced and dispatched in hard copy format. This over reliance resulted in expenditure that impact on the industry's clients consistently (Thomas, 1999).

The electronic tendering program sought to provide all tendering processes on the internet. It would allow clients and contractors to process tenders through a safe website. It would offer a simple, standard, secure, efficient and cost effective method of handling tender online and in effect provide a more reliable and corruption free process. This would mean in effect that contractors all over the country would have to register and secure tender using the web and shift from the traditional tender process which is paper-based, perceived to be more costly and is sometimes biased in awarding contracts (Thomas, 1999).

1.2 PROBLEM STATEMENT

Hughes (2003) highlighted on the substantial cost that is involved in tendering and found out that the cost to contractors of tendering was approximately 1.17% of the value of the work. When considered against a success ratio of, say, one in five, Hughes reported that the cost of each winning bid can be as much as 6% of the value of the work. It was found that tendering costs can account for up to 5.9% of the total value of a project cost to a client on a typical construction project.

Du *et al.* (2004) concluded that the traditional tendering process was open to abuse. They considered that through a lack of adequate security measures with the traditional system, prospective bids delivered to the consultants had the possibility to be tampered with. Tender prices may even be revealed to other prospective contractors. This leads to a tender process which lacks the key requirements of fair play and clarity that are required for a tender process.

A further inefficient process outlined by Curtis (2006) is the labour intensive nature of preparing, sending and receiving accurate sub-contractor tenders for trade packages. Curtis outlined that there are many stages included in this subprocess of tendering. The most labour intensive was seen to be the preparation of the tender package for each trade. Each trade package may contain drawings, specifications and other documentation that the contractor deems necessary to fully describe the project.

In order to address the aforementioned problems, this research therefore seeks to find the benefits of electronic tendering over the traditional method of tendering and recommend the best practices for its implementation in Ghana.

1.3 AIM

This research seeks to explore the benefits of electronic tendering over the traditional method of tendering and recommend the best practices for its implementation in Ghana.

1.4 SPECIFIC OBJECTIVES

The specific objectives of the research are as follows:

- To assess tendering activities involving use of ICT by professionals in tendering;
- To identify the challenges to be addressed within traditional tendering;
- To examine the benefits of e-tendering in the construction industry; and
- To develop a proposed framework for the implementation of electronic tendering system in the construction industry.

1.5 SIGNIFICANCE OF THE STUDY

This research in particular is of much significance to the construction industry as the findings of this study will identify ways of effectively implementing electronic tendering. This study is finally going to benefit academia as it will serve as a major and critical contribution to knowledge and this will consequently spur others on to engage in detailed and higher level research on electronic tendering.

1.6 STRUCTURE OF STUDY

This study was organized into six main chapters. Chapter was the introduction, which included the background to the study, problem statement, aims and objectives, hypothesis, scope, methodology, justification, limitations and the structure of the study. Chapter two was the review of related literature to the study. Chapter three examined the

details of the research methodology; chapters four and five focused on the analysis and discussion of the data collected for the study. Chapter six summed up the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter provides a critical review of pertinent literature on tendering in the Ghanaian construction industry. The chapter begins by giving a background of construction and an overview of the Ghanaian construction industry. It also explores traditional tendering and its challenges in the construction industry.

2.2 THE CONSTRUCTION INDUSTRY

Construction is a large, dynamic, and complex industry sector that plays an important role in economies (Takim *et al.*, 2003). Construction involves the organization and coordination of all the resources for the project - labor, construction equipment, permanent and temporary materials, supplies and utilities, money, technology and methods and time to enable completion of a desired Project on schedule, within budget and according to the standards of quality specified by the architectural and engineering drawings (Takim *et al.*, 2003).

The delivery process itself occurs in a number of phases as set out in the research studies of Lim and Mohamed (1999), Takim *et al.* (2003), and Ahadzie *et al.* (2006), with six phases of conception, planning, design, tender, construction, and operational phase.

Construction workers and employers build our roads, houses, and workplaces and repair and maintain our nation's physical infrastructure. Construction work can involve building of new structures, which may include activities involved with subdividing land for sale as

building sites or preparation of sites for new construction. Construction work also includes renovations involving additions, alterations, or maintenance and repair of buildings or engineering projects such as highways or utility systems (Gambatese *et al.*, 2007).

Construction could be divided into three distinct phases; pre-construction phase, construction phase, and post construction phase as shown in the figure below:

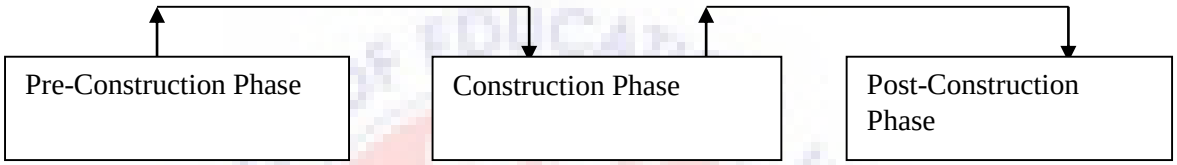

Figure 2.1: Different Phases of Linear Construction Process
Source: (Gambatese *et al.*, 2007)

The pre-construction phase could also be sub-divided into two phases: the pre-project phase and pre-construction phase itself (Takim *et al.*, 2003). The *pre-construction phase* includes the procurement process, the costing of the project, quantity surveying, design of the facility, user's requirements, client's awareness and involvement, etc. The *construction phase* includes the on-site construction process, waste management and re-cycling, supply and management of construction material, etc (Gambatese *et al.*, 2007). This also includes involvement of whole supply chain during the construction of the Project. The post-construction phase involves the maintenance period of a facility, life-cycle cost/economy and efficiency, including the demolition of a facility (Gambatese *et al.*, 2007).

2.2.1 Overview of the Ghanaian Construction Industry

In Ghana, the construction industry is a huge and a crucial sector in economic development. During the pre-independence era, local construction capacity especially with respect to local construction companies) was totally non-existent in any recognizable form (Anvuur *et al.,* 2006). Almost all construction contracts were awarded mostly to British conglomerates during this period. Naturally, the trend began to change when the care-taker government of Nkrumah was sworn in the early 1950s. Subsequently the then Ghana National Construction Corporation (GNCC) was formed. On attaining independence, the GNCC was renamed the State Construction Corporation (SCC) (Anvuur *et al.,* 2006).

The construction industry in Ghana has over the years developed into two sectors: the formal sector: which adopts a variety of procurement routes (Anvuur *et al.,* 2006); and the informal sector: which like in other African countries and indeed the world over, adopts an approach similar to the historical approach of master craftsman engaging labour in product delivery.

The Ghanaian construction industry, as observed in other parts of the world, is a vast and a crucial sector in economic development. This is because construction cuts across all sectors of the Ghanaian economy thus, construction activities are visibly undertaken everywhere. Construction works in Ghana together with agriculture, manufacturing and mining are the major income booster to the economy (UNESCO, Ghana National Commission, 2006). It is worthy to mention that proactive construction industry overly contributes positively to enhance the labour industry in Ghana and elsewhere as more skilled and unskilled workers are employed, from engineers and consultants to artisans and laborers. (UNESCO, Ghana National Commission, 2006).

As compared to other construction industries, the Ghanaian sector has come of age but with few challenges. Most often, the challenges culminating the sector are well highlighted on the roads and housing sectors of the industry (Ofori, 1993). For example, the elastic nature of the housing sector makes the demand for housing outwits or exceeds supply. (UNESCO, Ghana National Commission, 2006). The challenges facing the industry especially those relating to the private sector development, growth and sustainability of professionalism are still enormous (Ofori, 1993).

Contrarily, Ghana's construction industry could boost of its synergistic viability buttress with innovative human resources. These should be identified and used as the basis for improving the performance of the industry (Ofori, 2012). Finally, the industry faces some major restrictions including the impact of globalization; increased privatization; opportunities offered, and challenges posed, by the growth of information and communications technology; and development in knowledge (Ofori, 2012).

2.3 TENDERING IN CONSTRUCTION

Tendering in construction was portrayed by Runeson and Skitmore (1999) as a process that connects the buyer/client to the market place/construction firm. This process informs the client what construction firms are willing to sell and also indicates the price they are willing to sell those services to the client. The Aqua group (2006) expanded on this by defining tendering as: "A procedure to select a suitable contractor, at a time appropriate to the circumstances, and to obtain from him at the proper time an acceptable offer upon which a contract can be let."

The first step involved is qualification. This is the provision by a contractor of information, as part of a preselection process (Chartered Institute of Building, CIOB,

1997). The client can then review this information to compile a list of suitable contractors to tender for the works. Seeley (1997) maintained that this procedure can be completed without documentation being sent to the contractors. The client can himself compile a list from his/her previous experiences with firms or by drawing up an ad hoc list of contractors who, from common knowledge, would be capable of completing the type of works involved.

The qualified contractors are subsequently invited, at stage two, to submit their tenders for the project. The form of the tender and its documents take into account items, such as, the size of the project, level of pricing, resources of the firms and the character of the project (Hore *et. al.*, 1997). This documentation typically includes all relevant drawings, BOQ and the contractual forms, under which, the contract will be carried out. The BOQ is subsequently priced and the form of tender is completed. These documents are then submitted by the contractor on or before the deadline date.

During stage three, the submitted tenders are then appraised and examined for errors by the client's Project Quantity Surveyor (PQS). Smith (1995) comments that choosing the best buy "seems absurdly simple". However, he points out that tenders should not only be assessed on the basis of the lowest price but also on factors, such as, project timescale and safety records. Once a contractor is chosen, be it on price alone or a number of criteria, the client and the contractor will sign and counter sign the contractual documents, thus completing the fourth stage (tender acceptance).

2.4 TRADITIONAL CONSTRUCTION TENDERING PROCEDURES

The tendering process begins due to the client's requirement for a new or renovated piece of architecture or similarly engineering works. For that reason, the overall aim of the tender process must be to acquire a firm with the relevant skills to construct this project. Smith (1995) suggested that the client wishes to obtain a completed building with an acceptable quality and over a suitable timescale.

2.4.1 Stage 1: Qualification

The tender process begins with the client and his/her representatives drawing up a list of potential contractors interested in tendering for work. Following this, preliminary invitation to tender for the prospective works will be sent out. This preliminary enquiry informs the contractor of who the client is, who their representatives will be and an overview of the type, approximated cost, timescale and location of the project (Smith, 1995).

It is suggested that a pre-qualification questionnaire be attached to the preliminary enquiry. This should save time, for both the contractor and the consultant, as interested firms can reply promptly with the relevant information. This questionnaire will require information about the company and other projects, of similar nature to the tender works, which it has successfully completed in the last two to three years (Smith, 1995).

It is important to reduce the number of contractors tendering for the same projects. Due to the high cost of tendering, any unsuccessful tenderers simply allow for that unsuccessful tender by increasing their tender prices in the long run. Therefore, having received an adequate number of responses from contractors willing to tender, a final list of six to eight contractors is drawn up (Smith, 1995). Two additional names of suitable contractors

should be included on a stand-by list. In case of subsequent withdrawals, these contractors can be substituted onto the main list. Following the above tasks, the contractors who are not to be considered for the remainder of the tender process will be informed (CIB, 1997).

Internationally there are also a number of codes produced for ensuring that tendering is carried out in line with good practice. In the United Kingdom (UK) the Chartered Institute of Building (CIOB) has developed the Code of Estimating Practice (1997). This code advocates that an interview can be used to help the pre-qualification process. This it says can be advantageous to all parties involved, possibly as it introduces the key individuals who would be involved in any potential project. This view is similarly reflected in the UK's Construction Industry Boards (CIB) Code of Practice (1997).

2.4.2 Stage 2: Tender Invitation and Submission

With a list of suitable contractors willing to price for the proposed package of works, the finalized tender documentation should be dispatched within four to six weeks of the receipt of the preliminary enquiries (CIB, 1997). Should this time extend beyond three months, the contractor should be asked to reconfirm his/her willingness to submit a tender. It is advisable that the documents can be issued in both electronic and hard copy format. The documents discussed include:

1. The Bills of Quantities (BOQ) (If electronic/ Hard copy only upon request).

2. Specifications (If electronic/ Hard copy only upon request).

3. Drawings (Electronic and hard copy).

4. The form of Tender (If electronic/ Hard copy only upon request).

5. Instructions for return of the form of tender and BOQ (If electronic/ Hard copy only upon request).

6. Preliminary health and safety plan (If electronic/ Hard copy only upon request).

With the contractor now in receipt of the documents, they will undertake to complete and return the documents within the timescale outlined (CIB, 1997). The contractor, having received the relevant quotes and having completed any other work they deem necessary to confirm their prices, should then return the documents. A hard copy of the completed tender documents is subsequently returned in a separate sealed and endorsed envelope (CIOB, 1997).

Further communication is required between the parties when a change occurs in either the specification or the design of the scheme. However, should any changes be made to the documents, the contractors should be notified in writing. These changes should occur, no less than ten working days before the tender deadline. If these changes are significant then an extension of time for contractors to complete the tender should be considered.

According to the CIB (1997), standard forms of contract should be used. They suggest that the number of compliant tenders increases when a standard form of contract is used. This is due to the contractor's previous knowledge and experience with documents used. If standard forms are not used, it is advised that some additional time be given to the tenderers and that the contract terms are "unambiguous, consistent and complete" (CIB, 1997).

On occasions where there is a change from the information given in the preliminary invitation to tender, the CIOB (1997) suggests that the contractor will need to be afforded the opportunity to examine the documents, in detail, to establish whether the changes are of such significance to discourage tendering.

2.4.3 Stage 3: Tender Assessment

All tenders received before the tender deadline will now be assessed by the client and his/her representatives. All tender packages, but not BOQs, are opened to find the contractor who has submitted the lowest tender. The client will then instruct the consultant to open the BOQ of the lowest tender (CIOB, 1997).

The priced BOQ will be examined with the object of detecting any errors or qualifications within the bill. All rates and quotes given are expected to be confidential.

- Should the tender contain no qualifications or errors in the computation, the tender will be recommended for acceptance. However, should any errors or qualifications be found: In the case of qualifications, that the tenderer is given opportunity to withdraw the qualifications, with no amendment to the tender price. If the qualifications are not removed then the tender is rejected (CIOB, 1997).
- In the case of errors, that the tenderer will be notified of the errors contained within the BOQs. He can then accept the previous overall total sum of the BOQ or reject this overall sum total. Upon accepting, the contractor agrees to reduce or increase his/her unit rates for the notified errors and the consultant will recommend the tender for acceptance by the client (CIB, 1997).

Should the lowest tenderer withdraw, the consultant will contact the second lowest tenderer to obtain permission to open his/her BOQ. The process is repeated until the client is advised to accept a tender (CIOB, 1997).

2.4.4 Stage 4: Tender Acceptance

Upon choosing an acceptable tender the client will, in effect, be rejecting the other contractor's tenders. Therefore, within two days all tendering companies are informed that a successful tender has been chosen (Pauw *et al*., 2002). Also this notice should inform the contractors of all tender amounts received in numerical order. Following this, the formal contract documentation will have to be completed by both parties to seal the agreement (Pauw *et al*., 2002).

2.5 TENDERING IN PRIVATE SECTOR

According to Lewis (2007), the following factors come to play particularly in private sector and these factors can influence decisively their views about the bid that is right for them:

Overall value for money: In this respect, the private sector's priorities are not so far removed from public sector concept of the most economically advantageous tender (Pauw *et al*., 2002).

Prices: Are the prices realistic in relations to the scale of the contract? They also look for quality in the inputs and resources proposed for the work and they will need the outcomes and deliverables clearly defined, as well as they will seek evidence of distinctive added value and reliable performance. With that said and done, business are advised not to think in terms of the lowest cost, private sector should appreciate that in working with

contractors they get what they pay for, and that contractors who offer services at rates cut to the born may be offering also low quality, poor performance and minimal standards of professionalism (Lewis, 2007).

Insight into the client's operating environment: Does the bidder appear informed about the sectors of activity in which the business is engaged and the factors that influence its market environment and profitability (Lewis, 2007)

Partnering and synergy: Is there a sense that this bidder is the one best placed to work with the client in a productive team effort? Are the corporate value and policies of the business understood and supported (Lewis, 2007)

Risk and professional accountability: Has the bid addressed these concepts? Does it indicate an understanding of their significance for successful contract performance? Does it indicate an understanding of their significance for successful contract performance? Innovation: New ideas, fresh thinking and solutions that competitors will find it hard to match are ingredients that can win the day, but innovation needs to be dependable. Has the bidder taken account of the risks associated with innovation? Flexibility and responsiveness: Does the bid communicate a willingness to adapt methods and procedure in response to unforeseen changes in the requirements of the contract (Lewis, 2007).

2.6 TENDERING PROCEDURES OUTLINED IN PUBLIC PROCUREMENT ACT, 2003 OF GHANA

2.6.1 Procurement Planning

The Public Procurement Act 663 provides for the activity of planning under part 3. Section 21 is stipulate as follows; A Procurement Entity shall prepare a procurement plan

to support the approved programme and the plan shall indicate: Contract packages, Estimated cost for each package, The procurement method, processing steps and times, and A Procurement Entity shall submit to its Tender Committee not later than one month to the end of the financial year, the procurement plan for the following year for approval. After budget approval and at quarterly intervals, each Procurement Entity shall submit an update of the procurement plan to the Tender Committee.

2.6.2 Development of Specification/Tender Document

The preparation of Tender Documents is the responsibility of head of procurement unit. Upon receipt of requisition to procure and notification of availability of funds, the head of procurement proceeds with the preparation of the document (Procurement Manual, section 5). Schedule 4 of the Act, required the use of a Standard Tender Document (STD) for all procurement of works funded by Government of Ghana, unless an alternative format has been specifically approved by the Public Procurement Authority

2.6.3 Selection of Procurement Methods

The thresholds for applying the different procurement methods are defined in schedule of Act 663.

2.6.4 Tender Invitation

The requirement to advertise the intention to procure works is outlined in Section 47 of Act 663 for procurement using International and National Competitive Tendering. Section 47 (1, 2) required that invitation to tender or invitation to pre-qualify, to be published in the Procurement Bulletin and at least two newspapers of wide national circulation.

2.6.5 Tender Submission

Section 53 (1) of Act 663 stated as follows:

Fix the place for, and a specific date and time as the deadline for the submission of tenders;

Allow tenders at least six weeks to prepare their tenders for International Competitive Tendering and for National Competitive Tendering not exceeding four weeks. Section 53 (2) allows a minimum of two weeks for preparation of tenders for National Competitive Tenders; Tenders are deposited in a tender box provided at the place of submission as stated in the tender documents until the due closing date.

2.6.6 Tender Opening

Section 56 of Act 663, requires that tenders should be opened immediately after the close of tenders. A tender opening committee is constituted and is made up of at least three persons including a member of the Entity Tender Committee. Section 56 of the Regulation stated that "tender opening should commence not later than two (2) hours after the deadline for submission of tenders and continued without break until all tenders have been opened by the entity tender committee.

2.6.7 Formation of Tender Evaluation Panel

In accordance with Section 19 of Act 663, the Entity Tender Committee, appoint a Tender Evaluation panel constituting of minimum of three qualified members and not more than five members (Section 5 (14) Manual, Section 19 (1, 2) Regulations) to evaluate tenders received.

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2.6.8 Tender Evaluation and Reporting

Section 57, 58 and 59 of Act 663 describe the general procedures to be followed in the examination of tenders, determination of responsiveness of tenders and evaluation of tenders. The determination of responsiveness of tenders shall conform to the requirements set out in the tender invitation documents.

2.6.9 Submission of Tender Evaluation Report for Approval

The Tender Evaluation Panel submits an Evaluation Report to the Entity Tender Committee for approval using SPF2B form (Section 59 (6) Regulations).The evaluation Report forms part of the Records of procurements proceedings required under Section 28 of the Act.

2.6.10 Award of Contract and Notification of Contractors

Section 65 of the Act specifies the procedures of acceptance of tender and entry into force of a procurement contract. The Act requires notice of the tender award issue to the successful tenderer within 30 days of the acceptance of the contractor submitting the tender (Section 65 (1) Act 663).

2.6.11 Contract Documentation/Request for Approval

The Procurement Unit (PU) prepares the Contract Document. The Contract Documents contain specific details relating to the tenderer, the tenderers offer, agreement, and performance security.

2.6.12 Signing of Contract

With the approval of the contract document, the P.U. arrange for the contract to be signed by each party to the contract (Section 65 (2) of Act 663, Section 5 (17) Manual). Provision of performance security is a pre-requisite for contract signature.

2.6.13 Notification of Unsuccessful Tenderers

All unsuccessful tenderers are notified immediately the contract is awarded. Tender security of unsuccessful tenderers is released (Section 65 (9) Act 663, Section 5

2.7 INTERNATIONAL STANDARDS ORGANISATION (ISO)

The ISO 10845 series of standards for construction tendering, which consists of eight parts, will help organisations establish a procurement system that is fair, equitable, transparent, competitive and cost- effective (Pauw *et al*., 2002). These International Standards are designed to help public, private and international organisations and their main contractors to align their procurement systems with international best practice (Pauw *et al*., 2002).

ISO 9000 is the mostly widely available range of quality standards and is produced by the ISO. According to Pauw *et al*., (2002), these standards assure purchasers of receiving acceptable product and service quality.

2.7.1 Code of best practice

According to Pauw *et al*. (2002), managers must consider the following best practices, which have been developed through international experience in both the private and public sectors:

- Introduce the greater flexibility as regards dialogue between purchasers and suppliers
- Encourage the use of modern information and communications technologies.
- Use negotiation only in exceptional circumstances; it should not preclude competition. Evaluate supply offers against recognized technical specifications such as ISO 9000.
- Consider the economic and financial feasibility of the supplier and its technical abilities and experience, when making selections.
- Use benchmarking to compare the costs and methods of industrial and consumer products.
- Allow the tendering process to take place swiftly because this can significantly reduce transactions costs.
- Avoid the tendency for public tender procedure to become complex and slow.

2.8 PROJECT DELIVERY SYSTEMS

According to Masucci (2008), the careful choice of Project Delivery System (PDS) can help overcome many project challenges. A project delivery system is, simply, the contractual structure (exclusive of the financial arrangements) for how the final project is produced and provided, i.e. delivered, to the owner.

According to Trauner Consulting Services (2007), project delivery systems refer to the overall processes by which a project is designed, constructed, and/or maintained. In the public sector, this has traditionally entailed the almost exclusive use of the design-bid-build system, involving the separation of design and construction services and sequential performance of design and construction. In recent years, however, the public sector has begun experimenting with alternative methods to improve the speed and efficiency of the project delivery process.

In recent years, various delivery methods have been created or gained renewed popularity to address owners' concerns with finger pointing, cost overruns, and increasing project complexity. Owners should be aware that each project delivery method should include the development of carefully crafted contracts defining the roles of the players appropriate to that methodology. The main criteria for measuring the success of any project delivery method are cost, quality, time, safety and how the project ultimately meets its intended purpose. However, responsibilities for meeting these criteria vary by method. Each delivery method offers a different level of risk to the owner (The American Institute of Architects and The Associated General Contractors of America, 2011).

The various types of project delivery systems are often consolidated down to three basic approaches:

• Design-bid-build (DBB)

• Construction Manager at Risk (CM@R)

• Design-build (DB)

The appropriateness of any given project delivery system varies, depending upon the project goals, time constraints, cost constraints, party at risk, and existing site conditions. Project owners generally want the same things: construction at the lowest cost, of the highest quality, and done within the shortest period of time. Some goals, however, may take precedent over others. The speed of implementation, for example, may be more important than cost on certain projects. For others, maintainability and low life-cycle costs may be more important than initial cost. Owner control of the design and/or construction may be important for some, while, for others, limiting the risk of costly changes is paramount. Goals to consider include:

• Lowest cost consistent with quality and performance objectives

• Initial cost versus life-cycle cost

• Shortest schedule for overall project delivery

• High quality

• Comply with technical specifications

• Meet overall expectations

• Promotes innovation and value engineering

• Limit the cost of design changes

• Limit the risk of cost and schedule growth

• Control over design decisions

• Control over construction quality

• Limit impact on current operations, safety, and security

• Limit construction 'aggravation'

• Limit demands on owner resources

• Limit number of contractual entities/points of responsibility

• Limit claims for additional cost

When selecting an appropriate project delivery system, first define the goals and objectives for the project, and define any unique issues that could significantly impact it (Masucci, 2008).

Then rank these goals, objectives and issues in order of priority and importance, and match them to the strengths and attributes of the various project delivery systems. For example, some projects may be challenged by frequent design changes or by other potential disruptions (Masucci, 2008). The selection of a project delivery system should take these issues into account. Also, project owners must recognize the various trade-offs relating to cost, time, quality, control and risk, and select a PDS approach that provides the proper balance (Masucci, 2008).

The selection process should strive to match PDS strengths to the project goals and match PDS attributes to the important issues which must be effectively addressed and managed to enhance successful project delivery (Masucci, 2008). The analysis is not so much a question of advantages versus disadvantages but rather to select the PDS whose strengths and attributes best match or align with the goals and needs of the project. A PDS may have attributes viewed as a disadvantage for one specific project while those same attributes may prove advantageous for a different project (Masucci, 2008).

2.8.1 DESIGN-BID-BUILD (DBB) DELIVERY SYSTEM

Design-Bid-Build (DBB), or design then bid then build, is the traditional delivery system for the public sector, in which an agency will use in-house staff (or, alternatively, use consultants) to prepare fully completed plans and specifications that are then incorporated into a bid package (Masucci, 2008). Contractors competitively bid the project based on these completed plans and specifications. The agency evaluates the bids received, awards the contract to the lowest responsible and responsive bidder, uses prescriptive or method specifications for construction, and retains significant responsibility for quality, cost, and time performance (Trauner Consulting Services, 2007).

According to The American Institute of Architects and The Associated General Contractors of America (2011), this method involves three roles in the project delivery process—owner, architect, and contractor—in traditionally separate contracts. "Traditional" is frequently used to describe the Design-Bid-Build method, which typically involves competitively bid, lump sum construction contracts that are based on complete and prescriptive contract documents prepared by architects. These documents generally include drawings, specifications, and supporting information (Trauner Consulting Services, 2007). The phases of work are usually conducted in linear sequence. The owner contracts with an architect for design, uses the design documents produced by the architect to secure competitive bids from contractors; and, based on an accepted bid, contracts with a contractor for construction of the building (Trauner Consulting Services, 2007).

For most of the 20th century, public work was routinely built using the Design-Bid-Build delivery method. This has included competitive bidding among general contractors,

performance bonds, and employment of various other statutory requirements to protect taxpayer investments. Much private work has also been performed for a lump sum figure, in the belief that the marketplace ensures economic discipline and yields the lowest cost. It should be noted that this may not be the lowest cost for the project, but it represents the lowest cost associated with the design documents prepared for the project before actual construction begins (Trauner Consulting Services, 2007).

In many instances private organizations with large constituencies, such as churches and schools, use project delivery methods with sealed bids and formal procedures similar to procedures for public projects (Trauner Consulting Services, 2007).

The following *defining characteristics* identify Design-Bid-Build:

• Three prime players—owner, designer, contractor

• Two separate contracts—owner-designer, owner-contractor

• Final contractor selection is based on Low Bid or Best Value: Total Cost

Typical characteristics of the Design-Bid-Build approach include the following:

• Three phases—design, bid, build. These phases may be linear or overlapping if a project is fast-tracked or bid-out to multiple prime contractors.

• Well-established and broadly documented roles

• Contract documents that are typically completed in a single package before construction begins, requiring construction - related decisions in advance of actual execution

• Construction planning based on completed documents

• Complete specifications that produce clear quality standards

• Configuration and details of finished product agreed to by all parties before construction begins (The American Institute of Architects and The Associated General Contractors of America, 2011).

Some variables to think about when considering the Design-Bid-Build (DBB) delivery method:

- Design and Construction phases must be well planned, since phases occur separately. Lack of coordination can prolong a project.
- Owner manages the design and construction contracts separately, which means that there are two parties coordinating efforts with versus one with other delivery methods.
- Owner holds all the risk in the project, and costs are based on a flat fee, which does not reflect savings for work that was completed for less than the original quote.
- Construction team bases bids on the lowest bidder versus other delivery methods where the owner is given recommendations and has a voice in this process.
- During the design phase for other delivery methods, the team has the opportunity to share constructability reviews with the owner. However, the D-B-B method does not account for this type of feedback (Sampson Construction, 2015).

According to Trauner Consulting Services (2007), the advantages and disadvantages of the Design-Bid-Build (DBB) delivery system are summarized below:

a. Advantages

- Applicable to a wide range of projects
- Well established and easily understood
- Clearly defined roles for all parties
- Provides the lowest initial price that responsible, competitive bidders can offer
- Extensive litigation has resulted in well-established legal precedents
- No legal barriers in procurement and licensing
- Insurance and bonding are well defined
- Discourages favoritism in spending public funds while stimulating competition in the private sector
- As construction features are typically fully specified, DBB provides agencies with significant control over the end product (however, this may come at the expense of increased agency-inspection efforts)

b. Disadvantages

- Tends to yield base level quality
- Least-cost approach requires higher level of inspection by the agency
- Initial low bid might not result in ultimate lowest cost or final best value
- Designers may have limited knowledge of the true cost and scheduling ramifications of design decisions
- Lack of input from the construction industry during the design stage exposes the agency to claims related to design and constructability issues

- Tends to create an adversarial relationship among the contracting parties, rather than foster a cooperative atmosphere in which issues can be resolved efficiently and effectively
- Agency bears design adequacy risk
- No built-in incentives for contractors to provide enhanced performance (cost, time, quality, or combination thereof)
- Greatest potential for cost/time growth (in comparison to other delivery methods)
- Often prone to adversarial positions that lead to disputes and claims

2.8.2 CONSTRUCTION MANAGER AT RISK (CM@R) DELIVERY METHOD

With CM at Risk, the agency engages a construction manager (CM) to act as the agency's consultant during the pre-construction phase and as the general contractor (GC) during construction (Trauner Consulting Services, 2007).

During the design phase, the CM acts in an advisory role, providing constructability reviews, value engineering suggestions, construction estimates, and other construction-related recommendations (Trauner Consulting Services, 2007). At a mutually agreed upon point during the design process, the CM and the agency will negotiate a Guaranteed Maximum Price (GMP). The GMP is typically based on a partially completed design and includes the CM's estimated cost for the remaining design features, general conditions, a CM fee, and construction contingency.

The construction contingency can be split into CM and agency components. The CM contingency will cover increased costs due to unavoidable circumstances, for example material escalation. The agency contingency would cover cost increases from agency-

directed or agency-caused changes. The construction contingency can be handled in different ways under the contract. Unused CM contingency can be returned to the agency, shared by the agency and CM, or given to the CM (Trauner Consulting Services, 2007).

Agencies are increasingly experimenting with sharing the contingency pool with the CM to provide the CM with an incentive to control cost growth associated with change orders to meet the GMP. The agency may elect to remove pricing of some material or work items as part of the GMP if pricing of these items results in an excessively high CM contingency or GMP (Trauner Consulting Services, 2007). For example, if the price of steel were too volatile to achieve an acceptable GMP, the agency could establish a separate bid item and pre-pay or pay for the steel directly under this item at actual cost. After the GMP is established, the CM can begin construction, allowing for the overlap of the design and construction phases to accelerate the schedule. Once construction starts, the CM assumes the role of a GC for the duration of the construction phase. The CM holds the construction contracts and the risk for construction costs exceeding the GMP (Trauner Consulting Services, 2007).

According to The American Institute of Architects and The Associated General Contractors of America (2011), Construction Management at-Risk (CM at-Risk) approaches involve a construction manager who takes on the risk of building a project. The architect is hired under a separate contract. The construction manager oversees project management and building technology issues, in which they typically have particular background and expertise (Trauner Consulting Services, 2007). Such management services may include preparation of cost models, advice on the time and cost consequences of design and construction decisions, scheduling, cost control,

coordination of construction contract negotiations and awards, timely purchasing of critical materials and long-lead-time items, and coordination of construction activities (Trauner Consulting Services, 2007).

In CM at-Risk, the construction entity, after providing preconstruction services during the design phase, takes on the financial obligation for construction under a specified cost agreement. The construction manager frequently provides a Guaranteed Maximum Price (GMP). CM at-Risk is sometimes referred to as CM/GC because the construction entity becomes a general contractor (GC) through the at-risk agreement (Trauner Consulting Services, 2007).

The term “at-risk” is often a source of confusion. Sometimes it refers to the fact that the contractor holds the trade contracts and takes the performance risk for construction. In other contexts, the term is tied to the existence of a cost guarantee or GMP. Because the term “at-risk” has two distinct meanings, it is important to understand how it is being used in a particular situation. The definition used for CM at-Risk in this document is based primarily on the fact that the construction manager holds the trade contracts and takes the performance risk (Trauner Consulting Services, 2007). The eventual establishment of a guaranteed maximum price is typical of CM at-Risk project delivery, but it is not a defining characteristic of the delivery method in this case (Trauner Consulting Services, 2007).

When a GMP is used, the CM at-Risk approach is flexible as to when the construction price becomes fixed. As a result, the timing for agreeing to a GMP varies by project. Considerations of risk should include an evaluation of the amount of design information

available, the amount of contingency included, and the owner's willingness to share in the risk of cost overruns (Trauner Consulting Services, 2007).

The CM at-Risk contracts with trade contractors who perform their portion of the construction. These entities are contractually bound only to the CM at-Risk. It should be noted that there is no contractual relationship between the designer and the CM at-Risk.

The following *defining characteristics* identify CM at-Risk:

• Three prime players—owner, architect, CM at-Risk

• Two separate contracts—owner to architect, owner to CM at-Risk

• Final provider selection based on Qualifications Based Selection or Best Value: Fees

Typical characteristics of the CM at-Risk approach include the following:

• Hiring of the CM at-Risk during the design phase

• Clear quality standards produced by the contract's prescriptive specifications

Establishment of a guaranteed maximum price

Other characteristics that may be seen in the CM at-Risk approach include the following:

Overlapping phases—design and build

Preconstruction services offered by the architect, CM or contractor (such as constructability review, bid climate, and bid management). Construction Management at-Risk is also known by the designations CM at-Risk, CMAR, CM@R, CMc, CM/GC and GC/CM (The American Institute of Architects and The Associated General Contractors of America, 2011).

Some variables to think about when considering the CM At-Risk delivery method:

- Contractor acts as a consultant to the owner during the design phase and must act in the Owner's best interest while delivering the project within the agreed upon GMP. This GMP is established after the project is awarded, so the Owner selects the CM based on criteria that is other than fee-based (Sampson Construction, 2015).
- Owner manages design and construction contracts separately, which means that there are two parties coordinating efforts, versus one with other delivery methods.
- Owner holds less risk in the project with the established GMP. Plus, any savings that are realized throughout the project are returned to the owner and reflected in the final GMP, which other delivery methods do not account for (Sampson Construction, 2015).
- The CM bases bids on lowest bidder, while taking into consideration: quality, performance, track-record, etc. Then, the owner can provide input about who participates in the project versus other delivery methods where bids are awarded solely based on the lowest bidder (Sampson Construction, 2015).
- During the design phase, the CM acts as a consultant to the owner and has the opportunity to share constructability reviews, system/material recommendations, and value engineering solutions, which other delivery methods do not allow (Sampson Construction, 2015).

According to Trauner Consulting Services (2007), the advantages and disadvantages of the Construction Management at-Risk (CM at-Risk) delivery system are summarized below;

a. Advantages

- Allows for innovation and constructability recommendations in the design phase, yet the agency still retains significant control over the design
- CM holds construction contracts, transferring performance risk to GC
- GC puts more investment in cost engineering and constructability review than with CM-Agency
- Fixes project cost and completion responsibility earlier than Design-Bid-Build
- Potential to fast-track early components of construction prior to complete design
- Reduces agency's general management and oversight responsibilities
- Use of a GMP with a fixed-fee and opportunity for shared savings provides an incentive for CM to control costs and work within funding limits

b. Disadvantages

- Once construction begins, the CM assumes the role of a general contractor, leading to possible tensions with the agency over project quality, budget, and schedule
- Use of a GMP may lead to disputes over the completeness of the design and what constitutes a change to the contract
- Agency retains design liability
- CM input may not be included by designer
- Incentive split of savings scheme may create perception of inflated GMP
- GMP approach may lead to a large contingency to cover uncertainties and incomplete design elements

2.8.3 DESIGN-BUILD (DB) DELIVERY SYSTEM

According to Brett (2001), Design/Build has become in the 1990's the Project delivery system of choice. More than 50% of Construction Projects are using this method of delivery. Overseas, the use of this method of delivery is even higher. More and more owners are acknowledging the Design/Build delivery approach (Sampson Construction, 2015). It is being used more and more in the public sector. Owners in the Public Sector are now searching for ways that can deliver a proposed facility faster and within the cost restraints required in today's political environment, but still allowing innovation, and maintaining a high quality finished product. The downsizing of Corporations has led to the elimination of various departments within these Corporations (Sampson Construction, 2015). The re-engineering or downsizing of Corporations has also contributed to the growth in the Design/Build method of delivery. Corporations and the Public Sector are no longer able to manage these projects (Sampson Construction, 2015). This has allowed the growth of alternative methods of filling this void. The opportunity now exists for companies to introduce to their owners the "Design/Build" approach to a proposed project. These firms can now demonstrate to their owners the savings in costs, the enhanced creativity, and the team concept that produces better cooperation between the parties involved on the project. It is now generally accepted that Design/Build projects allows for new ideas which in turn produces innovation, implementation of the new ideas and the development of new materials (Brett, 2001).

Design-build is a project delivery system involving a single contract between the project owner and a design-build contractor covering both the design and construction of a

project. The design-builder performs design, construction engineering, and construction according to design parameters, performance criteria, and other requirements established by the agency (Brett, 2001).

Design-Build has been implemented in the highway construction industry in a variety of ways based in part on how the state statutes are written and on how much responsibility is transferred to the design-builder for the design and other aspects of project performance (Brett, 2001).

Several highway agencies have used an approach called *Modified Design-Build*, also called Low Bid design-build or Draft/Detail-Build, where the agency completes a significant portion of the design before selecting the contractor using a low bid solicitation or qualified low bid process. The design-builder then completes the remainder of the design work and constructs the project under a single contract. Modified Design-Build is primarily used in cases where state law prohibits the procurement of construction services using a method other than low bid or before the design is substantially complete, and the agency administers the project using traditional practices and retains greater responsibility for project performance (Brett, 2001).

Highway agencies with statutory authority and more experience have increasingly implemented design-build consistent with approaches recommended by the Design-Build Institute of America (DBIA) and other practitioners, where the agency completes the conceptual design to a lower level and then procures the design-builder under a two-step best-value proposal process. This two-step best-value approach allows for much earlier

involvement by the design-builder and shifts greater control and responsibility for the design and project performance to the design-builder (Brett, 2001).

A design-build contract may also include responsibilities that extend beyond the design and construction phases of a project, shifting more performance risk to the private sector. These have included:

- *Design-Build-Warranty.* A single entity designs, constructs, and warrants specified components over a prescribed time period (e.g., 5, 10, or 20 years). Warranty requirements shift quality responsibility to the design-builder and reduce the agency's need to inspect during construction and maintain the facility during its service life.
- *Design-Build-Maintain.* A single entity designs, builds, and maintains the project works for a specified period of time under a single contract. Payment beyond completion of construction is typically tied to meeting certain prescribed performance-based standards for a period of years.
- *Design-Build-Operate.* A single entity designs, builds, and operates the project (e.g., a toll road) for a specified period of time under a single contract.

Design-build delivery has been expanded to a Public-Private Partnership concept, where a private entity or developer takes part in financing and leasing a transportation project in return for monetary compensation based on contractual authorization to collect toll revenues, or pursue development rights with the contracting agency (Brett, 2001). The private entity will be responsible for financing, design and construction, and often will operate and maintain the roadway or bridge for a specified duration. The public-private

contract may give full or partial contracting authority to the private entity (Trauner Consulting Services, 2007).

According to The American Institute of Architects and The Associated General Contractors of America (2011), Design-Build has gained popularity in recent years in both the private and public sectors. The primary reason for this interest in Design-Build as a viable project delivery option is the owner's desire for a single source of responsibility for design and construction (Trauner Consulting Services, 2007). In the Design-Build approach to project delivery, the owner contracts with a single entity, the design-build entity, for both design and construction. The design-build entity can be led by an architect or a contractor and can consist of any number of people. As with CM at-Risk, the timing of agreement on a GMP varies with each project (Trauner Consulting Services, 2007).

The following *defining characteristics* identify Design-Build:

• Two prime players—owner, design-build entity

• One contract—owner to design-build entity

Typical characteristics of the Design-Build approach include the following:

• Final design-builder selection may be based on any of the following: Direct Negotiation, Qualifications Based Selection, Best Value: Fees or Total Project Cost, or Low Bid.

• Project-by-project basis for establishing and documenting roles

• Continuous execution of design and construction

• Overlapping phases—design and build

• Some construction-related decisions after the start of the project

• Overall project planning and scheduling by the design-build entity prior to mobilization (made possible by the single point of responsibility)

Other characteristics that may be seen in the Design-Build approach include the following:

Preconstruction services offered by the architect, CM or contractor (such as constructability review, bid climate, and bid management) (The American Institute of Architects and The Associated General Contractors of America, 2011).

Some variables to think about when considering the Design-Build delivery method:

- Contractor oversees the design phase and is the point-of-contact for the owner throughout the duration of the project. This transparency can enhance the project schedule.
- Owner only manages the construction team, which means that they need to be informed about the entire process, and their requests are reliant on this knowledge.
- Owner holds less risk in the project than other delivery methods. However, costs are based on a flat fee, which does not reflect savings for work that was completed for less than the original quote.
- Construction team bases bids on lowest bidder versus other delivery methods where the owner is given recommendations and has a voice in this process.

- During the design phase, the construction team has the opportunity to share constructability reviews with the design team and owner, which other delivery methods do not allow for (Sampson Construction, 2015).

According to Trauner Consulting Services (2007), the advantages and disadvantages of the Design-Build (DB) delivery system are summarized below;

a. Advantages

- Single point responsibility for design and construction
- Accelerated project delivery by:
  - Fast-tracking design and construction
  - Close coordination between designer and contractor
  - Early contractor involvement to enhance constructability of plans
- Cost containment by minimizing owner's exposure to design errors and omissions
- Earlier schedule and cost certainty
- Innovation and quality improvements through:
  - Alternative designs and construction methods suited to the contractor's capabilities
  - Flexibility in the selection of design, materials, and construction methods

b. Disadvantages

- Reduced opportunities for smaller, local construction firms
- Fewer competitors and increased risk may result in higher initial costs

- Elimination of traditional checks and balances. Designer is no longer agency's advocate. Quality may be subordinated by cost or schedule considerations.
- Less agency control over final design
- Higher procurement costs
- Traditional funding may not support fast-tracking construction or may require accelerated cash flow.
- Accelerated construction can potentially overextend the workforce.

Once the selection of a delivery system is made, it is important that the owner take additional and continuing steps to maximize the chances of its success:

- Effectively communicate to the various team members (architects, engineers, CMs, contractors and consultants) the goals, objectives and issues that drove the selection of project delivery system. It is important they understand and commit to the owner's expectations (Trauner Consulting Services, 2007).
- Ensure that the terms and conditions of the various contracts reflect the goals, objectives, issues and expectations for the project, and memorialize all related agreements. For example, if changes during construction are anticipated, be sure that the contract language defines how those changes will be managed and their cost and schedule impact minimized (Trauner Consulting Services, 2007).
- Consider legal assistance experienced in construction matters for crafting the contract language.

- Commit to the appropriate level of owner involvement, e.g. active involvement with timely and informed decision-making so as to not delay or impact the project. Conversely, avoid imposing owner changes or controls on DB contracts.
- Assess potential risks and plan how to manage the overall program, e.g., internally or via a program management consultant.
- Finally, recognize that disputes over scope, quality and other issues may still arise. Define how such disputes will be handled so that disruption and cost/schedule impact are minimized. Consider using alternate dispute resolution ADR) approaches such as Project Neutral®, dispute review boards, or similar alternatives. No project delivery system is faultless. But, choosing the system that best works for your specific project, and actively ensuring that it is properly implemented, can mean the difference between the success and failure of your next project (Masucci, 2008).

2.9 CHALLENGES TO BE ADDRESSED WITHIN TRADITIONAL TENDERING

Hughes (2003) highlighted the substantial cost that is involved in tendering finding that the cost to contractors of tendering was approximately 1.17% of the value of the work. When considered against a success ratio of, say, one in five, Hughes reported that the cost of each winning bid can be as much as 6% of the value of the work. It was found that tendering costs can account for up to 5.9% of the total value of a project cost to a client on a typical construction project. Construction companies must recuperate this substantial

cost, so that it can remain profitable. In addition, the cost of tendering was considered to be very expensive.

Du *et al*. (2004) concluded that the traditional tendering process was open to abuse. They considered that through a lack of adequate security measures with the traditional system, prospective bids delivered to the consultants had the possibility to be tampered with. Tender prices may even be revealed to other prospective contractors. This leads to a tender process which lacks the key requirements of fair play and clarity that are required for a tender process.

A further inefficient process outlined by Curtis (2006) is the labour intensive nature of preparing, sending and receiving accurate sub-contractor tenders for trade packages. Curtis outlined that there are many stages included in this subprocess of tendering. The most labour intensive was seen to be the preparation of the tender package for each trade. Each trade package may contain drawings, specifications and other documentation that the contractor deems necessary to fully describe the project.

This individual trade information has to be sorted, photocopied, compiled for each subcontractor and finally checked that all information is present before it is delivered in hard copy to the subcontractor. Curtis explained that, on occasion after completing this work, the subcontractor may not even price the work. This can lead to a large amount of time and resources (photocopying/paper) being spent without any return (Curtis, 2006).

2.10 ELECTRONIC TENDERING

Before the coming of the internet, procurement functions were perceived by many to be routine and repetitive processes. This perception has been modified by the expanding

capabilities of the World Wide Web in recent years. Most organizations used to have separate procurement offices, or preferred to assign people within the individual departments to specific procurement tasks. These processes have been labour-intensive, dominated by paper, thereby making them costly and inefficient. Various business concerns have found it both appropriate and inevitable to embrace the use of internet facilities to enhance the performance of their tasks.

Electronic procurement has been labelled as a tool that can improve competence and performance while enabling simplicity and automation (Phillips and Piotrowicz, 2006; Henriksen and Mahnke, 2005). Davila *et al*. (2002) explained e-procurement as any technology that facilitates the acquisition of goods and services by a private or public organization over the internet, a view that is substantiated by Parida and Parida, (2005). Several researchers have also discussed the challenges involved with public procurement. The most important of these bothers on how best to employ the use of IT in this era of communication revolution to enhance the procurement process (Henriksen and Mahnke, 2005; Lou and Ashalwi, 2009). E-procurement does not however represent a single application but consists of many different tools (Phillips and Piotrowicz, 2006; Kajewski and Weippert, 2004). It encompasses application of several ICT tools a major part of which is the internet, to transform the traditional processes of acquisition, purchase or supply of goods and services into the e-processes such as e-tendering, e-awarding, e-auction, e-sourcing, by a private or public organization.

E-tendering is essentially an expression used to describe the dissemination and receipt of tender information, indication of interest in tendering, receipt of tender documents, submission of tender sum and final selection of successful tender for contracts via the

internet (Black *et al*., 2004). In the opinion of Seah (2004), the objective of e-tendering is to specifically increase productivity during the tendering process by decreasing paper handling and speeding up communication and interaction. This represents the ultimate goal of e-tendering, a shift from manual paper methods to fully electronically enabled means of communication. One of the major strengths of arguments for e-tendering is the remote accessibility of the system. Thus making it possible for a tender manager, tenderer, contractor or client to access the facilities of the tender engine from anywhere in the world without being impeded by geographical location constraints (Seah, 2004).

E- Uptake

The Internet has debatably revolutionised the way in which information is stored, exchanged and viewed, opening new avenues for business, which only a decade ago were deemed almost inconceivable (DCITA, 1998) and (IIB, 2002). In an attempt to put these 'new avenues of business' into perspective, the following section provides an overall 'snapshot' of current public and private construction industry sector opportunities and practices in the implementation and application of web-based ICT tools, systems and processes (e-Uptake).

E-Commerce

According to 'Information Technology in Construction Best Practice' (ITCBP), online trading (e-Commerce) is forecast to grow rapidly, with the undertaking of business electronically leading to significant improvements in cost, time and quality of business products and services. Rapid developments in ICT, its uptake, and increase in computer-literate customers' expectations, reinforces the need for companies to reconsider their strategy with respect to e-Commerce and e-Business (ITCBP, 2003). E-Commerce can be

defined as any value adding business exchange conducted electronically within or between businesses, or between businesses and consumers. It covers all forms of electronic trading including electronic data interchange, electronic banking, electronic mail (email) and other online service and communication tools (NSW Government, 2002).

The benefits of e-Commerce and its e-Commerce strategies include lower costs and wider markets for business, cheaper prices and greater choice for consumers, higher productivity for the economy as a whole and greater effectiveness of Government programs (Queensland Government, 2001). The examination of various international case studies in 2001, verify a definite trend for e-Commerce to develop in the construction industry. At the outset, this trend is slower than initially expected, as construction industry companies come to grips with, and eventually embrace, this innovative online business trend (Murray, 2003).

The Victorian Government states that e-Commerce is profoundly transforming the way people and businesses interact, with worldwide predictions of its potential to reach around US$300 billion in 2003. E-Commerce has the potential to be a major competitive advantage to businesses, which can lead to:

1. improved customer service;
2. better business hours;
3. reduced inventories;
4. an easier and cheaper way of doing business; and
5. new competitors / business
6. The construction industry and its participants need to start realizing that:

7. e-Commerce is here to stay and that the ‘open ’availability of essential information and data is important to facilitate on-line decision-making.
8. Technology can bridge the traditional gap between design and production.
9. Joined-up manufacturers, suppliers and off-site production can lead to greater resources for research and development into new products and processes.
10. Industry standard models may enable automated information sharing across the entire value chain - from products to projects.
11. It is essential for the construction industry to play an active part in setting the world standards that everyone will eventually need to use.
12. Specialist contractors, suppliers, contractors and the design team will use web-based project portals to manage the project and its associated information.
13. For an industry susceptible to adversarial approaches, the issue of trust in the supply chain will be critical.
14. Greater operating effectiveness and supply-chain efficiency needs new skills and talent - attracted through better prospects and changed perceptions.

E-Procurement

E-Procurement covers a wide range of web-based methods and tools (for obtaining prices, awarding and managing contracts, etc) spanning every stage of the purchase of goods or services.

E-Procurement can therefore be described as using e-Commerce for procurement. A business tool and enabler, involving the use of electronic technologies to automate and streamline the procurement processes of an organization, improving efficiencies and

transparency, and thereby reducing the costs of those processes within and between businesses (NSW Government, 2002).

The New South Wales (NSW) Department of Public Works and Services, for example, through their 'NSW Government Electronic Procurement Implementation Strategy', states a key outcome of the strategy is to maximise consistency in approach in implementing e-Procurement and ICT across government agencies and the construction industry (NSW Government, 2003).

The primary benefit that government agencies, service providers and industry seek to achieve from implementing e-Procurement is to reduce the cost of doing business. As a result, the key objectives of one of its strategies (Strategy 5) includes providing better access to tendering information and streamlining the whole tendering process, by offering electronic access to tender information (e-Tender), thereby providing greater opportunity for business (NSW Government, 2002).

E-Business

E-Business solutions enable local and international businesses to get online quickly and effectively over the Internet (DCITA, 1998) and (IIB, 2002). Australia (Queensland in particular) is described as being globally competitive, delivering world-class e-Business solutions to a diverse range of clients. E-Business, in its narrowest sense, can be defined as the use of information and Internet technologies to conduct business among buyers, sellers and other trading partners (NOIE, 2002). e-Business solutions can be divided into six main categories, namely:

• *Business-to-Business (B2B):*

an electronic means of carrying out business transactions between two or more businesses, incorporating everything from manufacturing to service providers – that is, electronic orders, e-Tender, receiving electronic invoices and making payments electronically. During the last decade, business-to-business (B2B) e-Commerce has grown rapidly (DIST, 1998), mainly because companies needed the related cost-savings and efficiencies to stay competitive.

• *Business-to-Consumer (B2C):*

similar in concept to the traditional method of retailing. The main difference being the medium used to carry out business – that is, Internet.

• *Business-to-Administration (B2A):*

covers all the transactions that are carried out between businesses and government bodies (e.g. details of government policies, initiatives and other information).

• *Consumer-to-Administration (C2A):*

is relatively new through various UK governments initiatives such as:

•UK Online, which is a joint venture between the UK government, industry, voluntary sector, trades unions, and consumer groups to facilitate Internet access to UK citizens. Facilities include e-Democracy, e-Voting, information about public services, e-Health, and publishing of advantages such as paperless offices, faster communications and reduced costs compared to traditional methods, etc.

• *Consumer-to-Consumer (C2C):*

even though no financial transaction takes place, the exchange of value is still deemed as an internet-based economic activity; and

• *Administration-to-Administration (A2A):*

where future governments from different countries exchange documents and data or conduct business transactions electronically.

• *Business-to-Government (B2G):*

Governments placing their procurement processes online, allowing private companies to bid to tender via the Internet – reducing administration costs and allowing a larger number of private companies to bid.

• *Consumer-to-Government (C2G)*

: Governments selling, for example, publications, surplus supplies, property and licences, etc. (many of which are auctioned off online) – again reducing administration costs (Ecommerce 2002).

For successful implementation of any e-Business solution, research indicates a carefully planned strategy based on clear business objectives is essential. Adequate resources must be available and sufficient time allowed results to be achieved. High level backing from a champion will be required and staff expected to operate the new procedures and to be informed and involved from an early stage. CITE (2003), for example, suggest industry organisations who consider adopting e-Business are to follow three initial steps:

•Step 1: Ask yourself three questions –

•Where is your organization now in relation to the adoption of e-Business?

Where do you want to be in the future?

•How are you going to reach that goal?

•Step 2: Develop an IT strategy.

•Develop an IT strategy that is designed to support the vision of the business plan to establish a clear case for moving towards e-Business.

•A series of high-level guides are suggested to assist in the development of this strategy and to help answer the questions in Step 1.

•Step 3: Ensure success:

•The introduction of a new technology or e-process into construction projects is likely to be a success if they are:

- Easy to use.
- Rely on existing industry standard hardware and data exchange software.
- Fully integrate with existing software packages for word processing, etc.
- Tailored to the particular need of the construction industry.

Core requirements and considerations for e-tendering

1. Distribute all tender documentation via a secure web-based tender system — a paperless system.

2. Clients should be able to upload a notice and/or invitation to tender.

3. Notifications should be sent out electronically (usually via email) for suppliers to download and respond to electronically.

4. Updates and queries should be exchanged through the same eTender system during the tender period.

5. The client should be able to access the tenders only after the process closes.

6. All tender-related information should be held in a central database, which should be easily searchable and fully audited, with all activities recorded.

7. Tender documents must be read or submitted only by authorised parties.

8. Users of the eTender system are to be properly identified and registered via controlled access.

• Each tenderer is to be an eTender system member — registered in a central database.

• Data is to be encrypted and users authenticated by means such as digital signatures, electronic certificates or smartcards.

• Users are to have a unique username and password to confirm their eligibility to participate in the eTender system.

9. The eTender system should ensure that only 'monitored' or 'authorised' alterations can be made to any tender.

10. The tenderer should be able to amend the bid online at any stage up to tender close.

11. The eTender system may also include features such as a database of service providers with spreadsheet-based pricing schedules, which can make it easier for a potential tenderer to electronically prepare and analyse a tender.

12. Back-up procedures for eTender documents are essential. Routine archiving should take place regularly.

13. Consider the possibility of allowing tenderers the option of tendering on paper (at least during a transition period)

User-specific requirements and considerations for e-tendering

1. eTender systems must suit their intended audience.

• Does the system just suit large companies or are small-to-medium enterprises (SMEs) catered for?

• Smaller projects such as minor works, refurbishing and alterations are usually undertaken by smaller contractors with limited Information and Communication Technology (ICT) infrastructure.

2. The system must be flexible enough to account for project-to-project and region-to-region specifics.

3. An eTender system that requires tenderers to submit a tender electronically should be designed around timing and accuracy that allow tenderers to 'hold out' for subcontractors to submit last-minute prices and quotes.

4. The system must allow tenderers to receive all tender documents electronically — then easily forward them to printers, suppliers and subcontractors.

5. An eTender system must considerably reduce the need, cost and time spent in having to print, bind, and courier tender documents.

6. The system must effortlessly, professionally and securely manage and record all tender documents.

7. An eTender system must encourage trades and subcontractors to upgrade their existing hardware and software and/or upgrade to take advantage of the eTender process.

8. eTender portals should:

• be professionally developed and displayed

• be presented in a logical, clear and user-friendly format

• have effective yet easy-to-use security access in place

• retain familiarity by ensuring that portals stay essentially unchanged

• allow tenderers to review all tender documents on the system before actually submitting them.

9. Users must have access to professional assistance:

• on-line ‘help files’, ‘tutorials’ and ‘start-up guides’

• ‘help desk’ style of support available by phone and/or online chat

• an administrator may be made available (by email or telephone) to assist users with specific queries regarding the tender

Security related requirements and considerations for e-tendering

1. There is to be a nominated, continuing, primary email contact within each tendering firm on the central database to which other email contacts can be added or specified by the firm.

2. The eTender system should routinely notify the primary email contact whenever a secondary user is detected accessing eTender information.

3. Each eTender system username and password is to be specific for that tender and a ‘one-off’ for an individual firm.

4. For audit trail purposes, logging of all user access to an eTender system must be available for inspection.

Legal requirements and considerations for e-tendering

1. An e-Tendering process must be compatible with the current legal status regarding electronic transmissions and use of electronic signatures.

2. Authenticity — what is the source of the communication and does it come from the apparent author?

3. Integrity — was the communication received the same as that sent or has it been altered either in transmission, receipt or storage?

4. Confidentiality — is the disclosure of and access to the information contained in the communication confidential?

5. Matters of evidence — does the communication meet current evidentiary requirements for courts of law?

6. Matters of jurisdiction — the electronic environment has no physical boundaries, unlike the physical or geographical boundaries of an individual state or country. Which state's or country's laws will govern legal disputes?

7. Ensure that appropriate legal policies and processes are developed to deal with extenuating circumstances pertaining to the electronic submission of final tenders.

• Policies and procedures should be established to allow the extension of the tender-close period if the eTender system becomes unavailable for some reason at a key period in the process.

• Preventive and/or responsive actions that will be taken, for example, when a tenderer's Internet server fails, preventing a tender being submitted on time.

e-Tender system network requirements and considerations for e-tendering

1. eTender systems can use commercialised ICT service providers as their Internet service and network provider — an in-house or propriety system is not essential.

2. eTender system administrators are to ensure that tenders released and received via an eTender system do not cause any upload or download transmission bottlenecks at peak times.

• Tenderers may lodge documents in support or in addition to the tender and these attachments may have some influence on the speed of transmission.

3. To ensure minimal downtime if one server fails, the eTender system should be housed on 'dual, mirrored server' hardware.

Information and eTender risks

1. Information posted on the eTender system as 'pure information' — although this information is exposed to minimum levels of risk, sufficient attention must be given to its contents — it must be true, accurate, not misleading or defamatory.

2. If the eTender system has tender-related information that tenderers need to rely on and perhaps download, it is essential that the completeness and accuracy of the information is verified.

• The inclusion of a 'non-reliance' exclusion clause may also be necessary.

3. A fully interactive eTender system, in which tenderers both receive an invitation to tender and reply with a tender bid electronically, represents maximum risk in relation to the veracity of information supplied and received.

• Security of information and integrity of the eTender system is of paramount importance. Here, legally binding and enforceable contracts may be formed electronically, leaving little room for error in receiving, sending, or storing the information.

2.10.1 E-TENDERING BENEFITS

Economic arguments emphasized in research are those of reduction of workload, and associated cost savings through information technology systems. E-tendering, from an

economic stand point, enhances efficiency through transaction cost savings and reduced direct procurement costs. While transparency, accountability, ease of use, speedy exchange of information, including other intangible benefits such as reduced administrative costs are achievable (Davila *et al*, 2002; Henriksen and Mahnke, 2005).

During e-tendering the traditional functions and responsibilities of project team members are maintained throughout the process of e-tendering and do not overlap, rather the efficiency of their activities is greatly enhanced. E-tendering however requires the use of a web collaboration platform through which the project team members make their contributions and queries for information. This must however be done on the platform of an effective electronic data interchange (EDI) format to promote acceptable levels of interoperability (Parida and Parida, 2005).

Cost savings have expectedly been shown to be the primary rationale for investment across all technology platforms (Davila *et al.*, 2002). While some cost benefits may accrue from e-tendering, sustainable benefits will only amass from the adoption of a strategic management perspective (Phillips and Piotrowicz, 2006). E-tendering implementations must thus be able to strategically anticipate and manage change in the construction environment, providing ad-hoc solutions whenever necessary. Initial investment required for the system are relatively minimal if the adopting organization uses the facilities of an existing communications network, but is however substantially higher when there is no existing network or the system requires unique features to support these technologies. These benefits nonetheless depend on the size of the organizations providing the service as the benefits must be weighed against the cost. A significant benefit to cost ratio must be achieved for the use of such technology to be

acceptable (Davila *et al.*, 2002). Organizations already using e-tendering technologies report a savings of up to forty two percent in transaction costs; most of this is associated with less paper work, which translates to fewer mistakes and more efficient procurement process.

Administrative benefits (intangible benefits) obtainable from e-tendering are also numerous. However, these benefits may not be as obvious as the tangible forms. These come in form of reduction in workload and improved efficiencies. Government agencies and ministries across the world seeking administrative efficiencies and cost reductions experienced in the private sector have widely embraced e-tendering. This is a trend that has gained prominence in Europe (Coulthard *et al.*, 2001). Private organizations or public authorities that implement e-tendering also achieve efficiency gains. Paper work is substituted for new electronically enabled collaboration and integration of tendering data by private consultant/client concerns (Davila *et al.*, 2004).

E-Tendering can also play a strong role in risk mitigation and business continuity management (BCM) strategies. In terms of BCM, firms need to identify critical suppliers and to mitigate their exposure. E-Tendering systems make it easy to keep track of key suppliers and to keep the organization's supply chain exposure under review.

E-Tendering promotes accountability, transparency and compliance. It provides a secure history of every tender. In terms of governance and compliance, e-Tendering makes it straightforward to enforce processes and workflows. Tender procedures and policies can be configured into the solution so that all procurement staff can only operate within organizationally approved processes. In addition, where responsible sourcing is

important, e-Tendering systems simplify the process of keeping track of supplier credentials, and where and how they source materials.

E-Tendering is a highly effective way to manage these complex supply chains with multiple tiers of suppliers. Additionally, the fragmented, sub-contracted, on-site nature of construction demands a light, flexible, easy-to-use solution. Multi-site, temporary and/or complex organizational structures lend themselves to flexible e-Tendering solutions rather than legacy eProcurement platforms (Davila *et al.*, 2002).

Adopting e-Tendering provides easy-to-access tools that help firms maximize their margin by increasing competition when buying products and services or sub-tendering elements of their projects (Davila *et al.*, 2002).

Automating key parts of the procurement process reduces overhead and makes bid evaluation easier. A good system is intuitive and user-friendly, meaning that non-procurement staff to run tenders (Davila *et al.*, 2002).

E-Tendering also provides a way to grow your supplier pool and increased competition while monitoring external spend and keeping an eye on key procurement metrics and performance against previous projects and/or industry benchmarks (Davila *et al.*, 2002).

2.11 KEY SUCCESS FACTORS FOR E-TENDERING ADOPTION

Significant success factors for the implementation of e-tendering can be classified into four major characteristics: construction project; project team; service provider characteristics; system characteristics. The traditional tendering process will be the basis of comparison, similar to the evaluation of process changes.

Alshawi and Ingirige (2003) discuss the importance of project characteristics, project team and service providers where collaborative environments could be successfully implemented. These factors include project duration, size and cost, type of contract, type of collaborative environments used, internet facilities and more. The construction project itself is important; the complexity of construction, design and engineering works is decisive in making the system successful (Deng *et al*., 2001; NCCTP, 2006). Qualitative benefits and quantifiable benefits of a centralized digital information management system are discussed by Sulankvi (2004), providing evidence of the impact on project and document management to benefit various parties; in addition to monetary benefits, work time savings, reduction in the time delays for information distribution, fewer field errors, slightly fewer disputes because of documented information exchange and less paper to be filed. Security is also a major issue, for both the collaborative environment service providers and the end-users (Eriksson and Laan, 2007; Vlosky *et al.*, 2000).

The timely and efficient distribution of key information is another reason companies participate in a common environment as this creates a secure environment for the interchange of critical data with business partners, customers and suppliers (Business Wire, 1998). Vlosky *et al.* (2000) added that the champion, initiator and paymaster of the collaborative environment are all essential for successful implementation.

Users, or project team members, are essentially the core to the construction team. The team's IT skills, enthusiasm and prior experience are the forefront for success. This could be further strengthened through training and additional resources for the collaborative environment. The involvement of project members from initiation stage provides the insights towards the project from the start, conversely better understanding of the project

equates to the higher usage of collaborative environment for implementation (Hedelin and Allwood, 2002; Keil *et al.,* 1994; NCCTP, 2006; Lou, 2006). Brockway and Hurley (1998) also illustrate that support from top management and the ability of the project manager has a positive effect on implementation. A strategic approach in aligning collaborative environments into the project team and their integration among the collaborative environment's features is imperative in providing a smooth transaction in data interchange and maintenance (Neef, 2001).

There are technology issues that may impact on the operation of the collaborative environment and extranets. The software must be tested and reliable and have simple-to-use interfaces. Complex and disorganized interfaces will only put-off users (Chulkov and Desai, 2005; Lou, 2006). The exchange of data with other systems, within the organization or external software, must be seamless to provide smooth data integration. The provider should be able to provide technical competency when needed by users, and be well versed in knowledge and understanding of the construction business (Blismas *et al.,* 2004). The provider must ensure that the software is running optimally at all times and provide prompt responses when needed.

Research also indicates an e-Tender system should have a number of basic features and capabilities, including:

• All tender documentation to be distributed via a secure web-based tender system – thereby avoiding the need for collating paperwork and couriers.

• The client/purchaser should be able to upload a notice and/or invitation to tender onto the system.

• Notification is sent out electronically (usually via email) for suppliers to download the information and return their responses electronically (online).

• During the tender period, updates and queries are exchanged through the same e-Tender system.

• The client/purchaser should only be able to access the tenders after the deadline has passed.

• All tender related information is held in a central database, which should be easily searchable and fully audited, with all activities recorded.

• It is essential that tender documents are not read or submitted by unauthorized parties.

• Users of the e-Tender system are to be properly identified and registered via controlled access. In simple terms, security has to be as good as if not better than a manual tender process. Data is to be encrypted and users authenticated by means such as digital signatures, electronic certificates or smartcards.

• All parties must be assured that no 'undetected' alterations can be made to any tender.

• The tenderer should be able to amend the bid right up to the deadline – whilst the client/purchaser cannot obtain access until the submission deadline has passed.

• The e-Tender system may also include features such as a database of service providers with spreadsheet-based pricing schedules, which can make it easier for a potential tenderer to electronically prepare and analyze a tender.

2.12 CHALLENGES AND RISKS ASSOCIATED WITH THE ADOPTION OF E-TENDERING

The reasons for the relatively low adoption of e-tendering in developing nations are not farfetched. There are numerous barriers impeding the adoption and implementation of e-tendering. Despite initial optimism about the use of ICT to improve productivity and profitability in the Ghanaian construction industry, the benefits have since been localized to minute immediate administrative gains. The far-reaching benefits of e-tendering are yet to be achieved in developing countries. Nonetheless, various studies have suggested reasons for this. Issues relating to the legal ramifications of electronic communications, vague security framework, ownership of intellectual property, and the capture/management of the knowledge generated during the project, as well as issues of trust have been prominent in these postulations (Rezgui *et al.,* 2004; Brewer *et al.,* 2005; Pasupathinathan and Pieprzyk, 2008). Challenges local to Ghana while not differing from these also include the inherent inadequacy or total lack of facilities necessary for participation in e-tendering.

Organizational and human issues have also been highlighted as key factors affecting the use of technologies in the construction sector. This view forms the crux of the study carried out by Lou and Ashalwi (2009). It gives specific recognition to the importance of human resources training and professional development. This is similar to earlier work carried out by Rezgui *et al.* (2004). There is also a perception within the construction sector that senior management tend to be lacking in awareness of the available and forthcoming technologies and of the potential benefits of these technologies for process improvement and competitive advantage (Rezgui *et al.*,2004). This can greatly hamper

the adoption of new technologies since most investment decisions are usually taken at the senior management level. There is immense need for trained technical staff with ICT support skills, such as programming, network development and maintenance, website development and maintenance skills, database administrator skills, etc., to support the increased use of and dependency upon ICT both in the workplace and for workers on project sites, (Rezgui *et al.,* 2004).

The internet provides access to a vast reservoir of information and it is transforming the nature and methods of perpetrating commerce. It is not surprising that there is some offensive, and even illegal, use of the internet since millions of users globally make use of the facility (Darlington, 2006; Dara and Gundemoni, 2006). The terms or scope of cyber-laws is not clear in many countries. Laws governing the use of internet can be observed from two different standpoints, one is for the relevant legislations dealing with or regulating telecommunications; the other is for those tackling the emerging cyber related crimes. The major risks factors relating to electronic transactions on the internet include hacking, viruses, pirating, illegal trading, fraud, money laundry, defamatory libel, among several others (Darlington, 2006). All of these have very destructive impacts on trust and transparency in the process of tendering (Dara and Gundemoni, 2006). They could also lead to the undermining of tendering data.

Organizations must in essence be confident that unauthorized actions would not disrupt the processes when committing to e-tendering technologies. Thus, the challenge to e-tendering technology advocates is to present evidence to non-users that these technologies do not weaken control, security or privacy requirements (Davila *et al.*, 2002). Remarkable progress has been made in this area of research. Pasupathinathan and

Pieprzyk (2008) generated an e-tendering protocol for the purpose of engendering security and fairness in the process.

2.13 FACTORS INFLUENCING THE SUCCESSFUL IMPLEMENTATION OF E-TENDERING

Critical success factors (CSFs) for the implementation of e-tendering can be classified into four major characteristics – construction project; project team; collaborative environments service provider; collaborative environments software.

The traditional tendering process will be the basis of comparison, similar to the evaluation of process changes. Alshawi and Ingirige (2003) discuss the importance of project characteristics, project team and service providers where collaborative environments could be successfully implemented. These factors include project duration, size and cost, type of contract, type of collaborative environments used, internet facilities and more. The construction project itself is important; the complexity of construction, design and engineering works is decisive in making the system successful (Deng *et al.*, 2001; NCCTP, 2006).

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environment service providers and the end-users (Eriksson and Laan, 2007; Vlosky *et al.*, 2000).

The timely and efficient distribution of key information is another reason companies participate in a common environment as this creates a secure environment for the interchange of critical data with business partners, customers and suppliers (Vlosky *et al.*, 2000).

The champion, initiator and paymaster of the collaborative environment are all essential for successful implementation (Vlosky *et al.*, 2000). Users, or project team members, are essentially the core to the construction team. The team's IT skills, enthusiasm and prior experience are the forefront for success. This could be further strengthened through training and additional resources for the collaborative environment. The involvement of project members from initiation stage provides the insights towards the project from the start, conversely better understanding of the project equates to the higher usage of collaborative environment for implementation (Hedelin and Allwood, 2002; Keil *et al.*, 1994; NCCTP, 2006; Lou, 2006). Brockway and Hurley (1998) also illustrate that support from top management and the ability of the project manager has a positive effect on implementation. A strategic approach in aligning collaborative environments in to the project team and their integration among the collaborative environment's features is imperative in providing a smooth transaction in data interchange and maintenance (Neef, 2001).

There are technology issues that may impact on the operation of the collaborative environment and extranets. The software must be tested and reliable and have simple-to-use interfaces. Complex and disorganized interfaces will only put-off users (Chulkov and

Desai, 2005; Lou, 2006). The exchange of data with other systems, within the organization or external software, must be seamless to provide smooth data integration.

In terms of the collaborative environment the provider should be able to provide technical competency when needed by users, and be well versed in knowledge and understanding of the construction business (Blismas *et al.*, 2004). The provider must ensure that the software is running optimally at all times and provide prompt responses when needed.

Table 2.1 Factors influencing the successful implementation of e-tendering

Project characteristics	Project location
	Project cost
	Project duration
	Project size
	Type of contract
	Type of project
	Complexity to construction task
Project team characteristics	Ability of project manager
	Involvement of team member
	Team attitude towards IT
	Type of internet service
	Internet access availability
Service provider characteristics	Level of top management support
	Promptness of response
	Technical competency
	Attitude of staff
	Knowledge in construction
System characteristics	Contact facilities
	Ease of use
	Output quality
	Frequency of software update
	System reliability
	Data quality and reliability
	Data security
	Type of services

Source: Adapted from Lou and Ashalwi (2009)

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter explains the detailed methodology of this study. The availability and selection of appropriate research design, strategy and method that would address the key questions raised are presented in the chapter. In this chapter the "what is done", "why" and "how it was done" aspects of the research were the cardinal point of this chapter. In this thinking, the research methodological terms and concept were thoroughly discussed followed by the exposition of their application in the research process.

3.2 RESEARCH APPROACH

3.2.1 Philosophical Considerations

There are a number of considerations that underpin the philosophical position of any research. Several views exist on these positions and the debate continues within the research community on which position best represents an appropriate research design and approach. The two main philosophical positions of social research, discussed below in this section, are ontological and epistemological considerations (Bryman 2004). This thesis clarifies the philosophical stance considered in the course of the research.

3.2.2 Ontological Consideration

Ontology involves the logical investigation of the different ways in which types of things are thought to exist, and the nature of various kinds of existence indicate that there are

relativist and realist ontological positions. The philosophy underpinning this research at the ontological level, is the realist position. At the ontological level, the realist position is that the external world comprises of pre-existing hard and tangible structures. This structure exists independently of an individual's ability to acquire knowledge. This position is practical and not concerned with abstract or idealistic view of life (Bryman 2004). The relativist position at the ontological level holds to the multiple existences of realities as subjective constructions of the mind. The perception of reality is directed by socially transmitted terms and varies according to language and culture. Concepts such as right and wrong, goodness and badness, or truth and falsehood are, therefore, not absolute but change from culture to culture and situation to situation (Bryman 2004).

3.2.3 Epistemological consideration

Epistemological issues deal with the question of knowledge acceptability in a discipline. It is the methods through which knowledge are acquired. Epistemological position can be positivist or interpretivist. The positivist epistemological position advocates the application of natural sciences method to the study of social reality and beyond. It is believed that the world conforms to fixed laws of causes and effects, and complex issues can be tackled using simplified or fundamental approach. The position emphasizes on objectivity, measurement and repeatability. The researcher can therefore be objective from a detached position of the research situation. Neutral observation of reality must take place without bias from the researcher (Bryman 2004). The interpretivist epistemological position is contrary to the positivist and hence critical to the application of scientific model to social study. It advocates the absence of a universal truth and places more emphasis on the realism of context. Understanding and interpretation are from the

researcher's perspective and point of reference. An uncommitted neutral position is impossible when taking the interpretivist position in research. The researcher is engrossed in the research situation and the values and beliefs of the researcher become the driving force in the interpretation of findings (Bryman 2004). Table 3.1 summarizes the philosophical considerations discussed above.

Table 3.1 Summary of philosophical considerations

Ontological considerations	
Realist	**Relativist**
External world comprises pre-existing hard and tangible structures. Structures exist independent of individual's ability to acquire knowledge.	Existence of multiple realities as subjective construction of the mind. Perception of reality is directed by varying socially transmitted terms.
Epistemological considerations	
Positivist	**Interpretivist**
Application of natural science methods to the study of social reality and beyond. World conforms to the laws of causation and complex issues can be resolved by reductionism.	Absence of universal truth and emphasis on realism of context. Understanding and interpretation come from researcher's own frame of reference.

Source: Bryman (2004)

3.3 SURVEY PROCESS

Cohen *et al.* (2005) observed that researchers who adopt positivist perception use a range of traditional options such as surveys and questionnaires. According to Isaac & Michael (1997), survey research is an avenue for answering questions that have been raised, to solve problems that have been posed or observed, assess needs and goals set, to determine whether or not specific objectives have been met, to establish baselines against which future comparisons can be made, to analyze trends across time, and generally to describe what exist, in what amount and in what context. Kraemer (1991) opined that

survey research is used to quantitatively describe specific aspects of a given population which consist of relationship between variables. Kraemer (1991) further pointed other characteristics of survey research by asserting that the data required for the survey research are collected from people by using certain portion of the population from which findings can later be generalized back to the population. According to Glasow (2005) independent and dependent variables are used to define the scope of survey research; and that before the commencement of the research, the researcher must predicate a model of relationship existing among the variables.

In keeping with the above works demonstrated in extant literature, the rationale for adopting the survey process for this study is embedded in the philosophy of the researcher that the survey process enables data to be gathered from large number of respondents in order to generalize the results of the study. Again, the survey process was adopted because of its ability to allow for the aggregation of the opinions and attitude of respondents on the various facets of construction stakeholders under investigation.

3.4 RESEARCH STRATEGY

Apart from the philosophical considerations supporting this research, there is the need for the elucidation of the orientation of the researcher to the conduct of research (Bryman 2004). It is the way in which the research objectives are questioned. Two known strategies, quantitative and qualitative research, differ in many ways but can complement each other (Neuman, 2003). The decision to follow any particular strategy depends on the purpose of the study, the type and availability of information for the research (Naoum, 2002). This research follows a quantitative strategy for the research design and method.

The two main research strategies are discussed below to clarify the choice adopted in this research.

3.4.1 Quantitative research

Quantitative research follows a deductive approach in relation to theory and is concerned with the design measurement and sampling. The strategy employs the use of mathematical and statistical techniques to identify facts and causal relationships. It follows the practices and norms of natural scientific model and particularly, positivism; and viewing social reality as an external, objective reality. Quantitative research is, therefore, objective in nature and based on testing a hypothesis or theory composed of variables (Naoum 2002).

Frechtling and Sharp (1997) characterized the common data collection techniques used in quantitative research as questionnaires, tests and existing databases. Hard and reliable data are often collected in quantitative research and, therefore, emphasizes on quantification. The samples collected are often large and representative. This means that quantitative research results can be generalized to a larger population within acceptable error limits. Quantitative or “hard” measures are also required for evaluation and can be replicated using sophisticated statistical techniques (Bryman, 2004). The validity of results depends on the careful choice of measuring instrument and how accurately it measures targets (Patton 2002). Bryman (2004) outlined the main steps in quantitative research as but emphasized that they represents an ideal account of how research should progress. He however, argued that, though research is rarely linear it provides a good indication of the interconnections between the main steps in quantitative research.

Quantitative research process:

1. Theory
2. Hypothesis
3. Research design
4. Devise measurement of concepts
5. Select research sites
6. Select research subjects/respondents
7. Administer research instrument/collect data
8. Process data
9. Analyse data
10. Findings/conclusions
11. Write up findings/conclusions

Source: Bryman (2004)

Naoum (2002) concluded that quantitative research strategy is selected for:

- finding facts about a concept, a question or an attribute; and
- collecting factual evidence and study the relationships between the facts in order to test a particular theory or hypothesis.

Quantitative research has received criticisms over the years from researchers as an appropriate research strategy. These criticisms were outlined by Bryman (2004) as:

- failure of quantitative researchers to distinguish between people and social institutions from the natural world;

 artificial measurement process and a sense of precision and accuracy not proceeding from the true or claimed source;

 reliance on instruments and procedures that hinders the correction between research and everyday life; and

 creation of a static view of social life that is independent of people's life in analysing the relationships between variables.

3.4.2 Qualitative research

According to Frechtling and Sharp (1997), qualitative research follows an inductive approach in relation to theory. It emphasises words rather than quantification in the collection and analysis of data. This research is subjective in nature and is exploratory and attitudinal. Qualitative researchers frequently rely on interpretive or critical social science and follow a non linear research path. The language of this strategy is, therefore, cases and contexts (Neuman, 2003). Sherif (2002) states that small number of, usually, non-representative cases are used and respondents are selected to fill a given requirement. Qualitative researchers have a propensity to collect three kinds of data; in-depth and open-ended interviews; direct observations and written documents. These yield quotations, descriptions and excerpts which are either unstructured or semi-structured (Patton, 2002). The data are soft, rich and deep and determine what things exist rather than how many there are. Consequently, the qualitative research strategy is more responsive to needs and nature of research situation (Patton, 2002). The credibility of qualitative research depends on the skill, competence and the rigor of the researcher (Patton, 2002).

Outline of qualitative research process:

1. General research question

2. Selecting relevant site(s) and subjects

3. Collection of relevant data

4. Interpretation of data

5. Conceptual and theoretical work

6. Write up findings/conclusions

5a. Tighter specification of the research questions

5b. Collection of further data

Source: Bryman (2004)

As presented above, the main steps involved in qualitative research are non-linear and the research questions are driven by theoretical issues which in turn drive the data collection and analysis (Bryman 2004).

A qualitative research strategy may be used when:

 there is no existing research data on the topic and the most appropriate unit of measurement is not certain; and

 the concepts to be researched are assessed on a nominal scale, with no clear demarcation and involve exploring behaviour or attitudes.

Qualitative research has not escaped criticisms from researchers. According to Bryman (2004), critics of qualitative research argue that the strategy:

 is too impressionist and subjective and the findings are based on unsystematic views about what is important and significant;

 is difficult to replicate because it relies on unstructured data and because there are hardly any standardized procedure to follow, the quality depends on the researcher's ingenuity;

 has problems of generalization because the scope of qualitative research is often restricted: and

 lacks transparency due to the difficulty which sometimes arises from the establishment of what the qualitative researcher actually did and how the study conclusions were arrived at.

Table 3.2 is a summary of differences between quantitative and qualitative research.

Table 3.2 Differences between quantitative and qualitative research

	Quantitative research	**Qualitative research**
Objective	Gather factual data and study relationships between facts and relationships in accordance with theory.	Study issues in depth and detail and seeks to gain insight and understand people's perceptions.
Orientation to the role of theory to research	Deductive and thus associated with verification of theory and hypothesis testing.	Inductive and geared towards the generation of theory from specific instances.
Common data collection techniques	Questionnaires, tests and existing databases.	Interviews, observations and documents.
Data characteristics	Hard data, structured, large sample size, analyzed using statistical methods.	Soft data, descriptive, less structured, analyzed using non-statistical methods.
Outcome	Conclusive findings used to recommend a final course of action.	Exploratory and/or investigate and findings are contextual.

Sources: Bryman (2004), Fellow and Liu (2003), Naoum (2002)

Quantitative strategy was adopted for this research. This is because it employs the use of statistical techniques to identify facts and casual relationships. It is deductive and thus associated with verification of theory and hypothesis testing, uses questionnaires and existing databases.

3.5 SAMPLE DESIGN PROCESS

The purpose of the sample was to gain information about the population by observing only a small proportion, i.e. the sample size.

3.5.1 Population Definition

The selection of the respondents was limited to stakeholders in the construction industry. Consultants and building contractors in Kumasi were targeted. The choice of the class of building contractors was made on the basis that they are well established firms with their offices quite easily to be located. A list of consultants and contractors in good standing was obtained from the Registrar General's Department.

3.5.2 Sampling Techniques Used

The general aim of all sampling methods is to obtain a sample that is representative of the target population. By this, the information derived from the sample survey is the same (allowing for inevitable variations in the estimates due to imprecision) as we would find if we carried out a census of the target population. When selecting a sampling method we need some minimal prior knowledge of the target population; with this and some reasonable assumptions we can estimate a sample size required to achieve a reasonable estimate of population characteristics. The term "sample" means a part of a whole (population) drawn to reflect the remaining (Naoum, 1998). Thus, sampling refers to the

process of selecting a quota of the population to characterize the entire population. A sample, then, consists of a subject of the units that constitute the population (Polit and Hungler, 1999) and normally used in large-scale survey research for the sake of economy and accuracy (Weisberg and Bowen, 1977). However, research studies use simply a small fraction of the population, referred to as a sample. This is because using a sample is more practical and less costly than collecting data from the entire population. Polit and Hungler (1999) asserted that, the major risk of using a selected sample is that it might not adequately reflect the behaviours, traits, or beliefs of the population.

The non-probability sampling techniques were used in the study. Purposive and snowball techniques were adopted. Purposive sampling indicates the strategies where the researcher applies discretion as to who will best provide answers concerning field of study, and then deliberately requests those definite viewpoints into the study. Purposive sampling is very useful for instances where one needs to contact a targeted sample fast.

Snowball sampling technique, which is an example of a non - probability technique was used to locate respondents. This sample technique was used to initially contact a few potential respondents who were then asked to give names of persons or organisations with the characteristics sought. The process based on the assumption that a ‘link’ exists between the initial sample and others in the same target population, allows series of referrals made within a circle of acquaintance (Berg, 1988; Atkinson & Flint, 2001). Hence, purposive helped in choosing respondents while the snowball sampling was used for identifying respondents with rich information that are relevant to the study.

3.5.3 Sample Size Obtained

According to Israel (1992) there are several approaches used in determining the sample size. These, include using a census for small populations, imitating a sample size of similar studies, using published tables, and lastly applying formulas to calculate a sample size. From the list from the Registrar General's Department, the population for contractors and consultants in good standing was 80. Kish formula was used to determine the sample size.

$n = n^1 (1 + {}^{n^1}/_{N})$ …… (1)

Where, n = the sample size, N = the total population size

$n^1 = {}^{S^2}/_{V^2}$ …… (2)

V= the standard error of sampling distribution assumed to be 0.05

S= the maximum standard deviation of the population size (Total error of 0.05 @ 95% confidence level)

$S^2 = P (1–P)$ …….... (3)

Where, P = the proportion of the population elements that belong to the defined class assumed to be 0.89

From eqn (3), $S^2 = P (1–P) = 0.89 (1– 0.89) = 0.0979$

From eqn (2), $n^1 = {}^{S^2}/_{V^2} = {}^{0.0979}/_{0.05^2} = 39$

From eqn (1), $n = n^1 (1 + {}^{n^1}/_{N}) = 39 (1 + {}^{39}/_{80}) = 60$ questionnaires

3.6 DATA COLLECTION

This aspect of the research methodology addresses data collection instruments, methods, and procedures. It provides exhaustive explanations to each of the methods used in addressing the aims, objectives, and research questions. Data gathering is crucial in research, as the data contributes to a better understanding of a theoretical background (Bernard, 2002). It then becomes imperative that selecting the manner of obtaining data and from whom the data will be acquired be done with sound judgment, especially since no amount of analysis can make up for improperly collected data (Bernard *et al.*, 1986; Tongoco, 2007). It should be noted that clear description of these important components of the research design and methods are critical to communicating what was done in addressing the research concerns.

Based on the specific objectives and the research questions a questionnaire was developed to obtain as exhaustive, a collection of data as practicable, from these construction stakeholders. A structured questionnaire was therefore prepared and self-administered to the various respondents. The questionnaires consisted of closed ended questions.

The first part of questions related to respondents' profile. This was intended to find out the background and experience of respondents. The second part of questions related to the specific objectives of the study. A 5-point Likert ranking system was used.

Sources of Data

It has been mentioned earlier that multiple sources of information were used to address the research goals. However, this approach was time consuming and relatively expensive as compared to single source of data. The approach for collecting data in this study was divided into two main parts. The first discusses the desk study and the second talked about the field

survey. The desk study forms an essential aspect of the research since it sets the pace for the development of the field survey instrument using questionnaires and interview (Fadhley, 1991). The secondary data obtained from reviewed literature on the area of study includes; brochures, magazines, reports, relevant books obtained from libraries, journals, articles, and published works of interest. The field survey involved with the collection of empirical data. A multiple approach of data gathering was adopted for the purpose of this study which focuses on questionnaires and interviews.

3.6.1 Development of Questionnaires

The questionnaires were devised to deal with the aim, objective and research questions of the research (Oppenheim, 1996). A good questionnaire is made up of questions which generate varying kinds of information from the respondents (Gall *et al*., 2003). Questionnaires should be short, and questions set in a simple way (Gall *et al*., 2003).

The design of an effectual survey questionnaire is dependent on four essential factors: question wording, categorization, coding of variables and general acceptance (Sarantakos, 2005). Survey instrument design must first clearly define the focus of the research. It must translate the objectives to measureable features which add to the research focus (Salant and Dillman, 1994). A good question is one that generates responses which are valid and reliable (Fowler and Floyd, 1995). Survey questions must employ words which match the levels of education of respondents (McIntyre, 1999). Fowler and Floyd (1995) implied that the question and response options should be clear to the respondent and the investigator. Wording must avoid ambiguous understandings (Salant and Dillman, 1994; Fowler and Floyd, 1995).

3.6.2 Questionnaire Format

Literature recommends that the optimal length of questionnaire varies from one side of A4 paper to eight pages of A4 paper (Naoum, 1998; Oppenheim 2000; Saunders *et. al*., 2000; Fellows and Liu, 2003).

3.6.3 Content of Questionnaires

After identifying the respondents for the questionnaire and their characteristics was to concentrate on the design of the questions that provided the essential knowledge for the study. The way in which the survey questions were presented has an effect on the quality of the responses hence needful to guarantee that accurate questions were posed, understood well and presented in the correct format (Wahab, 1996). The questionnaire comprised questions primarily closed-ended and scaled-response type and the questions were typed on normal A4, white colour sheets including a cover page.

3.7 METHOD OF ANALYSES

Variable's measurement scale determines which statistical methods are appropriate (Agresti, 2002). A variable is a characteristic that is measured on individuals (Tebbs, 2006). According to Ryan (2004) a variable depict the characteristics of a population which can contain different values. According to Agresti (2002) variables are suitable for measuring attitudes and opinions; and the subjective evaluation of certain characteristics. In a research, response scales measure attitudes, attributes, client satisfaction, cultural beliefs and values; they are means of collecting responses from people on an instrument (Kapadia-Kundu & Dyalchand, 2007).

3.7.1 Descriptive Analysis

After the collection of data using the questionnaire, there exist an enormous data that needs to be presented to audience. As a matter of fact, the data collected require summarization in order to deduce meaningful information from it. The descriptive statistics is the analytical tool for this agenda. According to Ryan (2004), descriptive statistics consists of methods for presenting and summarizing data. The descriptive statistics in the analysis of data as a priori to easy digestion and understanding of large quantities of data; and provision of opportunity to communicate the research results to others (Ryan, 2004).

3.7.2 Data Presentation Using Tables

Good tables are integral part of packaging and presenting data to audience. Tables help to minimize the amount of data values in a text; and aid in eliminating less important variables in discussing the data (UN, 2009). According to Miller (2004), good tables must aid audience to find and understand numbers within the table; and both the layout and labeling must be straightforward and unobtrusive in order to draw substantive attention to the data which is conveying information to audience. Tables should contain concise and well-organized data that supports the analysis to be made (*ibid*, 2009). The UN (2009) clearly pointed out that tables should be able to stand on their own; and should contain descriptive title; indicate source. The UN (2009) identified the five support components needed to describe data presented in a format to include the **table title (**should give a clear and accurate description of the data, it should answer the three questions “what”, “where” and “when.”); **column headers** (at the top of the table, should identify the data presented in each column of the table and provide any relevant metadata (e.g. unit of

measurement, time period or geographic area); **row stubs** (in the first column of the table, should identify the data presented in each row of the table); **footnotes**(at the bottom of the table, may provide any additional information needed to understand and use the data correctly (e.g. definitions); and the **source line** (at the bottom of the table, should provide the source of the data, i.e. the organization that produced the data and the data collection method (e.g. population census or labour force survey).

Drawing on from the above, the data collected from the field through the use of questionnaire was presented in table format which belong to the demonstration or presentation categories of tables in order to highlight key figures and as this research is analytical. The results were presented in table format as it will aid in the analysis of key and critical results. The tables were corresponding to the number of questions. The tables were designed to suit the five components of table design identified by UN (2009). The statistical methods which were used in analyzing the data were frequencies and descriptive statistics. The descriptive statistics is the analytical tool for presenting data. Descriptive statistics comprises of methods for summarizing and presenting data. The descriptive statistics in the analysis of data helps for easy comprehension of huge amounts of data; and provides chance to correspond the research results to people (Ryan, 2004). Mean score ranking also helped in ranking phenomena.

3.8 CHAPTER SUMMARY

This chapter has discussed research methods and given reasons for the options selected to achieve the research aims and objectives. The chapter also described the research design and methodology, including the philosophical positions of the research, research strategy, and research design adopted for this study. The methods and techniques which were used in the

data collection and analyses were also presented. The chapter concluded with the research process and covered issues such as scope of questionnaire survey, data sources, sampling and sample size determination, questionnaires development, content of the questionnaires, questionnaires distribution, and data analytical tools.

CHAPTER FOUR

ANALYSIS OF RESULTS

4.1 INTRODUCTION

The analysis of primary data collected from fifty-four respondents operating in the Kumasi metropolis is recorded in this chapter. It discusses level of use of ICT by professionals in tendering, challenges to be addressed within traditional tendering and benefits of e-tendering in the construction industry. The analysis used is descriptive statistics. Tables, pie charts, and bar charts aided the discussion of the results.

4.2 PRESENTATION AND DESCRIPTIVE ANALYSIS OF DATA (DEMOGRAPHIC)

This section of the questionnaire comprised questions seeking basic information and some related issues in order to provide detailed respondent characteristics. The importance of knowing the profile of the respondents is to help have confidence in the reliability of the data generated.

Data included position of respondents, years of experience in the construction industry, whether tender process is expensive and level of awareness of e-tendering in the construction industry.

4.2.1 Position of respondents

From Figure 4.1 below, 18% of the respondents are civil engineers. Furthermore, 39% of them are quantity surveyors while the remaining 43% are architects. This implies the majority of respondents for this study are architects. The study also has the right fusion of

professionals who have a knowledge in tendering hence there is confidence in their responses.

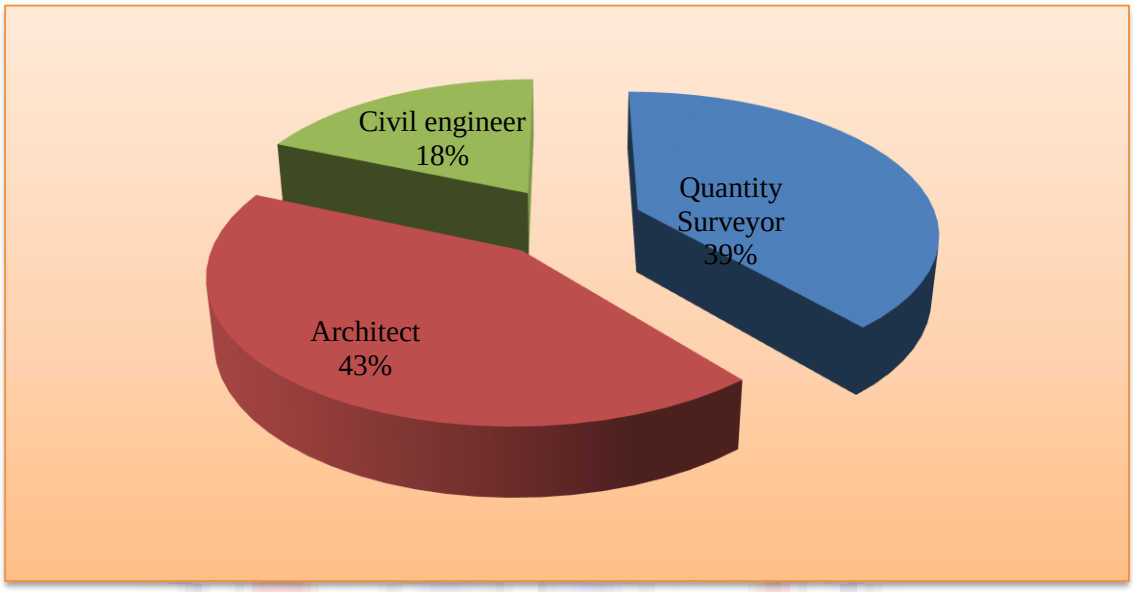


Fig 4.1 Position of respondents

Source: Author's Fieldwork (2016)

5.2.2 Experience of respondents

Figure 4.2 below shows the experience of the respondents. From the bar chart, 55% of the respondents have 5-10 years working experience in the construction industry. The remaining 45% of the respondents have 10-15 experience. This implies the respondents have adequate number of years of experience and therefore their responses on e-tendering can be trusted.

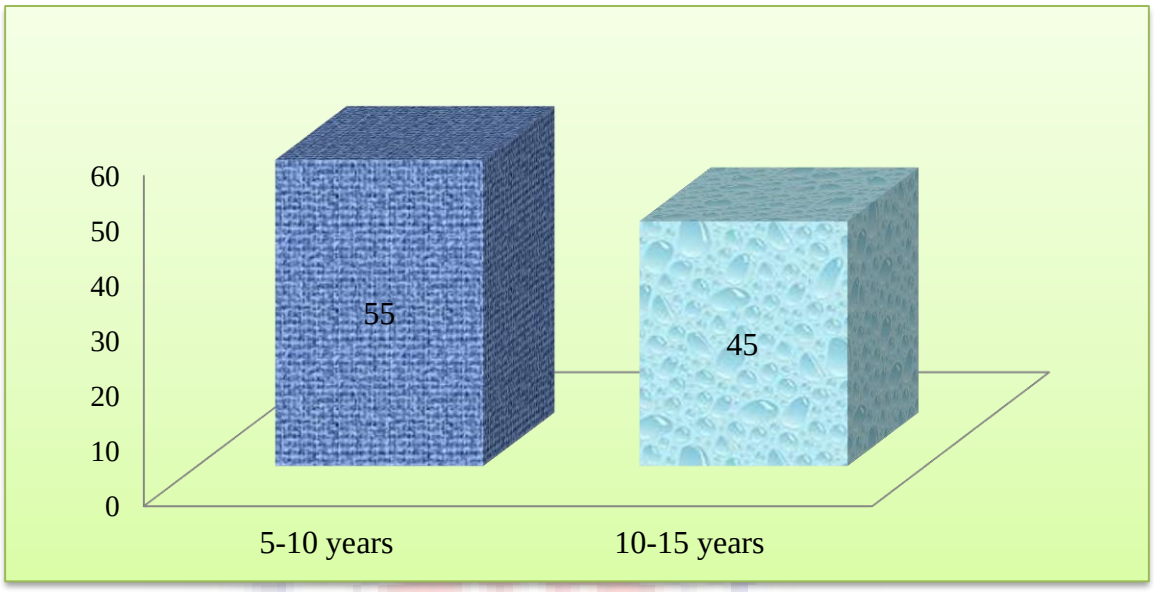


Fig 4.2 Experience of respondents

Source: Author's Fieldwork (2016)

5.2.3 Expensive nature of tendering process

Respondents were asked in this section if the tendering process was expensive. 41 of the respondents representing 76% indicated yes. The remaining 13 respondents representing 76% indicated no. This implies majority of the respondents acknowledge that tendering is expensive.

Table 4.1 Expensive nature of tendering process

	Frequency	Percent
Yes	41	75.9
No	13	24.1
Total	54	100.0

Source: Author's Fieldwork (2016)

4.2.4 Level of awareness of e-tendering

This section sought to know the level of awareness of the respondents on e-tendering in the construction industry. 24 of the respondents representing 44% were partially aware. The remaining 30 respondents representing 56% are fully aware of e-tendering. This is positive for the research since all the respondents are informed on e-tendering. This generates a high level of confidence in the answers provided.

Table 4.2 Level of awareness of e-tendering

	Frequency	Percent
Partially aware	24	44.4
Fully aware	30	55.6
Total	54	100.0

Source: Author's Fieldwork (2016)

4.3 TENDERING ACTIVITIES INVOLVING USE OF ICT BY PROFESSIONALS IN TENDERING

This section sought to know from the respondents the tendering activities involving use of ICT in undertaking tendering activities. Descriptive statistics was used to rank the responses. Table 4.3 ranks the responses of the respondents. From the table, *Preparation of tenders* was ranked 1st with a mean of 4.333 and standard deviation of 0.846. *Tender analysis reporting* was ranked 2nd with a mean of 3.8148 and standard deviation of 1.01077. *Interaction with other professionals* was ranked 3rd with a mean of 3.6667 and standard deviation of 1.02791. *Making of payments* was ranked 4th with a mean of 3.6667 and standard deviation of 1.22859. *Receipt of tender notification* was ranked 5th with a mean of 3.6111 and standard deviation of 1.05360.

Furthermore, the tendering activities: *Contractor prequalification, Receipt of payments, Project Management, Distribution of contract drawings* and *Sending out tenders* were ranked 15th, 16th, 17th,18th, and 19th respectively.

Table 4.3 Tendering activities

	Mean	Std. Deviation	Ranking
Preparation of tenders	4.3333	.84675	1st
Production of contract drawings	3.0185	1.36659	12th
BOQ preparation	3.1296	1.63737	11th
Invitation to tender	2.9815	1.33869	13th
Contract formulation	3.2222	.86147	9th
Contractor prequalification	2.8148	1.30419	15th
Sending out tenders	2.5000	1.31393	19th
Distribution of contract drawings	2.6111	.97935	18th
Tender submission	3.2593	.75698	7th
Obtaining design brief	2.9259	1.42553	14th
Receipt of tender notification	3.6111	1.05360	5th
Interaction with other professionals	3.6667	1.02791	3rd
Making of payments	3.6667	1.22859	4th
Receipt of payments	2.6852	1.34338	16th
Tender analysis reporting	3.8148	1.01077	2nd
Project Management	2.6481	1.37577	17th
Consultation with client	3.4630	.60541	6th
Tender enquiries	3.2037	.40653	10th
Estimation	3.2222	.74395	8th

Source: Author's Fieldwork (2016)

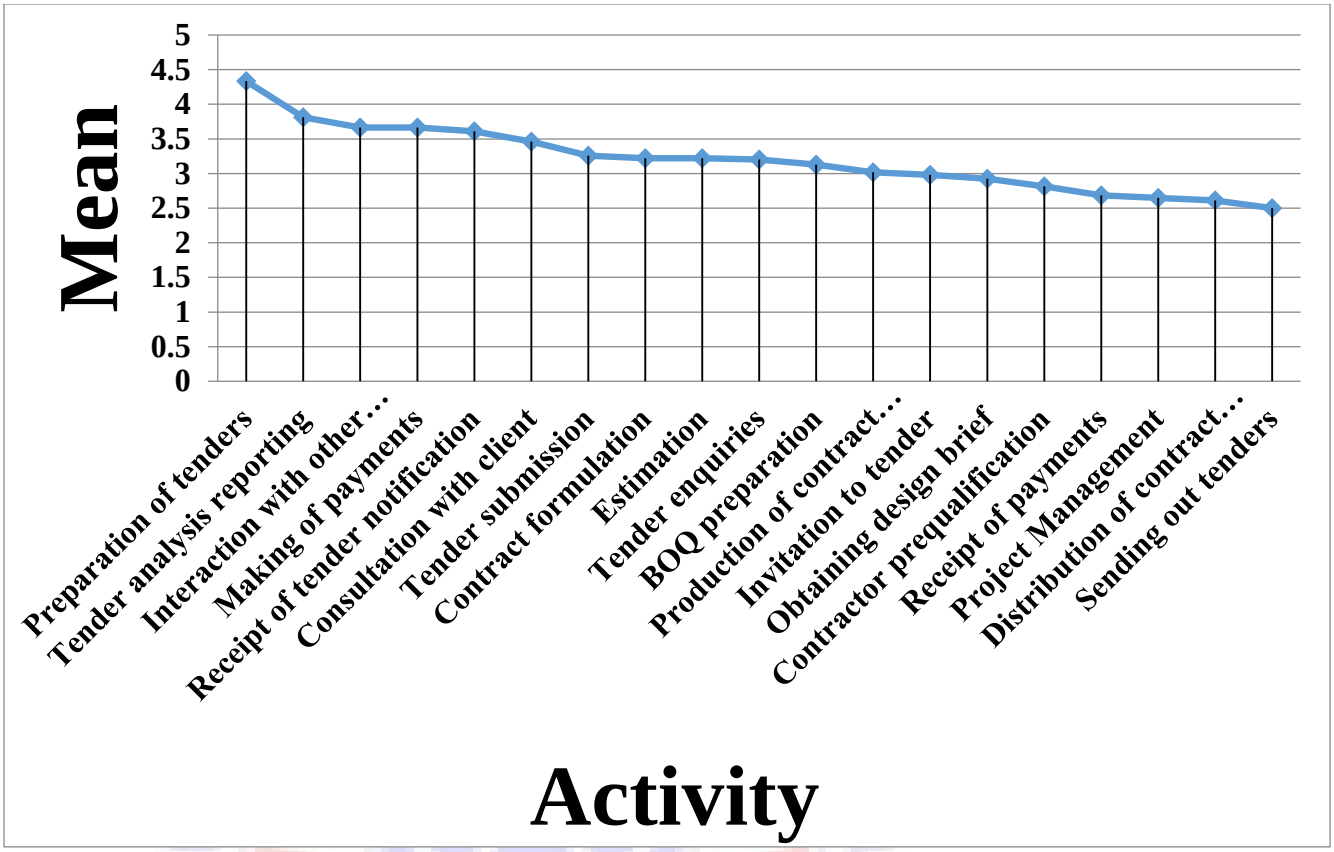


Fig 4.3 Tendering activities

Source: Author's Fieldwork (2016)

4.4 CHALLENGES TO BE ADDRESSED WITHIN TRADITIONAL TENDERING

The challenges to be addressed within traditional tendering were given to the respondents to be ranked. From Table 4.4 below, the factors *High levels of risk, abuse of tendering process, increased errors, low involvement of contractor at design stage, lack of adoption of new tendering methods* and *low level of professionalism* were ranked to be the most severe challenges with mean values of 3.1852, 3.0926, 3.0741, 3.0000, 2.9444 and 2.8889 respectively.

According to Hughes (2003), there is substantial cost that is involved in tendering. He found that the cost to contractors of tendering was approximately 1.17% of the value of

the work. When considered against a success ratio of, say, one in five, Hughes reported that the cost of each winning bid can be as much as 6% of the value of the work. It was found that tendering costs can account for up to 5.9% of the total value of a project cost to a client on a typical construction project. Construction companies must recuperate this substantial cost, so that it can remain profitable. In addition, the cost of tendering was considered to be very expensive.

Du *et al*., (2004) concluded that the traditional tendering process was open to abuse. They considered that through a lack of adequate security measures with the traditional system, prospective bids delivered to the consultants had the possibility to be tampered with. Tender prices may even be revealed to other prospective contractors.

Table 4.4 Challenges to be addressed within traditional tendering

	Mean	Std. Deviation	Ranking
High cost of tendering	2.4444	1.47516	12th
Abuse of tendering process	3.0926	.97649	2nd
Lack of adequate security measures	2.3889	1.12295	13th
Labour intensive nature	2.7037	1.35465	9th
Time consuming	2.7037	.69035	8th
Waste of resources	2.5185	1.23991	11th
Lower level of accuracy	2.7222	1.15606	7th
Lack of structures	2.5185	.72008	10th
Low level of professionalism	2.8889	.69137	6th
Lack of adoption of new tendering methods	2.9444	.23121	5th
Low involvement of contractor at design stage	3.0000	.00000	4th
High levels of risk	3.1852	.61657	1st
Increased errors	3.0741	.42789	3rd

Source: Author's Fieldwork (2016)

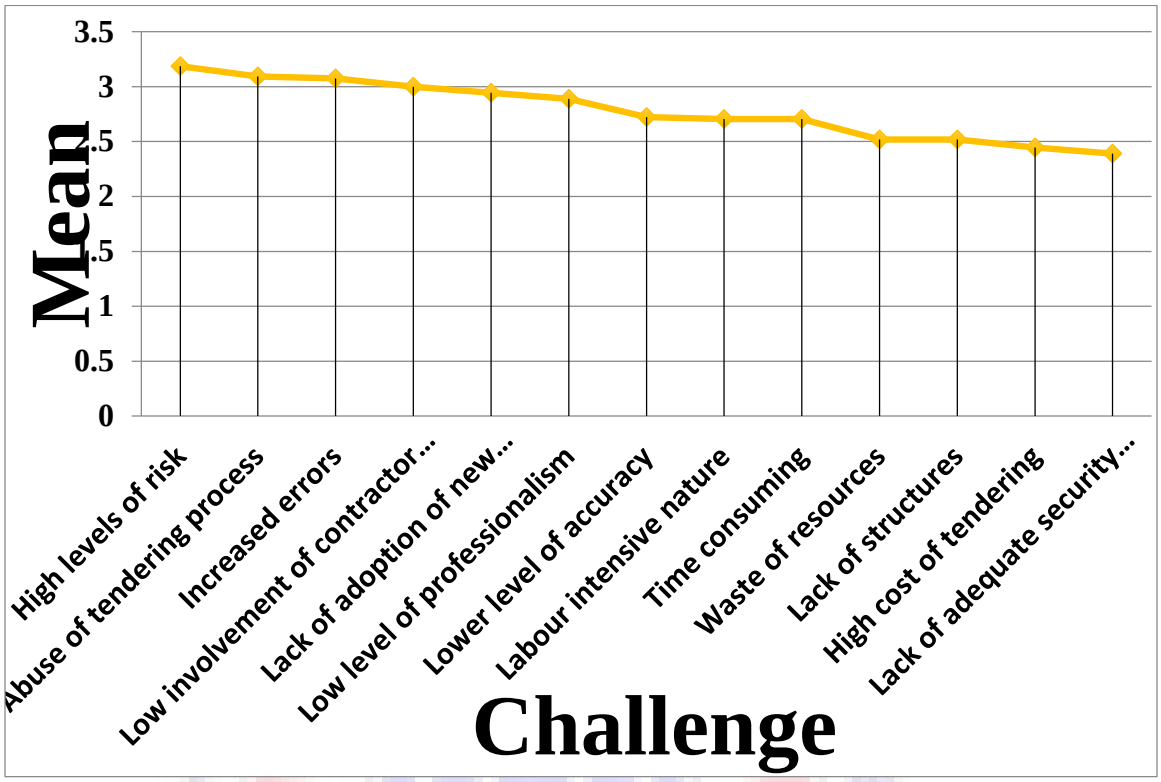


Fig 4.4 Challenges to be addressed within traditional tendering
Source: Author's Fieldwork (2016)

4.5 BENEFITS OF E-TENDERING

Electronic tendering has many benefits to the construction industry. This section sought to let the respondents rank these benefits. Descriptive statistics was used to rank these benefits. From Table 4.5 and Figure 4.5 below, *potential for time saving* was ranked 1st with a mean of 4.4630 and standard deviation of 0.50331. *Better financial control* was ranked 2nd with mean of 4.2593 and standard deviation of 0.44234. Furthermore, *reduced administrative costs* was ranked 3rd with mean of 4.2222 and standard deviation of 0.74395. *Reduced manpower required* was ranked 4th with mean of 4.1481 and standard deviation of 0.49172. *Greater efficiency of activities* was ranked 5th with mean of 4.1296 and standard deviation of 0.72804.

According to literature, cost savings have expectedly been shown to be the primary rationale for investment across all technology platforms (Davila *et al.,* 2002). While some cost benefits may accrue from e-tendering, sustainable benefits will only amass from the adoption of a strategic management perspective (Phillips and Piotrowicz, 2006). During e-tendering the traditional functions and responsibilities of project team members are maintained throughout the process of e-tendering and do not overlap, rather the efficiency of their activities is greatly enhanced. E-tendering however requires the use of a web collaboration platform through which the project team members make their contributions and queries for information. This must however be done on the platform of an effective electronic data interchange (EDI) format to promote acceptable levels of interoperability (Parida and Parida, 2005).

Economic arguments emphasized in research are those of reduction of workload, and associated cost savings through information technology systems. E-tendering, from an economic stand point, enhances efficiency through transaction cost savings and reduced direct procurement costs. While transparency, accountability, ease of use, speedy exchange of information, including other intangible benefits such as reduced administrative costs are achievable (Davila *et al*, 2002; Henriksen and Mahnke, 2005).

E-Tendering promotes accountability, transparency and compliance. It provides a secure history of every tender. In terms of governance and compliance, e-Tendering makes it straightforward to enforce processes and workflows. Tender procedures and policies can be configured into the solution so that all procurement staff can only operate within organizationally approved processes. In addition, where responsible sourcing is

important, e-Tendering systems simplify the process of keeping track of supplier credentials, and where and how they source materials.

Table 5.5 Benefits of e-tendering

	Mean	Std. Deviation	Ranking
Reduced photocopying	3.4259	.81500	15th
Reduced manpower required	4.1481	.49172	4th
Improved communication	3.9259	.69640	7th
Potential for time saving	4.4630	.50331	1st
Better access to information	3.3519	.91440	16th
Reduces risks	3.6296	.48744	13th
Better financial control	4.2593	.44234	2nd
Reduced administrative costs	4.2222	.74395	3rd
Fewer errors in recording and handling of information	3.7407	.58874	9th
Reduction in rekeying of information	3.9259	.77342	8th
Better sharing of information	3.6296	1.08673	14th
Improved accessibility to time and cost data	4.0000	.82416	6th
Ability to contribute to national protocol	3.6667	.77703	12th
Improved communication	3.7407	.89411	10th
Price reduction in tendering	3.2593	1.06727	17th
Cost savings	3.7222	.76273	11th
Greater efficiency of activities	4.1296	.72804	5th

Source: Author's Fieldwork (2016)

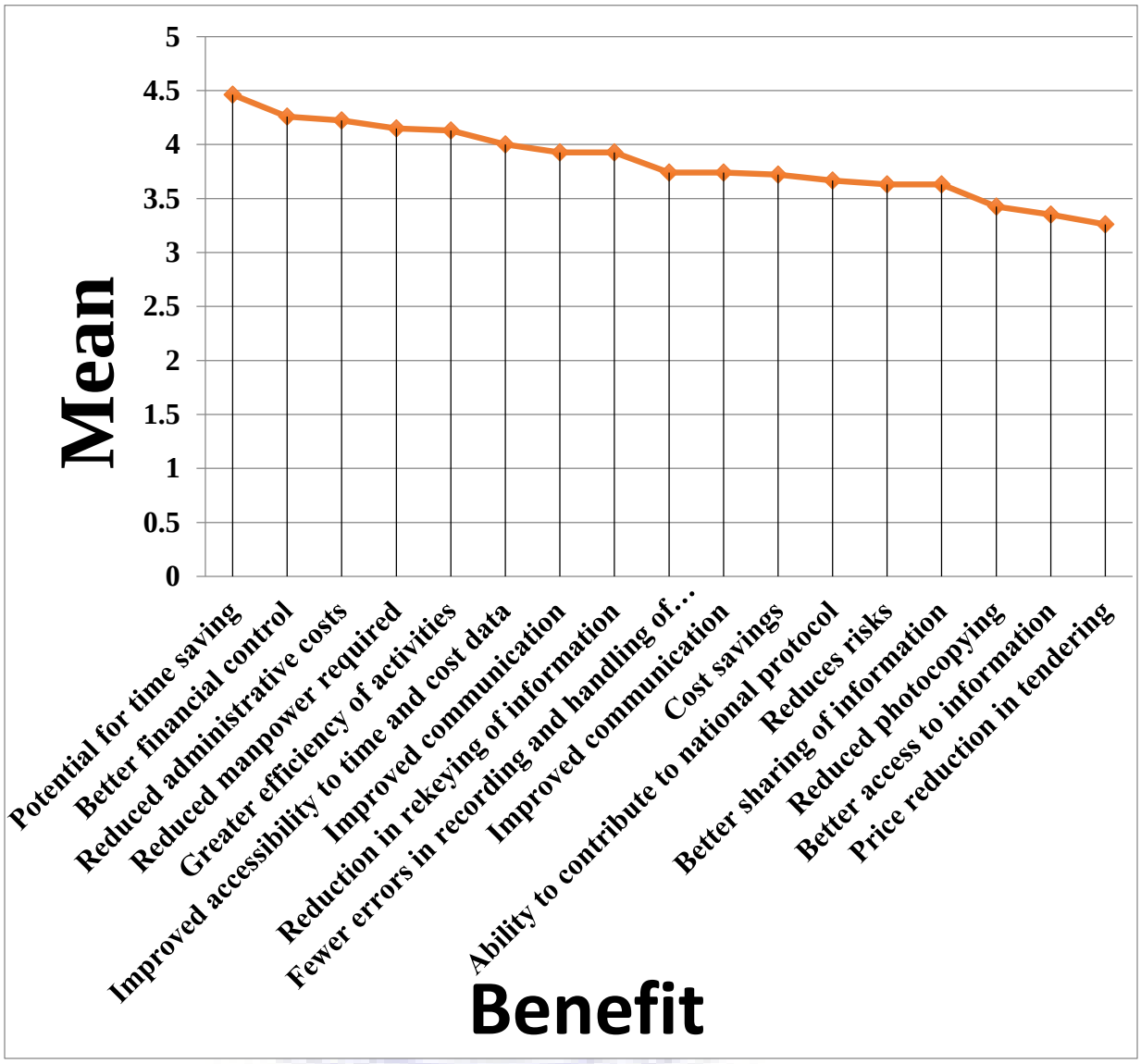


Fig 4.5 Benefits of e-tendering

Source: Author's Fieldwork (2016)

4.6 PROPOSED FRAMEWORK FOR SUCCESSFUL IMPLEMENTATION OF ELECTRONIC TENDERING SYSTEM

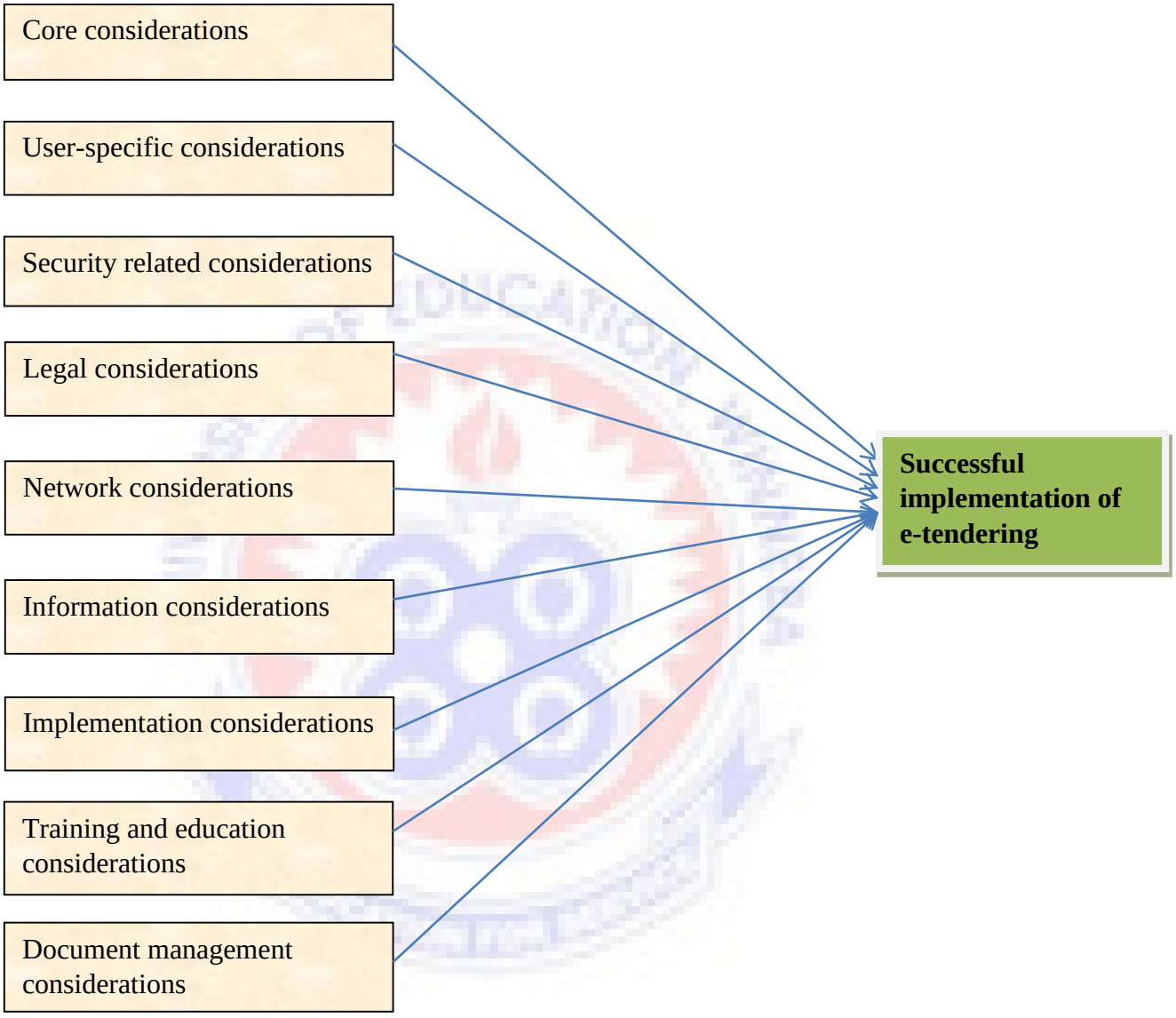


Figure 4.6 Proposed Framework for successful implementation of electronic tendering system

Source: Author's Construct (2016)

The figure above shows the proposed framework for successful implementation of electronic tendering system in the Ghanaian construction industry.

4.6.1 Core considerations

1. Distribute all tender documentation via a secure web-based tender system — a paperless system.

2. Clients should be able to upload a notice and/or invitation to tender.

3. Notifications should be sent out electronically (usually via email) for suppliers to download and respond to electronically.

4. Updates and queries should be exchanged through the same e-Tender system during the tender period.

5. The client should be able to access the tenders only after the process closes.

6. All tender-related information should be held in a central database, which should be easily searchable and fully audited, with all activities recorded.

7. Tender documents must be read or submitted only by authorized parties.

8. Users of the e-Tender system are to be properly identified and registered via controlled access.

• Each tenderer is to be an e-Tender system member — registered in a central database.

• Data is to be encrypted and users authenticated by means such as digital signatures, electronic certificates or smartcards.

• Users are to have a unique username and password to confirm their eligibility to participate in the e-Tender system.

9. The e-Tender system should ensure that only ‘monitored’ or ‘authorized’ alterations can be made to any tender.

10. The tenderer should be able to amend the bid online at any stage up to tender close.

11. The e-Tender system may also include features such as a database of service providers with spreadsheet-based pricing schedules, which can make it easier for a potential tenderer to electronically prepare and analyze a tender.

12. Back-up procedures for eTender documents are essential. Routine archiving should take place regularly.

13. Consider the possibility of allowing tenderers the option of tendering on paper (at least during a transition period).

4.6.2 User-specific considerations

1. eTender systems must suit their intended audience.

• Does the system just suit large companies or are small-to-medium enterprises (SMEs) catered for?

• Smaller projects such as minor works, refurbishing and alterations are usually undertaken by smaller contractors with limited Information and Communication Technology (ICT) infrastructure.

2. The system must be flexible enough to account for project-to-project and region-to-region specifics.

3. An e-Tender system that requires tenderers to submit a tender electronically should be designed around timing and accuracy that allow tenderers to ‘hold out’ for subcontractors to submit last-minute prices and quotes.

4. The system must allow tenderers to receive all tender documents electronically — then easily forward them to printers, suppliers and subcontractors.

5. An e-Tender system must considerably reduce the need, cost and time spent in having to print, bind, and courier tender documents.

6. The system must effortlessly, professionally and securely manage and record all tender documents.

7. An e-Tender system must encourage trades and subcontractors to upgrade their existing hardware and software and/or upgrade to take advantage of the e-Tender process.

8. e-Tender portals should:

• be professionally developed and displayed

• be presented in a logical, clear and user-friendly format

• have effective yet easy-to-use security access in place

• retain familiarity by ensuring that portals stay essentially unchanged

• allow tenderers to review all tender documents on the system before actually submitting them.

9. Users must have access to professional assistance:

• on-line ‘help files’, ‘tutorials’ and ‘start-up guides’

• ‘help desk’ style of support available by phone and/or online chat

• an administrator may be made available (by email or telephone) to assist users with specific queries regarding the tender.

4.6.3 Security related considerations

1. There is to be a nominated, continuing, primary email contact within each tendering firm on the central database to which other email contacts can be added or specified by the firm.

2. The e-Tender system should routinely notify the primary email contact whenever a secondary user is detected accessing e-Tender information.

3. Each e-Tender system username and password is to be specific for that tender and a 'one-off' for an individual firm.

4. For audit trail purposes, logging of all user access to an e-Tender system must be available for inspection.

4.6.4 Legal considerations

1. An e-Tendering process must be compatible with the current legal status regarding electronic transmissions and use of electronic signatures.

2. Authenticity — what is the source of the communication and does it come from the apparent author?

3. Integrity — was the communication received the same as that sent or has it been altered either in transmission, receipt or storage?

4. Confidentiality — is the disclosure of and access to the information contained in the communication confidential?

5. Matters of evidence — does the communication meet current evidentiary requirements for courts of law?

6. Matters of jurisdiction — the electronic environment has no physical boundaries, unlike the physical or geographical boundaries of an individual state or country. Which state's or country's laws will govern legal disputes?

7. Ensure that appropriate legal policies and processes are developed to deal with extenuating circumstances pertaining to the electronic submission of final tenders.

• Policies and procedures should be established to allow the extension of the tender-close period if the e-Tender system becomes unavailable for some reason at a key period in the process.

• Preventive and/or responsive actions that will be taken, for example, when a tenderer's Internet server fails, preventing a tender being submitted on time.

4.6.5 Network considerations

1. e-Tender systems can use commercialized ICT service providers as their Internet service and network provider - an in-house or propriety system is not essential.

2. e-Tender system administrators are to ensure that tenders released and received via an e-Tender system do not cause any upload or download transmission bottlenecks at peak times.

• Tenderers may lodge documents in support or in addition to the tender and these attachments may have some influence on the speed of transmission.

3. To ensure minimal downtime if one server fails, the e-Tender system should be housed on 'dual, mirrored server' hardware

4.6.6 Information considerations

1. Information posted on the e-Tender system as 'pure information' — although this information is exposed to minimum levels of risk, sufficient attention must be given to its contents — it must be true, accurate, not misleading or defamatory.

2. If the e-Tender system has tender-related information that tenderers need to rely on and perhaps download, it is essential that the completeness and accuracy of the information is verified.

• The inclusion of a 'non-reliance' exclusion clause may also be necessary.

3. A fully interactive e-Tender system, in which tenderers both receive an invitation to tender and reply with a tender bid electronically, represents maximum risk in relation to the veracity of information supplied and received.

• Security of information and integrity of the e-Tender system is of paramount importance. Here, legally binding and enforceable contracts may be formed electronically, leaving little room for error in receiving, sending, or storing the information.

4.6.7 Implementation considerations

1. An e-Tender system must be robust and secure.

• Introduce a security policy and perform regular security and system 'health checks'.

2. Ensure confidential information remains confidential.

• Instil heightened security awareness within individuals - no email account sharing, no username or password sharing.

3. Clarify certain 'grey areas' regarding timing of electronic tender documents by allowing the e-Tender system to automatically generate and archive dispatch and receipt times of electronically distributed/submitted documents.

4. Provide access to advanced capabilities within the system, for example:

• allowing a person to compare data from project to project in order to view relative prices and timely decision making

• allowing the reuse of standard information on regular tenderers, such as pre-qualification documents and information of a regular pool of tenderers.

5. Tender terms, conditions, application forms, and software installation procedures (if applicable) should be 'user-friendly'.

6. Develop policy and procedure to deal with the liability for lost or corrupted data.

7. Ensure that servers are well protected and that fallback procedures are in place if the e-Tender service becomes unavailable.

8. Ensure that firewalls and other security-related features do not restrict the usability of the e-Tender system.

9. An e-Tender system's levels of security and availability/reliability are to be in line with commercial expectations.

• The development of, for example, a whole-of-government electronic marketplace system (based largely on an e-Tender 'engine') should also ensure that sufficient ICT resources are made available to promote rapid ongoing development and deployment.

4.6.8 Training and education considerations

1. As an e-Tender system becomes more widely used and its accessibility permeates through to the smaller firms, administrators need to:

• be confident in dealing with the education and training requirements of potential e-Tender users

• provide technical assistance

• let commercial entrepreneurs take up the training and education opportunity if this appears to be the best way.

2. Individual — owing to the increasing 'electronic integration' of construction processes, industry participants have no choice but to reskill with an emphasis on electronic and Internet-enabled technologies.

3. Corporate - organizations must become 'learning' organizations to assist the reskilling of its workforce and to capitalize on the rapidly emerging technologies.

4. Education sector — there is a significant role for tertiary education to develop and support the understanding of how to accept, evaluate and implement technological change and innovation.

4.6.9 Document management considerations

Architectural drawings and detailed computer-aided drafting (CAD) plans necessary to supplement the textual information for a tender should be converted to suitable formats recognizing the need for interoperability, appropriate upload/download speeds, and security of document content version is not to be amended.

2. Administrators should operate under the principle that the information held on an e-Tender system is the definitive set of documentation for each tender — security, accuracy and non-corruptibility of information content is paramount.

3. If alterations to the tender are found necessary, the original e-Tender document version is not to be amended.

• An addendum or full (amended) document is to be reissued; users are to be formally notified of the issue of such an addendum, and asked to acknowledge the receipt of any such addendum.

4.7 SUMMARY

In this chapter, data was analyzed and discussed using Statistical Package for Social Sciences (SPSS). The profile of the respondents was analyzed using descriptive statistics (specifically percentages) and the dependent variables are also analyzed using descriptive statistics. *Preparation of tenders, tender analysis reporting, interaction with other professionals, making of payments* and *receipt of tender notification* were the five activities respondents use ICT for the most in tendering. *High levels of risk, abuse of tendering process, increased errors, low involvement of contractor at design stage, lack of adoption of new tendering methods* and *low level of professionalism* were ranked to be the most severe challenges to be addressed within traditional tendering. Finally, the

factors *potential for time saving*, *better financial control*, *reduced administrative costs*, *reduced manpower required* and *greater efficiency of activities* were ranked to be the most important benefits of e-tendering.

CHAPTER FIVE

DISCUSSION OF RESULTS

5.1 INTRODUCTION

This chapter documents the discussion of results obtained from the field. It discusses level of use of ICT by professionals in tendering, challenges to be addressed within traditional tendering and benefits of e-tendering in the construction industry. The analysis used is descriptive statistics. Tables, pie charts, and bar charts aided the discussion of the results.

5.3 DISCUSSIONS ON MAIN FINDINGS

Tendering activities involving use of ICT by professionals in tendering

This section sought to know from the respondents tendering activities involving the use of ICT in undertaking tendering activities. Descriptive statistics was used to rank the responses. *Preparation of tenders* was ranked 1st. *Tender analysis reporting* was ranked 2nd. *Interaction with other professionals* was ranked 3rd. *Making of payments* was ranked 4th. *Receipt of tender notification* was ranked 5th. Furthermore, the tendering activities: *Contractor prequalification, Receipt of payments, Project Management, Distribution of contract drawings* and *Sending out tenders* were ranked 15th, 16th, 17th,18th, and 19th respectively.

In a similar study by Oyediran and Akintola (2011) in Nigeria, the tendering activities: *preparation of tenders, production of contract drawings, tender analysis, contract*

formulation and *distribution of contract drawings* were ranked 1st, 2nd, 3rd, 4th an d 5th respectively.

E-tendering is essentially an expression used to describe the dissemination and receipt of tender information, indication of interest in tendering, receipt of tender documents, submission of tender sum and final selection of successful tender for contracts via the internet (Black *et al*., 2004). In the opinion of Seah (2004), the objective of e-tendering is to specifically increase productivity during the tendering process by decreasing paper handling and speeding up communication and interaction. This represents the ultimate goal of e-tendering, a shift from manual paper methods to fully electronically enabled means of communication. One of the major strengths of arguments for e-tendering is the remote accessibility of the system. Thus making it possible for a tender manager, tenderer, contractor or client to access the facilities of the tender engine from anywhere in the world without being impeded by geographical location constraints (Seah, 2004). This implies the findings from this study have an agreement with that of Oyediran and Akintola (2011).

With a list of suitable contractors willing to price for the proposed package of works, the finalized tender documentation should be dispatched within four to six weeks of the receipt of the preliminary enquiries. Should this time extend beyond three months, the contractor should be asked to reconfirm his/her willingness to submit a tender. It is advisable that the documents can be issued in both electronic and hard copy format. The documents discussed include: the BOQ (If electronic/ Hard copy only upon request); specifications (If electronic/ Hard copy only upon request); Drawings (Electronic and hard copy); The form of Tender (If electronic/ Hard copy only upon request); Instructions

for return of the form of tender and BOQ (If electronic/ Hard copy only upon request); and Preliminary health and safety plan (If electronic/ Hard copy only upon request).

With the contractor now in receipt of the documents, they will undertake to complete and return the documents within the timescale outlined. The contractor, having received the relevant quotes and having completed any other work they deem necessary to confirm their prices, should then return the documents. A hard copy of the completed tender documents is subsequently returned in a separate sealed and endorsed envelope. Further communication is required between the parties when a change occurs in either the specification or the design of the scheme. However, should any changes be made to the documents, the contractors should be notified in writing. These changes should occur, no less than ten working days before the tender deadline. If these changes are significant then an extension of time for contractors to complete the tender should be considered.

Challenges to be addressed within traditional tendering

The challenges to be addressed within traditional tendering were given to the respondents to be ranked. *High levels of risk, abuse of tendering process, increased errors, low involvement of contractor at design stage, lack of adoption of new tendering methods* and *low level of professionalism* were ranked to be the five most severe challenges. This finding confirms literature. Hughes (2003) highlighted the substantial cost that is involved in tendering finding that the cost to contractors of tendering was approximately 1.17% of the value of the work. When considered against a success ratio of, say, one in five, Hughes reported that the cost of each winning bid can be as much as 6% of the value of the work. It was found that tendering costs can account for up to 5.9%

of the total value of a project cost to a client on a typical construction project. Construction companies must recuperate this substantial cost, so that it can remain profitable. In addition, the cost of tendering was considered to be very expensive.

Du *et al*., (2004) concluded that the traditional tendering process was open to abuse. They considered that through a lack of adequate security measures with the traditional system, prospective bids delivered to the consultants had the possibility to be tampered with. Tender prices may even be revealed to other prospective contractors. This leads to a tender process which lacks the key requirements of fair play and clarity that are required for a tender process.

A further inefficient process outlined by (Curtis, 2006) is the labour intensive nature of preparing, sending and receiving accurate sub-contractor tenders for trade packages. Curtis outlined that there are many stages included in this subprocess of tendering. The most labour intensive was seen to be the preparation of the tender package for each trade. Each trade package may contain drawings, specifications and other documentation that the contractor deems necessary to fully describe the project.

This individual trade information has to be sorted, photocopied, compiled for each subcontractor and finally checked that all information is present before it is delivered in hard copy to the subcontractor. Curtis explained that, on occasion after completing this work, the subcontractor may not even price the work. This can lead to a large amount of time and resources (photocopying/paper) being spent without any return. Due to lack of adequate security measures with the traditional system, prospective bids delivered to the consultants had the possibility to be tampered with. Tender prices may even be revealed

to other prospective contractors. This leads to a tender process which lacks the key requirements of fair play and clarity that are required for a tender process.

Benefits of e-tendering

Electronic tendering has many benefits to the construction industry. *Potential for time saving* was ranked 1st. *Better financial control* was ranked 2nd. Furthermore, *reduced administrative costs* was ranked 3rd. *Reduced manpower required* was ranked 4th. *Greater efficiency of activities* was ranked 5th. The factors *better sharing of information, reduced photocopying, better access to information* and *price reduction in tendering* were ranked 14th, 15th, 16th and 17th respectively implying they were the least important of the benefits of e-tendering.

Economic arguments emphasized in research are those of reduction of workload, and associated cost savings through information technology systems. E-tendering, from an economic stand point, enhances efficiency through transaction cost savings and reduced direct procurement costs. While transparency, accountability, ease of use, speedy exchange of information, including other intangible benefits such as reduced administrative costs are achievable (Davila *et al*, 2002; Henriksen and Mahnke, 2005).

During e-tendering the traditional functions and responsibilities of project team members are maintained throughout the process of e-tendering and do not overlap, rather the efficiency of their activities is greatly enhanced. E-tendering however requires the use of a web collaboration platform through which the project team members make their contributions and queries for information. This must however be done on the platform of

an effective electronic data interchange (EDI) format to promote acceptable levels of interoperability (Parida and Parida, 2005).

Cost savings have expectedly been shown to be the primary rationale for investment across all technology platforms (Davila *et al.,* 2002). While some cost benefits may accrue from e-tendering, sustainable benefits will only amass from the adoption of a strategic management perspective (Phillips and Piotrowicz, 2006). E-tendering implementations must thus be able to strategically anticipate and manage change in the construction environment, providing ad-hoc solutions whenever necessary. Initial investment required for the system are relatively minimal if the adopting organization uses the facilities of an existing communications network, but is however substantially higher when there is no existing network or the system requires unique features to support these technologies. These benefits nonetheless depend on the size of the organizations providing the service as the benefits must be weighed against the cost. A significant benefit to cost ratio must be achieved for the use of such technology to be acceptable (Davila *et al.,* 2002). Organizations already using e-tendering technologies report a savings of up to forty two percent in transaction costs; most of this is associated with less paper work, which translates to fewer mistakes and more efficient procurement process.

Administrative benefits (intangible benefits) obtainable from e-tendering are also numerous. However, these benefits may not be as obvious as the tangible forms. These come in form of reduction in workload and improved efficiencies. Government agencies and ministries across the world seeking administrative efficiencies and cost reductions experienced in the private sector have widely embraced e-tendering. This is a trend that

has gained prominence in Europe (Coulthard *et al.*, 2001). Private organizations or public authorities that implement e-tendering also achieve efficiency gains. Paper work is substituted for new electronically enabled collaboration and integration of tendering data by private consultant/client concerns (Davila *et al.*, 2004).

E-Tendering can also play a strong role in risk mitigation and business continuity management (BCM) strategies. In terms of BCM, firms need to identify critical suppliers and to mitigate their exposure. E-Tendering systems make it easy to keep track of key suppliers and to keep the organization's supply chain exposure under review.

E-Tendering promotes accountability, transparency and compliance. It provides a secure history of every tender. In terms of governance and compliance, e-Tendering makes it straightforward to enforce processes and workflows. Tender procedures and policies can be configured into the solution so that all procurement staff can only operate within organizationally approved processes. In addition, where responsible sourcing is important, e-Tendering systems simplify the process of keeping track of supplier credentials, and where and how they source materials.

E-Tendering is a highly effective way to manage these complex supply chains with multiple tiers of suppliers. Additionally, the fragmented, sub-contracted, on-site nature of construction demands a light, flexible, easy-to-use solution. Multi-site, temporary and/or complex organizational structures lend themselves to flexible e-Tendering solutions rather than legacy eProcurement platforms (Davila *et al.*, 2002).

Adopting e-Tendering provides easy-to-access tools that help firms maximize their margin by increasing competition when buying products and services or sub-tendering elements of their projects (Davila *et al.,* 2002).

Automating key parts of the procurement process reduces overhead and makes bid evaluation easier. A good system is intuitive and user-friendly, meaning that non-procurement staff to run tenders (Davila *et al.,* 2002).

E-Tendering also provides a way to grow your supplier pool and increased competition while monitoring external spend and keeping an eye on key procurement metrics and performance against previous projects and/or industry benchmarks (Davila *et al.,* 2002).

5.3 SUMMARY

Generally, the results confirm past findings from literature. On the framework for successful implementation of e-tendering in the Ghanaian construction industry, the factors are useful and implementable. The core considerations; user considerations; legal considerations; implementation considerations; training and education considerations; information; network considerations and security considerations are important considerations in implementing e-tendering in the Ghanaian construction industry. Furthermore, relating to the current practice in the Ghanaian construction industry, e-tendering is gradually gaining prominence and will be become an integral part of practice with time. In essence, it can be concluded that e-tendering in the construction industry has more opportunities than problems.

CHAPTER SIX

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

6.1 INTRODUCTION

This research which is a study into the possibility of using electronic tendering in the Ghanaian construction industry is divided into six chapters. The previous chapters talked about the introduction, literature review, methodology used and analyses of the data and results. Chapter six is the conclusion and recommendations for the research. It also shows how the research objectives were achieved.

6.2 SUMMARY OF FINDINGS

i. Objective 1: Tendering activities involving use of ICT by professionals in tendering

The following were found in descending order of practice:

Preparation of tenders,

Tender analysis reporting,

Interaction with other professionals,

Making of payments and

Receipt of tender notification

to be the five activities respondents use ICT for the most in tendering.

ii. Objective 2: Challenges to be addressed within traditional tendering

The following were found in descending order of practice:

High levels of risk,

Abuse of tendering process,

Increased errors,

Low involvement of contractor at design stage,

Lack of adoption of new tendering methods and

Low level of professionalism

to be the most severe challenges to be addressed within traditional tendering.

iii. Objective 3: Benefits of e-tendering

The following were found in descending order of practice:

Potential for time saving,

Better financial control,

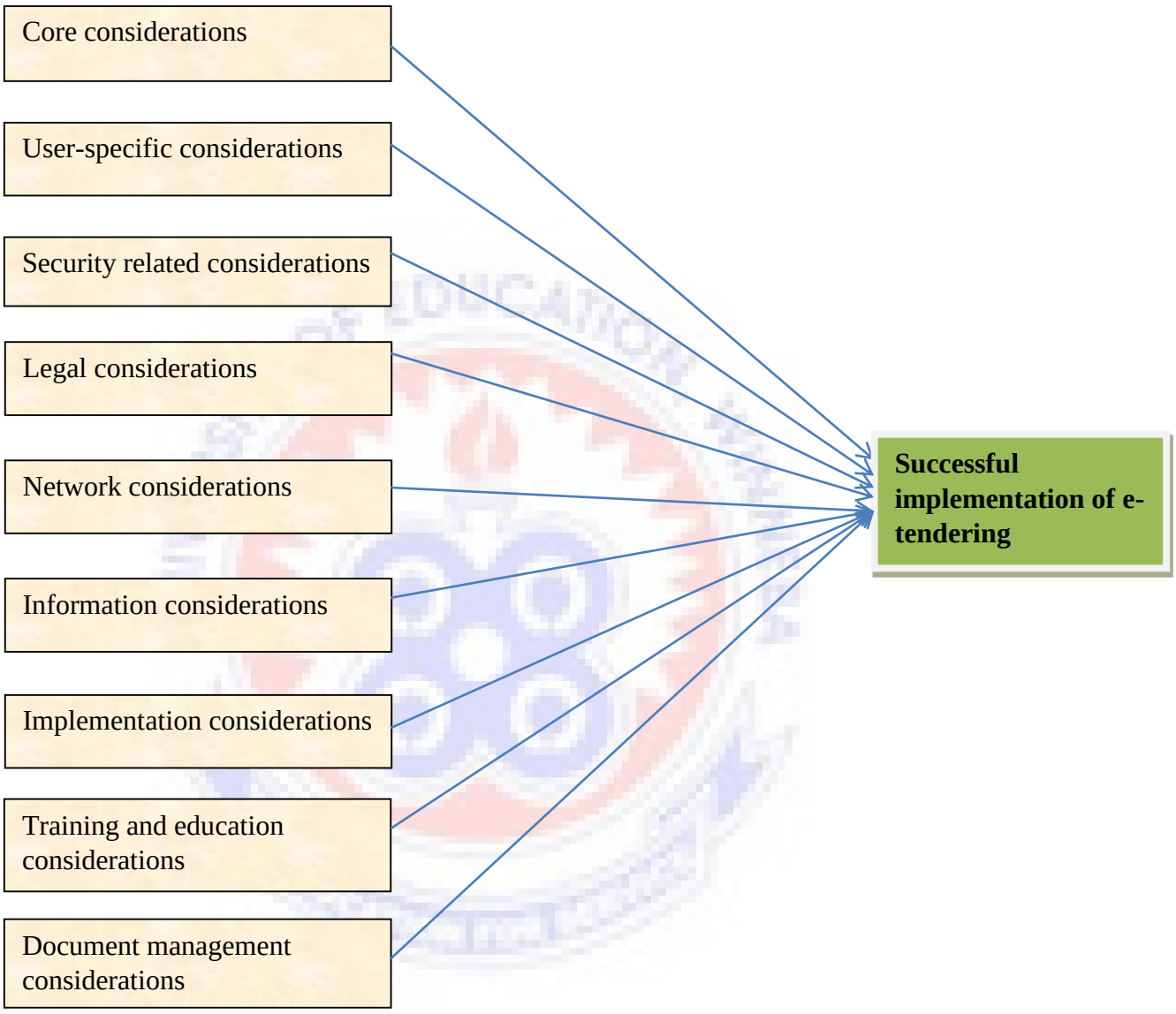
Reduced administrative costs,

Reduced manpower required and

Greater efficiency of activities

to be the most important benefits of e-tendering.

iii. Objective 4: Proposed framework for successful implementation of electronic tendering system



Source: Author's Construct (2016)

6.3 CONCLUSION

This research reflects an industry that is sure of fully embracing new technology rather than to remain with old tried and tested methods. It is evident, that the majority of those within construction can envision a future for electronic tendering, and acknowledge the

benefits that e-tendering can provide. E-tendering is also regarded as a positive development that eliminates many of the routine, administrative tasks and advances efficiencies in comparison to the traditional tender process.

The results from the analysis of the objectives closely confirm past findings from literature. The framework proposed for successful implementation of e-tendering in the Ghanaian construction industry is also implementable. Through this research, the challenges to be addressed within the traditional tendering have been addressed. Furthermore, the benefits of e-tendering have been identified while a framework for the successful implementation of e-tendering in the Ghanaian construction industry has been designed.

6.4 RECOMMENDATIONS

Based on the findings of the research, the following recommendations are proposed:

- There is the need to develop a capacity building knowledge backbone to drive the adoption of e-tendering.
- Built environment professionals should engage computer specialists as to how the concerns of security of submitted sealed tender bids and frequent computer virus attacks can be addressed without raising questions of possible hacking to win the confidence of the construction industry stakeholders.
- There is a need to civic educate built environment practitioners to embrace recently discovered ICT technologies for example e-tendering system, according to the empirical findings improves the efficiency and drives down tendering cost.

This will reduce technology phobia which has been haunting the industry for decades now.

- There is need to review rules governing the tendering process to reflect the new dawn of the ICT technology in the construction industry.
- There should be legal backing for e-tendering and e-commerce.
- Support from the top management is crucial to boost confidence among employees in using e-tendering.
- Adequate training and resources must be provided to employees to efficiently integrate IT into their new learning experience.
- The construction industry must be ready for change.

6.5 RECOMMENDATIONS FOR FUTURE RESEARCH

Further studies should be conducted to identify ways of increasing security for e-tendering.

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APPENDIX

UNIVERSITY OF EDUCATION WINNEBA

COLLEGE OF TECHNOLOGY EDUCATION-KUMASI

FACULTY OF TECHNICAL AND VOCATIONAL EDUCATION

DEPARTMENT OF DESIGN AND TECHNOLOGY EDUCATION

QUESTIONNAIRE

TOPIC: "A STUDY INTO THE POSSIBILITY OF USING ELECTRONIC TENDERING IN THE GHANAIAN CONSTRUCTION INDUSTRY"

I am a final year student of the University of Education Winneba- Kumasi (UEW-K) conducting a research on electronic tendering (e-tendering).

This research is to study on the possibility of using e-tendering in the Ghanaian construction industry.

This is purely for academic purposes and all information will be treated with strict confidentiality. Your response would be highly appreciated for the success of the research.

Kindly respond to the questions by ticking the appropriate box for each item.

PART ONE: RESPONDENT PROFILE

1. Which of the following describes your position?

[ ] Quantity Surveyor
[ ] Architect
[ ] Civil engineer
[ ] Other (specify) …….....

2. How many years of experience do you have in the construction industry?

[ ] Less than 5 years
[ ] 5 - 10 years
[ ] 10 – 15 years
[ ] 16 years and above

3. Do you believe that the tender process is expensive?

[ ] Yes
[ ] No
[ ] Unsure

4. What is your level of awareness of e-tendering in the construction industry?

[ ] Not aware

[ ] Partially aware

[ ] Fully aware

PART TWO

1. LEVEL OF USE OF ICT BY PROFESSIONALS IN TENDERING

The following are various tendering activities. Kindly rank your level of proficiency in using ICT for these activities using the following Likert scale **[1= Not skilled; 2= Less skilled; 3=Moderately skilled; 4= Skilled; 5= Very skilled]**. Please tick (√) in the space provided.

Tendering activities	**1**	**2**	**3**	**4**	**5**
Production of contract drawings					
BOQ preparation					
Invitation to tender					
Contractor prequalification					
Sending out tenders					
Distribution of contract drawings					
Tender submission					
Receipt of tender notification					
Interaction with other professionals					
Making of payments					
Receipt of payments					
Tender analysis reporting					
Final selection of successful contractor					
Any other, please state and rank					

2. CHALLENGES TO BE ADRESSED WITHIN TRADITIONAL TENDERING

Kindly rank the following challenges of traditional tendering using the following Likert scale **[1= Not severe; 2= Less severe; 3=Moderately severe; 4= Severe; 5= Very severe]**. Please tick (√) in the space provided.

Challenges	**1**	**2**	**3**	**4**	**5**
High cost of tendering					
Abuse of tendering process					
Lack of adequate security measures					
Labour intensive nature					
Time consuming					
Waste of resources					
Lower level of accuracy					
Any other, please state and rank					

3. BENEFITS OF E-TENDERING IN THE CONSTRUCTION INDUSTRY

Kindly rank the following benefits of e-tendering using the following Likert scale **[1= Not important; 2= Less important; 3=Moderately important; 4= Important; 5= Very important]**. Please tick (√) in the space provided.

Benefits	**1**	**2**	**3**	**4**	**5**
Reduced photocopying					
Reduced manpower required					
Improved communication					
Potential for time saving					
Better access to information					
Reduces risks					
Better financial control					
Reduced administrative costs					
Fewer errors in recording and handling of information					
Reduction in rekeying of information					
Better sharing of information					
Any other, please state and rank					