KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI
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THE USE OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) IN THE MANAGEMENT OF PUBLIC PROCUREMENT OF ROAD WORKS
CASE STUDY: GHANA HIGHWAY AUTHORITY (GHA)

BY

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MASTER OF SCIENCE

IN

PROCUREMENT MANAGEMENT

DECLARATION

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

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DEDICATION

I dedicate this work first to God almighty for the protection, wisdom and knowledge granted me for successfully going through this programme and to Ghana Highway Authority (GHA) for their support.

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ABSTRACT

The application of Information and Communication Technology (ICT) has become necessary in all human endeavors as the world continues to experience globalization of all forms. ICT has been applied in various fields of human endeavor to improve the operations of organizations both corporate and governmental in nature. One area that has not witnessed massive application of globalization is the construction industry. In this industry, one main function required for commencement of works is procurement; a major part of the construction industry and its variant forms of projects such as buildings and road construction. The road construction subsector is crucial to the development of every country and this is why works procurement in this subsector of the construction industry must be improved. One way of improving procurement in the road construction sector is the utilization of ICT facilities. However, this novel agenda has been lacking for some time now hence the desire to embark on a study of this nature to assess the modalities for utilization of ICT in road works procurement. The study adopted the quantitative approach in its conduct yielding key findings including online documentation of tender processes; creation of feedback system (Frequently Ask Questions) to pave way for sharing of information; training of employees in the use of ICT tools among others. The study found that the implementation of the ICT tool in public procurement of roadwork is still in the infancy stage in Ghana. Usage is limited to transfer of documentation and tender adverts; however obstacles such as employee resistance, security, cost, and lack of involvement of end users in the developmental stages impede the process of implementation. Employees in public procurement entities responsible for road works procurement must be trained in the rudiments of using ICT facilities.

Key words: Information and Communication Technology, Roadwork, Public Procurement.

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

It is undoubted that Information and Communication Technology (ICT) has come to stay in the operations of organizations (Hengst and Sol, 2001). Organizational dynamism is inevitable as the environment of their operations keep changing (Donaldson, 1996); this organizational transformation is only feasible by the adoption of ICT *(*Malone and Crowston, 1994). ICT services facilitating the routine operations of organizations in global business arena include the World Wide Web, Electronic Data Interchange and electronic mail, electronic trading markets, electronic auctions and electronic bookstores and many others which transcend various spheres of the globe (Hengst and Sol, 2001). From its humble evolution, ICT has expanded its scope in the affairs of humans to the extent that it has now become the dominant force in corporate world and all organizations on the surface of the earth propelling key global activities notably globalization, outsourcing and coordination of organizational activities (Hengst and Sol, 2001). The adoption of ICT requires organizations to make large, technological and organizational investments to connect and coordinate routine organizational operations effectively (Hengst and Sol, 2001).

The benefits of ICT on organizations are enormous thus enabling people to shape coordination of processes (Bodendorf and Reinheimer, 1997; Malone and Rockart, 1991; Malone and Crowston, 1994). Similarly, the use of ICT in organizational operations has the potential of lowering the cost of coordination of activities hence larger scope of activities are covered (Malone *et al*., 1987).

ICT usage in organizations undertaking procurement activities especially the execution of contracts has the potential to shorten the duration of the process (Hengst and Sol, 2001). The utilization of ICT in organizations like the Ghana Highway Authority (GHA) has the potential of influencing the critical aspects of their operations especially in the area of contract administration under the auspices of the Public Procurement Act (Act 663). Notable aspects of influence include homogeneity of procurement activities where same opportunities are provided to prospective contractors at the same time (Bodendorf and Reinheimer, 1997; Malone et al., 1987); specification in delivering services that will meet the desires of all project stakeholders including meeting time schedules agreed upon by using ICT to speed up the communication and decision making processes (Bakos and Brynjolfsson, 1993 and Cramton, 1991); processing of information is drastically improved by the use of ICT in procurement (Hengst and Sol, 2001).

ICT usage has the capacity to facilitate specialization, generating a reduction in the variety of tasks performed by workers as agents rely more on others, cheaper information access has an empowering effect allowing agents to handle more of the problems they face without relying on others (Bloom *et al*., 2010). Bloom *et al*. (2010) decoupled the impacts of both information and technology on organizational operations and asserted that better information access drives down effectively to enhance superior decentralized decision making without an undue cognitive burden on those lower in the hierarchy while better communication propels up decision making as it provides the opportunity for employees to rely on those above them in the hierarchy to make decisions.

The promulgation of the Public Procurement Act (663) in Ghana intends to unify the procurement procedures in government agencies to ensure judicious use of state funds and resources and to provide transparency and non-discrimination (Ministry of Finance, 2001). The Public Procurement Act(663) came into existence after many governmental agencies groped in the dark in procuring goods, services and works which accounts for about 50% to 70% of the national budget (Osei-Tutu *et al.,* 2011). According to the World Bank (2003a) public procurements are intended for both social and economic benefits of a country. The Development Assistance Committee (DAC) (2005) copiously identified several assessment indicators for enhancing the performance of procurement systems.

The utilization of ICT in public procurement will address most of the teething challenges confronting the implementation of procurement systems in developing countries such as Ghana. Infusing IT into the procurement systems has the potential of maintaining and managing information security which is vital for upholding the integrity of procurement systems; and ensuring continual improvement in terms of implementing corrective actions; gathering information for processing and analysis (Atul, 2011). In the light of improving the public procurement system in Ghana it is imperative to consider the strategies of infusing ICT to fully achieve the benefits of the procurement guidelines especially in the GHA.

1.2 Problem Statement

Largely, countries all over the world have acknowledged the need to improve the effectiveness of procurement systems which can only be guaranteed by the constant perfection of the procurement system (Osei-Tutu *et al*., 2011). In many developing

countries such as Ghana, procurement is transiting from the age old clerical works slowly to the utilization of an advanced technological process such as ICT. However this transition is observed to be slow among public entities in Ghana due to a host of mitigating factors. This study will investigate this claim further within the roadwork subsector of the Ghana Highway Authority in the Upper West Region of Ghana.

1.3 Research Questions

This study seeks to find lasting and workable answers to the following questions:

1. What is the status of information communication technology (ICT) utilization in the public procurement system?
2. What are the existing public procurement services that are delivered through information communication technology (ICT)?
3. What are the challenges confronting the utilization of information communication technology (ICT) in public procurement of road works?
4. What recommend strategy is appropriate for smooth utilization of information communication technology (ICT) in road works procurement?

1.4 Aim of the Study

The aim of this study is to examine the utilization of ICT in public procurement of road works in Ghana.

1.5 Objectives of the Study

In a bid to achieve the above stated aim of the study; the following objectives were set:

1. To assess the existing ICT milieu in public procurement of road woks through an elaborate literature review;

2. To identify the procurement services provided using Information and Communication Technology(ICT) in road sector

3. To unravel the challenges confronting the implementation of ICT in the public procurement of road works; and

4. To recommend strategies/ for ICT usage in public road works procurement by the development of an innovative framework.

1.6 Scope of the Study

Geographically, this study was conducted in the Wa municipality of the Upper West region of Ghana. The choice of Wa for this study is underpinned by the socio economic status of the area being the least on the developmental agenda of the republic of Ghana. Hence it is highly possible to find critical challenges confronting governmental organizations in the area. In contextual terms, the study focused on the road sector because most of the operations of this sector are conservative in terms of the application of modern technologies notably in the area of ICT. Currently the Wa municipality and for that matter upper West region is witnessing considerable construction projects including road works. This phenomenon has the potential of causing key construction professionals and organizations to gravitate towards the area hence it appropriateness for the study.

1.7 Research Methodology

This study adopted a quantitative approach where an elaborate literature review was conducted. The samples for the study was composed of procurement officers, project management, consultants, quantity surveyors, engineers and contractors operating in the road sector. Simple random sampling was used to select the appropriate sample size using snow balling technique of referrals. Structured questionnaire was the main research instrument used. The retrieved questionnaires were then analyzed using the Statistical Packages for Social Sciences (SPSS) Version 16 using descriptive analytical tools.

1.8 Significance of the Study

ICT is very instrumental in the cost mitigation of organizational operations hence ensuring the viability and sustainability of organizations (Hengst and Sol, 2001). The outcome of this study is anticipated to be of immense benefit to stakeholders in the public procurement system in the administration of public contracts, services, goods and works to ensure smooth and faster delivery of services by procurement authorities. The study will also address the issue of non-transparency bedeviling the procurement system as an undercurrent. The academia will also benefit by accumulation of new knowledge espoused to the existing ones. The use of ICT in the procurement of works in the road sector has the potential of curbing shady dealings that have confronted the procurement system over the years; it will mitigate the thorny issues of corruption and favouritism thus ensuring value for money.

1.9 Organization of the Study

This study comprises of five interrelated chapters dovetailing into each other. Chapter one focused on the introduction to the study. It addressed key issues bordering on the background of the study, problem statement, research questions, aim and objectives, the scope of the study among others. Chapter two delve into the review of pertinent literature lending support to the crafting of cogent questionnaires for data collection. Chapter three touched on the methodology adopted for the study. It considers issues of sampling and sampling frame, sample size selection, instrument design and administration to respondents *inter alia*. Chapter four is the analysis of data collected whilst Chapter five tied the research knot by addressing the conclusions and recommendations of the study by focusing on the review of research objectives in tandem with the findings of the research; and recommendations for future study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Concept of Public Procurement

Procurement is the process of buying products and services. It covers everything from identifying a need to developing a business case, selecting a supplier and managing the product or service until either the contracted service has been delivered or the product has reached the end of its useful life (or has been disposed of). Procurement often involves inviting suppliers to bid for work (Government Procurement Development Group and Ministry of Economic Development, 2010).

Similarly, procurement is a process of identifying and obtaining goods and services. It includes sourcing, purchasing and covers all activities from identifying potential suppliers through to delivery from supplier to the users or beneficiary. It is favourable that the goods/services are appropriate and that they are procured at the best possible cost to meet the needs of the purchaser in terms of quality and quantity, time, and location (Mangan et al., 2008). Public procurement system is the process in which public sector institutions acquire goods and services. Public procurement systems are highly centralized and State Procurement Boards govern procurement (Bovis, 2007).

When private individuals or corporations buy things, they may use various terms, such as purchasing or buying, to describe their actions. In government organizations, many different terms are used when referring to the buying function, from "public procurement" to "purchasing," "contracting," or "acquisition," and many other variations (Lloyd and McCue, 2004:2). Public procurement includes all functions that pertain to the obtaining of any public procurement, including description of

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requirements, selection and solicitation of sources, preparation and award of contract, disposal of commodities, and all phases of contract administration.

Another approach to defining public procurement is to examine what public procurement practitioners actually do on a daily basis. Recent surveys and analyses (McCue and Gianakis, 2001) provide insight into the breadth and scope of public procurement. Public procurement officials spend most of their time on the following major tasks: handling procurement requests, soliciting and evaluating bids and proposals, performing supplier analysis, negotiating, and contract award and administration (Lloyd and McCue, 2004). One of the most common observations of public procurement in general is that it tends to be rule bound. Some rules establish decision-making guides (such as awarding to the lowest responsive, responsible bidder), while others are process rules (such as how much advance notice is needed when publicizing upcoming contracts).

Public procurement means that a public organization buys a product; this can be a good or a service or a combination of the two, which might be called a system (Edquist and Zabala-Iturriagagoitia, 2012). According to Government Procurement Development Group and Ministry of Economic Development (2010), procurement activities can lead to significant savings and a number of other benefits. Some can be quantified, such as saving money while others are more intangible, such as improved service delivery. Government Procurement Development Group and Ministry of Economic Development (2010) assert that types of procurements include renewal where the term of a contract or agreement has ended and it is renewed through a procurement activity. A renewal activity often has a strong historic baseline that can

be used to compare and quantify the savings/benefits that the activity creates. However, any specification changes should be identified and considered in the comparison. For example, in property maintenance contract the buildings involved might have changed, or a contract for new vehicles might have different safety specifications from the original; new (for procuring products/services for the first time, outsourcing existing services or undertaking a one-off procurement activity. New procurement also requires an appropriate baseline for comparison, such as the budget in the original business case (as long as it's realistic); and renegotiation or improvement of terms (an interaction with an existing supplier that results in savings to the business without a formal procurement process. The savings/benefits might be simple to quantify, such as those that result from reduced delivery costs, or bulk ordering that leads to supplier discounts or rebates).

2.2 Procurement Ethics

Public Procurement involves the expenditure of public monies, and public employees must always ensure that all procurements are conducted so as not to cause any concern that special considerations have been shown to a vendor. Actions such as providing a vendor with information that is not available to other vendors, accepting a gift, or having lunch with a potential vendor could be construed as showing favoritism to a vendor, and may violate procurement and other statutory laws (New State Procurement Council, 2009).

2.3 Role of Procurement

Lewis and Roehrich (2009) agitate that procurement is a key activity in the supply chain. Procurement can significantly influence the overall success of an emergency

response depending on how it is managed. In most organisations, procurement represents a very large proportion of the total spend and should be managed effectively to achieve optimum value. Procurement works like a pivot in the internal supply chain process turning around requests into actual products/commodities or services to fulfill the needs (Caldwell et al., 2009). Caldwell et al. (2009) further argue that procurement serves three levels of users and these are the internal customer, programs in response to emergencies and ongoing programs, and prepositioning of stocks, for both internal customers and program needs. In addition, Benslimane et al. (2005) contend that the overall aim and objective of procurement is to carry out activities related to procurement in such a way that the goods and services so procured are of the right quality, from the right source, are at the right cost and can be delivered in the right quantities, to the right place, at the right time.

There are 'six rights' in procurement and they can be achieved through following specific objectives notably buying quality materials, items and services economically from reliable sources; ensuring timely delivery through the selection of capable and efficient suppliers; continuously locating, evaluating and developing economical and reliable supply sources; identifying the most reliable sources of supply through either open tender, multi-stage tendering (pre-qualifying suppliers and retaining only those that are capable of meeting the organisation's requirements; strategic sourcing) and limited tendering; investigating the availability of new materials and monitoring trends in market prices; and buying in accordance with organisational policies (Benslimane et al., 2005).

2.4 Principles of Procurement

The first principle is transparency, which provides that all phases in the procurement process are fair and accurately documented. The second principle is that of accountability and it points out that there is need for accountability to financiers, who may require certain rules to be followed when using the money they have provided. Finally, there is the principle of efficiency and cost effectiveness and this principle is about meeting the 'six rights' of supply (price, right time, right quantity, quality services, and delivery to the required places and from the most cost effective source)(Caldwell et al., 2009).

2.5 5 Procurement Processes

Shaw (2010) points out that the procurement process can be wrapped into three steps. These are need identification, planning and specification of goods or services required, and sourcing, awarding, and supplier management to facilitate timely delivery. Procurement processes comprise of the following: **need identification (**Procurement is done to desire to accomplish a specific task. Given that resources are always scarce, the task to be accomplished should be important to an organization (Nakamura, 2004). **Planning and specification of goods or services required,** once the needs have been identified, the procurement department should develop or communicate a plan on how to deliver the service or goods required. The plan must be developed in collaboration with the other functions within the organisation, so that it is integrated into the organization's strategy and therefore provided for adequately (Shaw, 2010).

To be able to purchase the right goods or services, the specifications of what the organization needs must be clear. These specifications are used to communicate to the supplier what is needed and what should be supplied. It is therefore important to have clear, specifications. Most organizations have standard specifications for the most regularly procured items and services such as medical and construction (Shaw, 2010). Thai et al. (2005) provide that a specification is a detailed description of the design, the service, or materials. It describes in detail the requirements to which the supplies or services must conform. The basic requirement of a good specification is to clearly identify the service or product to stakeholders. The specifications must be clear to all parties. That is the user, procurement and the supplier. Factors to consider in specifying a product include physical attributes, technical specification, and intended use (Thai et al., 2005). **Sourcing, awarding, and supplier management**; According to Hinson and McCue (2004) sourcing is the process of identifying sources of supply that can meet the organization's immediate and future requirements for goods and services. The sourcing process adopted will depend on the situation and on the time available to carry out sourcing. For instance, in a sudden on-set emergency the need to respond quickly to the emergency will mean there will be limited time to gather sourcing information and approve suppliers; therefore, an organization may make use of existing suppliers.

2.6 ICT Usage in Public Procurement: A tool for organizational change

It is necessary to move towards a systemic usage of technological innovation, with a continuous flux of electronic purchasing activities affecting important volumes of expenditure (Ramayah et al., 2006). Davenport (1994) defines nine (9) principal groups of specific effects of IT on organizational processes: automating (eliminating

or reducing drastically the effort of human resources), informative (generating more information and allowing a better understanding of it), sequential (modifying the sequence of the process and the activities that are part of them), of control (improving monitoring), analytical (improving the understanding of the phenomena), geographical (improving the ability to coordinate remote processes), integrative (assuring coordination among tasks and processes), intellectual (getting and spreading knowledge), disintermediation (reducing redundancy and intermediate activities). Nasi et al.(2005) adopted the paradigm people – process –technology (PPT) to define the Critical Success Factor (CSF) to effectively achieve an organizational improvement through IT. Technology: such as web sites, ERP, system security, digital signature. Process: a thorough business process re-engineering is needed along with the adoption of standards and coding acknowledged internationally. People: it is necessary to raise awareness and train the employees on themes such as sharing knowledge through IT, networking and change management.

2.7 Critical Success Factors for ICT deployment in Public Procurement

According to Gardenal (2008), the critical success factors for ICT deployment in public procurement include **technology** (availability of a suitable and capillary IT infrastructure integration among the applications (ICT procurement web platform and ERP); **process** (business process re-engineering on the basis of shared organizational models, adoption of standard commodity categorizations (CPV coding), adjustment of internal rules and shared logics and methodology for measuring, reporting and publicize the results); **people** (raising awareness towards the use of new technologies, training, networking and management techniques; training on ICT procurement tools; technical, legal and strategic consultancy for the first tendering procedures online);

and **environment** (Political definition of goals related to the effective use of ICT procurement; a comprehensive and unique normative discipline; creation and development of public "centers of excellence" whose goal has to be the diffusion of knowledge and innovative tools in ICT procurement; facilitations to involve suppliers, often tied to the "traditional" modus operandi).

2.8 The Impact of ICT Usage in Procurement

ICT in public procurement reduces administrative costs and, bureaucracy by helping the State avoids repeating tasks such as registration and certification of contractors, allowing for additional effective control mechanisms and reducing paperwork (Singer and Marcos, 2009). ICT in procurement ensures better value for money in the award of public contracts; improve transparency and reduce transaction cost. Similarly, ICT in procurement has the potential of reducing purchasing prices due to a more efficient operation and to a larger number of potential contractors (Singer and Marcos, 2009). Following an extensive work done by Davenport (1994) the impact of ICT usage in procurement are summarized in the Table 2.1 below.

Table 2.1 Usage of Information and Communication Technology

Impact	Application	Benefits
1. Automating	Sending of the invitations to the suppliers and publishing of the tendering procedure documentation; technical / qualitative evaluation of the offers (only when non-discretionary parameters are defined); and Final and intermediate report production, archiving of the documents received.	reduction of the duration of the phases of the process; and eliminate or reduce drastically the effort of human resources
2. Informative	Generate more information and allow a better understanding of it	Tender documents are available from more sources. Tendering procedure documentation is more accurate, as the employees can spend more time in its preparation. Documents produced by every user of the platform are shared and available for consultation (spreading of the best practices).
3. Sequential	Standardizing, expediting and innovating; modify the sequence of the process and the activity that accompany them; creation of standardized tendering	The tendering procedure is clearly divided in phases, with no possibility of overlap (or "forget") activities; automation liberates time to be used in

	procedure "template" using the platform; and using new IT instruments(digital signature, certified e-mail, e-invoicing)	activities generating an higher value-added;
4. Control	Using E-mail alerts notice new events real-time	Better organization and archiving of the offers; improve monitoring; no risk of losing documents or confusing them with those presented by other suppliers, or even regarding a different tendering procedure.

Source: Regional Procurement Agency 2009, Davenport, (1997)

2.9 Challenges Confronting Public Procurement

Public procurement is an important function of government. However, a number of challenges are faced (Shaw, 2010). Firstly, the sheer magnitude of procurement outlays has a great impact on the economy and needs to be well managed. Efficiently handling this size of procurement outlays has been a policy and management concern as well as a challenge for public procurement practitioners. Similarly, reasons such as greater scrutiny of taxpayers and competing vendors; public procurement has been perceived as an area of waste and corruption (Shaw, 2010).

2.10 Challenges of ICT Usage in Public Procurement

Unsuitability of software platforms, organizational resistance, lack of strategic systems' integration and failure to involve public procurement professionals in the design of ICT facilities for public procurement systems were identified as the primary

obstacles of effectively implementing digital procurement (McCue and Roman, 2012). The implementation of information communication technology (ICT) in procurement can be costly (Croom and Johnston, 2003), especially in cases when systems based on incompatible platforms are attempted to be incorporated at a later date (McCue and Roman, 2012). The impacts of technological errors, system constraints and technological failures, which are seldom discussed or acknowledged, are also a major concern for ICT usage in procurement (Coulthard and Castleman, 2001; Mota and Filho, 2011; Sun et al., 2012). While tools such as e-signature, e-notice or e-bids do significantly reduce processing time – these constructs might raise security issues, costly errors and authenticating bidders problematic; and digital procurement platforms do not exist in a vacuum; and as such require supportive administrative constructs and technological systems (McCue and Roman, 2012).

2.11 ICT in Construction

ICT is being used, to some extent and in varying degrees by construction firms and a number of practitioners (Whyte, et al., 2002). ICT deployment have shown that large construction firms often had established ICT infrastructures compared to SMEs (Ng et al., 2001; Love et al., 2000), where SMEs ICT investments were often driven by large construction firms (Walker and Rowlinson, 2000).

Recent studies showed ICT uptake in the SMEs tended to concentrate on basic functionalities such as, using electronic mail (e-mail) for documents transfer and web pages for establishing a marketing presence and promoting their services and products (Tam, 1999; Walker and Rowlinson, 2000; Love et al., 2001). Such applications have been identified as a traditional mode of ICT transition in the construction industry

(Love et al., 2000), which attributed the blame for slow progress in the integration of ICT business processes (Cheng et al., 2001). This seems to be the common trend of ICT penetration in construction SMEs.

Essentially, the evaluation of the ICT investment has been a difficult and time-consuming task for all the construction players (Love et al., 2001). Love, et al (2000) found that construction firms might lose competitiveness or risk losing contracts if they did not recognize the potential of ICT. Meanwhile, suppliers and small construction firms who adopted information and communication technology (ICT) to establish partnering alliances with larger construction firms were more likely to have competitive advantage compared to SMEs who had not implement ICT (Walker and Rowlinson, 2000). Types of ICT communications can be varied with different stages of a procurement process. E-mailing for exchanging business information for instance, has become common practice in the construction sector (Wong and Sloan, 2004). Communication has always been a challenge for the construction industry (*ibid*). The emergence of ICT applications facilitates today's construction process; it is worth noting that use of ICT is improving communication for construction businesses (Wong and Sloan, 2004).

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the methodology adopted for the conduct of this research. It concentrate on the research approach adopted; the determination of the sampling frame and sample size for the study; data collection with specific emphasis on questionnaire design; administration and deployment of appropriate statistical tools for analysis of the acquired data.

3.2 Research Approach

A quantitative research approach was adopted for this study in order to measure the opinion of respondents concerning the adoption of ICT in the procurement of public works in the Ghana Highway Authority. Similarly, the nature of the measurement and the scale used in the collection of data makes the adoption of a quantitative approach appropriate. The approach was adopted with the philosophical underpinning of social constructivism (Polit and Hungler, 1999). Again the desire of the researcher was to adopt a systematic approach which is scientific (Koch and Harrington, 1998) in nature in the understanding of the issues relating to the use of ICT in road works procurement. The research also seeks to collect numerical data

(Jack and Clarke, 1998) as it is easily comprehensible to policy makers in the implementation of procurement rules and guidelines in the public sector. Numerical data simplifies complex issues and save time for policy makers in the public procurement during decision making. Quantitative research approach also leans towards deductive reasoning (Burney, 2008) which considers issues from the general

perspective aimed at the confirmation of key practices and theories being vigorously used concerning ICT utilization in public procurement.

3.3 Data Collection and Instrumentation

3.3.1 Questionnaire Design

A questionnaire is one of the tools for collecting data especially in survey research. It consists of a set of desired questions that the researcher intends to use to solicit responses from respondents to achieve the aim of the study. There are various forms of questions that can be captured in a questionnaire which depends mostly on the type of answers desired and the methodology adopted for the research. Closed-ended and open-ended questions are the commonest. This study adopted closed-ended questionnaires which provide required answers for the questions that respondents are to choose from. The desk survey paved way for the extraction of key variables which were used in designing the questionnaire. The four key questions addressed respondents' work experience in the road sector in relation to works procurement. Similarly, the benefits of the implementation of ICT in road works procurement with specific reference to the Ghana Highway Authority were also explored in the study. In addition, the procurement services that should be provided using ICT in public road construction were also looked at. In every organizational environment just like the Ghana Highway Authority, challenges are bound to be present hence the study explored the challenges to the implementation of ICT in road works procurement. The responses to these questions were measured using a five point likert scale in most cases except work experience. The responses consisted of 1= strongly disagree, 2= disagree, 3= moderately agree, 4= agree and 5= strongly agree. The adoption of the

likert scale made the data collected for the research to be ordinal, assigning labels to the level of effect being investigated.

In order to encourage respondents' understanding of the questions very well, the questions were crafted using words that respondents are familiar with and efforts were made to desist from using technical terms in the writing of the questions. Also, enough instructions and information were provided to aid the active reaction of respondents to the questionnaire. Ethically, an introduction to the questionnaire was provided to assure respondents of the intent and the type of usage for the study. Respondents were assured of confidentiality.

3.3.2 Sampling Technique and Sample Size

The sampling frame was derived from respondents with professional background of two (2) architect, four (4) quantity surveyors, three (3) project managers, three (3) site supervisors, four(4) civil engineers, ten(10) contractors and five (5) procurement officers. The aggregation of these categories gave a sampling size of 31 respondents. The snowball sampling technique was used to identify key respondents for the administration of questionnaires. The snowball sampling was adopted because of the difficulty in identifying respondents as a result of poor structural planning and standard identification of locations and structures. Snowball sampling is a chain referral sampling method that relies on referrals from initial subjects to generate additional subjects (Johnstona and Sabin, 2010). This sampling method produces biased samples because respondents who have a large number of social connections are able to provide researchers with a higher proportion of other respondents who most likely have characteristics similar to that initial respondent. In using the

snowball sampling which is a non-probability sampling technique, the most visible respondent was identified for questionnaire administration. After the administration of the questionnaire, the first respondent gave information to the location of other respondents; the researcher depended on this network of information from the respondents to administer questionnaire to the 31 respondents.

3.3.3 Questionnaire Administration

The questionnaires were self- administered by the researcher by hand delivery to architect, quantity surveyors, project managers, site supervisors, civil engineers, contractors and procurement officers to answer, and on some occasions the questionnaires were administered and retrieved on the spot. After the administration of the questionnaires the researcher used two (2) weeks to retrieve the answered questionnaires, and in all thirty-one questionnaires was administered and 20 representing the sample size were retrieved. In this regard, the response rate for the study was 66%.

3.3.4 Data Preparation and Analysis

The individual responses were aggregated to give larger units for analysis. The aggregated units were packaged and entered into Statistical Packages for Social Sciences (SPSS Version 16) and later transferred to Microsoft Excel 2007 for analysis. The statistical tool used to run the analysis was descriptive statistics. Relative index of importance (RII) was used to rank the identified factors in order to identify the most pressing issues in order of importance or significance.

3.4 Development of Strategic Framework for ICT Usage in Public Road Works Procurement

The study through the combination of the findings of objectives 1, 2 and 3 of the research study which culminated into the development of an innovative framework for the implementation of ICT usage in road works procurement. The framework featured prominently human resource processes which entail the training of employees of public road procurement agencies in the use of ICT facilities. The framework considered the ICT tools that employees would use in procurement hence the need to train them effectively in the use of those ICT tools. The procurement services that the tools would be used to deliver were also captured by the framework including online tender documentation, expression of interest, contract award, feedback systems among others. Similarly, the use of ICT tools in the procurement of the above procurement services would inure to the benefits of stakeholders in the procurement of public sector road works which were within the framework.. The framework regarded human resource processes, tools for ICT usage and procurement services as the ICT implementation steps that needed to be taken to realize the absolute usage of ICT in public road works procurement.

CHAPTER FOUR

ANALYSIS AND DISCUSSION OF RESULTS

4.0 Introduction

This chapter analyses and discusses the data collected using survey questionnaires during the field work. The chapter discusses the key issues of work experience of respondents; tools for enhancing ICT implementation in public road works procurement; procurement services requiring ICT usage; and challenges confronting the use of ICT in road sector works procurement.

4.1 Work Experience of Respondents in the Road Construction Sector

To ensure the credibility and accuracy of data collected for the research, it is important to delve into the background of respondents by ascertaining the number of years they have been operating in the road sector. This ensures that data is collected from experience respondents who have witness a lot of phenomenon in the road construction sector procurement of works.

Drawing on figure one below, it has been clearly demonstrated that 50 per cent of respondents have work experience in the road sector below ten (10) years; 25 per cent have work experience between 11-20 years and another 25 percent of respondents have work experience between 21-30 years. The analysis above clearly demonstrates that data was collected from respondents who have being working in the road construction sector for a considerable number of years. This result provides an

evidence of authenticity in the information provided by respondents which is crucial to this study.
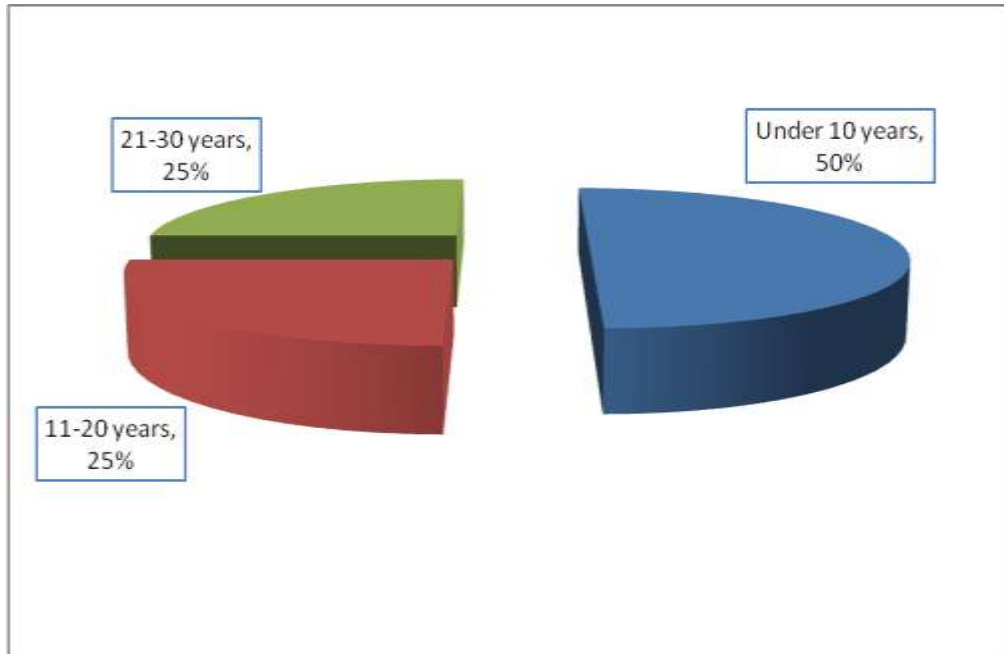
Figure 4.1: Work experience of respondents in the road construction sector

4.2   Tools for enhancing information communication technology (ICT) usage in Public Road Works Procurement

In a bid to implement the usage of ICT in public sector road works procurement, it is important to identify the necessary pragmatic tools for such a novel approach. This section of the analysis and discussion dwells on the key tools that would be instrumental in the usage of ICT in road works procurement.

Drawing on from Table 4.1, the Relative Importance Index (RII) analysis was used as inferential tool for the analysis of the data. It is an index that describes how each of the variables performed in relation to other variables in terms of significance. The indexes have been ranked from the most significant to the least significant (thus;

strongly agree to strongly disagree). Higher index indicates higher significance through to the least significant raking. An index value more than 0.70 or 70%, is highly significant. This is because, values above 0.5 measures are deemed to be positive agreement of the categories of rankings.

Chi-square (Sig) value of less than 0.05 with positive direction of ranking (toward agreeing) shows that the variable is significant. This means that, most of the respondents' rankings (from strongly disagree to strongly agree) are skewed to the positive direction and few of them to the other direction. If on the other hand, the frequency shows that it is skewed to the negative direction, we cannot conclude that the variable is significant. More than 0.05 level of significant may also indicate highly significant depending on the direction of the chi-square frequency.

Relatively, ICT implementation variables are highly significant as shown from the relative importance index. The ranking of the indexes in Table 4.1, training of employees on procurement ICT tools; email alerts; generating more information for better understanding of procurement regulations; website design and security systems; and networking of all procurement entities in the road sector have indexes greater or equal to 0.8 showing that respondents strongly agree that, the implementation of ICT in road works procurement in public sector would be significantly enhanced by these five information communication technology (ICT) activities. It is observed that, there are three most significant or pressing information communication technology (ICT) implementation of road works procurement activities; training of employees on procurement ICT tools, email alerts and generating more information for better understanding of procurement regulations.

It has been observed from the chi-square frequency (*appendix 2 table 7)* that, observed frequencies are higher toward the agreement level of ICT implementation activity of training of employees on performance ICT tools. Thus; 10 of the respondents strongly agree and 8 of them agree, while 2 moderately disagreed. Hence all the respondents agreed to this activity of procurement implementation. There is no significant difference on the ranking of agreement, thus all the respondent ranked toward one direction (agreement). It can be concluded that, training is the highest rating of ICT implementation activity in road works.

The next on the ratings is email alerts with index of 0.86, thus; strongly agree. Almost all of the respondents at least agreed that, ICT implementation in the public procurement system is enhanced by email alerts (thus, 12 agreed and 7 strongly agreed in table 2 in the *appendix 2*). The third on the ratings of (ICT) implementation in the public procurement system is generating more information for better understanding of procurement regulations. The least of the index also shows significant agreement, thus; respondents averagely agreed (0.6), that implementation of information and communication technology (ICT) in road works procurement in public sector would be enhanced by creation of digital signatures. The variable with the least relative index is creation of digital signatures with index of 0.6, thus, respondents agreed.

Therefore, it can be concluded from the above analysis and discussion that using information communication technology (ICT) in the procurement of road works would be greatly enhanced by training of employees on procurement ICT tools; using

email alerts; generating more information for better understanding of procurement regulations; website design and security systems; and networking of all procurement entities in the road sector.

Table 4.1: Tools for ICT Implementation in public sector road works procurement

ICT Tools/Activities	Descriptive		Relative Importance Index(RII)	Ranking	Chi-Square	
	N	Sum	RII		Chi-Sq	Asymp. Sig.
1. Training of employees on procurement ICT Tools	20	88	0.88	1	5.200[b]	0.074
2. Email alerts	20	86	0.86	2	9.100[b]	0.011
3. Generating more information for better understanding of procurement regulations	20	86	0.86	3	13.200[a]	0.004
4. Website design and security systems	20	80	0.8	4	6.400[b]	0.041
5. Networking of all procurement entities in the road sector	20	80	0.8	5	9.200[a]	0.027
6. Automation of road works procurement	20	78	0.78	6	8.400[a]	0.038
7. Creation of digital signatures	20	60	0.6	7	7.500[c]	0.112

Source: Author's Field Data (2013)

4.3 Procurement Services requiring information communication technology (ICT) usage

In this research study, it is important to identify procurement services or activities that would require the application of ICT in their provision to stakeholders in the procurement of public sector road construction works. The study revealed from Table 4.2 that, the most significant procurement services to be provided using ICT is online documents provision to contractors. At least 18 of the respondents agreed (9 of them agreed and 9 strongly agreed, as in table 13 of appendix 2) that online documents as procurement services are to be provided using ICT. Contracts award and frequently asked questions are the next on the relative importance index of the procurement service that need to be provided using ICT after online documents with 0.83 each of the index. Chi-square sig. value (0.000) shows significant difference among the categories of ranking, thus; with contracts award, the observed frequencies were lower than the expected for the negative scaling. Nevertheless, contracts award was strongly agree ranked with the highest observed frequency (12). Frequently asked questions have the same distribution as the contracts award. The least among the variables in the ranking is opened and restricted tenders and offers. Its index is equally high (0.78) where most of the respondents ranked agreed (17 of the respondents).

From the above analysis, it has been realized that there are procurement services that are in dire need of Information and Communication Technology implementation to ensure their effectiveness in the procurement of public sector road works. It is therefore appropriate to conclude that procurement services notably Online documents provision during procurement; contracts award; frequently asked

questions; posting of tenders among others like price list database are the procurement services to be provided using ICT.

-This result implies that authorities of public procurement with specific reference to the road sector should take pragmatic steps to ensure that these services are provided to stakeholder using ICT especially at the local and other decentralized levels of the governance of public road procurement entities.

Table 4.2: Procurement services to be provided using ICT

Road Procurement Services using ICT	Descriptive		Relative Importance Index(RII)		Chi-Square	
	N	*Sum*	*RII*	*Ranking*	*Chi-Sq*	*Asymp. Sig.*
1. Online documents	20	85	0.85	1	4.900[a]	0.086
2. Contracts award	20	83	0.83	2	20.500[c]	0.000
3. Frequently Asked Questions	20	83	0.83	3	17.000[c]	0.002

4. Posting of tenders	20	82	0.82	4	7.600[a]	0.022
5. Expression of interest	20	82	0.82	5	7.600[b]	0.055
6. Price list database	20	81	0.81	6	22.800[b]	0.000
7. News and events concerning procurement	20	80	0.80	7	9.200[b]	0.027
8. Opened and restricted tenders and offers	20	78	0.78	8	38.400[b]	0.000

Source: Author's field Data (2013)

4.4 ICT Implementation challenges in road works procurement

The use of Information Communication Technology (ICT) in public road works procurement would be confronted by some challenges. It is important to ascertain these challenges in order to prepare for their eventuality. Tables 4.3 explore seven challenges likely to hamper the use of ICT in public road works procurement. Referring to Table 4.3, it has been demonstrated that Errors and system failures can delay the submission of tenders on time was ranked first with was ranked first with an RII of 0.87; followed by Hacking of computer systems to disclose confidential information with RII of 0.82. Other crucial challenges include lack of system integration and failure to involve public procurement officers in information communication technology (ICT). Per the Relative Importance Index obtained by ranking of challenges by respondents all the challenges in Table 4.3 were deemed to be significant except inadequate funds for implementation; organizational resistance; and unsuitability of software platform all have their RII below 0.70 which makes them to be mediocre. This results in table 4.3 imply that implementation authorities in both the public road sector and at the public procurement authority must take due cognizance of these challenges when intending to implement the utilization of

information communication technology (ICT) facilities in the procurement of road works.

Table 4.3: Information communication technology (ICT) usage challenges in the road sector

Information communication technology (ICT) Challenges	Descriptive		Relative Importance Index(RII)		Chi-Square	
	N	Sum	Index (%)	Ranking	Chi-Sq	Asymp. Sig.
1. Errors and system failures can delay the submission of tenders on time	20	87	0.87	1	3.700[c]	0.157
2. Hacking of computer systems to disclose confidential information	20	82	0.82	2	10.800[a]	0.013
3. Lack of system integration	20	76	0.76	3	7.200[a]	0.066
4. Failure to involve public procurement officers in ICT	20	70	0.70	4	6.000[b]	0.199
5. Inadequate funds for ICT Implementation	20	67	0.67	5	2.500[b]	0.645
6. Organisational resistance	20	56	0.56	6	1.600[c]	0.449

7. Unsuitability of software Platform	20	51	0.51	7	7.000^b	0.136

Source: Author's field Data (2013)

So far, the analysis and discussion of results revolved round the four thematic areas of work experience of respondents within the purview of respondents profile; the key tools for the enhancement of ICT usage in the public road works procurement; procurement services of the road sector requiring ICT usage; and challenges confronting ICT usage in road works procurement. The whole idea of procurement is to ensure goods and services acquisition through value for money for all stakeholders in the procurement process (Mangan, 2008).

The four main thematic areas of exploration for this research (that is levels of ICT utilization, procurement services to be provided through ICT, barriers of ICT implementation and framework for successful implementation) are crucial for achieving the desired value in road works procurement. For instance, under the tools for ICT usage, identifiable tools notably email alerts; training of employees in using procurement information and communication technology (ICT) tools among others (Table 4.1). The above results are consistent with the assertions of Davenport (1994); Gardenal (2008); Singer and Marcos (2009); Tam (1999) among others in the extant literature would ensure procurement. The implementation of the result will ensure the principles advocated by Cadwell *et al*. (2009) and Thai *et al*. (2005) are adhered in public sector road procurement. This study therefore reinforces existing theories in use a key contribution to the academia in terms of teaching and learning. Practically, this result would pep up procurement authorities and stakeholders to consider implementing the utilization of these tools.

In a bid to use ICT in public procurement of road works, challenges are bound to be encountered in ICT usage in road works procurement. The key challenges identified by the study include errors and systems failures causing delay in submission of tender documents on time; hacking of the systems to steal data among others (*see for instance Table 4.3*). The value of this research in uncovering these challenges is that it serves as an eye opener for procurement authorities to take pragmatic measures to avert these challenges. *The limitation of this study is that it has not explored the modalities for the aversion of these challenges in the public road procurement sector; a further research in that direction would be a novel undertaking.*

On the whole, the third objective which was to recommend strategies for ICT application in procurement of public road works was attained by the combination of the results of the study bordering on the first and second objective to develop a framework for such a novel purpose. This framework is depicted in Figure 4.2 on the next page.
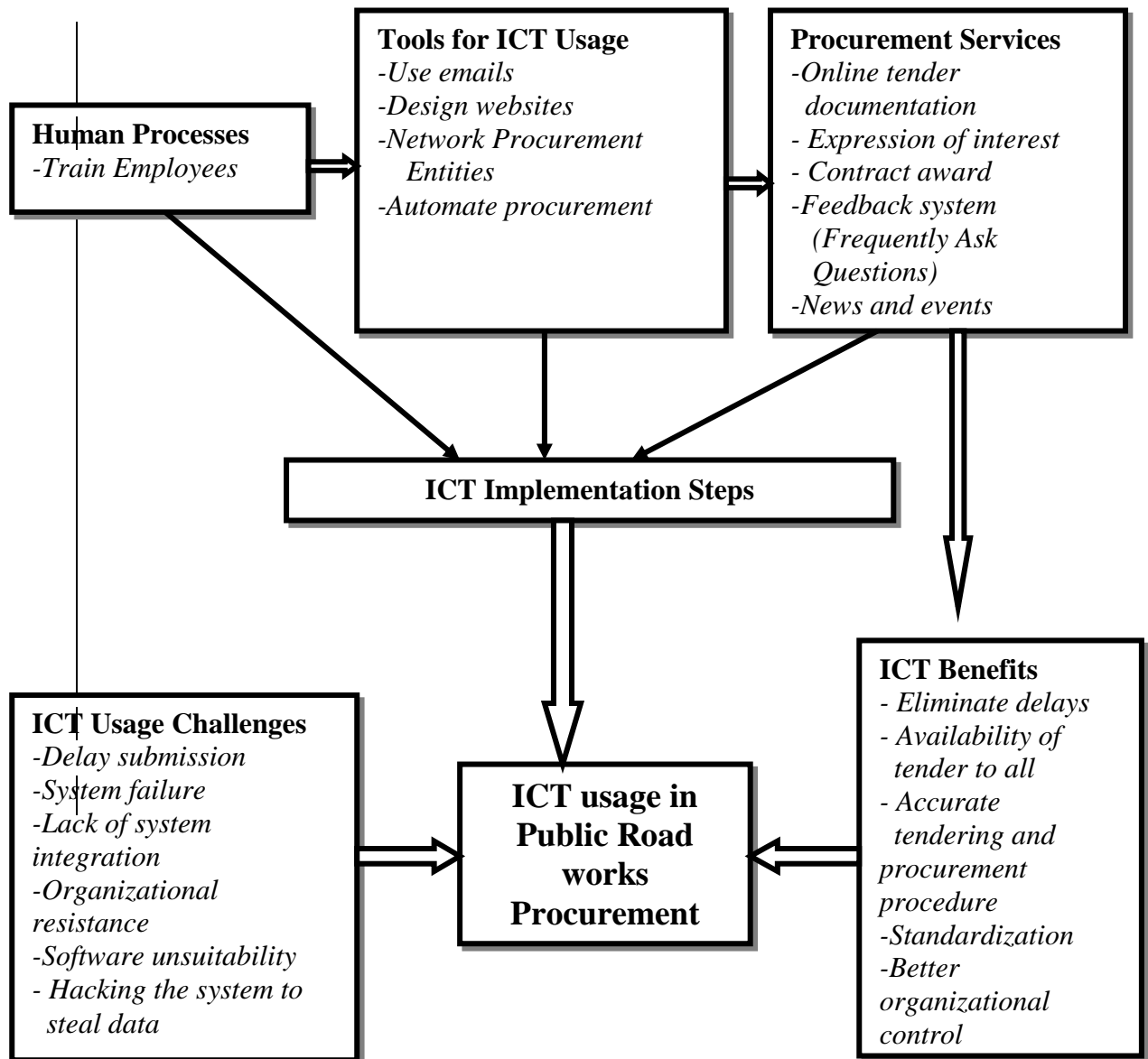
Figure 4.2: __ *–A framework for ICT usage in public road works procurement management*

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This study has been necessitated by the ICT evolution currently engulfing every facet of human endeavours. Throughout the whole world Information and Communication Technology applications are used to simplify operations in many organizations. In Ghana, the problems being encountered since the implementation of the public procurement Act is enormous as far as every sector of the economy is concerned. Hitherto the advent of this chapter, four chapters were undertaken covering the background of the study; the review of extant literature relevant to the conduct of this study; the methodologies adopted for the research; and the analysis and discussion of results obtained after field data collection. This chapter draws the research agenda to a close. It deals with issues comprising of review of research objectives and findings; recommendations and directions for future research.

5.2 Summary of Objectives, Findings and Conclusions

The main aim of this research was to examine the utilization of ICT in public procurement of road works; and to devise a criterion for improving the current state of the procurement structure in road contract administration in Ghana with regards to the use of ICT. To achieve this aim, four key research objectives were set comprising of: to assess the existing ICT milieu in the public procurement of road works through an elaborate literature review; to identify the procurement services provided using information and communication and technology (ICT) in the road sector; to unravel the challenges confronting the implementation of ICT in the public procurement of

road works; and to recommend strategy for ICT usage in public road works by the development of an innovative framework.

Persuing the above objective has culminated into the foregoing findings of the study.

Pertinent issues on public procurement and Information Communication Technology (ICT) usage were critically reviewed including ICT usage in public procurement as a tool for organizational change; critical success factors for ICT deployment in public procurement; the impact of ICT usage in procurement; challenges of ICT usage in public procurement; ICT in construction. The review revealed that ICT usage in the construction industry has not really caught up with operators in the industry not excluding those in the road construction sector. The review uncovered the most dominant form of ICT usage to be electronic email for document transfer and use of web pages for marketing purposes. The study also found out that construction entities risk losing their competitiveness if they neglect the use of ICT.

It is important to identify the critical services that require the application of ICT in the procurement of public sector road works. Identifiable procurement services requiring ICT application in the road construction sector include online documentation of tender processes; contracts award; provision of feedback system through the operation of frequently asked questions on web pages of procurement entities; posting of tenders; *inter alia*.

In spite of its immense benefits to the procurement of road works in the public sector, the use of ICT has some critical challenges that ought to be addressed with pragmatic approaches. The study uncovered challenges that could emanate from the use of ICT

in the procurement of public road works as errors and system failures can delay the submission of tenders on time; hacking of computer systems to disclose confidential information. Similarly, the study identified other challenges notably lack of system integration; failure to involve public procurement officers in ICT; inadequate funds for ICT implementation; organizational resistance; and unsuitability of software platform

Considering the critical issues of examination in this research works; it is important to combine all the key dynamics explored in order to come up with workable strategies for ICT usage in road works procurement. Within the domain of the *objective 4* above, the study has developed a framework within which the utilization of Information and Communication Technology (ICT) in public road procurement by combining the findings of *objectives 1, 2 and 3* of the study. The framework is thus demonstrated in figure 4.2.

5.3 Recommendations

In view of the above findings in the review of research objectives in section 5.2, the following recommendations are appropriate for adoption to enhance the use of ICT in public road works procurement:

- Employees in public procurement entities responsible for road works procurement must be trained in the rudiments of using ICT facilities at the work place. This is to ensure the smooth delivery of services to clients and meeting other mandatory obligations satisfactorily;

- The procedure advocated in figure 5.1 above must be pursued to the letter in order to successfully use ICT in the procurement of works in public spirited organizations;

- To successfully use ICT in road procurement, authorities must also institute measures such as implementation of high security algorithms softwares to ensure the integrity of the system to prevent the intrusion of unwanted users from tampering with sensitive data; and

- It is also important that procurement entities make substantial funds available for implementation of ICT in road works procurement;

5.4 Directions for Future Research

This study has uncovered some research areas which need to be addressed in the future. In this light future research agenda include the following:

- An exploration into the modalities for the aversion of ICT usage challenges in the public road procurement sector;

- A future research agenda into the design of appropriate ICT software for public road works procurement would be a novel approach;

-

5.5 Conclusion

This study considered the ICT usage in the procurement of public sector road works. In the wake of ICT revolution throughout the entire globe, it is the believe of the research that this study would set the tone for the total acceptance of ICT in the procurement of road works in most developing countries especially Ghana. This

acceptance of ICT usage in public road works procurement will curb the current

problems bedeviling procurement in the road sector notably corruption among others.

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APPENDIX 1: QUESTIONNAIRE

This research is a Postgraduate level research entitled "The use of information communication technology (ICT) in the management of public procurement of Road works: Ghana Highway Authority (GHA). It is intended to examine the utilization of information communication technology (ICT) in public procurement of road works; and to devise a criterion for improving the current state of the procurement structure in road contract administration in Ghana." **Please , kindly respond to the questions by ticking(√) the appropriate box for each item. Please note that all information provided will be strictly treated as confidential as this work is for academic purposes.**

1. How long have you worked in the road construction sector?

[ ] under 10 years   [   ] 11 – 20 years   [   ] 21 – 30 years   [ ] over 30 years

2. Do you agree that the implementation of ICT in road works procurement in public sector would be enhanced by the following activities in the table below? Please respond using the scale: **1= strongly disagree, 2= disagree, 3= moderately agree, 4= agree, 5= strongly agree.**

No.	ICT Implementation	1	2	3	4	5
1	Automation of road works procurement					
2	Email alerts					
3	Generating more information for better understanding of procurement regulations					
4	Website design and security systems					
5	Creation of digital signatures					
6	Networking of all procurement entities in the road sector					
7	Training of employees on procurement ICT tools					

3. Do you agree that the following procurement services should be provided using ICT in the road sector? Please respond using the scale: **1= strongly disagree, 2= disagree, 3= moderately agree, 4= agree, 5= strongly agree.**

No.	Procurement services to be provided using ICT	1	2	3	4	5
1	Posting of tenders					
2	Expression of interest					
3	Opened and restricted tenders and offers					
4	Contracts award					
5	Online documents					
6	News and events concerning procurement					
7	Price list database					
8	Frequently Asked Questions					

4. Do you think ICT implementation in the road sector would be hampered by the following in the table below? Please respond using the scale: **1= strongly disagree, 2= disagree, 3= moderately agree, 4= agree, 5= strongly agree.**

No	ICT implementation challenges in the road sector	1	2	3	4	5
1	Hacking of the computer systems to disclose confidential information					
2	Inadequate funds for implementation					
3	Unsuitability of software platform					
4	Organizational resistance					
5	Lack of system integration					
6	Failure to involve public procurement officers in design of ICT facilities for procurement of road works					
7	Errors and system failures can delay the submission of tenders on time					

Frequencies

Table 1: Automation of road works procurement

	Observed N	Expected N	Residual
Strongly Disagree	1	5.0	-4.0
Moderately Agree	4	5.0	-1.0
Agree	10	5.0	5.0
Strongly Agree	5	5.0	.0
Total	20		

Table 2:Email alerts

	Observed N	Expected N	Residual
Moderately Agree	1	6.7	-5.7
Agree	12	6.7	5.3
Strongly Agree	7	6.7	.3
Total	20		

Table 3: Generating more information for better understanding of procurement regulations

	Observed N	Expected N	Residual
Strongly Disagree	1	5.0	-4.0
Moderately Agree	1	5.0	-4.0
Agree	8	5.0	3.0

Strongly Agree	10	5.0	5.0
Total	20		

Table 4: Website design and security systems

	Observed N	Expected N	Residual
Moderately Agree	4	6.7	-2.7
Agree	12	6.7	5.3
Strongly Agree	4	6.7	-2.7
Total	20		

Table 5: Creation of digital signatures

	Observed N	Expected N	Residual
Strongly Disagree	1	4.0	-3.0
Disagree	6	4.0	2.0
Moderately Agree	6	4.0	2.0
Agree	6	4.0	2.0
Strongly Agree	1	4.0	-3.0
Total	20		

Table 6: Networking of all procurement entities in the road sector

	Observed N	Expected N	Residual
Strongly Disagree	1	5.0	-4.0
Moderately Agree	3	5.0	-2.0
Agree	10	5.0	5.0
Strongly Agree	6	5.0	1.0
Total	20		

Table 7: Training of employees on procurement ICT

tools

	Observed N	Expected N	Residual
Moderately Agree	2	6.7	-4.7
Agree	8	6.7	1.3
Strongly Agree	10	6.7	3.3
Total	20		

Table 8: Test Statistics

	Automation of road works procurement	Email alerts	Generating more information for better understanding of procurement regulations	Website design and security systems	Creation of digital signatures	Networking of all procurement entities in the road sector	Training of employees on procurement ICT tools
Chi-Square	8.400^a	9.100^b	13.200^a	6.400^b	7.500^c	9.200^a	5.200^b
Df	3	2	3	2	4	3	2
Asymp. Sig.	.038	.011	.004	.041	.112	.027	.074

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5.0.

b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 6.7.

c. 5 cells (100.0%) have expected frequencies less than 5. The minimum expected cell frequency is 4.0.

Table 9: Posting of tenders

	Observed N	Expected N	Residual
Disagree	2	6.7	-4.7
Agree	12	6.7	5.3
Strongly Agree	6	6.7	-.7
Total	20		

Table 10: Expression of interest

	Observed N	Expected N	Residual
Strongly Disagree	1	5.0	-4.0
Moderately Agree	3	5.0	-2.0
Agree	8	5.0	3.0
Strongly Agree	8	5.0	3.0
Total	20		

Table 11: Opened and restricted tenders and offers

	Observed N	Expected N	Residual
Disagree	1	5.0	-4.0
Moderately Agree	1	5.0	-4.0
Agree	17	5.0	12.0
Strongly Agree	1	5.0	-4.0
Total	20		

Table 12: Contracts award

	Observed N	Expected N	Residual
Strongly Disagree	1	4.0	-3.0
Disagree	2	4.0	-2.0
Moderately Agree	2	4.0	-2.0
Agree	3	4.0	-1.0
Strongly Agree	12	4.0	8.0
Total	20		

Table 13: Online documents

	Observed N	Expected N	Residual
Disagree	2	6.7	-4.7
Agree	9	6.7	2.3
Strongly Agree	9	6.7	2.3
Total	20		

Table 14: News and events concerning procurement

	Observed N	Expected N	Residual
Strongly Disagree	1	5.0	-4.0
Moderately Agree	3	5.0	-2.0
Agree	10	5.0	5.0
Strongly Agree	6	5.0	1.0
Total	20		

Table 15: Price list database

	Observed N	Expected N	Residual
Disagree	1	5.0	-4.0
Moderately Agree	1	5.0	-4.0
Agree	14	5.0	9.0
Strongly Agree	4	5.0	-1.0
Total	20		

Table 16: Frequently Asked Questions

	Observed N	Expected N	Residual
Strongly Disagree	1	4.0	-3.0
Disagree	1	4.0	-3.0
Moderately Agree	1	4.0	-3.0
Agree	8	4.0	4.0
Strongly Agree	9	4.0	5.0
Total	20		

Table 17: Test Statistics

	Posting of tenders	Expression of interest	Opened and restricted tenders and offers	Contracts award	Online documents	News and events concerning procurement	Price list database	Frequently Aked Questions
Chi-Square	7.600[a]	7.600[b]	38.400[b]	20.500[c]	4.900[a]	9.200[b]	22.800[b]	17.000[c]
Df	2	3	3	4	2	3	3	4
Asymp. Sig.	.022	.055	.000	.000	.086	.027	.000	.002

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 6.7.

b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5.0.

c. 5 cells (100.0%) have expected frequencies less than 5. The minimum expected cell frequency is 4.0.

Table :18 Hacking of computer systems to disclose confidential information

	Observed N	Expected N	Residual
Disagree	2	5.0	-3.0
Moderately Agree	1	5.0	-4.0
Agree	10	5.0	5.0
Strongly Agree	7	5.0	2.0
Total	20		

Table 19: Inadequate funds for implementation

	Observed N	Expected N	Residual
Strongly Disagree	3	4.0	-1.0
Disagree	4	4.0	.0
Moderately Agree	2	4.0	-2.0
Agree	5	4.0	1.0
Strongly Agree	6	4.0	2.0
Total	20		

Table 20: Unsuitability of software platform

	Observed N	Expected N	Residual
Strongly Disagree	3	4.0	-1.0
Disagree	8	4.0	4.0
Moderately Agree	5	4.0	1.0
Agree	3	4.0	-1.0
Strongly Agree	1	4.0	-3.0
Total	20		

Table 21: Organisational resistance

	Observed N	Expected N	Residual
Disagree	8	6.7	1.3
Moderately Agree	8	6.7	1.3
Agree	4	6.7	-2.7
Total	20		

Table 22: Lack of system integration

	Observed N	Expected N	Residual
Disagree	2	5.0	-3.0
Moderately Agree	4	5.0	-1.0
Agree	10	5.0	5.0
Strongly Agree	4	5.0	-1.0
Total	20		

Table 23: Failure to involve public procurement officers in ICT

	Observed N	Expected N	Residual
Strongly Disagree	1	4.0	-3.0
Disagree	5	4.0	1.0
Moderately Agree	2	4.0	-2.0
Agree	7	4.0	3.0
Strongly Agree	5	4.0	1.0
Total	20		

Table 24: Errors and system failures can delay the submission of tenders on time

	Observed N	Expected N	Residual
Moderately Agree	3	6.7	-3.7
Agree	7	6.7	.3
Strongly Agree	10	6.7	3.3
Total	20		

Table 25: Test Statistics

	Hacking of computer systems to disclose confidential information	Inadequate funds for implementation	Unsuitability of software platform	Organisational resistance	Lack of system integration	Failure to involve public procurement officers in ICT	Errors and system failures can delay the submission of tenders on time
Chi-Square	10.800[a]	2.500[b]	7.000[b]	1.600[c]	7.200[a]	6.000[b]	3.700[c]
Df	3	4	4	2	3	4	2
Asymp. Sig.	.013	.645	.136	.449	.066	.199	.157

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5.0.

b. 5 cells (100.0%) have expected frequencies less than 5. The minimum expected cell frequency is 4.0.

c. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 6.7.