



**FACTORS AFFECTING USAGE OF INFORMATION AND COMMUNICATION
TECHNOLOGY AMONGST BUILDING CONTRACTORS IN THE DEMOCRATIC
REPUBLIC OF CONGO (DRC)
Case study of Kinshasa**

**LANDRY M. MITIMA
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DECLARATION

This research project is my original work and has not been presented for a degree in any other University.

Signature..... Date.....

Landry M. Mitima

B53/8151/2017

This research project has been submitted in partial fulfilment of the examination requirements with my approval as the University of Nairobi supervisor.

Signature..... Date.....

Isabella Njeri Wachira-Towey, PhD.

Senior Lecturer

Department of Real Estate and Construction Management

DEDICATION

To
Gracia Kindja Mitima

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TABLE OF CONTENTS

DECLARATION	i
DEDICATION	ii
ACKNOWLEDGEMENT.....	iii
LIST OF TABLES	vii
LIST OF FIGURES	viii
ACRONYMS.....	ix
ABSTRACT.....	xi
1. CHAPTER ONE - INTRODUCTION.....	1
1.1. Background of research	1
1.2. Problem statement.....	2
1.3. Research questions.....	4
1.4. Aim of the study.....	4
1.5. Objectives of the research.....	4
1.6. Study hypothesis	4
1.7. Scope of the study.....	5
1.8. Limitation of the study.....	5
1.9. Research justification.....	5
1.10. Definition of terms.....	6
1.11. Organization of the study.....	6
1.12. Summary.....	6
2. CHAPTER TWO - LITERATURE REVIEW.....	7
2.1. Introduction.....	7
2.2. ICT in the construction sector.....	7
2.2.1. The Construction sector	7
2.2.2. Usage of ICT in construction.....	8
2.2.3. Benefits of ICT to construction sector.....	9
2.2.4. Role of ICT in construction	11
2.2.5. Different ICT tools and applications in the construction sector	12
2.2.6. Impact of ICT in the construction industry.....	24
2.3. The contractor organisations in the DRC.....	25

2.4.	ICT in the construction industry in the DRC	26
2.4.1.	Legacy of colonial politics.....	26
2.4.2.	Telecom Management after Independence	26
2.4.3.	Internet in the DRC.....	27
2.4.4.	ICT in the construction industry in the DRC.....	27
2.5.	ICT usage factors	28
2.5.1.	Factors determining use of ICT (Zachiang, 2017).....	28
2.5.2.	Factors affecting usage of Information and Communication Technology in construction.....	30
2.5.3.	Barriers to implementing ICT by contractors	31
2.6.	Summary	32
3.	CHAPTER THREE - RESEARCH METHODOLOGY	33
3.1.	Introduction.....	33
3.2.	IT Barometer.....	33
3.3.	Research design	34
3.4.	Study area.....	35
3.5.	Research instrument and target population.....	36
3.5.1.	Questionnaire	36
3.5.2.	Target population.....	36
3.5.3.	The sample size and sampling procedures.....	36
3.6.	Data collection	38
3.6.1.	Pilot questionnaire	38
3.6.2.	Main questionnaire.....	38
3.7.	Data analysis and presentation.....	38
3.7.1.	Frequency analysis.....	38
3.7.2.	Mean Score	38
3.7.3.	One Sample T-Test	39
4.	CHAPTER FOUR - DATA PRESENTATION AND ANALYSIS	40
4.1.	Introduction.....	40
4.2.	ICT in general	40
4.3.	Extent of usage of ICT.....	43
4.4.	Infrastructure platforms used by contractors in the DRC	49
4.5.	Elements that affect use of ICT among contractors in the DRC.....	53

4.6.	ICT usage and tenders won.....	62
4.6.1.	Hypothesis testing.....	64
5.	CHAPTER FIVE	67
	SUMMARY, CONCLUSIONS AND RECOMMENDATIONS	67
5.1.	Introduction.....	67
5.2.	Summary and conclusions	67
5.3.	Recommendations.....	69
5.4.	Areas of further research.....	69
	REFERENCES.....	70
	APPENDICES	78

LIST OF TABLES

Table 3.1: Contractors population based on financial classification	37
Table 4.1: Questionnaires received for analysis	40
Table 4.2: Mean scores of level of activities computerization	44
Table 4.3: Mean scores of Information Communication Technology application tools	47
Table 4.4: Financial factors mean rating.....	53
Table 4.5: Financial factors T-test	54
Table 4.6: Human factors mean rating.....	55
Table 4.7: Human factors T-test	57
Table 4.8 : Technical factors mean rating.....	57
Table 4.9: Technical factors T-test	58
Table 4.10: Environmental factors mean rating.....	59
Table 4.11: Environmental factors T-test	60
Table 4.12: Legal factors mean rating	60
Table 4.13:Legal factors T-test.....	61
Table 4.14: ANOVA for tenders won.....	64
Table 4.15: Coefficients for study model	65
Table 4.16: Model summary	66

LIST OF FIGURES

Figure 3.1: Kinshasa Province, administrative map	35
Figure 4.1: Contractors response rate	41
Figure 4.2: Respondents work experience	41
Figure 4.3: Professional background of respondents	42
Figure 4.4: Extent of ICT application	42
Figure 4.5: Role of ICT in construction	43
Figure 4.6: Contractors level of computerization	45
Figure 4.7: Contractors level of computerization	48
Figure 4.8: ICT hardware items	49
Figure 4.9: Operating system choice consideration	50
Figure 4.10: General administration systems	51
Figure 4.11: Project planning and scheduling softwares	51
Figure 4.12: Estimating softwares	52
Figure 4.13: Computer Aided Design	53
Figure 4.14: Tenders received/sent electronically	62
Figure 4.15: Level of awareness of e-Tendering opportunities	63
Figure 4.16: Relationship between tenders won and ICT usage	63

ACRONYMS

3D	Three-dimensional
4D	Four-dimensional
ANOVA	Analysis of variance
BIM	Building Information Modelling
CAD	Computer-Aided Design
CCTV	Closed-Circuit Television
CD-ROM	Compact Disc Read-Only Memory
CEO	Chief Executive Officer
CPD	Continuous Professional Development
DRC	Democratic Republic of Congo
DVD	Digital Versatile Disc
EC	Electronic Commerce
EDMS	Electronic Document Management Systems
ERP	Enterprise Resource Planning
GIS	Geographic Information System
GPRS	General Packet Radio Service
ICT	Information and Communication Technology
IT	Information Technology
KTH	Royal Institute of Technology
LAN	Local Area Network
MS	Microsoft
PAPI	Paper and pencil interviewing
PDA	Personal Digital Assistants
PDF	Portable Document Format
PM	Performance Management (PM Systems)
PMBOK	Project Management Body of Knowledge
PPC	Perfectionnement Professionnel Continu
PTT	Posts, Telephones and Telecommunications
Qs	Quantity Surveyor
RDC	République Démocratique du Congo
RFID	Radio Frequency Identification
SIG	Services d'information géographique

SMEs	Small and medium-sized enterprises
SMS	Short Message Service
SNEL	Société National d'Electricité (National Electricity Company)
SPSS	Statistical Package of Social Sciences
SWOT	Strengths, Weaknesses, Opportunities and Threats
TIC	Technologie de l'Information et de la Communication
VDC	Virtual Design and Construction
VPN	Virtual Private Network
WAN	Wide area network
WLAN	Wireless LAN
WWW	World Wide Web

ABSTRACT

ICT plays an essential role in the transmission, generation, and interpretation of information for project maintenance, recycling and reusability hence it is evident today that reliance on it is unquestionable. Additionally, introduction of ICT updates the ancient methods of construction and it is therefore an agent of change. This research aimed at assessing the elements that affect ICT usage among building contractors in the DRC. To achieve this objective, the study explored ICT usage level, state of ICT infrastructure in the DRC, elements that affect the use of ICT and the relationship between tenders won and ICT usage. The study was conducted through survey method via collection of data using self-administered questionnaires distributed to the managerial level (managing directors) and personnel (quantity surveyors, project managers, IT managers and architects, engineers) working in financial class A and B contractor organizations in Kinshasa. Data was analysed by use of Microsoft excel and SPSS.

The study established that the use of ICT among DRC building contractors is moderate with ICT infrastructure status being at its rudimentary stages. Project drawings; cost and budgeting and estimating are the most highly computerised activity while modelling and visualisation; email and SMS; and internet mobile are the most common ICT tools application. The study established that budget constraints, highly charged costs in employment of ICT experts and low return on investment (financial factors), inadequate construction ICT content, concerns for losing one's employment, and satisfaction with existing working technique (human factors), speedy ICT (technological) changes, hardware and software problems related to reliability, security concerns, high ICT obsolescence rate and access to relatively cheap workforce (technical factors) and finally risks of liability, lack of legal support of use of ICT and security implications of use of Information Communication Technology to undertake transactions were the significant elements that affect ICT usage among building contractors in the DRC. The research has also established a strong relationship between ICT and the winning of tenders thus the alternative hypothesis was accepted.

The study recommends that contracting firms develop adequate policies that will devote a part of their internal budget to investment in ICT, establishment of a cooperative relationship between ICT contractors and developers for the training of professionals and the development of ICT systems and software that will meet the special operational necessities of contractors in the DRC.

1. CHAPTER ONE - INTRODUCTION

1.1. Background of research

In construction work there are a variety of stages involved. Various techniques, tools as well as incorporation and interaction of vast resources occur. For transmission, generation, and interpretation of information for project maintenance, recycling and reusability, ICT plays an essential role. It is evident today that reliance on ICT is unquestionable. This has consequently impacted positively on groups and individuals' lives thus its global dissemination (Ikechukwu et. al, 2011). Howard and Sun (2004) depict ICT effects on modern world crucial as faster rate of acceptance results into globalisation with introduction of internet: internet has been defined as an interconnection of computer networks globally. Individuals, firms and institutions, therefore, communicate easily, share and exchange data and information effectively (Weippert et al., 2003). Introduction of ICT updates the ancient methods of construction and it is therefore an agent of change as far as new cultural adoption, change of techniques and construction processes are concerned (Zachiang, 2017).

The question and criticism whether ICT is effective, productive and has quality assurance has been highlighted by the mass. Blame on the contractors serves as a response to the latter. Additionally, communication techniques and data/information sharing within a given setup affect productivity, quality of output and efficiency of a (construction) project. ICT, consequently, serves as a remedy for efficiency, productivity and quality improvement, and increased profit, a project's cost and time reduction (Gunasekeran et. al, 2001). According to Brown et. al, (1996) demand for ICT in construction emanates from the special and complex requirements of projects, time required for completion of the project, and costs budgeted for in the projects. ICT has therefore improved data and information spread in the construction sector. This has resulted into vast business opportunities being created (Doherty, 1997; Peansupap, 2006). Apparently, this discovery globally motivates construction companies and has led to faster ICT related adoption and investment: surveys simultaneously report an increase in the firms' trend (Rivard, 2000; Peansupap, 2006). It is noteworthy that the ICT adoption concept is below average in the third world countries. However, many companies in the developed countries are increasingly investing in ICT in construction. This, therefore, increases quality of products, raises production, ensures proper time management, enables control of finance and access to data and communication (Ikechukwu et al., 2011).

In as much as adoption of ICT in other sectors eliminates "paper copy documentation" hence adopting the improved, cheap, fast, accurate paper drawings and documents thus improvement of communication and information dissemination, this method is expected to explicitly win full interest of individuals in the construction sector (Farag et al., 2009; Egbu and Botterill, 2002). Crucial impeding, enabling and success elements of ICT in construction sector in technology harnessing and business streamlining were the topics of evaluation of this study. The study depicts challenges discussed as the critical elements possible for success. Likewise, the deterrents make it possible to adopt, implement, use and diffuse construction ICT (Ugwu and Kumaraswamy, 2007). Taking into account all these documentations on the growing role and interest of construction ICT it is therefore worthwhile addressing this issue in the DRC.

1.2. Problem statement

Essence and upcoming ICT role in construction is apparent from the background information. Clearly, ICT is increasingly becoming a new "must-have" that radically changes the national and international environment. It brings new impetus to business growth and well-being to projects. In the DRC, the ICT sector underwent an important development during the 1990s (Mpoto, 2004). At the centre of this development, is the orientation made by the Government towards its opening to competition. This change has led to the birth of a real telecommunications economy with, among other things, a positive externality, including the emergence of microfinance transfer institutions and the establishment of foreign firms operating in telecommunications and mainly in the phone segment (Mpoto, 2004).

High dependency on the ancient methods of information, documentation, communication and data delivery majorly challenges the construction sector in the DRC: they include face to face conducted meetings and manual paper, drawings, instruction and specification deliveries. This traditional way of communicating and dissemination of information and data is paramount in the construction sector. Anumba and Ruikar (2006) highlight the method as operating manually and slowly therefore;

- Bulky amount of paperwork: drawings and documents, are produced.
- It is tedious and time consuming to recover and manage lost papers: documents.
- Maintenance of document library archive is mandatory for effectiveness and access to data.

- Data may delay or be lost due to dependence on courier companies and other third parties.
- It is financially hectic since delivery charges are incurred while distributing documents to distant members of the project.

According to Samuelson (2002) and Doherty (1997), most construction industry experts are often satisfied with their traditional methods of working thus they find it of no essence to adopt the new emerging technologies. The construction industry in the DRC has also long suffered from inadequate performances from the traditional construction process in terms of time, quality, cost, customers satisfaction; members' cooperation, coordination and collaboration; and project completion on time and on budget.

As change is inevitable, there is need for global paradigm shift towards innovation from the traditional construction methods and processes. This will make the DRC and other parts of the world improve on productivity and output. In addition, there is improved productivity and output as a result of increased competition and demand for new methods arising due to customer awareness of the innovation in construction. This hence suggests advanced approaches in dealing with issues in construction. Since the sector seems complex, matters concerning the ICT essential areas such as finance, planning, design, implementation, approvals, and project completion must be addressed with caution (Wang, 1994). To enhance quality managerial skills, procurement, processes, collaboration, and integration, application of ICT is of essence (Sarshar et al., 2004). Integration of construction ICT is still underway: it is not fully integrated. This depicts partial integration of ICT by countable contractors and architects in construction practice (Mak, 2001).

According to Samuelson (2002), contractors are ICT and computer illiterate, these negatively impact on the construction sector: in almost all cases, contractors' practices are actualised on-site, among other factors. Borrowing from a study by Peansupap and Walker (2005), it is pretty clear that ICT is very essential and recognisable, however it is noteworthy that this new method is slowly adopted in construction sector in the DRC. The study ranks constructors the least in usage of ICT in construction. Moreover, most contractors' firms in the DRC do not seem to recognize the benefits of using ICT and are comfortable in the old traditional practices they are used to. They however recognize that they are being edged out of the market little by little by various foreign companies that come to work in the DRC with

their more innovative practices that make them more competitive thus earning the trust of customers.

The situation of the construction industry in the DRC in facing the ICT rise is still uncertain and details related to the scope and problems encountered in using ICT in construction in the DRC is undocumented. The study will thus seek assessment of the condition of the construction/building firms in the DRC in using ICT, considering the fact that such situation is undocumented for construction sector in the DRC, the country still emerging in that field.

1.3. Research questions

- i. To what level is ICT used among building contractors in the DRC?
- ii. What are the conditions of ICT infrastructure in building and construction companies in the DRC?
- iii. What are the significant elements that affect usage of ICT amongst contractors in the DRC?
- iv. Is there a relationship between ICT usage and number of tenders won?

1.4. Aim of the study

The research aims at exploring the ICT usage in building and construction industry in the DRC and the challenges affecting contractors in the DRC.

1.5. Objectives of the research

Major objectives in this study were:

- i. To explore the level of ICT usage among the building contractors in the DRC.
- ii. To assess the ICT infrastructural platform used by contractors in the DRC.
- iii. To identify the significant elements affecting the usage of ICT by contractors in the DRC.
- iv. To establish a causal-effect relation between ICT usage and number of tenders won.

1.6. Study hypothesis

Null hypothesis

HO₁: Usage of ICT by contractors in the DRC has no significant impact on the winning of tenders.

Alternative Hypothesis

HA₁: Usage of ICT by contractors in the DRC has a significant impact on the number of tenders won.

1.7. Scope of the study

The study focuses on ICT, and how it is used in construction in the DRC. To achieve the intended goal, this research is focused on how ICT is used among the building contractors in the DRC. Primary information was collected through survey questionnaires of classes "A" and "B" distributed to firms specialising in Building and Construction and Civil Engineering: upon structuring and developing the questionnaires, they were delivered to the managerial and administrative team. The study was confined to the capital city of the DRC, Kinshasa, since the latter city is ranked as a geographically large city in the DRC and the entire Sub Saharan African Region. It is as well renown to be dominant as far as construction firms of potential respondents of financial class "A" is concerned.

1.8. Limitation of the study

Due to the vastness of the country coupled with the financial and the time constraint, the research was confined to a limited area, Kinshasa, the capital of the DRC.

1.9. Research justification

Construction sector addresses an essential issue since application of ICT is essential part in construction projects. ICT usage can allow companies in the DRC in particular to access, with very little means, a large amount of potentially effective information for better decision-making. It also ensures increase in production, quality assurance, accomplishment of project within budgeted time, controls of finance, and enhances communication and information access. It can also make it possible to widen the choice of markets, customers and suppliers, for the top managers of construction projects. Similarly, ICT would make an important contribution to reducing the uncertainty surrounding the management of construction projects in the DRC. Finally, newer construction approaches are being introduced into the system which will make construction easier.

1.10. Definition of terms

Project – An impermanent effort aiming at creating special products or services. (PMBOK, 2016. 5th Edition, Chapter 1, Section 1.2, p3).

Construction Project Performance – It is the eventual accomplishment of a given project within the original budgeted range of time and specifications (Nyanga, 2016).

ICT adoption – It is a process of acceptance of change emerging within the setup of an organization and society (Kling, 1980).

Information and communication technology – Use of electronics and programs (decision support techniques) geared to store, present, transfer, analyze and control construction related information in the course of a project (Al-Hussein and El-Ghandour, 2004).

1.11. Organization of the study

This study comprises of five chapters. Chapter one includes definition of terms, background, context, problem statement, study questions, objectives, hypothesis, significance, justification, scope, and limitations of the study. Chapter two handles a review of the applicable literature related to ICT usage, needs, benefits and general challenges affecting the construction sector. The chapter also discusses the construction sector in the DRC and firms of the contractors. Elements such as means to implement ICT, barriers to ICT and as well as its importance in construction in the DRC is discussed. Techniques, driving factors, and application of ICT is also elaborated in this section. The third chapter discusses the research methodology applied, research design, sampling, data collection procedures, and analysis. Chapter four comprises the data presentation and analysis. Chapter five comprises of conclusion, recommendations from the findings and areas proposed for further studies.

1.12. Summary

This chapter presented the research background, problem statement, research questions, aim and objectives of the study, study hypothesis, scope and limitation of the study, research justification, definition of terms and organization of the study. The next chapter is devoted to the literature on usage and applications of information and communication technology in the construction industry in general, and in the DRC in particular.

2. CHAPTER TWO - LITERATURE REVIEW

2.1. Introduction

Integrated processing of data and computer technology jointly defines IT. IT entails usage of technology and equipment in storage, retrieval, transmission, and manipulation of information (El-Ghandour and Al-Hussein, 2004).

ICT is as a result of the present essence of communication as a resource on information technology. ICT therefore is regarded as a special application of IT since it possesses elements of communication. ICT is similarly identified as technology for enhancing communication, it stores and processes data and its operation has hardware, software and network involvement for transformation of raw information into its appropriate use (Farag et al., 2009).

Other ICT fields include cyber security, research network, hand-set devices, developing of software, cloud computer, and data centres, among other areas. Application of ICT in construction entails involvement of "the decision support techniques" using electronics: programs and machines in order to present, control, transfer, analyse, process, and store construction related information related to project processes in construction (El-Ghandour and Al-Hussein, 2004).

2.2. ICT in the construction sector

2.2.1. The Construction sector

Social and economic growth of any nation is obviously affected by construction sector. This signifies the essential function performed by this sector which differs depending on the structures of an individual country. For instance, there is likelihood that raw materials are extracted while construction is done on-site in a developing country. This is because of demand for infrastructural facilities such as houses, roads, and railways. A developed country in the contrary strives to provide sales for finished goods and services, and professionalism (Foulkes, 2003).

Firms for designers, constructors, suppliers, regulatory agencies, developers, and architects are among individuals and parties with major roles in the construction industry. Due to

geographical distance between these parties, it is pretty obvious that communication is critical to simplify the hectic workload and ensure effective performance of the project.

According to Love et al (1999), due to its various characteristics both on-site and off-site, the uniqueness of products and rising employee turnover, the learnt ideas on product reuse, storage, and coordination are complex to understand. This consequently results into communication breakdown and ineffectiveness in information sharing in the sector leading to dysfunction of supply chain(s). Additionally, the fact that today's construction industry is becoming more and more complex creates an urgent need of change in the traditional practices to improve productivity and face competition, therefore the implementation of adequate measures to increase project performance including the integration of innovation and technology.

2.2.2. Usage of ICT in construction

There is shifting from the ancient methods of data and communication transmission: just as in construction sector, banking, insurance, aircraft and manufacturing industries, among other goods and services providers are currently adopting the efficient digital means of exchanging data (Rivard et al., 2004). This new system is spearheaded by popularising computer usage, essence and power and by reducing costs of purchasing computer hardware and software (Rivard et al., 2004). With ICT's global discovery, there is visibility of development, benefits and change following connection of internet to computers, forming global web. This allows companies and organisations of vast locality connect by exchanging data (Adebayo, 2007). Changes in production process, culture and methods are due to occur with adoption of ICT in a given construction site or firm. This is a digital migration from the analogue approaches of production (Ruikar et al., 2005).

Variety of contractors prefer the usage of ICT since it appeals in terms of time efficiency, splendid output and improved decision making. It is noticeable that data is processed within budgeted time, and project members coordinate and communicate easily due to ICT (Peansupap and Walker, 2005). The above discussed issues are oriented towards enhancing productivity (Liston et al., 2000). There is high possibility of boosting output since the use ICT has created a global village. Internet services are accessible from various localities; urban and rural areas, towns or villages, cities and states thus effectiveness in commenting, posting and sharing of information (De Lapp et al., 2004).

In expounding on each ICT tool, Oladapo (2007) reports that it is majorly the computer hardware essential for quantity surveyors, architects, and engineers while software is commonly applied by specific professionals. CAD, processor, internet and spreadsheet are frequently used softwares in building and construction (Goh, 2005). According to Doherty et al. (1997), the software ensures better communication and presentation, improved managerial and administrative work, marketing and desktop publishing. In construction, architectural and engineering practices, the CAD is preferred in presentations, drawings and designs, while in quantity survey, the CAD is used in bill preparations, measuring of materials, presentation and estimation (De Lapp et al., 2004; Arif and Karam, 2001; Rivard et al., 2000).

2.2.3. Benefits of ICT to construction sector

Usage of ICT impacts on the ancient construction leading to changes in organizational processes, operational and cultural techniques. The key ICT benefits in construction include efficiency of time required for production processes and reporting, as well as improved way of coordinating and communicating and this ensures that decisions are made effectively among the individuals participating in the construction project thus increased output.

All construction projects in general generate substantial documentation, and a large project implies voluminous number of documents to be sorted. In a summarised form, the list below highlights among the major essential ICT accrued benefits according to Hassan and Hassan, (2011);

- i. Improvement in the quality of work: ICT improves information availability, team work, external access to records of procurement, communication between management stakeholders, integration in design process, etc. It also facilitates the process of getting meaningful information and enables data collaboration between parties in entire work without re-entry.
- ii. Productivity improvement: hourly labour productivity, increased quality of work, gains in overall factor productivity.
- iii. Management: ICT provides better information to management by improving data management, full life-cycle information management and contract administration by reducing project risk efficiently, minimizing business risk, lowers the chances of design and construction technological perils, enhancing inventory management, and therefore improving level of making design and construction related decisions.

- iv. Facilitation in the decision-making: ICT changes many business functions: decision-making information, communication information, creation information, and social data. Thus, emerges a new form of work organization, centred in particular on collaborative activities that constitute an important cultural break, especially when they involve people located in different places, hierarchical situations and temporalities.
- v. Time saving: ICT operates on a 24-hour basis. Business operations therefore can perpetually run worldwide as they are opened at any moment and place, exchange of goods and services can easily occur in distinct countries simultaneously and conveniently. It is also certain that goods and services delivery to one's specific doorstep within short time. ICT can also help in reducing the time of preparing cost plans, time required to collect construction tenders, overall procurement cycle time, invoicing time, lead times for design, project-planning time, project duration time, service delivery, communication time, time through greater transparency (fewer objections), work evaluation time, etc.
- vi. Cost reduction: reducing marketing costs, work transaction costs, operating costs, labour costs, staff requirement and training costs; leading to increased possibility of providing procurement quotations in terms of prices instantly to customers and profit margins; strategic cost savings.
- vii. Documents produced are of high quality with the reduction of errors in documents, paperwork, and an increase in the quality of information by getting more relevant and reliable data.
- viii. Reduction of the proportion of new work by improving the ability of referring back to data and reducing impact of mistakes.
- ix. Work relation: ICT improves the teamwork, the ability to develop technical skills and select appropriate staff, and the employee relations within office.
- x. Client satisfaction: attaining client expectations thus they are satisfied. This happens through focusing on clients' needs and improving service.
- xi. Response rate: quick reply to customers' inquiries, to project requirements and problems, to supplier quotations and in arrangement of impromptu project assemblies.
- xii. Market share: ICT increases the market share by achieving strategic intelligence of new markets and realizing market leadership.

- xiii. Organizational growth: improving growth and success, providing space and capacity for business growth, satisfying requirements for new technology, promoting proactive culture, etc.

2.2.4. Role of ICT in construction

The stages below highlight the role of ICT implementation in construction, and they are;

a. Tender stage

This stage is characterised by distribution and advertisement of tenders, and awarding contracts. COBRA (2009) depicts the following features of software in this stage:

- i. Stimulates document dispersal and tender communication.
- ii. Downloading of packages and registration of tenders online.
- iii. Simplified evaluation of tenders replies on standard template.
- iv. Security techniques ensuring access by only authorised personnel.
- v. Quick and easy communication on any document alteration in the event of processing any tender.

b. Design and construction stage

Cowel (2008) idealised that ICT is a mandatory requirement in construction sector: during its production and design processes. However, it depicted a difficulty for the sector to improve on ICT support in variety of its construction and design processes capable of increasing output and efficient operation (Samuelson, 2002). In order to meet the project deadlines, the managerial team and contractors participate in controlling and managing the documents by exchanging them among project members (e-Business Market Watch, 2005).

The following are functions of ICT in this stage;

- i. Improved work effectiveness.
- ii. There is "re-work" and error reduction since there is digital documentation and use of updated drawings.
- iii. It is time saving in terms of requisition for information and other approvals. It therefore provides opportunity for designers to share drawing comments and provide mark ups online.
- iv. Past and present documents or drawings are free from loss and theft since all information is kept at a central place.

- v. There is an improved communication since there is a forum for raising and responding to questions.
- vi. Every information can be tracked since there is maintenance of whole log of data.
- vii. It readily equips team members and customers with the layout of the project since a given category of software is capable of providing models of virtual realities.
- viii. Project members and customers can easily collaborate due to ease of online participation through a given website.

Use of SMS, e-mails, and cell phones are among the commonly valued informal means of communication. It enables members' "one on one" networking and cooperation (e-Business Market Watch, 2005; Peansupap and Walker, 2005; Çağlar, 2005).

2.2.5. Different ICT tools and applications in the construction sector

ICT hardware and software are very essential in the processes of construction. They therefore serve as remedies to variety of challenges in the industry. The various ICT applications are categorized as elaborated below;

Computers

There is speedy and daily development of construction related software and hardware technologies. Presently than between 1970-1980, architects and constructors use computers to speed up their operations (Howard et al., 1998). It is noticeable that depending on one's need for instance, high working speed and graphic outcome, a special configured system is purchasable.

Presentation, printing, scanning, faxing, and telephoning hardware, among other machines are compatible with a computer. In history, ICT has improved over time due to various applications and software thus positively altering the state of procuring and designing processes in construction industry. Additionally, specific applications serve specific purposes whereas a good number demonstrates compatibility with other applications. For example, there is a possibility of transferring an AutoCAD software drawing to a 3D StudioMAX model. Construction and surveying applications involving data processing and accounts ensure that results are consolidated and contacts kept for architectural and engineering practitioners. Some applications create specific models, drawings, processing, accounts records, and management of information, among other roles: present in a single package, for

instance a BIM software named ArchiCAD able to incorporate a variety of tasks jointly in a package.

Internet

Internet use exploded in 1993 as a result of World Wide / Global Web: "www" establishment leading to web commercial use amongst the non-science specialists (Sun and Howard, 2004). Through the web, individuals use computers to share videos, audios, photos, coloured graphics and texts. Publications and presentations are among the shared types of data to various websites and pages. This process is possible in any internet equipped computer or machine. This interactional connection is a stimulus to provision of universal data access. Traditionally, distance affected different medium and modes of communication thus creating barriers. For instance, in as much as radios were preferred, distortion and delays were experienced due to signal interferences. It was furthermore expensive to depend on courier companies and call abroad compared to cheap internet charges. This ensures that first-hand messages are received by the intended recipients unaltered and able to be tracked. Due to applicability of internet worldwide, any computer at any place and time can access it (Tam, 1999; Ikechukwu et al., 2011).

Networking

Distance is highlighted by Cheng et al. (2001) as a major problem in exchanging and sharing data among project participants. However, internet and network are major key role players in communicating and exchanging of data in construction sector. Network is also depicted as device or computer means of digital connections. This operation ensures ease of transferring videos, audios, photos, and music, among other files with no storage disks or any device.

Networking types;

- i. LAN: this is the network operating within a small area, it links a computer with another data processor. A construction headquarters is an example of such areas.
- ii. Virtual Private Network: this is a regulated type of networking that permits access only by specified interest for example world-wide internet. This networking enhances security among personal/private networks. Constructors prefer VPN due to its confirmed security level.
- iii. Intranet: There is restriction in terms of access to this network. It also refers to an internal network for instance, its internal presence is evident only within organisations. Announcements, news on new products and documents in a

construction firm uses intranet. This allows strictly devices and computers within the firm to access the organisational data.

- iv. Extranet: Secure network access and data provision by external companies is possible by use of this network. Just as intranet, it similarly avails information on a computer with no specified device. It is noteworthy that extranet necessitates security extension thus requiring specified software for data encryption and authentication. Extension of business applications by companies to their clients, customers, vendors, and suppliers, among other operations is therefore possible by this network. This ensures cost effectiveness, and simple data transfer thus enabling employees' telecommunication.

Electronic Mails

It is common to many individuals. By use of e-mail, apart from sending pictures and texts, one easily transfers videos, audio, music files using internet to another party. To send and receive documents, e-mail is also preferred in construction sector due to its speed and convenience. With use of e-mail, there is encryption and security assurance using an additional party software or a host of mailing site. New information is therefore exchanged in a speedy mode (Sun and Howard, 2004).

Teleconferencing

At the same time, a large number of individuals from different localities communicate by use of teleconferencing. This happens by use of videos, audios and text messages via computers. Construction project done in different places, or project done by individuals from different places is made a single unity thus enhancing effectiveness and administrative improvements, for example video and data conferencing.

Data conferences are restricted to graphics and text documents only. A similar drawing can be worked on by designers who are in geographically separated localities. With video conferencing technology, a face to face interaction is created to individuals located in different places incorporating communication and computing techniques, videos, and audios. This therefore allows electronic collaboration while sharing essential information such as pictures, documents, data and sounds. To ensure distance is no longer an impediment separating interacting individuals, constructors, architects, and developers, among other related parties apply video conferences to convey team, board of management, executive, and shareholders' meetings alongside plans and map review, job trainings and inductions as well as planning, among other activities.

Computer aided design

This is the usage of computers to modify, create, optimise and analyse designs. Drafting and CAD use ICT to design documents and for other design processes. CAD has softwares replacing hectic manual drafting using digital, fast, simple and computerised procedures. The softwares ensure exploration of design and visual concepts by animating the ideas via use of photos. This stimulates performance of designs in reality rather than in ideas. There are a variety of characteristics of CAD software, these depend on design processes undertaken. Among the two versions there is one providing graphical features with a vector of two dimensions, another with three-dimension feature on solids. Different from models that merely represents objects, ideas or concepts, 3D models represent those concepts, objects and the ideas as three-dimension polygons displayable on computers with technological advancements. Through the use of CAD's of three dimensions, a designer certainly applies variety of sources of light in rotation of objects in a 3D and therefore, a given design can be displayed at all angles (Autodesk, 2012).

As accuracy regarding relationship and size representation is equally valued, it is commonly required that the features and layout of drawings produced by engineers, architects and designers are schematically presented (Eastman et al., 2008). It is also noticeable that ease and speed of modifying and preparing drawings by use of computers is tremendously advantageous contrary to manual drawings. Various geographically situated designers specialising in areas like mechanics, structures, and landscape, among other areas are able share common drawings on their personal computers. In addition, there is a possibility of linking a drawing into a database containing particulars of a given material such as cost. This ensures that a design process such as in construction is duly examined. CAD systems, with a possibility of manual operation, are not limited to number as far model and drawing preparation is concerned (Howard et al., 1998). If advanced techniques for animation such as addition of source of light, motion paths of cameras, and materials, are used, then it will be easy to understand and use CAD model in presenting a given data since there is interactive motions like "walkthrough" and "fly-through" and production of realistically presented image.

Computer aided estimating systems

Cost control is a major essential factor in any project. To control costs most contractors are expected to make cost estimates accurately in order to attain tender prices. "WinSmesta,"

"Plainswift," "Resource Score Sheet" and "EstiMate" among other sophisticatedly developed computer software thus allowing tracking of spending and efficiently produced cost estimates by managerial team (Oladapo, 2007).

Quantity take-offs (when a bill of quantity is produced) is similarly supported by softwares such as "CATOPro," "Snape Vector," "WinQS," "Manifest," "Masterbill," and "Builsoft" (Hore, 2006; Oladapo, 2007). It is certain that there is integration of programs for costs estimation in the modern world with CAD plant, materials, data and programs. It is advantageous that there is no re-entering of cost data thus avoidance of error and improved speed.

Building Engineering Applications

Evaluation of solution to alternative designs is made possible by use of such applications. Optimum designs are therefore attainable by use of software such as Climasoft application- CARGASW, and Carrier application- ATEAN. They both offer comprehensive software designs in climatic energy. In lighting and buildings CALCULUX; in structural design, CYPE INGENIEROS S.A; to analyse finite elements, COSMOS; for water and electricity designs, DUCTISIZE (Matheu, 2005).

Planning, Scheduling, Site Management

In order to succeed in construction field, physical and human resource managers must possess appropriate skills and plan carefully. By use of computers, evaluation, adoption, execution, and planning ahead of operations is enhanced. It is not only the Power Project, Primavera and Microsoft Project packages that are used for scheduling and planning events in construction, but also the Presto Control, GEST, ICON, and Job Master which are used for tracking and logging processes in a given construction site (Paulson, 1995).

Computer Aided Facilities Management

At the dawn of the 1980's emerged a discipline named "Facilities Management" whose basis is to evaluate how a project's life-cycle cost is affected by building maintenance and operations. Data Base Management System and CAD combined is the Facilities Management's appropriate software. Therefore, reflection on possible firm changes is enabled by special routine checks; it is possible to stack and block studies for exploration of distinct layouts. In Facilities Management, databases play an essential role of holding services and data from individuals. One is therefore "followed" by one's services. In addition, reports on a

building's condition for instance can be created by a tool termed as "*Inspección Técnica de Edificios*" – ITE (Nuria, 2005).

Integration

Development of initial software triggered the rise of vast tools and equipment using data systems incompatible with one another. This results into a hectic electronic exchange of data. In the past few years, increased awareness of possibility of additional integration in construction industry has raised interest to many researchers. A platform to integrate such ideas has therefore been availed by upgraded database, product data modelling and object-oriented programs from the 1800's. STEP, referred to as International Standards Organisation, is furthermore developing high level of data standard with the support of IFC, referred to as the International Alliance for Interoperability. These standards have evolved to date as integrated database for entire construction project is maintained as a prospect of the future (Nuria, 2005).

Business and Information Management

Consumption and generation of variety of information through involvement of specialists guarantee a construction project intensive. Among these types of information are; surveying of sites, analysing of costs, drawing designs, fax, sending e-mails and files. documentation, and correspondences. In a given construction firm or project, there is forum for linking separate data into a single information with application of an Electronic Document Management System thus controlling and accessing relevant information becomes easier. In addition, there is similarly the generation of various tools and techniques essential to draft plans, schedules and for cost estimation at distinct levels of projects. It is noteworthy that the data presented during these processes are subject to updates, modifications, and consultation, among other important undertakings possible at any time during the project. Any information provided during the project is regulated by the Document Management System. This comprises the inception till maintenance of the project. These electronic systems are compatible with web-oriented systems: Web Management Systems, thus partners, and managers experience ameliorated communication. Finally, the web systems possess functions enhancing better schedules and coordination, among other functionalities (Nuria, 2005).

e-Commerce in construction

In a Tech Target Network article entitled "e-Commerce (Electronic Commerce or EC)," Rouse (2012) describes Electronic Commerce a situation where a good or a service is sold

and bought, or data/fund transmission using electronics basically online using internet connection. An EDI, a website, shopping cart, e-mail, and catalogue, are among the applications applied. It is presently an online trend by firms to persuade customers to market online by use of social media, digitalised coupons, and post adverts online.

For a long time, construction industry kept a traditional way of operating and almost neglecting or not realising the importance of the internet. Consequently, this sector was the most unproductive one compared to others. In comparison to other sectors in the engineering field such as the aerospace and automotive engineering, e-commerce adoption is depicted inefficient and limited (Anumba and Ruikar, 2002).

However, it has to be emphasised that the construction industry has a fragmented nature since the number of people participating in one operation such as the customer, fabricator, designer, architect, structural engineer and so on. Also, construction industry operates on a basis of the processes of the projects. A project is a unique and an individual operation. However, it is geared on a large scale. To accomplish a project, it requires years or months depending on the project (Erasmus, 2016). Construction as an industry, greatly contribute to the global economy. Indeed, a healthy economy most of the time means that the construction activity is doing well. Today, attitude of construction industry towards E-commerce tends to change in a positive way as they have realised that several benefits are gained while E-commerce is being implemented in the operation processes.

Compared to the traditional way of operating, E-commerce has a potential to:

- **Organisation and product promotion:** possibility to promote organisation and its product or service at a very low price.
- **Faster transactions and time saving:** it takes less time to get in touch with any party involved in the process.
- **Reduce costs involved:** costs of intermediaries are cut off as the channel will be a direct one.
- **More up-to-date information:** possibility to provide prospects with accurate information and to always keep them up-to-dated.
- **Easy and speed communication:** the internet makes it easier to get in touch with any participants involved in a transaction.

In construction industry in addition to the benefits cited above, usage of electronic commerce has other benefits like reducing paperwork, providing wider market reach, more accurate information, faster buying procedure, improved customer interaction, etc. As known, when a new strategy is being implemented, here we are talking about using the E-commerce in construction industry to meet customer satisfaction to the fullest and face the competition, an internal and external analysis commonly called SWOT (Strengths, Weaknesses, Opportunities and Threats) must be done so that all variables of the environment in which the organisation is operating can be evaluated and measures can be taken to ensure the welfare of the organisation. The following line will focus on a discussion about the external environment only, emphasising on the opportunities and threats.

Opportunities brought about by advancement of E-commerce in the construction industry:

- **New technologies:** number of people using internet is increasing day by day. People are feeling more comfortable to shop online, to consult online, etc.
- **Mega changing trends:** construction industry can now use internet to provide the best of what they can. The outcome will be totally different from the past as they will have access to multiple ideas and skills.
- **Availability:** today's customers are very demanding, with E-commerce, construction industry is now able to respond to a large number of requests without having to be physically present.
- **Advertising:** advertising become cost effective because a construction industry can promote its product or service to a large number of audiences without any fear about the costs.

Threats brought about by advancement of E-commerce in the construction industry:

- **Innovation:** prospects want new things, new products, new services, and new ways of being assisted. Construction industry cannot run away from customisation, and to succeed the key is to be as innovative as possible.
- **Competitors:** a number of big organizations in the construction are informed about the benefits of using the E-commerce. The level of competition is very high and only strong one will be able to stay on the market.
- **External environment:** variables in the external environment (physical, technological, political, social, international and economical) are not stable. They contribute a real challenge for any construction industry not to mention that the

construction industry has completely no control over them. A construction industry has no power, no control over regulations or laws which can be imposed on them.

- **Lack of trust and reliability:** participants might be afraid to share their private information thinking that they can be misused.
- **Risk of fraud:** the risk of fraud can be left behind as there is no physical interaction. Unconscious people can take advantage of that to make false transactions, orders, communication, etc.
- **Presence of Laggards in the world:** laggards are people who do not rely on group norms; their independence is rooted in their ties to tradition (Lamb et al., 2015). Construction industry will always come through such people who do not want to move hand in hand with technology improvement.

E-procurement

Carrying out tenders online or by use of IT is termed as "e-procurement. Design Building, (2016) further suggests components of e-procurement. They are as follows:

- E-informing: Involves the external and internal distribution and collection of procurement data from appropriate parties.
- E-tendering: use of technology, internet for tender processes online.
- E-auctioning: This is a web software enhancing suppliers' competition online. It provides prices for goods to be sold or auctioned.
- Vendor management: This is an application technique used in managing and procuring business staffing activities.
- Catalogue management: It is the availing of contents of products online to buyers with the aim of additional online procurement.
- Order status: it is the online tracking of orders.
- Advance ship notice: pending delivery notifications.
- E-invoicing: it is the act of exchanging invoice documents among buyers and suppliers.
- E-payment: It is the act of electronically paying for transactions made online.

A procurement process, procedure, or function with reduced human or paper" processes is automated by e-procurement software. E-procurement model is dependent on users' requirement. It is accessible on tablets and smartphones. This consequently leads to focus and realisation of high value tasks for example, contract negotiations in procuring processes of

the organisation. To implement e-procurement procedures in an organisation, challenges are inevitable. These ranges from integrating software with related systems, installing of the software, supplier liaising and supplier training for a success during transition to new systems, among other factors (Design Building, 2016). On other hand, individuals and firms benefit from e-procurement in the following ways:

- Low transaction cost
- "Automatic" and improved Reports
- Possibility of despatching the pre-qualification questionnaires and automatic evaluation of responses
- Reduced time of a tender cycle
- Possibility of tender process scheduling alerting parties with automated management
- Appraisal and weighting through e-evaluation
- Possibility of handling routine clerical check following awarded contracts, for instance making e-payments and invoicing
- Central document storage thus ease in managing contracts
- Additional tenders can be awarded since ease in management is a result of emerging competition
- Increased accountability though digital documentation, audits and tendering.
- Leads to improved partner cooperation and communication
- Proper documentation thus streamlined management of change
- There are substances, such as energy and paper use, reductions
- Accuracy in estimation of costs and data due to direct feedback solving data integration issues

ICT in construction tendering (e-Tendering)

The exchange and drawing of contract documents such as specification, bill of quantity, and tender invitation, were anciently made on paper independently. These tender processes are presently stimulated through software techniques supporting online transfer of data, better communication, and documentation by use of electronics. E-mails and storage devices like CD-ROM's memory cards, DVD's, and flash disks, are similarly applicable (Motzko et al., 2011).

In the early 1970s, a comprehensive tender procedure software tool was first innovated. It started with punch cards and consequently better methods of exchanging data were

developed. The use of internet has since then been a remedy to break down of spatial hindering factors. This is because by use of a computer, tenders' information can be exchanged from any place and binding digital signatures made within the globe at any time. Bill of quantities are prepared at the first phases of the processes through the support of the software tools. In addition, generation of tender documents and quantity calculations is enhanced for database stores information on design from building model, and from already defined specifications (Motzko et al., 2011).

In the processes of construction, there is automatic and additional filing depicting updates of added volumes and items. There is digital and structural transfer of bills of quantity to the calculation of the tenderers software thus saving money and time. The tenderer easily calculates prices basing on the provided data. There is electronic comparison, sending and reception of the tender by both the tenderer and the client. To ensue, creation of price schedule within the software of the client allows evaluation of bids following the stipulated procedure. Price or item cancellations resulting from the changes in the agreement, are possibly modified prior to the award of a given tender and appropriate alteration made in the ultimate documents of the contract (Motzko et al, 2011).

In addition, during construction process, variation agreements and calculations are supported by digitalised bill of quantity. Due to tendering online, web is viewed essential. There are consequently many platforms for specialising in public and private construction projects. From the beginning, the procurement processes in construction are supported by the online techniques and so do the offline methods. A construction process ranges from invitation download to the legal tender agreement. It is reported that large scale firms and public administration prefer the use of e-tendering for time and costs saving for example, the "Tenders Electronic Daily" of Europe. Motzko et al., (2011) further provides various types of software applicable in tender processes. They are as follows:

- i. Bill of quantity and specification preparation: this software has automatic relation of measurements to corresponding specifications depending on the given structures. Technically based norms define the specifications: usually applied as "standard text blocks"
- ii. Accounting and Costing: is a software for estimating and analysing costs. Both client and tenderer can use this software. Controlling and estimating of costs depend on information from the bill of quantity.

- iii. Unit Prices' Comparative Analysis: clients use this software in choosing a tenderer among many. This software already contains criteria evaluating the different characteristic of tenders and thus it is supportive in process of making decisions.
- iv. Web Base E-tendering: this software enhances tender processes. Requisition and dispersal of tender documents and data is role played by the web.

Mobile computing

According to Rebolj et al., (2002) electronic mobile communications has three characteristics: mobile service, device and network. In construction, the attempts of integrating the characteristics have resulted into mobile computing. It is quite noticeable that portable data terminals, notebooks, smartphones, tables, person digital assistants, and laptops, are categorized under mobile device (Ozumba and Shakantu, 2008). Such devices possess advanced applications and features such as Microsoft Windows. These applications are thus advantageous ICT application in construction industry for purposes of time and material management, safety audits, retrieval of drawings, field reports, web conferences, receiving e-mails and sending e-mails: these features are unique and enhances mobility (Colwel, 2008). ICT integration in construction also includes GPRS, WLAN and GPS technologies can ameliorate mobility of construction sites. It is difficult to find a mobile device without the above important features. With the use of GPS sites, materials, equipment, and facilities/ Infrastructure constructed like roads and buildings are located. WLAN is applied to attract a wireless internet connection. It is commonly preferred in remote areas for effective communication (Leskinen, 2008).

According to Colwel, (2008) due to modern technological advancement, mobile communication protocols and computing devices are amalgamated with mobile connectivity. This is similarly done by using bluetooth or internet wireless connections from a different phone. Data can therefore be downloaded via this means at any place with enough signal.

Building Information Modeling

The BIM uses software and processes to digitally develop building data in a manner that is collaborative and integrative. Different from computer-aided drafting (CAD), BIM leverages digital information about the building (including materials, furnishings, and equipment requirements) in a searchable database that is additive and scalable, enabling design and construction team members to participate in the virtual cocreation and co-development of a project design and operational requirements. Accurately described as virtual design and

construction (VDC), BIM facilitates three-dimensional (3D) digital development including coordination, estimating, scheduling, and material selection. BIM also creates a rich data source onto which rules-based project studies, such as occupancy simulations, fire and life-safety code reviews, and energy use calculations, can be applied. (Razzak, 2017).

2.2.6. Impact of ICT in the construction industry

Any construction project is required to appropriately implement the IT that is essential in the project. It is further identified that this sector uniquely faces various problems during implementation procedures. However, with these challenging features, other factors are indicators of change within the sector and they include:

- Inadequate skills labour and average growth in terms of age of workers.
- Low power of attraction and maintenance of educated, talented and skilled workers.
- High level of competition in the sector.
- Operational desire to work in areas identified with danger and inaccessibility.
- Need for quality improvement of work and output.
- Reduced production cost and over performing qualities favourable for competition (Perkinson and Ahmad, 2006).

Additional to the changes highlighted, in order to effectively and automatically inspect their sites, individuals' firms presently seek access to real time data. They demand for perpetual accessibility of this data. This therefore pressurise contractors to opt for IT for competitive advantage and satisfaction of the demand trends (Perkinson and Ahmad, 2006). It is vivid today that vast companies in the construction sector adopt the IT/automated systems or plan to commence in the near future. To ensue, need for role players in technological program expansion advocating for ICT arise. This requires the real time data from sites to improve managerial skills and boost making of decisions (Perkinson and Ahmad, 2006).

Contractors may integrate the IT or automated technologies leading to increased competitive advantage. These adopted techniques possess the following managerial components of analysing the whole project:

- Control Performance
- Management of equipment and materials
- Human Resource Management

Further managerial benefits accrued from ICT adoption and integration in construction sector include:

- Reduction in use of paper
- Speedy problem solving for problems are easily detected and responded to
- Operations are documented and monitored in real time
- Management capabilities are enhanced as assets, equipment and individuals can be tracked
- Management and collection of data are standardised
- Future planning is possible due to accuracy of data and performance
- History is created in resolving future disputes
- Reduced rate of verbal reports from the engineers or owners since any occurrence at the site is observable (Perkinson and Ahmad, 2006).

It is unfortunate that to date, the ancient methods are applied by some contractors in construction sector for managing and making decision within a project. This technique experiences many challenges ranging lack of record keeping to inability to convert data into meaningful information (Ligier et al., 2001).

2.3. The contractor organisations in the DRC

The Congolese Ministry of Public Works, Urban Planning, Planning and Housing (2003) classifies contractors into four distinct groups. These categories are dependent of one's job description (such as individuals specialising in plumbing, electricity, building, and maintenance, among other special areas) and financial classes of business type they belong to as listed below in ascending order:

- Class D: extremely small firms/businesses
- Class C: small sized firms or enterprises
- Class B: medium firms
- Class A: extremely large firms/companies

In general, contractors in the DRC are categorised into three main groups:

- General Contractors specialised in building residents, industries, and commercial houses.
- Civil and Heavy Engineering contractors specialised in road, highway, sewer, tunnel and bridge construction.

- Speciality Trade Contractors dealers in special and labour-intensive construction and they include the plumbers, electricians, and labour contractors among others.

Under the guidance and coordination of specialised or general contractor, construction of roads, and buildings, among other amenities, is usually undertaken. The specialists are fully responsible in ensuring the accomplishment of the project only in occasions when contractors omit part of the work for a specialist in a given area of specialisation. This implies that in construction sector there is division of labour and specialisation. Domestic workers similarly play a role in construction. As major work is done by the contractors, some contracts are delegated to subcontractors. These subcontractors are specialised in a given labour: can be single or more though related areas such as heating verses plumbing. They include the plumbers, and electricians, among others. It is the mandate from an architect, client or the general contractor to assign duties to the subcontractors. The subcontractors simply fit their duties to related trade, otherwise the general contractors are responsible for the entire construction activities and structures.

2.4. ICT in the construction industry in the DRC

2.4.1. Legacy of colonial politics

Originally, telecommunications in the DRC were used for the security of colonial agents, scattered over a vast and yet hostile territory, hence the first telegraphic posts that had to follow the colonial administrative organization. For the colonial power, telecoms were not designed in playing a leading role in economically developing the country, especially since the Belgian metropolis was a must for all communications outgoing or entering the DRC. Later, the Colonial Administration allowed large firms to own their own telecom networks regardless of the administrative division provided they did not connect third parties, accept state control and pay an appropriate fee (Mpoto, 2004).

2.4.2. Telecom Management after Independence

At independence, in the Ministry of Posts, Telephones and Telecommunications (PTT), the most trained Congolese had only six months of the postal school and therefore predestined to serve at the counter, hence the chaos after the departure of the Belgian executives. In 1968, at the creation of the PTT office, the Government uses the services of Bell Telephone Company (BTC), a Belgian subsidiary of the American company ITT, to provide for the replacement of obsolete equipment in order to give new impetus to the PTT office. In 1974, a

serious telecom planning study was initiated to set up a satellite telecom system with multipurpose stations (Musimba, 2010). Cellular telephony thus born of the marriage between the computer and the telecoms offers numerous advantages including the suppression of cable of transmission, very reduced connection time, virtual space augmentable with wish. In 1986, the country witnessed the birth of the first cell phone company to be allocated the full range of usable frequencies and even a prefix for the subsequent extension of the PTT office. 1990s marks the liberation of the PTT sector (Mpoto, 2004).

2.4.3. Internet in the DRC

Created in 1972 by the US Army and open to the public since 1983, it was only around 1995 that the internet was open to the Congolese public through some cybercafés in the capital. However, the internet in the DRC remained a luxury for a population concerned about survival (Mpoto, 2004).

2.4.4. ICT in the construction industry in the DRC

The integration of ICT in the Congolese economy and in the construction sector in particular still faces various constraints of endogenous and exogenous order. At the endogenous level, the shortage of ICT skills remains evident. Some of the larger companies recycle their staff with prerequisites in the use of ICT. In others, there are very few training plans for ICT staff. Still others rely on IT service providers outside the country. As for financial classes C and D enterprises (medium and small enterprises), the level of penetration in the ICT resource sector remains very low. The difficulties of access to finance, the high cost of ICT on the Congolese market and the lack of training in that area for some of the owner-managers and their staff, largely explain the weakness (Musimba, 2010). At the exogenous level, policies lack within professional companies to promote ICT in the sector. Similarly, policy makers have virtually no support policy for improving the business climate in the ICT field (Musimba, 2010). In addition, the poor performances generated in the energy and telecommunications sectors are preventing companies from making better use of ICTs and being competitive. According to the World Bank (2009), companies in the DRC use 40% of public electricity from the National Electricity Company (SNEL) and 60% from generators, batteries or solar panels.

Concerning telecommunications, despite efforts made in restructuring that sector, the cost of the internet is very high even though it covers the major part of the country. The lack of adequate training centres, the high cost of staff training and the difficult access to support services represent the brakes facing companies in the use of ICT in the DRC (Musimba, 2010).

2.5. ICT usage factors

2.5.1. Factors determining use of ICT (Zachiang, 2017)

a. Internal Factors

- i. CEO's academic qualifications
- ii. Business conducted in the premise
- iii. Computer Literacy Level
- iv. Age of the firm
- v. Organizational size
- vi. Demands in the sector
- vii. CEO's or managers attitudes towards ICT integration
- viii. Local or Foreign Ownership
- ix. Experience in the profession
- x. Type of business organisation, Limited Liability or Partnership, or others
- xi. Experience in the Computer Literacy

b. External Factors

- i. Competition level
- ii. Competition influences
- iii. Technological Demands
- iv. Demands from clients
- v. Software and hardware availability and affordability
- vi. Current global trend in construction

As quoted above, the factors determining the adoption and use of ICTs can be both external and internal to the company. Speaking of internal factors, among the internal factors are experience, age, and company's size, among other factors. A number of writers (David, 1975; Davies, 1979; Geroski, 2000; Hall, K., 2002; Lal, 1999; Nelson and Winter., 1982) depict

that there are various factors that can lead to adoption of new technology or innovation by a firm. They include cost and risk related to the traditional technique. It is added that it is the large companies with ability to discern the level of gain on a newly used and adopted technology. To install and purchase of new technologies in building in developing countries experiencing "perfect market asymmetry" is possible since financial resources are accessible to large firms which experience high profits. Required resources and skills are also available in companies opting for adoption of new techniques. Lastly, the benefits accrued from business production: economies of scale, are easily captured by large sized companies through learning curves and stimulates dispersal of adoption fixed costs by many units (Ben Khalifa, 2016).

Theoretically, it is difficult to fully ascertain the link between new technological adoption and age of the firm. According to Hollenstein (2004), advantages and experiences of old firms are possibly overbalanced by the high costs. Battisti (2000) further opines that corporative firm possesses seldom lacks finances and resources compared to independent firms. Therefore, a corporate firm new technological adoption. Galliano and Roux (2003) adds that firms with many units prefer technological adoption specifically ICT required for effective internal reception of services, stimuli and information through multi-establishment network. It is certain that flexibility of decision-making decisions towards ICT adoption is ineffective with these group-oriented networks (Ben Khalifa, 2016). Empirically, there exist unclear perceptions on the connection between ICT adoption and age of a firm. In Tunisia, positive correlation between firm age and adoption is depicted in majority of the companies (Ben Youssef, et al., 2010). In Ireland, a positive correlation, is similarly depicted by a survey on firms, on the two variables when selling online and using internet (Haller and Siedschlag, 2008). Other studies reveal insignificant relationship between the two variables (Ben Khalifa, 2016).

Response to external factors to boost the performance in construction sector is one of the elements determining a firm's capacity while adopting and using new technology. Increased clients' demands to improve on production and quality is as a result of competitive surrounding and created awareness. It is therefore deduced that companies operating "under pressure" from clients will necessarily prefer enforcement of high surviving power and performances, which is triggered by new technological adoption (Porter, 1990). Costs are

therefore reduced with adoption, market demands met and changes in the market adapted to, this is term as competitive advantage (Ben Khalifa, 2016; Porter, 1990).

2.5.2. Factors affecting usage of Information and Communication Technology in construction

In the attainment of competitiveness of ICT in marketing, general effectiveness, time saving, and costs reduction, among other elements, it necessarily requires investments (Çaglar, 2005). Botterill and Egbu (2002) put it that in spite of the evident ICT benefits, the rate at which construction sector stakeholders invest on ICT is minimal in comparison to other industries like accounts. It can be concluded that the following factors have resulted into the slower rate of technological adoption:

- ICT is immature
- Lack of finance
- Complexity of construction Sector
- Inappropriate ICT evaluation tools
- Inability to understand processes of implementing ICT

Çaglar (2005) thus concluded that for ICT to be deployed, the following factors are important:

- Project value
- Desire of being transparent
- Design for paperwork reduction
- Clients' demands creating competition thus increased output quality due to clients' awareness
- Availability of project experience on ICT
- Greater involvement and use of ICT terms of number
- Desire for partnership and collaboration triggered by central documentation
- Abilities of the parties to use the technologies thus increasing the applicability in innovation in product and business performance
- Desire for improved communication effective in managing data among the project members

Global trends and competition are however highly regarded as the among the most significant elements that influence ICT adoption (Oladapo, 2007; Peansupap and Walker, 2005). A

conclusion provided by Thon and Yap (1995) adoption is triggered by presence of an innovative CEO, having the desire for ICT adoption and use.

2.5.3. Barriers to implementing ICT by contractors

Tiresome and slowly performed data management processes causes problems in managing data in vast organisations. There is unavailability of appropriate policies regarding cultures, data, and impediments faced while adopting IT. Culture and structure of an organisation mismatch impedes ICT implementation thus hindering collaboration and integration of ICT. Due to decentralisation of construction sector, common participation is very essential on each project (Gyampoh-Vidogah et al., 2003). Young et al. (2001) also adds that frameworks involving multi-participation and multi-organisations is an impediment to ICT implementation. These impediments were restraints to usage and uptake of ICT adoption. In order for a company to prosper in exploiting ICT in a firm's operation, these hindrances must be resolved (ROADCON Project, 2003). Impediments like inadequate resources, incoherent ICT strategies, ICT incompetency, divide client demands, antagonist old and new costs, and reactive approaches to investments in ICT.

According to study by Rivard, (2000) there are other reasons explaining ICT adoption reluctance in construction sector. Acar et al., (2005) summarised these hindrances into three major categories: problems related to finances and operations (such as demands to upgrade the techniques and higher cost of investments); culture; and psychological well-being similarly hinder elements of essence to insemination of ICT innovation (Bäckblom et al., 2003).

The second factor applies to constructors, architects and engineers who prefer the use of ancient techniques and tools which are barriers to current trends (Doherty, 1997; Samuelson, 2002). Third, lack of ICT contextualised market solutions is another hindering factor (Egbu and Botterill, 2002). Samuelson, (2002) later depicted that in comparison to other participants in construction, contractors' ineffective or inappropriate of ICT application contributes to impediments. According to the report by e-Business Watch (2005) regarding construction sector, there are further identified hindrances in implementing ICT systems, they are as follows;

- i. Inadequate finances, ICT competency and knowledge on ICT costs and financial merits
- ii. Dependency on cultural and traditional methods of sharing data

- iii. Unavailability of a set standard in exchanging data
- iv. Terms and conditions for legal agreement and contracts such as contract validity, signatories, copyright holders and ownership of data

Zeng et al., (2007) classified the barriers into; categorical structures, how one behaves and data requirements. They impede the project members from smoothly experiencing data flow.

He classified the impediments as barriers of;

- a. Finance; financial lack, higher investment and maintenance costs; and budget constrain
- b. Organisation; unavailability of incentives, inappropriate ICT strategy, lack of support and training on ICT
- c. People; lack of individual incentives, trainings, and education; cultural influences and rigidity to changing trends. Personal opinion on software, processes, and essence of ICT are among the hindering factors to ICT implementation (Isikdag et al., 2008).
- d. Technology; infrastructural challenges, challenges of incompatibility, poor standards, challenges in using software and ICT, unsupportive ICT providers, and inappropriate definition of the processes
- e. Legality; ICT is legally unsupported, insecure ICT transaction, and liability risks, among other factors.

2.6. Summary

The literature covered the background to Information Communication Technology in construction, construction organisations in the DRC, ICT in the DRC and ICT usage factors highlighting the various barriers to implementation and factors affecting use of ICT. It is worth to note that, the aim of ICT is to increase efficiency, enable proper coordination and communication, improve managerial and administrative work all oriented towards enhancing productivity. The next chapter focuses on the study's adopted methodology.

3. CHAPTER THREE - RESEARCH METHODOLOGY

3.1. Introduction

The third chapter comprises the methodology applied in the study to achieve intended objectives. It thus includes the research design, analysis and presentation of data, target population and study approaches/strategies.

3.2. IT Barometer

Chapter two above generally reported overviews on application of ICT in construction as topic of concern in general and for building contractors in particular. Following that, the development of a conceptual framework employing a customized version of the IT Barometer solved some of the problems recognized in the literature review vivid in the study objectives. The field study adopted the format used on the IT Barometer project.

From the dawn of 1997 at KTH in Stockholm, emerged the IT barometer projects. This practice started among the Germans and the Scandinavians aiming “to create a method and perform a survey for measuring the use of IT in the construction industry” (Samuelson, 2008). The target was national samples of different construction firms within Sweden. Students' surveys via email and conducting interviews were therefore deemed the essential techniques to apply (Howard et al., 1998). This study employed a customized version of it aiming at creation of methods for performing surveys for measurements of IT use in the construction sector (Howard et al., 1998). The choice was informed by the successful use of the IT Barometer in other countries hence it has been tested. The similar IT Barometers can either be used or modifications made in carrying out research as evident in various nations and continents: Howard et al., (1998) in Scandinavia; Samuelson (2008) in Sweden; Davies (2010) in New Zealand; Arif and Karam (2001) in South Africa; Oladapo (2007) in Nigeria.

Samuelson (2008) and Howard et al. (1998) classified the main topic included in the IT Barometer the following way:

- Type and number of computers: proportions of usage of the previously, presently and ICT changing systems, and investments, to be used in the future; also includes various applications like planning, and administrative duties, among other applications.

- Type of building company: involves participants such as the engineers, craftsmen, architects, management team, investors, and supplies. Tally of staff members, office locality, work performed, and respondent's position.
- CAD: Includes CAD drawing proportions, tallying of licences, applied data structures, GIS usage and application in building, and software type.
- Level of ICT usage: includes number of digitally transferred documents, application's task proportions, number of trained staff and those in possession of computers and computer competency.
- Communication: network application: locally or widely availed, employee proportions to accessibility of better communication, frequency of use of IT, World Wide Web homepages and Intranet.
- IT role in a company: IT departments, managerial team, handbooks and strategies, staff attitude towards IT, purpose of investing, resultant change in IT usage, productivity level, investments in the future
- Questions for individual countries: usage and awareness of researches and standards, new staff ideologies and views on ICT, views on relevant areas for the study.

To attain the purpose of the study, four main elements affiliated to the study objectives focused on the contractor organizations in the DRC, covering the elements that affect ICT usage, ICT infrastructure, usage level and relationship between ICT usage and tender won.

3.3. Research design

The study design depicted that of a descriptive survey in answering any of the study questions. Descriptive research design according to Cooper and Schindler (2003) involves collecting questionnaires. In the survey, individual samples of respondents are consequently involved in answering the questionnaire. It aimed at identification of present levels of ICT uptake among building contractors in the DRC and the latter impeding factors in various firms.

This research was conducted through survey questionnaires in identification present levels of ICT usage by DRC contractors in construction and the impeding elements towards the usage of ICT in companies through the aid of integrated questionnaires. The quantitative method was applied in this study by using the survey questionnaires since it provides direct and specific responses from respondents; it also enhances explanations, counting there is also

involvement of the collection of prediction, and phenomenon of interest is controllable since data presented is numeric (Mojahed, 2005).

3.4. Study area

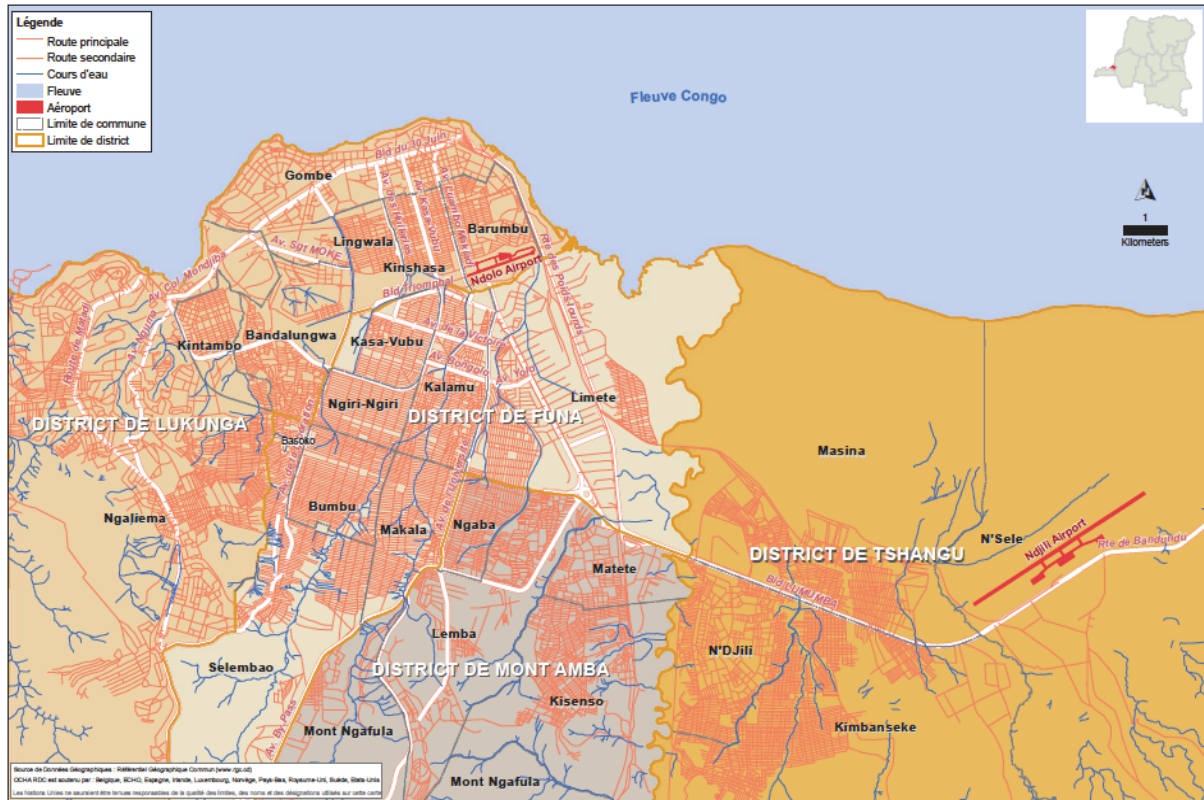


Figure 3.1: Kinshasa Province, administrative map

Source: Référentiel Géographique Commun (2012)

This study was done within the capital city of the DRC, Kinshasa. Which is the geographically deemed the largest in the whole country, with a population estimate beyond 12 million people over 9,965 km² area. Kinshasa hosts a large number of reputed building contractors ranging from small to large who are involved in construction projects that range from simple to complex and therefore sampling Kinshasa gives a representative result that most likely represent same scenarios in many parts of the DRC. The city limits are extremely extensive; the rural and forested areas within the city are rated to over 90% (especially in the municipality of Maluku). The urbanized parts are in the western parts. As part of the other Congolese 26 provinces, Kinshasa province has its independent administration.

3.5. Research instrument and target population

3.5.1. Questionnaire

The researcher prepared and personally delivered the structured questionnaires with closed-ended questions to respective respondents. The researcher divided the questions into four distinct groups:

- i. General information: concerning views on ICT, one's profession, experience, class category, demographics considering the location of the firm.
- ii. ICT Infrastructure: concerning the ICT workforce, usage of ICT software and hardware, networks and communications, and operation of the system.
- iii. ICT usage extent: inquiring on the levels of ICT application in various companies.
- iv. Impediments to usage of ICT: individuals to identify the factors hindering contractors from using ICT.
- v. Relationship between ICT and the winning of tenders: impact of ICT usage in the winning of tenders.

3.5.2. Target population

Mugenda & Mugenda (2003), depict that target population is a whole group covered by the study. In this study, the managerial level personnel working in building and civil engineering contractor organizations in Kinshasa are the target population.

3.5.3. The sample size and sampling procedures

In selection of respondents and contractors, this study used purposive sampling method and according to Mugenda & Mugenda (2003), this technique of sampling enables selection of respondents knowledgeable on the topic of discussion. Also, the study adopted that technique to select contractors and respondents following the recommendation indicated by Naoum (1998), these two criteria are crucial in selection of samples of researches. First, what is it that needs to be known? Secondly, who is to know about what is yet to be known? Furthermore, the fact that the research collects data only from a particular section of contractors in the DRC whose work and earnings in terms of finance and the work they do prerequisite to use ICT or invest in it, thus strictly selecting contractors belonging to financial Classes A and B. Additionally, it was purposive oriented to identify key respondents to the questionnaires of this research. This led targeting entrepreneurs in Kinshasa province only, in

the quest for answers relevant to the study as the DRC contractors' distribution is majorly biased and partisan to capital cities.

Israel (1992) referred to a few methodologies used in the determining the sample size for an investigation, including the use of an enumeration for small populations, and imitates a sample size of comparative researches using published tables, and lastly applying formulas of calculating a sample size. As explained by Chien and Barthope (2010) and because of the challenges experienced in obtaining exact and reliable information on the contractors' population covering the specified classes, a sample size of 100 was adopted and utilized for the for the investigation.

Table 3.1: Contractors population based on financial classification

Contractors financial classes	Sample size
A	50
B	50
Total	100

Furthermore, the total sample size of 100 corresponds to Kish (1965) formula and is adequate for large population because as the population increases, the sample size approaches 100 based on the below parameters:

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

where: n = Sample size

$$n^1 = S^2/ V^2$$

N = Population size

V = Standard error of sampling distribution = 0.05

$$S_2 = P(1-P) = (0.5) (0.5) = 0.25$$

P = the proportion of standard deviation in the population element
(total error = 0.1 at 95% confidence level)

3.6. Data collection

The primary data was derived from respondents' responses in the questionnaires distributed and collected. With the aim of capturing the views on variable indicators from the respondents, closed-ended questions were structured.

3.6.1. Pilot questionnaire

Before the completion of the main survey, took place a pilot version of the questionnaires had been tested in three construction companies in Lukunga. Another reason for the pilot questionnaires were for the intentions of eliciting questionnaire testing responses, ambiguity in the questions were to be identified, indicate questionnaires' completing time and also use various suggestions and comments to modify the questionnaire before final distribution.

3.6.2. Main questionnaire

The questionnaires administration started in June and ended in July. They were self-administered to the respondents using of traditionally used papers and pencils self-administrative interviewing methods known as (PAPI) while posting them to firms or distributing the hardcopy questionnaires in person to the selected respondents on purpose and contacted by phone or email, informing them to completely fill and collect them back.

3.7. Data analysis and presentation

3.7.1. Frequency analysis

Tables, bar charts and pie charts are among the descriptive statistical methods used in this research in analysis of the data from the answered questionnaires.

3.7.2. Mean Score

Microsoft Excel was used in the study to the variables of interest based on the scores assigned by the respondents.

The mean score was calculated as follows.

$$\text{Mean score } (I) = \sum a_1 x_1$$

where: I = Mean Score,
a = Rank of event i
x = frequency of event i

Construction experts majorly apply this formula (Egbu and Botterill, 2002; Kululanga et al., 2001).

3.7.3. One Sample T-Test

In determining whether samples derived arise from given population with specific mean, the one-sample-sample t-test is used. This is used in comparison of the mean score of a sample to a known value known as the population mean.

4. CHAPTER FOUR - DATA PRESENTATION AND ANALYSIS

4.1. Introduction

This section contains the study findings and the data derived from the survey is analysed in this section. It aimed at providing insights on the level of ICT usage, ICT infrastructure status, factors affecting ICT usage and relationship between ICT usage and number of tenders won. There was the use of questionnaires as primary source in collecting data.

The sample was 100 questionnaires to class A and B contractors in Kinshasa and managed to get a 72% response, that is, from 72 respondents. Data analysis employed descriptive and inferential statistical approaches. This response rate was very high, since responses depicting 50% are adequate, one not exceeding 60% and greater than 50% are good and responses beyond 69% are very high. It was therefore adequate for data analysis and conclusion as noted by Mugenda and Mugenda (2003).

Table 4.1: Questionnaires received for analysis

Financial class	Questionnaires distributed	Questionnaires received back
A	50	32
B	50	40
Total	100	72

Source: Field data, 2019

4.2. ICT in general

32 questionnaires were received from Class A contractors representing 44% while 40 was received from class B contractors representing 56%. Both groups had more than 50% response rate and thus were adequately represented for analysis. This has been represented in figure 4.1.

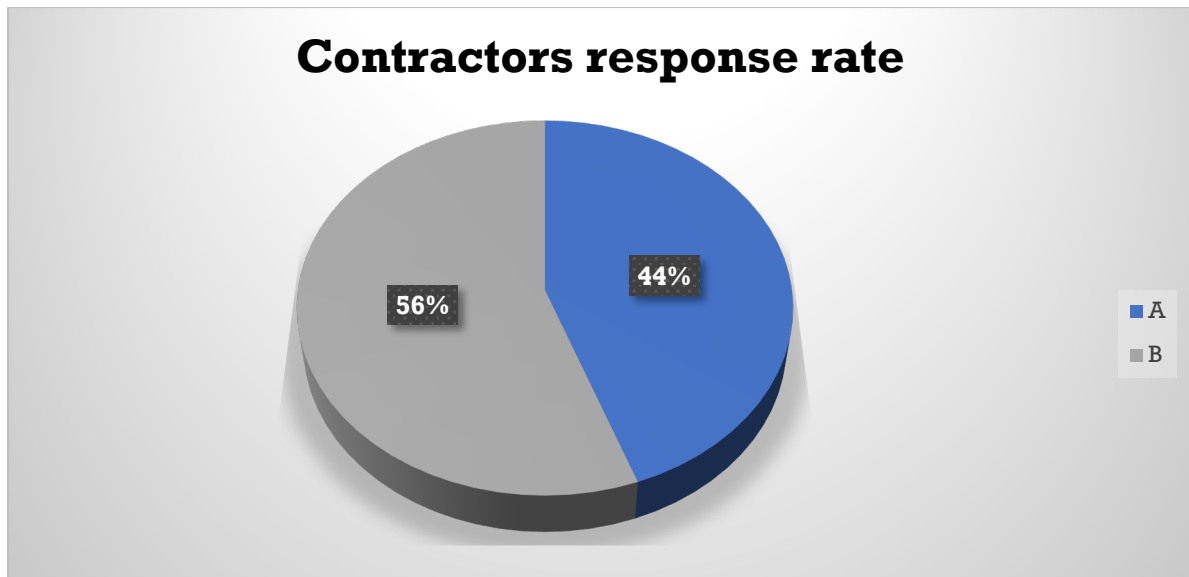


Figure 4.1: Contractors response rate

Source: Field data, 2019

Figure 4.2 displays the experience of the various contractors. The majority of the contractors possess work experience of 10-15 years and this gave a good representation of ICT usage in Kinshasa since they are firms that are already established.

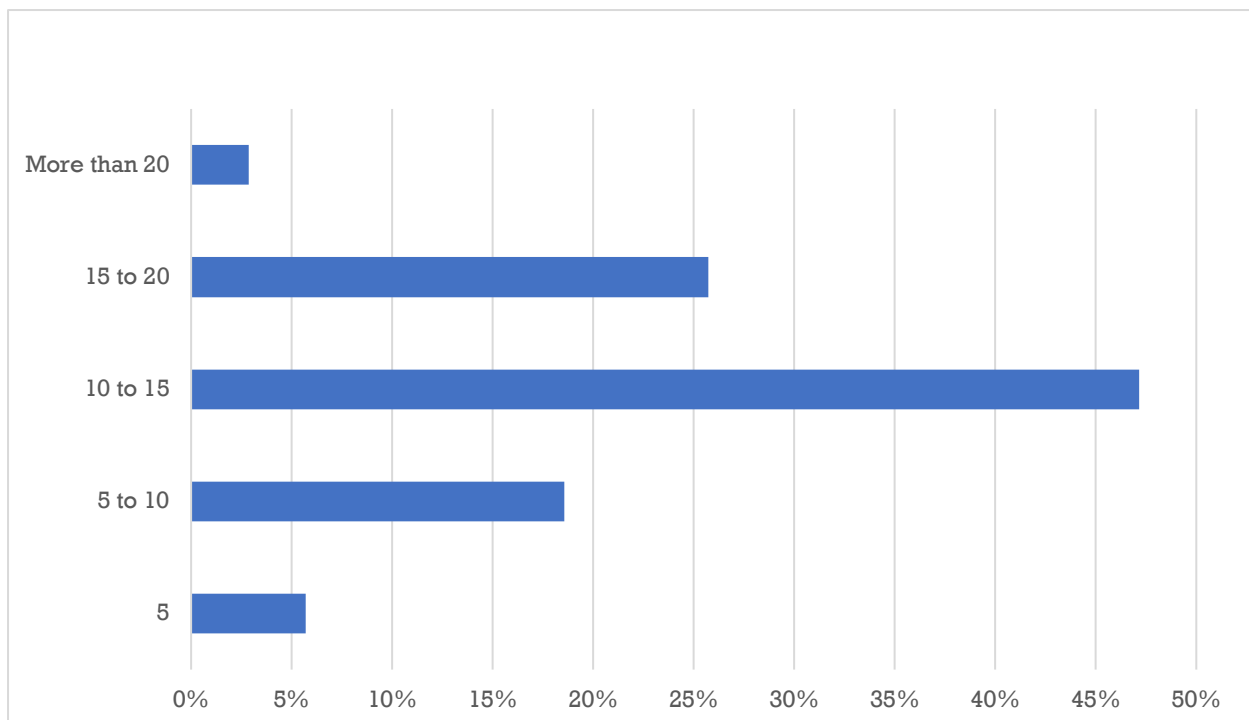


Figure 4.2: Respondents work experience

Source: Field data, 2019

Majority of the respondents constituted of trained project managers as highlighted in Figure 4.3.

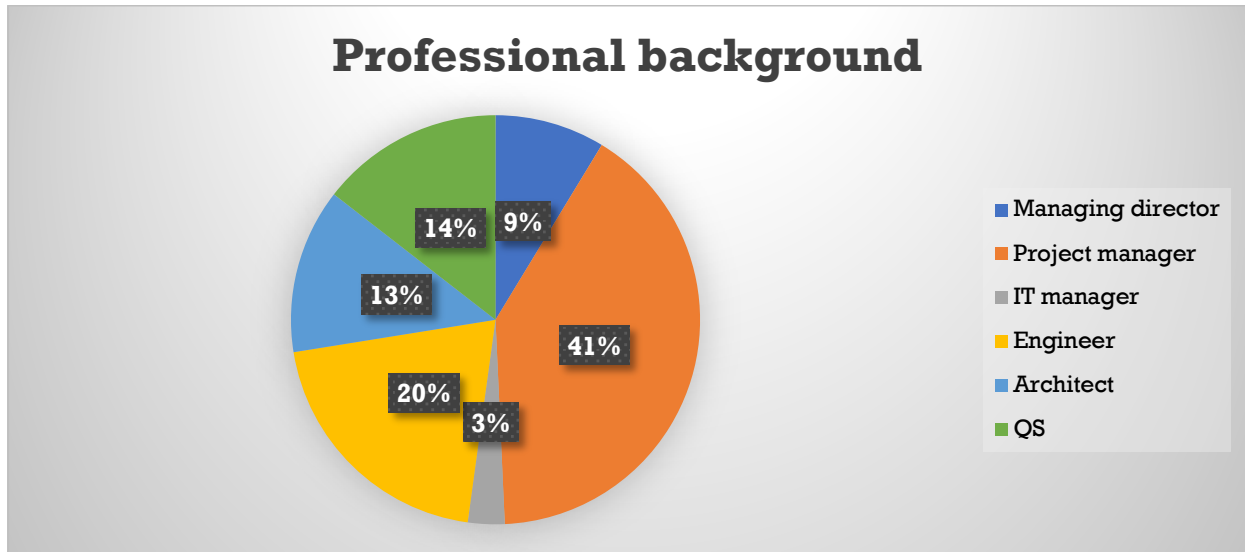


Figure 4.3: Professional background of respondents

Source: Field data, 2019

Respondents were also surveyed on extent of ICT usage. 52% indicated that the application in their firms is medium, 34% indicated low while only 14% indicated high. These results depict that a lot still needs to be done with regards to application of ICT in various construction firms in Kinshasa. This can be accomplished through dissemination of information to various contracting firms on the potentials of ICT usage while handling various construction activities.

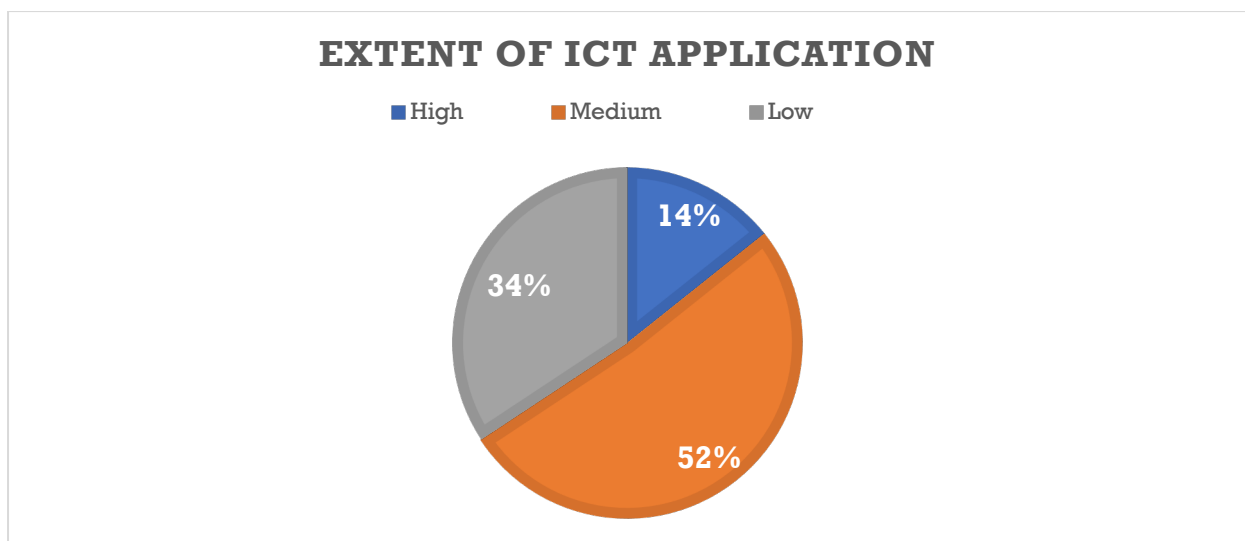


Figure 4.4: Extent of ICT application

Source: Field data, 2019

The study also aims at determining contractors views on role of Information Communication Technology in the construction industry. Figure 4.5 depicts that majority of contractors consider ICT as supporting at 43%, 42% consider it value adding while very few considered ICT as critical at 14%. This however contradicts Peansupap & Walker, 2005 who asserts that ICT is very critical to assist in performance of various construction activities like communication and data processing time reduction. This situation is different in Kinshasa since most contractors are yet to be sensitised on potentials of using ICT as a way of creating more efficiency when undertaking various works in the construction industry.

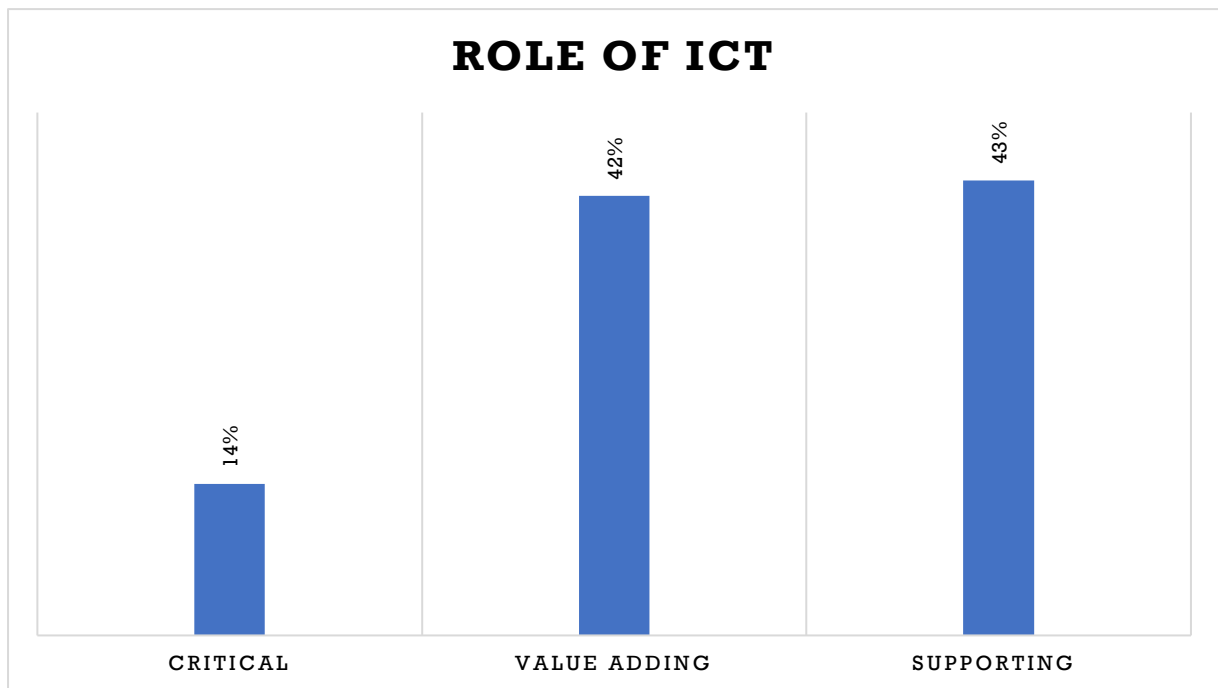


Figure 4.5: Role of ICT in construction

Source: Field data, 2019

4.3. Extent of usage of ICT

Objective one of the study was the exploration of ICT application level among contractors in the DRC. Upon request, respondents used a five-point Likert scale indicating the extent of computerization of various activities in their construction projects. Mean scores were determined and low mean score indicating low extent of usage for a given activity while a higher mean indicated a high extent of usage. Table 4.2 Indicates the mean scores of various activities while Figure 4.6 indicates the various percentages.

Table 4.2: Mean scores of level of activities computerization

Activities computerization	N	Mean	Standard dev.	Rank
Project drawings	72	4.17	0.83	1
Cost and budgeting	72	3.61	0.86	2
Estimating	72	3.44	0.93	3
Technical calculations	72	3.34	0.88	4
Communication	72	3.33	1.25	5
Progress reports	72	3.23	0.94	6
Scheduling and work planning	72	3.17	0.99	7
Accounting	72	3.10	0.98	8
Project records	72	3.09	1.21	9
Payroll	72	2.99	1.08	10
Distribution of project documents	72	2.93	1.05	11
Financial management	72	2.89	1.04	12
Project cost control	72	2.79	1.08	13
Taking off	72	2.53	1.06	14
Resources management	72	2.44	1.11	15
Purchases and invoicing	72	2.23	0.95	16
Subcontractors and supplier's information	72	2.00	1.04	17
Site management	72	1.91	1.04	18

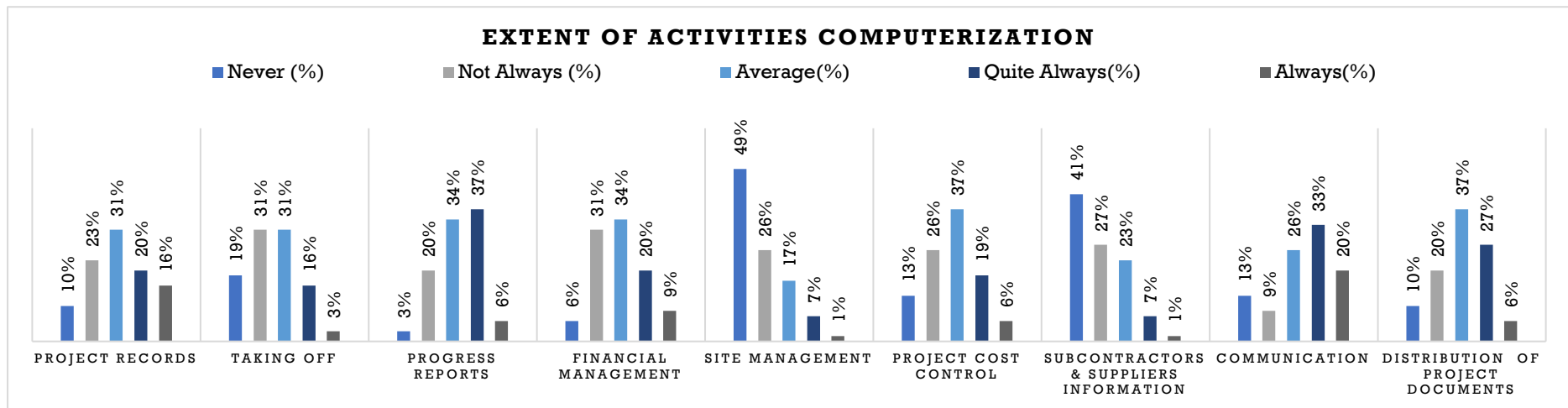
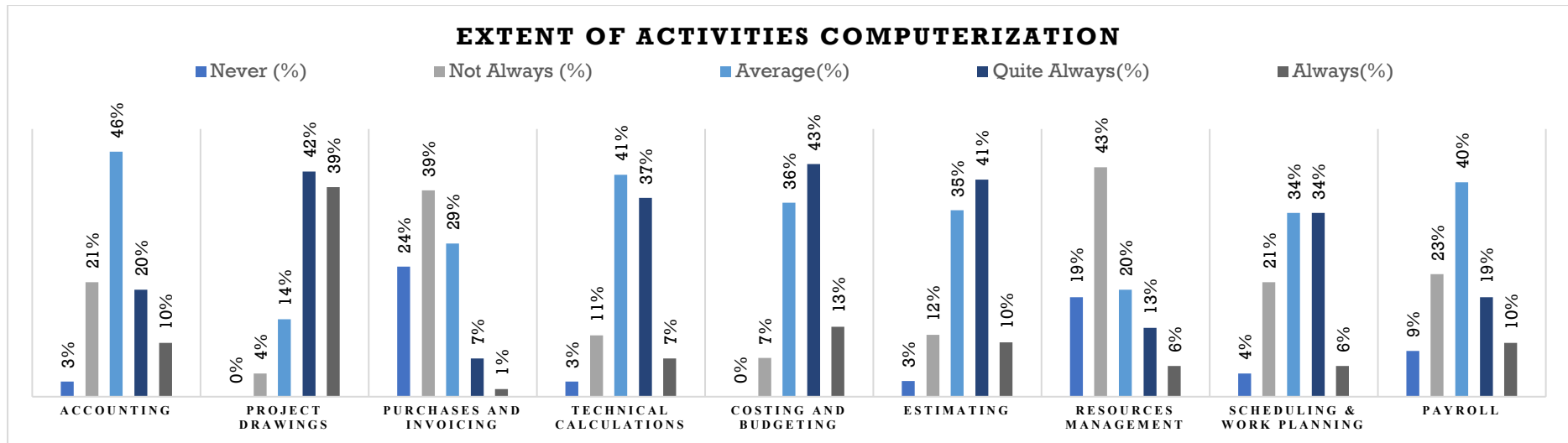


Figure 4.6: Contractors level of computerization

Source: Field data, 2019

The study revealed that project drawings were the most highly computerized activity with a mean of 4.17 while site management was the least rated with a mean of 1.89. Eight activities had a mean of 3 and above indicating an average level of usage. Activities with this rating of 3 and above are commonly and routinely undertaken activities in all construction projects hence amongst most respondents thus signifying the higher propensity of computerization. Eight activities had Std Dev of less than one showing less variation in the respondents rating on extent of computerization. As expected, most of these eight activities are the common/routine ones. 10 activities had a standard deviation greater than 1 indicating greater variations in respondents rating and again they are the less common activities.

The findings on project drawings being the most highly computerized activity can be attributed to reduction of exchange of documents in form of paper during the project initiation stage where currently there are various software's that help in exchange of various documents required during tendering as asserted by Motzko et al., (2011), companies currently move away from the traditional means of exchanging information required during tendering. This is also a reflection of greater usage of CAD amongst various project consultants. Other activities like cost and budgeting, estimating and technical calculations are also less tedious and more accurate when computerized since formulas are input and massive data is more easily manipulated. According to Oladapo (2007) most contractors are always expected to make estimates to accurately come up with tender prices thus computerization not only ensures accuracy but also allows tracking of spending with various sophisticated softwares available. Communication is key for every project to ensure information required is relayed effectively amongst various participants. Progress reports are critical in determining whether projects are on track and have appropriate remedial measures in place in case of deviations hence the high mean.

Site management having a lower mean can be attributed to most operations being undertaken in the headquarter offices hence few operations are required to be done on site, thus contractors don't consider it necessary to invest in a lot of computer software and hardware on site. Other activities that had a mean lower than 3 are majorly activities undertaken by accounts/finance teams where consideration of software used is not determined by the contractor since some of these activities are outsourced. The study sought the discovery of the level of use of various ICT tools in the contractor's companies. The level of usage of various advanced applications was below average evident in Figure 4.7 and Table 4.3

Table 4.3: Mean scores of Information Communication Technology application tools

ICT tools application

	N	Mean	Std. Deviation	Rank
Modelling & visualization	72	3.96	.863	1
Email and SMS	72	3.90	.825	2
Internet mobile	72	3.72	.892	3
Electronic tendering	72	3.43	1.005	4
Global positioning systems	72	2.19	.914	5
Videoconferencing	72	1.87	.963	6
Teleconferencing	72	1.76	.971	7
Site surveillance technologies	72	1.64	.844	8
Geographic information services	72	1.64	.893	9
Electronic purchasing	72	1.61	.723	10
Electronic document management system	72	1.47	.822	11
Radio frequency identification	72	1.36	.737	12
Project specific websites	72	1.24	.760	13
Integrated software	72	1.24	.544	14
Valid N (listwise)	72			

Source: Field data, 2019

10 application tools had a mean of below 3. This is an indication that most advanced ICT application tools level of utilization is low amongst contractors in the DRC. In as much as the level of ICT usage is moderate and contractors are aware of the various applications there are different elements (financial, technical, human, legal and environmental) hindering their uptake thus need to address these issues. Modelling and visualization, email and SMS were the highest ranked application tool with a mean of 3.96 and 3.9 respectively while Internet mobile and electronic tendering had a mean of 3.72 and 3.43 respectively. These ICT applications are commonly available and also used in day-to-day activities in projects for communication thus attributing to the mean of 3 and above. All the items had a standard deviation less than 1 except for electronic tendering indicating that there was no significant variation in the rating of the various items.

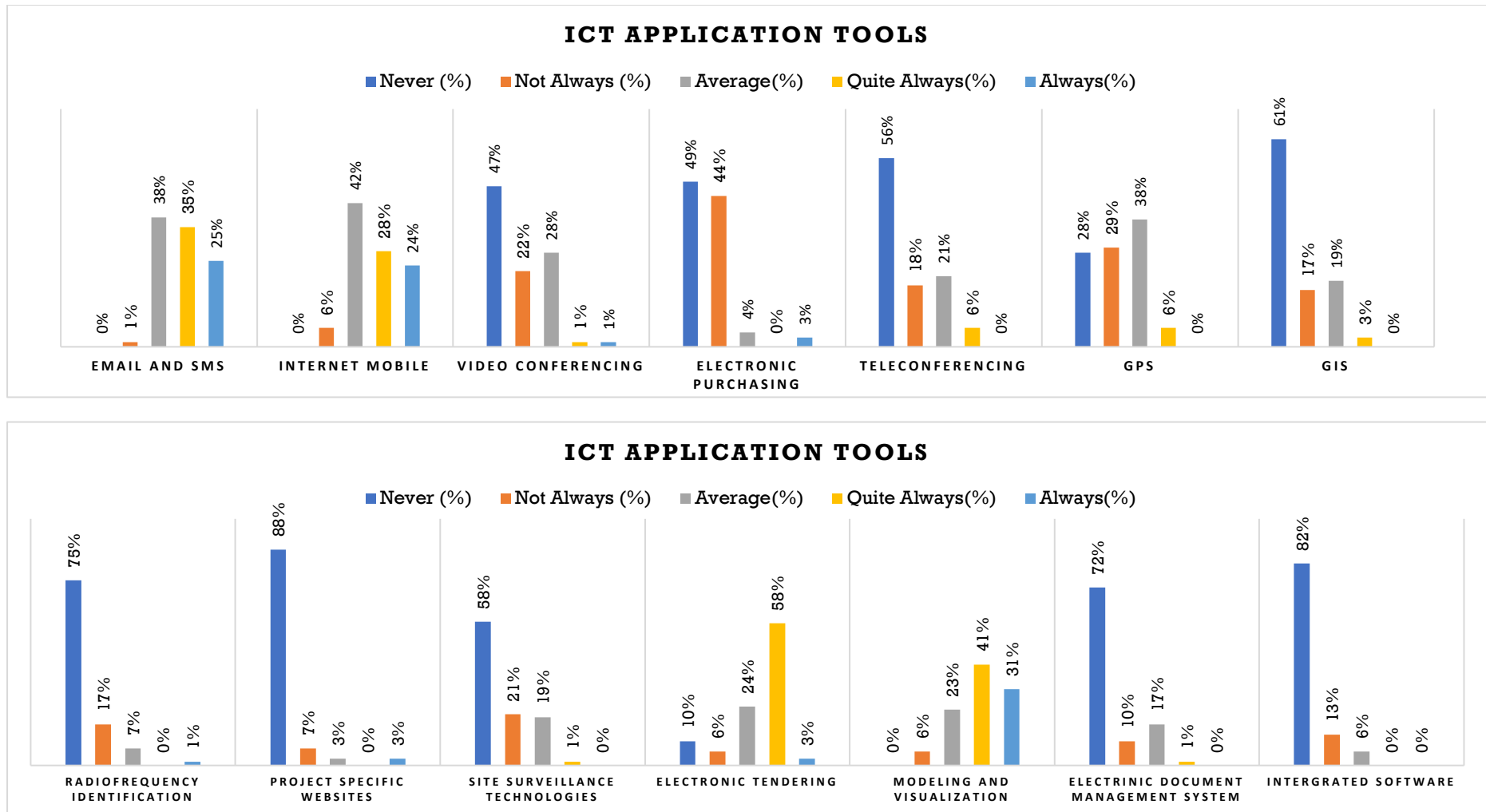


Figure 4.7: Contractors level of computerization

Source: Field data, 2019

Sun and Howard (2004), supports these findings since they assert that E-mails assists in faster sharing of information amongst various parties in the construction industry. This is further supported by Ikechukwu et al (2011) who indicates that internet is of great essence to various construction teams helping to eliminate communication barrier when professionals are in different geographical locations or even cities. Electronic tendering also helps in doing away with huge paperwork's. Modelling and visualization were the highly rated application tools and this can be attributed to allowing building data to be digitally developed in a collaborative and more integrative manner (Razzak, 2017).

4.4. Infrastructure platforms used by contractors in the DRC

Objective two of the study was the assessment of the platforms of the Information Communication Technology infrastructure used in construction in the DRC. In determining this, contractors were asked the various operating systems they are using, what determined their choice of operating system, softwares they use in various operations like project planning and scheduling, estimating and costing and computer aided design.

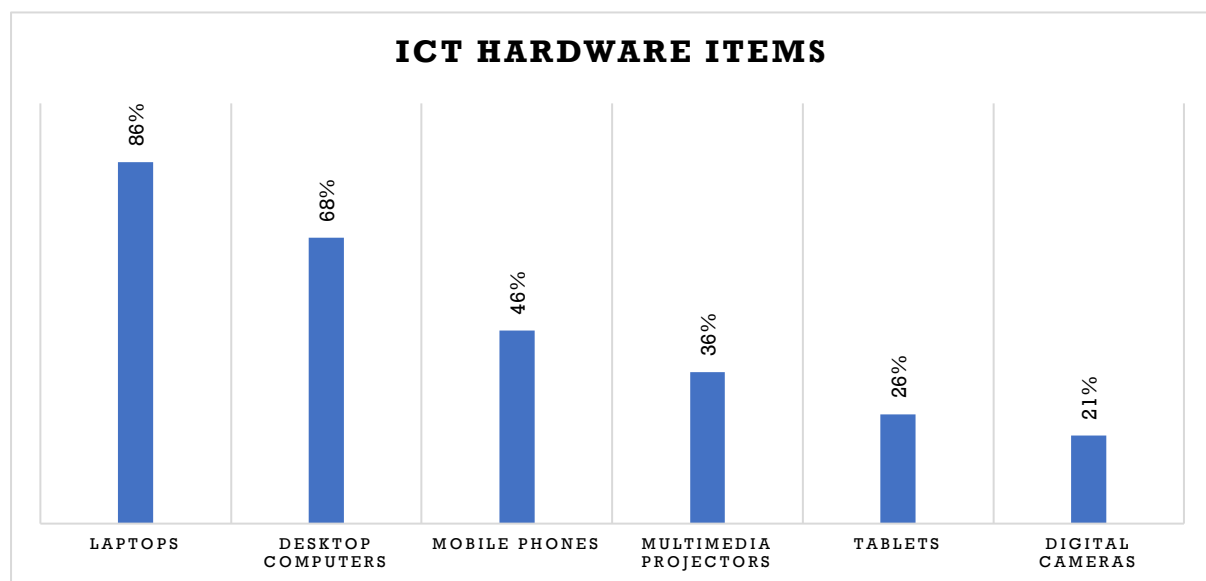


Figure 4.8: ICT hardware items

Source: Field data, 2019

Laptops had the highest rate of usage among respondents as shown in Figure 4.8. This can be attributed to them being portable hence one can easily move with them from one place to another. It had a rating of 86% usage among the contractors. Desktop computers was second with a percentage of 68%. They are found in most offices but has the disadvantage of not

being portable thus most contractors prefer using laptops. They are also not able to store power in case of power outages they can't be used if there is no back-up generator. Mobile phones were third with a percentage of 46, they assist in communication and capturing progress photos. Digital cameras had the least rating of usage at 21%, they are majorly used for taking photos but with advanced mobile phone camera applications that are able to capture clear photos most contractors find them unnecessary and they have been replaced by mobile phones.

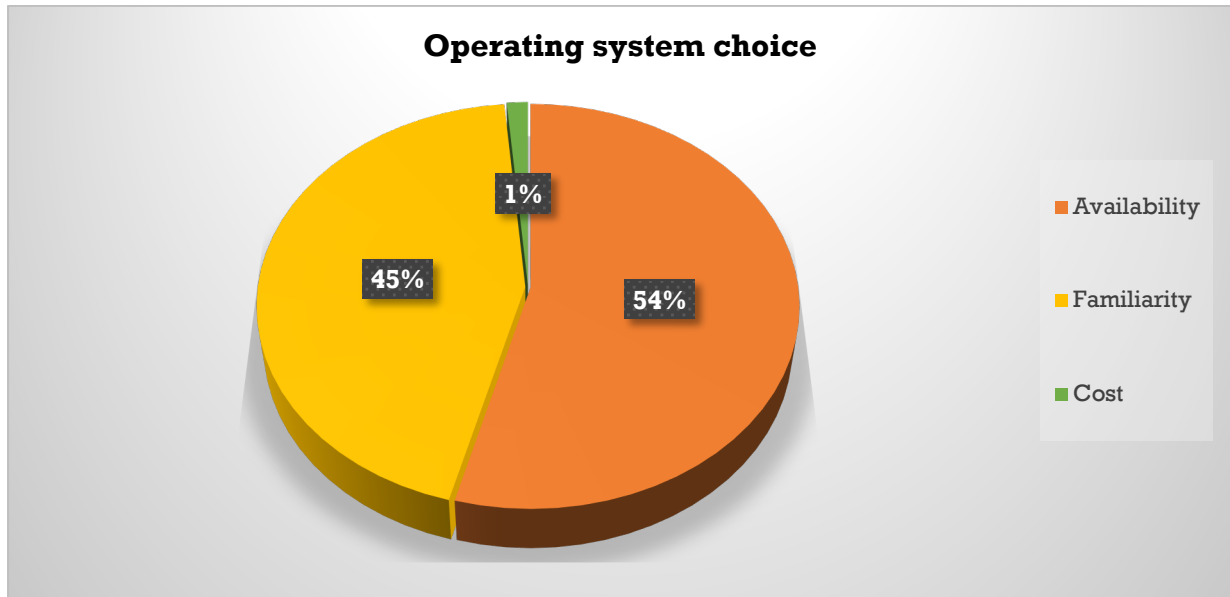


Figure 4.9: Operating system choice consideration

Source: Field data, 2019

Respondents also gave their insights on what determines their choice of operating system. Availability of operating system had the greatest impact on choice consideration with a percentage of 54 as shown in Figure 4.9. Contractors are more concerned about availability since it eases the hustle, they have to go through to acquire the operating system and time required to purchase since this can cause delays in operations. Familiarity also ensures the users are able to easily operate the various applications and also time/cost required for training is saved. It is noteworthy that cost was not a significant factor because familiarity and availability are in themselves a factor of cost i.e. familiarity helps in saving on training costs while availability saves transportation and importation costs.

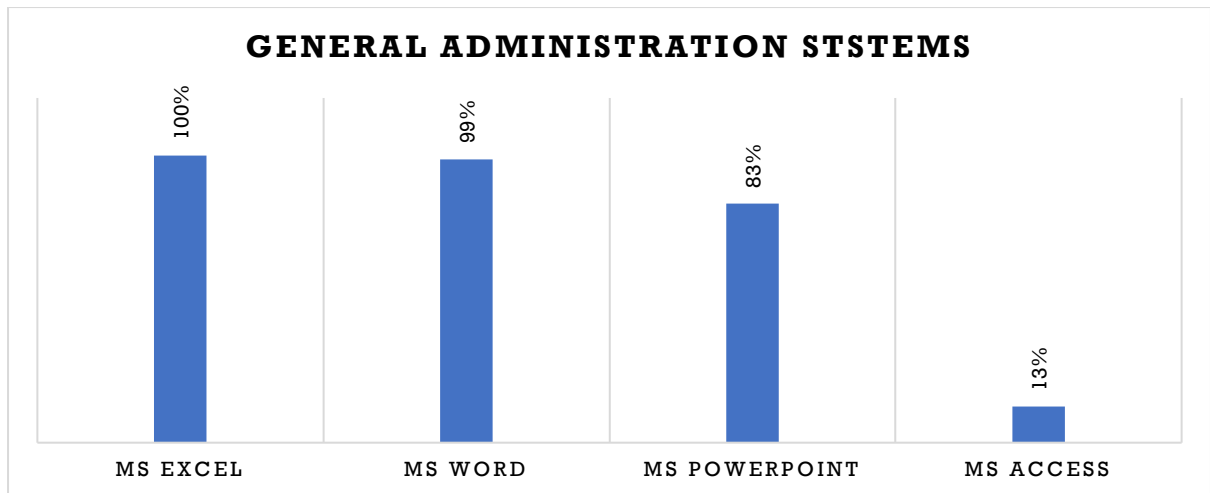


Figure 4.10: General administration systems

Source: Field data, 2019

General administration system softwares usage among contractors is very high among building contractors except for Ms Access as shown in Figure 4.10. Ms excel is 100% used by all respondents. This application high rating is attributed to lots of costing data manipulation activities being undertaken using it including preparation of Bills of quantities. Ms word was second with 99%, a lot of paperwork has to be done using this software before it can be converted in to other forms like PDF. Ms PowerPoint had usage of 83% usage mainly used for presentation. Ms access had the least usage at 13%, it is mainly used for data entry needs which can also be done using excel hence the low rating. Databases are kept using mainly excel which most respondents were extremely proficient with at a usage rate of 100%.

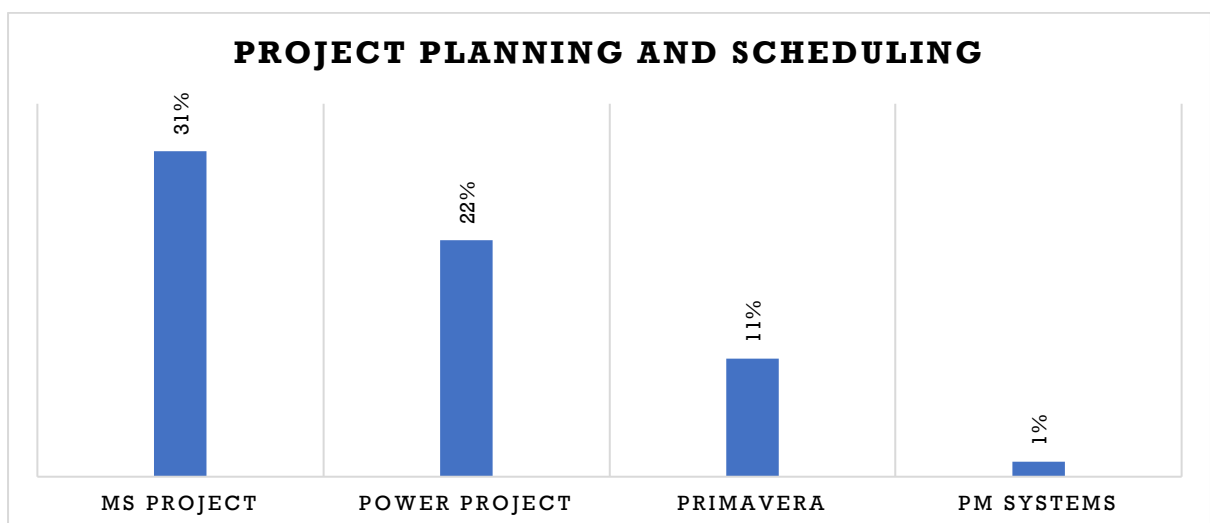


Figure 4.11: Project planning and scheduling softwares

Source: Field data, 2019

Findings in Figure 4.11 on project scheduling and planning revealed that power project and Microsoft project was highly used by contractors with 31% and 22% respectively. PM systems was the least used at 1%. This software is still new in the market and there is lack of familiarity with it hence the low rate of use. Microsoft project has been used in the industry for long hence most contractors are familiar with it. It is not only used for tracking progress but also plan and schedule for various activities and planning is very critical for all construction project success.

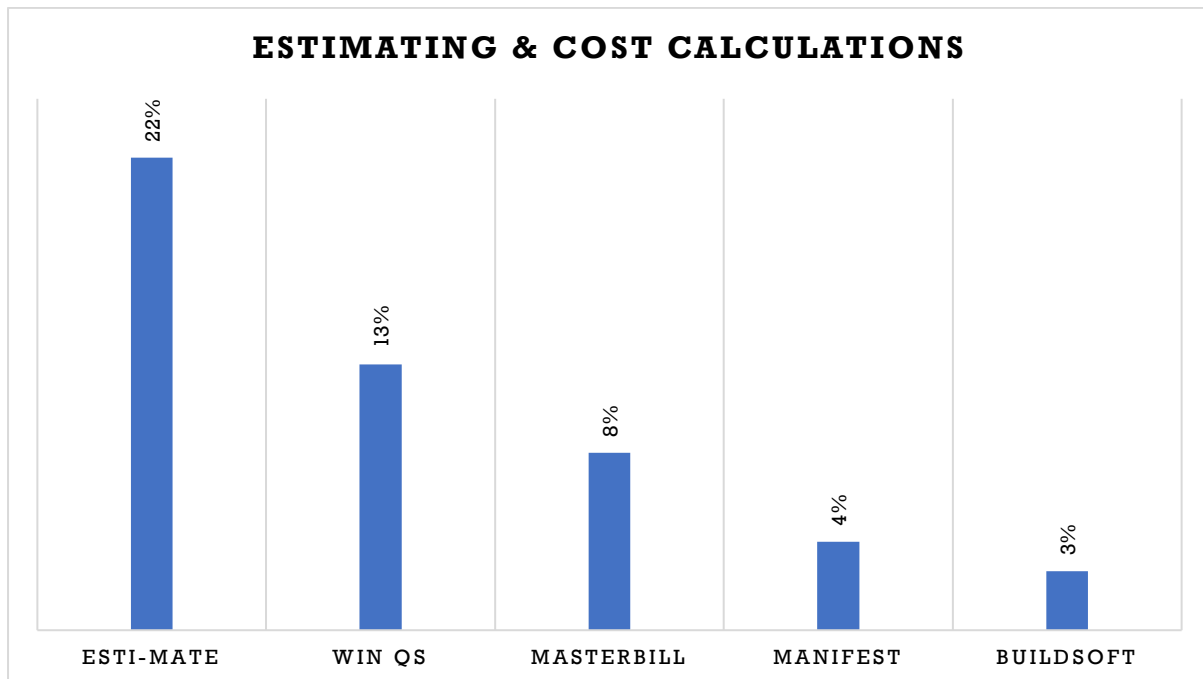


Figure 4.12: Estimating softwares

Source: Field data, 2019

Estimate software is the most commonly used Qs and estimating software among building contractors with 22% while build-soft is the least used with 3% as highlighted in Figure 4.12. The rate of usage of these softwares however is very low and to increase the uptake of these softwares contractors need to be trained on the significance of these softwares. This is similarly related to the evidence that only 14% of the contractors accounted for Quantity Surveyors. According to Oladapo (2007) these software systems not only assist in estimation but also helps in tracking of project expenses thus one is able to know if the budget is on track or off-track thus having remedial measures in place before extreme cost overruns.

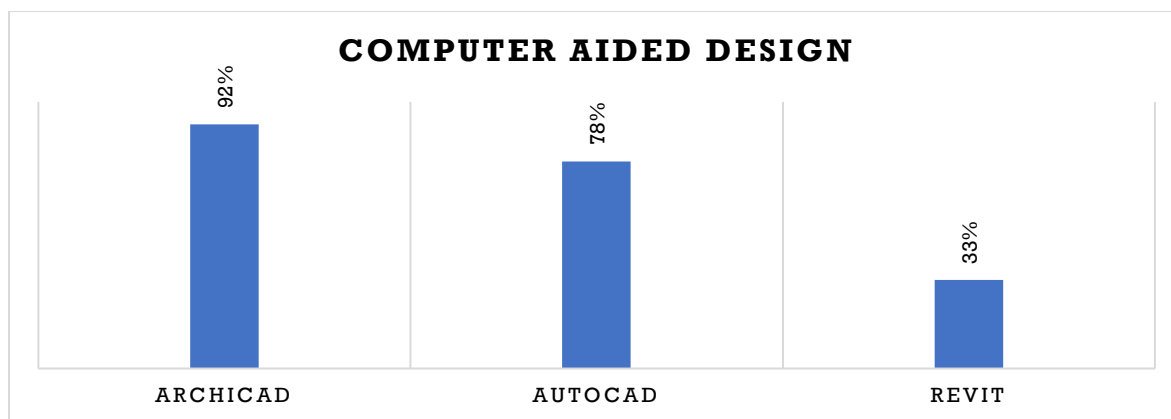


Figure 4.13: Computer Aided Design

Source: Field data 2019

Findings in Figure 4.13 discovered that ninety-two per cent of respondents used ArchiCAD, 78% used AutoCAD while 33% used Revit. This signifies that CAD is highly used amongst contractors in the DRC since most drawings are prepared and circulated in CAD highlighting the need for interpretation, better understanding and comprehension for tenderers. Other computer aided softwares respondents indicated they are using include Lumion and Artlantis studio which are normally used for architectural rendering after coming up with designs using ArchiCAD and civil 3D used by engineers.

4.5. Elements that affect use of ICT among contractors in the DRC

The research thirdly aimed at determining the various elements that affect the ICT use among building contractors. Five major variables were considered: Financial, human, technical environmental and legal factors.

Table 4.4: Financial factors mean rating

Financial factors					
	N	Mean	Std. Deviation	Variance	Rank
Budget constraint	72	4.19	1.016	1.032	1
Expensive costs of employment of ICT experts	72	3.85	.974	.948	2
Low investment returns	72	3.75	.960	.923	3
Training costs	72	3.69	1.083	1.173	4
Valid N (listwise)	72				

Source: Field data, 2019

The survey discovered that budget constraints highly impeded usage of ICT amongst DRC contractors with a Std Dev of 1.016 and 4.19 as the mean while training cost was the least rated with a Std Dev of 1.083 and 3.69 as the mean depicted in Table 4.4.

These findings differ from that of choice of operating system preference where cost was the least rated because the cost of acquiring one operating system is cumulatively low, as the single OS can be used with various computers/laptops; however, purchasing several computers is quite costly, considering the price associated with purchasing each computer/laptop and maintaining each unit. Furthermore, additional costs are incurred in electricity bills and the cost of training personnel to be efficient in handling and operating the computers, hence the difference in findings of cost being the least rated when considering an operating system and budget constraint being a major factor hindering uptake of ICT in the DRC. These findings are supported by Egbu and Botterill (2002) who indicate the slow uptake of ICT by various construction firms is a result of various financial constraints. It is however noteworthy that despite cost of training being the least rated item under the financial factors variable its mean rating was above average meaning both factors hinder uptake of ICT, but the impact is what differs.

Table 4.5: Financial factors T-test

One-Sample Test

	Test Value = 3.5					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Budget constraint	5.800	71	.000	.694	.46	.93
Cost of training	1.523	71	.132	.194	-.06	.45
Low return on investment	2.209	71	.030	.250	.02	.48
High cost of employing professionals	3.026	71	.003	.347	.12	.58

Source: Field data, 2019

T-test findings for financial factors hindering uptake of ICT among contractors in the DRC are shown Table 4.5. These findings indicate that budget constraint, low return on investment and high cost of employing ICT professionals are significant factors hindering uptake of ICT by contractors since their p-values are less than 0.05 while cost of training has an insignificant impact since its p-value is greater than 0.05 confidence level significance. These findings suggest that higher initial investment costs, inadequate resources impediments act as hindrances to usage of ICT and they need to be resolved as highlighted by ROADCON (2003). The cost of training on the other hand is not considered a barrier to uptake of ICT in the DRC because it is not expensive due to stiff competition hence training companies are forced to do a lot of marketing and offer extra benefits and subsidised rates to remain competitive.

Table 4.6: Human factors mean rating

Human factors				
	N	Mean	Std. Deviation	Variance
Satisfaction with existing method of working	72	4.04	1.156	1.336
Inadequate ICT content of construction	72	3.97	1.150	1.323
Inadequate knowledge about return on ICT investment	72	3.69	1.241	1.539
Lack of staff with appropriate skill on ICT	72	3.40	1.391	1.934
Lack of commitment by firm's management	72	3.26	1.151	1.324
Fear of job losses	72	3.06	1.197	1.433
Valid N (listwise)	72			

Source: Field data, 2019

The study revealed that satisfaction with existing working method greatly affected use of ICT amongst building contractors with Std Dev of 1.156 and 4.04 as the mean score while fear of job losses was the least rated with a Std Dev of 1.197 and 3.06 as the mean score as shown in Table 4.6. All the factors had a mean of 3 and above indicating that they all have a critical impact in hindering uptake though they have different weights with satisfaction with existing

working method carrying the greatest impact with a 4.04 mean. According to Doherty (1997) and Samuelson (2002) most construction industry experts are frequently satisfied with the ancient techniques of operation thus they find it of no essence to adopt the new emerging technologies. Emerging technologies afford a lot of advantages hence contractors need to be sensitised on the benefits it has than the traditional methods of working (Isikdag et al., 2008). T-test findings for human elements impeding uptake of ICT among contractors in the DRC shown Table 4.7 indicates that inadequate ICT content of construction, fear of job losses and satisfaction with existing working method are significant factors hindering uptake of ICT while lack of committed managers, incompetence on ICT investment issues and insufficient personnel and inappropriate skills on ICT have an insignificant effect towards hindering uptake of ICT by contractors with their p-values greater than 0.05 while inadequate ICT content of construction, fear of losing job and ideology that existing techniques are satisfactory hinder uptake ICT, the p-values were less than 0.05 significance level. These findings reveal that individuals are normally not ready to easily divert from the traditional ways of undertaking various activities and this acts as a barrier to uptake of ICT. Potentials of ICT needs to be addressed in construction firms for changes to occur. In most West African countries, the issue of unemployment is still being battled with, the fear of job losses always makes it difficult for changes to be accepted (Doherty (1997) and Samuelson (2002)) and this is the case in the DRC. However, it is noteworthy that usage of ICT in undertaking various construction activities would not cause job losses but rather create employment (Isikdag et al., 2008). Individuals only need to be trained on how to use the ICT applications to undertake the various activities. Concerning inadequate ICT content for construction, these findings suggest that most respondents not aware of the vast range of ICT applications for construction. As highlighted in previous section of this study, majority are more conversant with project drawing tools i.e. CAD suggesting that learning institutions need to develop a more robust system of an all-inclusive curriculum for acquisition of diverse/emerging construction ICT skills.

Table 4.7: Human factors T-test

One-Sample Test

	Test Value = 3.5					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Inadequate ICT content of construction content	3.483	71	.001	.472	.20	.74
Lack of commitment by firm's management	1.741	71	.086	-.236	-.51	.03
Inadequate knowledge about return on ICT investment	1.330	71	.188	.194	-.10	.49
Lack of staff with appropriate skill on ICT	.593	71	.555	-.097	-.42	.23
Fear of job losses	3.150	71	.002	-.444	-.73	-.16
Satisfaction with existing method of working	3.976	71	.000	.542	.27	.81

Source: Field data, 2019

Table 4.8 : Technical factors mean rating

Technical factors

	N	Mean	Std. Deviation	Rank
High rate of ICT obsolescence in the DRC	72	3.93	1.271	1
Access to relatively cheap workforce	72	3.93	1.105	2
Rapid changes in ICT technologies	72	3.90	1.235	3
Problem of ICT integration	72	3.44	1.161	4
Software and hardware reliability problems	72	2.78	1.21	5
Security concerns	72	2.54	1.278	6
Valid N (listwise)	72			

Source: Field data, 2019

Results in Table 4.8 discovered that high ICT obsolescence rates and accessibility to comparatively inexpensive manpower were the highest ranked elements with a Std Dev of 1.27 and 3.93 as the mean and 1.105 Std Dev comparatively and the least rated element was security issues with a Std Dev of 1.28 and 2.54 as the mean. The six undertakings had a Std Dev greater than one showing that all the responses had a variation while determining the rates technical causes impeding ICT adoption.

Table 4.9: Technical factors T-test

One-Sample Test

	Test Value = 3.5					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Rapid changes in ICT technologies	2.767	71	.007	.403	.11	.69
Problem of ICT integration	.406	71	.686	-.056	-.33	.22
Software and hardware reliability problems	5.053	71	.000	-.722	-1.01	-.44
Security concerns	6.365	71	.000	-.958	-1.26	-.66
High rate of ICT obsolescence in the DRC	2.875	71	.005	.431	.13	.73
Access to relatively cheap workforce	3.307	71	.001	.431	.17	.69

Source: Field data, 2019

Findings in Table 4.9 point that rapid changes in ICT technologies, ICT integration challenge, hardware and software dependency problems, security issues, high ICT obsolescence rate in the DRC and access to relatively cheap workforce have a significant impact on impeding adoption since the p-values are less than 0.05 while challenge of integrating ICT has an insignificant effects towards impeding adoption of ICT by contractors with p-value greater than the significance level of 0.05. In the DRC labour is relatively cheap

hence tasks can be done manually at fair rates without having to use ICT thus acting as a hindrance in investing in ICT. ICT also keeps on changing time from time with new trends emerging thus most firms find it difficult to keep up due to the high rate of obsolescence which exacerbates the hindrance. Additionally, softwares also tend to be unreliable at times if not properly protected from computer virus attack and this can lead to loss of important information in case there is no back up data.

Table 4.10: Environmental factors mean rating

Environmental factors				
	N	Mean	Std. Deviation	Rank
Inadequate jobs in the market	72	3.67	1.267	1
Majority of clients not interested in firm's ICT base	72	3.63	1.399	2
Valid N (listwise)	72			

Source: Field data, 2019

The research depicts that insufficient jobs with a Std Dev 1.267 and 3.67 as the mean while majority of customers not interested in companies' ICT base had a Std Dev of 1.399 and 3.63 as the mean as highlighted in Figure 4.10. The undertakings noted had a Std Dev greater than one indicates that all the respondents had a variation in showing rates of the environmental elements hindering usage of Information Communication Technology.

Table 4.11: Environmental factors T-test

One-Sample Test

	Test Value = 3.5					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Majority of clients not interested in firm's ICT base	.758	71	.451	.125	-.20	.45
Inadequate jobs in the market	1.116	71	.268	.167	-.13	.46

Source: Field data, 2019

Evident in Table 4.11, the majority of customers not interested in companies' ICT base and insufficient jobs have an important effect on impeding the ICT uptake by contractors because their p- values were greater than the significance level of 0.05. These findings reveal that for the case of the DRC it's not true that most clients are not interested in firms ICT base but rather their demands on ICT expectations is not very high nor is lack of adequate jobs since a high rate of ICT usage in itself would create jobs hence these two factors do not hinder uptake of ICT.

Table 4.12: Legal factors mean rating

Legal factors

	N	Mean	Std. Deviation	Rank
Security implications of ICT transactions	72	3.10	1.136	1
Lack of legal support of use of ICT	72	3.08	1.172	2
Risks of liability	71	2.93	1.066	3
Valid N (listwise)	71			

Source: Field data, 2019

Security transactions, insufficient legal support for ICT usage and liability risks were examined under legal cause. Table 4.12 shows the degree to which these elements impede ICT usage among contractors.

Table 4.12 depicts ICT transactions security implications as the highest in ranking with a Std Dev of 1.136 and 3.10 as the mean while risks of reliability had a Std Dev of 1.066 and 2.93 as the mean. The four undertakings had a Std Dev greater than one showing that all the responses had a variation while determining the rates legal factors impede ICT adoption.

Table 4.13: Legal factors T-test

One-Sample Test

	Test Value = 3.5					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Risks of liability	4.534	71	.000	-.569	-.82	-.32
Lack of legal support of use of ICT	3.017	71	.004	-.417	-.69	-.14
Security implications of ICT transactions	2.978	71	.004	-.401	-.67	-.13

Source: Field data, 2019

Findings in Table 4.13 unveil that all these elements have significant effect on impeding adoption of ICT by contractors because they had a p-values less than 0.05 significance level. ICT requires continuous protection against malwares and if this isn't taken care of, they can end up being unreliable and continuously fail during tasks and lead to loss of information and also transactions done over the internet requires protection against hacking which can lead to losses in a company. Terms and conditions for legal agreement and contracts such as contract validity, signatories, copyright holders and ownership of data are legally unsupported thus act as an hinderance.

4.6. ICT usage and tenders won

The final aim of this research was determination of the relation between ICT usage and tenders won among contractors in the DRC. The study established that all the 72 respondents had submitted and received tender documents electronically. Respondents further indicated the percentages of tenders received or sent electronically as illustrated in Figure 4.14.

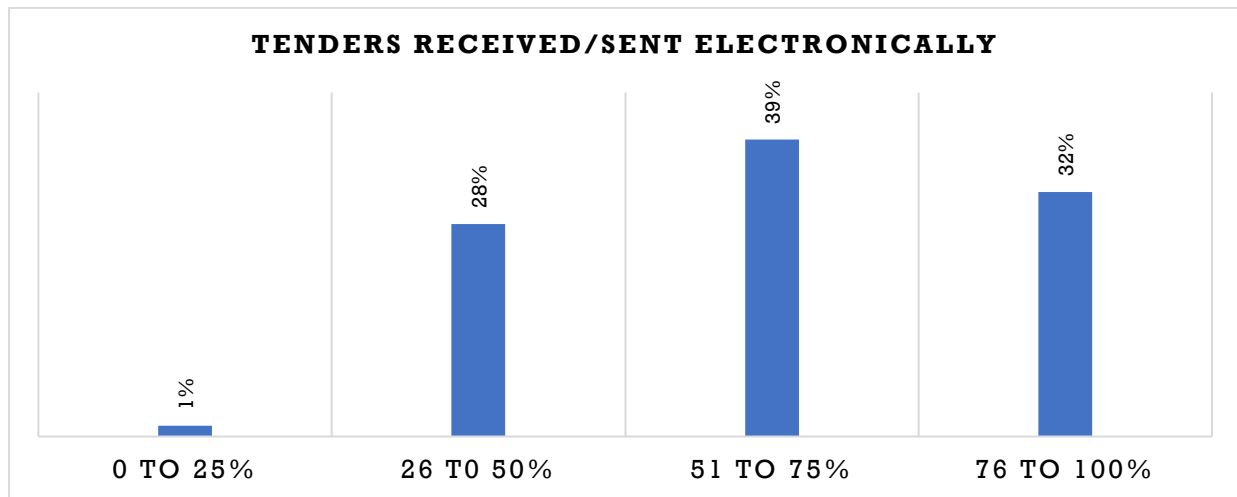


Figure 4.14: Tenders received/sent electronically

Source: Field data, 2019

These results depict that a high percentage of tenders amongst contractors in the DRC are being submitted electronically. This increases ICT usage, helps to reduce the amount of paperwork involved and also it makes it easier for contractors in different geographical location or cities to easily receive and submit tenders on time enhancing competition. Accordingly, the study further revealed that all the respondents were aware of e-tendering opportunities with the majority (40%) being very aware as shown in Figure 4.15.

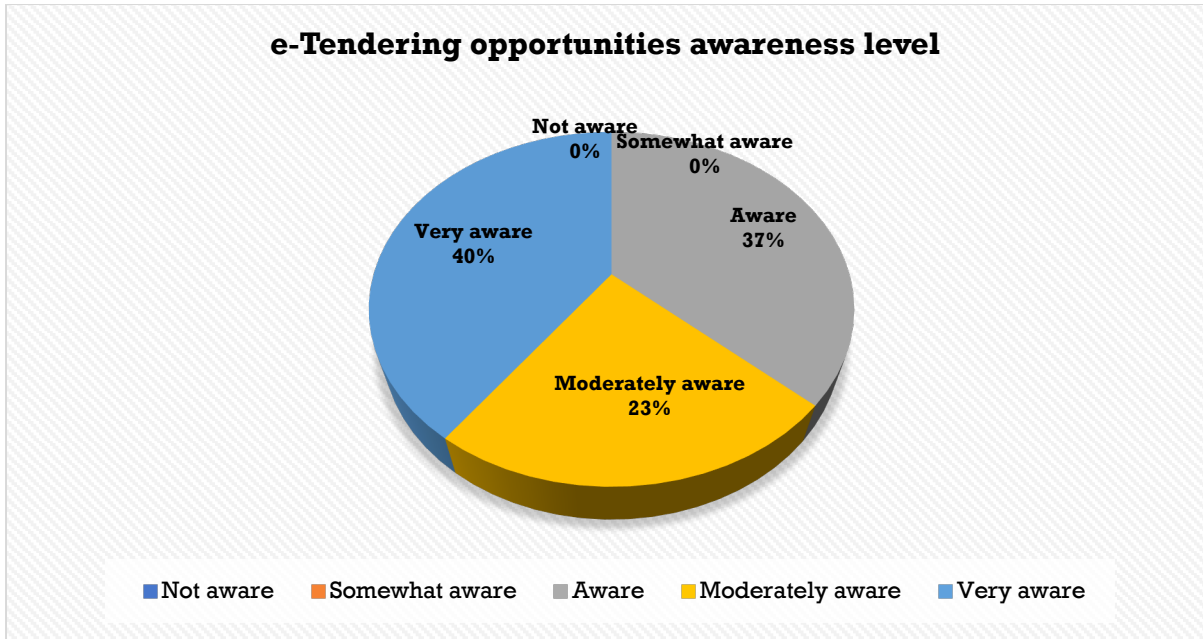


Figure 4.15: Level of awareness of e-Tendering opportunities

Source: Field data, 2019

These results are an indication that the level of e-tendering is high among contractors in the DRC as further supported by the tenders received and sent electronically.

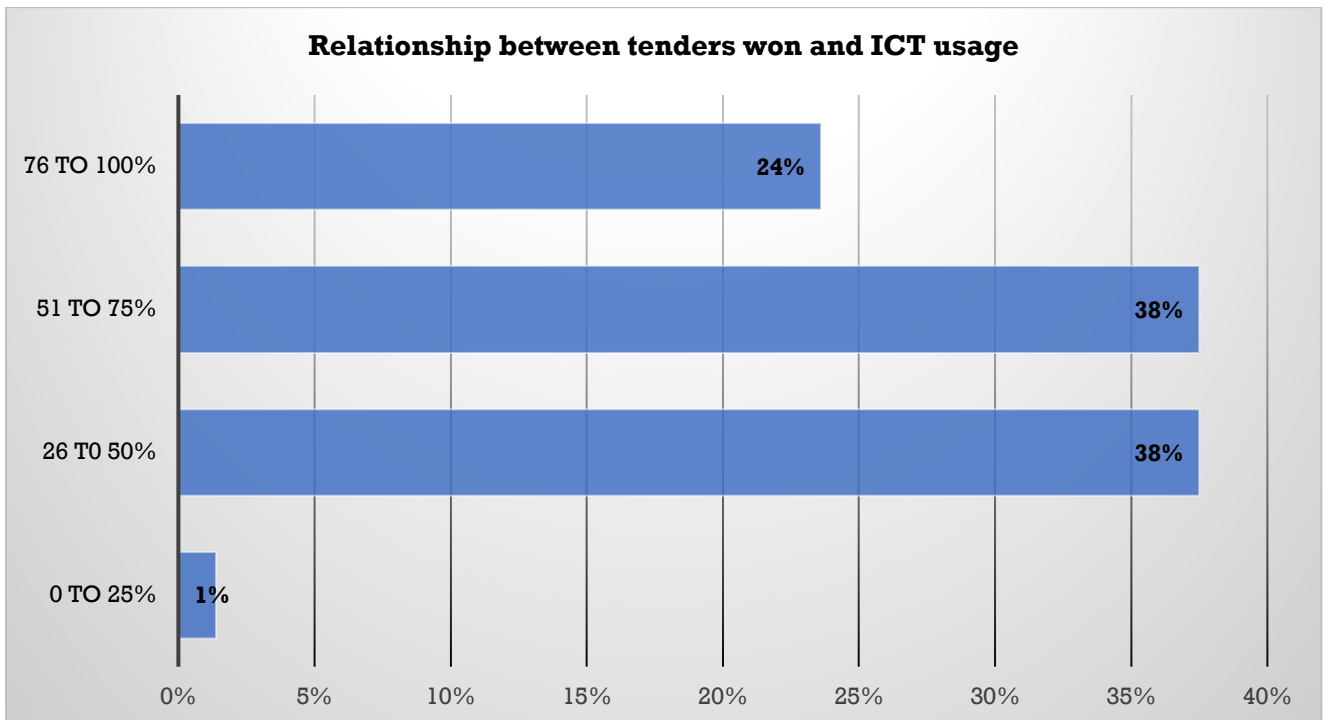


Figure 4.16: Relationship between tenders won and ICT usage

Source: Field data, 2019

4.6.1. Hypothesis testing

The independent variables (tenders submitted/received electronically and level of ICT usage) were tested to establish whether they were determinants of dependent variable (tenders won) using multiple regressions. 0.05 level of significance test was assumed. The regressions tests were carried out on the independent variables; tenders submitted electronically and level of ICT usage against the dependent variable; tenders won and thereby estimated the model.

The linear regression used in this model was:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \mu$$

Where: Y = Tenders won

α = Constant

μ = Error

β = Coefficient of the independent variables

X1 = Tenders submitted electronically

X2 = Level of ICT usage

Table 4.14: ANOVA for tenders won

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	23.508	2	11.754	36.058	.000 ^b
	Residual	22.492	69	.326		
	Total	46.000	71			

a. Dependent Variable: Tenders won

b. Predictors: (Constant), Tenders submitted/received electronically, Level of ICT usage.

Source: Field data, 2019

Null hypothesis is accepted if p-value >.05 (at 5% level of significance).

Null hypothesis is rejected if p-value <=.05 (at 5% level of significance) and alternative hypothesis is accepted.

From Table 4.14 it can observed that p-value = .000. Since p-value <0.05 (F=36.058, P-value=.000), null hypothesis is rejected and alternative hypothesis accepted. So, at the 5% significance level (i.e. $\alpha=0.05$, level of significance), there exists enough evidence to

conclude that at least one of the predictors; Tenders submitted electronically and level of ICT usage, is useful in predicting the tenders won. Therefore, the model is useful.

Table 4.15: Coefficients for study model

Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	.988	.342		2.892	.005
Level of ICT usage	.028	.052	.048	.543	.039
Tenders submitted/received electronically	.690	.088	.697	7.823	.000

a. Dependent Variable: Tenders won

Source: Field data, 2019

From the results in Table 4.15, the p-value for level of ICT usage is .039, and tenders submitted/received electronically is .000. Since the p-value for each predictor variable was less than 0.05, there is an indication that there was a significant relationship between each independent variable and the dependent variable. This is to say that all the predictor variables; level of ICT usage and tenders submitted/ received electronically could be used to measure (estimate) the dependent variable, tenders won. Further, the adjusted R² was 0.511, which means that 51.1% of change in tenders won is explained by the independent variables. This is shown in Table 4.16, which indicates that the coefficient of determination was .511, implying that a variation in level of ICT usage and tenders submitted/received electronically cause an increase of 51.1% of tenders won.

Table 4.16: Model summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.715 ^a	.511	.497	.57094	.511	36.058	2	69	.000

a. Predictors: (Constant), Tenders submitted/received electronically, Level of ICT usage

Source: Field data, 2019

It should also be noted that all the predictor variables; level of ICT usage and tenders submitted/received electronically β -values were positive. This was an indication that they were directly proportional to tenders won in which case an increase in any of them; level of ICT usage and tenders submitted/received electronically caused an increase in tenders won. Given that contractors are in business, it can be deduced from these findings that investment in ICT is a worthwhile strategy.

5. CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1. Introduction

This research aimed at exploring the use of ICT in the DRC construction industry. To achieve this, four main objectives summarized below were adopted:

- Exploration of ICT usage level among the building contractors in the DRC.
- Access the ICT infrastructural platform used by contractors in the DRC.
- Identify the essential elements affecting the usage of ICT by contractors in the DRC.
- Establish a causal-effect relation between ICT usage and number of tenders won.

This chapter lays out a summary of the findings, conclusions and recommendation of the study based on the data analysis, and discussions presented in the previous chapters.

5.2. Summary and conclusions

The results have shown that the majority of respondents who contributed to the study consisted of Project Managers (41%) followed by Engineers (20%), Quantity Surveyors (14%) and Architects (13%) from companies with more than 10 years of experience (47%) in the construction sector in the DRC. The extent of ICT usage in the majority (52%) of the firms was Medium which relatively good for a developing country. Majority (43%) of contractors considered use of ICT as supporting rather than critical (13%) in the performance of various activities. Most contractors are yet to be sensitised on potentials of using ICT as a way of creating more efficiency when undertaking various works in the construction industry hence they still don't consider it as critical but a tool that assists in undertaking various activities.

Project Drawings (mean of 4.7) was the most highly computerised activity by majority followed by cost and budgeting (3.61) and estimating (3.44). These are commonly and routinely undertaken activities in all construction projects amongst most respondents thus signifying the higher level of computerization. Hardware items like laptops (86%), desktops (68%) and mobile phones (46%) usage was found to be very high while items like digital cameras (21%) were hardly used by contractors. Laptops are portable hence one can easily move with them from one place to another and desktop computers are also found in most offices but has the disadvantage of not being portable thus most contractors prefer using

laptops while mobile phones assist in communication and capturing progress photos. Operating system choice was based on familiarity (54%) and availability (45%) as opposed to the cost (1%). Familiarity ensures the users are able to easily operate the various applications and also time required for training is saved while availability eases the hustle contractors have to go through to acquire the operating system. The cost of acquiring one operating system is cumulatively low, as the single operating system can be used with various computers/laptops hence the lower rating. Site Management was the least rated (mean of 1.91) computerized activity since most operations are undertaken at the headquarter offices hence few operations are required to be done on site, thus contractors don't consider it necessary to invest in a lot of computer software and hardware on site. It was also demonstrated that except for Ms Access (13%), general administration systems softwares usage was very high (Ms Excel: 100%; Ms Word: 99%; Ms PowerPoint: 83%). Costing data manipulation including preparation of Bills of quantities are done using MS excel while a lot of paperwork has to be done using Ms word before it can be converted in to other forms like PDF while Ms PowerPoint is mainly used for presentation. Ms access had the least usage since it is mainly used for data entry needs which can also be done using excel.

Project planning and scheduling tools that were majorly used were Power Project (22%) and Microsoft Project (31%) while advanced and emerging tools like Primavera (11%) and Project Management systems (1%) are hardly used. Microsoft project has been used in the industry for long hence most contractors are familiar with it while Project Management Systems are still new in the market and there is lack of familiarity with it hence the low rate of usage. Advanced softwares for estimation and calculations only, Esti-mate (22%) was slightly used by contractors. Win-QS (13%), Masterbill (8%), Manifest (4%) and Buildsoft (3%) are hardly used, as most contractors rely on Microsoft Excel for estimation rather than using the emerging technologies. Computer Aided Design application softwares usage is at its advanced stages with ArchiCAD (92%) and AutoCAD (78%) accounting for a larger percentage of usage among building contractors while others like Revit, Artlantis, Lumion and Civil 3D are also used. CAD had a high rating amongst contractors since most plans are done using these softwares and contractors need to be able to interpret and also have a better understanding and comprehension of them.

The five major variables that affect ICT usage amongst building contractors in the DRC were investigated. The findings revealed that budget constraint (mean of 4.9) was the main factor

affecting the use of ICT under financial variable; Satisfaction with existing method of working was considered significant factors under human variable with a mean of 4.04; while High rate of ICT obsolescence (3.93), Access to relatively cheap workforce (3.93), Rapid changes in ICT technologies (3.90) and Problem of ICT integration (3.44) were considered significant under technical variable. Interestingly no factor under environmental variable was significant i.e. lack of adequate jobs in the market isn't considered a hindrance to uptake of ICT since taking up ICT would create employment and all that is required is training of individuals to make them conversant with the emerging technologies and finally security implications of ICT transactions was mainly considered important under the legal variable with a mean score of 3.10.

All of the respondents have submitted and received tender documents electronically, all being aware of the opportunities offering construction items' e-tendering. The results also revealed that a high rate of winning of tenders was directly attributed to the use of ICT in tendering accounting for 51% increase. This makes it a worthwhile business strategy.

5.3. Recommendations

1. Development of internal means and policies by firms towards and assistance from financial institutions, to increase the motivation for firms in the DRC on ICT and promote uptake.
2. To create awareness, registration bodies, contractor associations and business leader are to encourage ICT literacy within institutions to develop partnerships with national or professional training institutions and individuals.
3. To create efficiency in construction work and promotion of the application of ICT, trainings on ICT are essential.
4. As means of disseminating the information on ICT, institutions for higher learning ought to establish units specialising on the current construction related software.

5.4 Areas of further research

1. Exploring the situation of smaller firms (C and D) to give a general overview on the use of ICT in the entire construction industry in the DRC.
2. Exploring the use BIM (Building Information Modelling) in the construction industry in the DRC.

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APPENDICES



UNIVERSITY OF NAIROBI
DEPARTMENT OF REAL ESTATE AND CONSTRUCTION MANAGEMENT
P.O. Box 30197, 00100 Nairobi, KENYA, *Tel: No. +254-020-491 3531*
E-mail:dept-recm@uonbi.ac.ke

Ref: B53/8151/2017

Date: 7th August, 2019

To Whom It May Concern

Dear Sir/Madam,

RE: LANDRY M. MITIMA – B53/8151/2017

This is to confirm that the above named is a second year student in the Department of Real Estate & Construction Management pursuing a course leading to the degree of M.A. Construction Management.

He is carrying out a research entitled ***"Assessing the Factors Affecting Usage of Information and Communication Technology Amongst Building Contractors in Democratic Republic of Congo, Case Study of Kinshasa"*** in partial fulfillment of the requirements for the degree programme.

The purpose of this letter is to request you to allow him access to any kind of material he may require to complete his research. The information will be used for research purposes only.

CHAIRMAN
DEPARTMENT OF REAL ESTATE
AND CONSTRUCTION MANAGEMENT
UNIVERSITY OF NAIROBI

Dr. Luke Obala
Ag. Chair & Senior Lecturer
Dept. of Real Estate & Construction Management



UNIVERSITY OF NAIROBI
SCHOOL OF THE BUILT ENVIRONMENT
DEPARTMENT OF REAL ESTATE AND CONSTRUCTION MANAGEMENT
M.A. IN CONSTRUCTION MANAGEMENT

QUESTIONNAIRE D'ENQUETE – SURVEY QUESTIONNAIRE

Factors affecting usage of Information and Communication Technology amongst building contractors in the Democratic Republic Congo (DRC)

Ce travail est entrepris par Landry M. Mitima, étudiant en deuxième année de maîtrise en Construction Management sur *"les facteurs influant sur l'usage des TIC (Technologies de l'Information et de la Communication) dans les entreprises de construction en République Démocratique du Congo"*. La recherche vise à explorer l'utilisation des TIC dans l'industrie de la construction congolaise et les défis auxquels sont confrontés les entrepreneurs en construction en République Démocratique du Congo.

Les objectifs spécifiques sont:

- i. Explorer le niveau d'utilisation des TIC par les entrepreneurs en construction en RDC.
- ii. Évaluer les plates-formes d'infrastructures TIC utilisées par les entrepreneurs en construction en RDC.
- iii. Déterminer les facteurs affectant l'utilisation des TIC par les entrepreneurs de construction en RDC.
- iv. Établir la relation entre l'utilisation des TIC et le nombre d'offres gagnées.

Dans le cadre de ce processus, ce questionnaire a été conçu pour une enquête. Votre organisation est invitée à participer et à contribuer à cette étude. Vos commentaires, opinions et points de vue seraient très appréciés.

Soyez assuré que vos réponses seront traitées avec la plus grande confidentialité. Rien qui puisse révéler votre identité ne sera publié, l'enquête étant menée que dans un contexte académique.

Merci d'avance pour votre coopération.

This work is undertaken by Landry M. Mitima, a master's student in Construction Management as partial fulfilment of award of the degree. The title of the research is ***"Factors affecting usage of Information and Communication Technology amongst building contractors in the Democratic Republic Congo. "***

The research aims to explore the use ICT in the construction industry in the DRC and the challenges affecting building contractors in the DRC. The specific objectives are:

- i. To explore the level of ICT usage amongst building contractors in the DRC
- ii. To assess the ICT infrastructure platforms used by building contractors in the DRC.
- iii. To ascertain the factors affecting the use of ICT amongst building contractors in the DRC.
- iv. To establish the relationship between ICT usage and number of tenders won.

As part of this process, this questionnaire was designed for data collection. Your organization is invited to participate and contribute to this study. Your comments, opinions and views are very much appreciated.

All the information provided by you will be treated with utmost confidentiality. Your identity will not be or published as the survey being conducted for academic purposes only.

Thank you in advance for your cooperation.

SECTION A : Généralités – General information

1. À Propos de votre entreprise – About your company

1.1. Veuillez indiquer la classe financière de votre société.

Please indicate the financial class of your company using a tick (✓).

A []	B []	C []	D []
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1.2. Quelle est l'année d'expérience de votre entreprise dans le secteur de la construction en RDC ? (Veuillez cocher✓)

What is your company's years of experience in the construction sector in the DRC? (Please tick✓)

< 5ans []	5-10 ans []	10-15 ans []	15-20 ans []	Plus de 20 ans []
------------	--------------	---------------	---------------	--------------------

2. À propos du répondant – About respondent

2.1. Veuillez indiquer votre position actuelle dans cette société (veuillez cocher✓).

Please indicate your current position in this company (please tick).

Directeur général (Managing Director)	Chef de projet (Project Manager)	Responsable informatique (IT Manager)	Ingénieur (Engineer)	Architecte (Architect)	Métreur (QS)	Autre (Other)
[]	[]	[]	[]	[]	[]	[]

2.2. Depuis combien de temps pratiquez-vous dans le secteur de la construction en RDC? (Veuillez cocher).

How long have you been practicing in the construction sector in the DRC? (Please tick)

< 5ans []	5-10 ans []	10-15 ans []	15-20 ans []	Plus de 20 ans []
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2.3. Veuillez indiquer votre mode d'acquisition de connaissances en informatique (cocher la ou les cases appropriées).

Please indicate your mode of acquisition of computer literacy (Tick the appropriate).

Appris à l'école (Learnt at school) []	En service par l'employeur (In service by employer) []	Cours particuliers (Private lessons) []	Auto formation (Self thought) []	Formation PPC par organisme professionnel (CPD training by Professional body) []
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PPC: Perfectionnement Professionnel Continu

CPD: Continuous Professional Development

3. TIC en général - ICT in general

3.1. Votre entreprise possède-t-elle et utilise-t-elle des ordinateurs pour ses opérations?

Does your firm own and use computers for its operations?

Oui [] Non []

(Si non, veuillez aller à la section E) - *If no, please go to section E*

3.2. Si oui, veuillez indiquer où les ordinateurs sont accessibles dans votre organisation?

(Cocher la ou les cases appropriées)

If yes, please indicate where computers can be accessed in your organization? (Please tick box/es)

Bureau de la compagnie seulement (Company Office/s only) []	Site du projet seulement (Project Site/s only) []	Bureau de la compagnie et site du projet (Both Company Office/s and Site/s) []
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3.3. Selon vous, à quel degré les TIC sont-elles actuellement appliquées dans votre entreprise?

In your view, to what extent is ICT currently being applied in your company?

Haut - High []	Moyen - Medium []	Faible - Low []
-----------------	--------------------	------------------

3.4. Comment percevez-vous le rôle des TIC par rapport au fonctionnement stratégique votre entreprise ?

How do you perceive the role of ICT in respect to the overall business strategy of your company?

Critique <i>Critical</i> []	-	Valeur ajoutée - <i>Value adding</i> []	-	De Soutien - <i>Supporting</i> []	-	Aucun - <i>None</i> []
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SECTION B: Etat de l'infrastructure informatique des entreprises - *Firms ICT*

Infrastructure Status

1. Plateformes matérielles - *Hardware Platforms*

1.1. Veuillez indiquer l'utilisation des éléments matériels informatiques suivants dans votre organisation (cochez la ou les cases correspondantes).

Please indicate usage of the following ICT hardware items in your organization (Please tick box/es).

Ordinateurs de bureau - <i>Desktop computers</i>	[]
Ordinateurs portables ou assistants numériques personnels (PDA) - <i>Laptops Personal Digital Assistants (PDAs)</i>	[]
Ordinateurs de poche / Tablet PC - <i>Handheld computers/Tablet PCs</i>	[]
Téléphones portables - <i>Mobile phones</i>	[]
Caméras digitales - <i>Digital Cameras</i>	[]
Projecteurs multimédia - <i>Multimedia projectors</i>	[]
Autre (veuillez préciser) - <i>Other (Please Specify)</i>	[]

2. Systèmes d'exploitation utilisés - *Operating systems in use*

2.1. Veuillez indiquer le système d'exploitation actuellement utilisé dans votre organisation?

Veuillez cocher.

Please indicate the operating System currently being used in your organization? Please tick.

Windows 2000/2003 []	Windows XP []	Windows Vista []	Windows 10 []	Mac OS []	Autre (<i>Other</i>)
-----------------------------	----------------------	-------------------------	-------------------	---------------	--

2.2. Veuillez indiquer pourquoi le choix du système d'exploitation indiqué ci-dessus? Veuillez cocher.

Please state why the choice of Operating System indicated above? Please tick.

Disponibilité (Availability)	-	Coût - Cost	Familiarité Familiarity	-	Autre (veuillez préciser)- Other (Please Specify)
[]		[]	[]	 []

3. Communications et plates-formes de réseau - *Communications and Network*

Platforms

3.1. Les ordinateurs de votre organisation sont-ils en réseau? (Veuillez cocher la case appropriée)

Are computers in your organization Networked? (Please tick appropriate box)

Oui [] Non []

Si non, veuillez aller à (3.3) - *If no, please go to (3.3)*

3.2. Si oui, veuillez indiquer l'infrastructure de réseau informatique utilisée dans votre organisation? (Veuillez cocher)

If yes, please indicate the Computer network infrastructure being used in your organization? (Please tick)

Réseau local (LAN) (réseau au sein du bureau, site etc)	Réseau étendu (WAN) (réseau entre bureaux et des sites)	Autre veuillez préciser - Other (Please Specify)
[]	[] []

3.3. Votre organisation a-t-elle des comptes de messagerie pour la communication officielle?

Does your organization have e-mail accounts for official communication?

Oui [] Non []

3.4. Votre organisation est-elle connectée à Internet?

Is your organization connected to the internet?

Oui [] Non []

Si non, veuillez aller à (4.1) - *If no, please go to (4.1)*

3.5. Veuillez indiquer où Internet est accessible dans votre organisation? (Veuillez cocher des cases)

Please indicate where internet can be accessed in your organization? (Please tick box/es)

Bureau de la compagnie seulement - <i>Company</i> <i>Office/s only</i>	Site du projet seulement - <i>Project Site/s only</i>	Bureau de la compagnie et site du projet - <i>Both</i> <i>Company Office/s and</i> <i>Project site/s</i>
[]	[]	[]

3.6. Votre entreprise a-t-elle une page sur le World Wide Web (WWW)?

Does your company have a website on the World Wide Web (WWW)?

Oui [] Non []

4. Effectif TIC - *ICT Workforce*

4.1. Avez-vous une division informatique distincte ou un responsable informatique au sein de votre organisation?

Do you have a Separate IT Division or someone responsible for IT within your organization?

Oui [] Non []

Si NON, veuillez aller à (3) - *If NO, please go to (3)*

4.2. Si oui, veuillez indiquer lesquels des services suivants sont fournis par votre division informatique interne (Veuillez cocher les cases correspondantes)

If yes, Please indicate which of the following services is/are provided by your in-house IT Division? (Please tick relevant box/es)

01. Support technique - <i>Desk side support</i>	[]
02. Support Internet et e-mail - <i>Internet & e-Mail support</i>	[]
03. Maintenance de la base de données - <i>Database Maintenance</i>	[]
04. Mise en réseau - <i>Networking</i>	[]
05. Maintenance du matériel - <i>Hardware Maintenance</i>	[]
06. Services d'assistance logicielle – <i>Software Support Services</i>	[]
07. Maintenance du logiciel – <i>Software Maintenance</i>	[]
08. Autres (Veuillez préciser) – <i>Other (Please specify)</i>	[]

4.3. Veuillez indiquer lequel des services suivants est / sont externalisés (veuillez cocher la ou les cases correspondantes)

Please indicate which of the following services is/are outsourced (Please tick relevant box/es)

01. Support technique - <i>Desk side support</i>	[]
02. Support Internet et e-mail - <i>Internet & e-Mail support</i>	[]
03. Maintenance de la base de données - <i>Database Maintenance</i>	[]
04. Mise en réseau - <i>Networking</i>	[]
05. Maintenance du materiel - <i>Hardware Maintenance</i>	[]
06. Services d'assistance logicielle – <i>Software Support Services</i>	[]
07. Maintenance du logiciel – <i>Software Maintenance</i>	[]
08. Autres (Veuillez préciser) – <i>Other (Please specify)</i>	

4.4. Quel est le ratio moyen actuel personnel/ordinateur dans votre organisation ? (Cochez la case correspondante). (REMARQUE : Ratio = nombre d'employés ÷ Nombre d'ordinateurs)

What is the current average staff to computer ratio in your organization? (Please tick relevant box) (NOTE: Ratio= No. of staff ÷ No of Computers)

1:1 []	2:1 []	3:1 []	4:1 []	Autre (veuillez spécifier)
---------	---------	---------	---------	----------------------------

4.5. Quelles sont les qualifications académiques minimales requises par les utilisateurs actuels d'ordinateurs de votre organisation ?

What minimum academic qualifications do current users of computer in your organization have?

Qualification académique	IT Qualification	Non IT Qualification
Masters - <i>Master</i>	[]	[]
Licence - <i>Degree</i>	[]	[]
Graduat - <i>Diploma</i>	[]	[]
Certificat - <i>Certificate</i>	[]	[]
Autres (Veuillez spécifier) - <i>Other (Please specify)</i>	[]	[]

SECTION C: Niveau d'utilisation des technologies de l'information et de la communication (TIC) dans l'organisation - *Level of usage of Information and Communication Technology (ICT) in the organisation*

1. Veuillez indiquer l'importance de l'informatisation ou de l'utilisation des logiciels informatiques pour les activités suivantes de votre organisation (Remarque : 1 = jamais ; 2 = pas toujours ; 3 = moyen ; 4 = presque toujours ; 5 = toujours.)

Please indicate the extent of Computerization or usage of computer softwares for the following activities in your organization. (Note: 1= Never; 2=Not always;3=Average; 4=Quiet always; 5=Always.)

Activité	1	2	3	4	5
01. Comptabilité - <i>Accounting</i>	[]	[]	[]	[]	[]
02. Dessins de projet – <i>Project Drawings</i>	[]	[]	[]	[]	[]
03. Achats et facturation - <i>Purchases and Invoicing</i>	[]	[]	[]	[]	[]
04. Calculs techniques - <i>Technical Calculations</i>	[]	[]	[]	[]	[]
05. Établissement des coûts et budgétisation - <i>Costing and budgeting</i>	[]	[]	[]	[]	[]
06. Estimation - <i>Estimating</i>	[]	[]	[]	[]	[]
07. Gestion des ressources (main-d'œuvre, matériel et équipement) - <i>Resources Management (Labour, Material and Equipment)</i>	[]	[]	[]	[]	[]
08. Planification et programmation des travaux - <i>Scheduling and works planning</i>	[]	[]	[]	[]	[]
09. Comptabilité / Paie - <i>Accounting/payroll</i>	[]	[]	[]	[]	[]
10. Dossiers de projets - <i>Project Records</i>	[]	[]	[]	[]	[]
11. Commencement des travaux - <i>Taken-off</i>	[]	[]	[]	[]	[]
12. Rapports d'avancement - <i>Progress reports</i>	[]	[]	[]	[]	[]
13. Gestion financière - <i>Financial management</i>	[]	[]	[]	[]	[]
14. Gestion du site et sécurité - <i>Site management and security</i>	[]	[]	[]	[]	[]
15. Contrôle des coûts du projet - <i>Project Cost control</i>	[]	[]	[]	[]	[]
16. Informations sur les sous-traitants et les fournisseurs - <i>Subcontractors and suppliers information</i>	[]	[]	[]	[]	[]

17. Communication (avec les sites du projet et les parties externes) - <i>Communication (with project sites and external Parties)</i>	[]	[]	[]	[]	[]
18. Distributions des documents de projet – <i>Distributions of project Documents</i>	[]	[]	[]	[]	[]

2. Veuillez indiquer le degré d'utilisation ou d'application des outils informatiques suivants dans votre entreprise.

Please indicate the extent of usage or application of the following ICT tools in your company

Application TIC	1	2	3	4	5
01. Services de messagerie électronique et de messages courts (SMS) - <i>E-mail and Short Message Services (SMS)</i>	[]	[]	[]	[]	[]
02. Internet mobile - <i>Mobile internet</i>	[]	[]	[]	[]	[]
03. Vidéoconférence - <i>Videoconferencing</i>	[]	[]	[]	[]	[]
04. Achat électronique (achat en ligne) - <i>Electronic purchasing (E-purchasing)</i>	[]	[]	[]	[]	[]
05. Téléconférence - <i>Teleconferencing</i>	[]	[]	[]	[]	[]
06. Systèmes de positionnement global (GPS) - <i>Global Positioning Systems (GPS)</i>	[]	[]	[]	[]	[]
07. Services d'information géographique (SIG) - <i>Geographic information Services (GIS)</i>	[]	[]	[]	[]	[]
08. Identification par radiofréquence (RFID) et codes à barres - <i>Radio Frequency Identification (RFID) and barcodes</i>	[]	[]	[]	[]	[]
09. Sites Web spécifiques au projet (Extranets) - <i>Project specific websites (Extranets)</i>	[]	[]	[]	[]	[]
10. Technologies de surveillance du site (par exemple, vidéosurveillance, etc.) - <i>Site surveillance Technologies (e.g CCTV etc)</i>	[]	[]	[]	[]	[]
11. Appel d'offres électronique (appel d'offres électronique) - <i>Electronic tendering (E-tendering)</i>	[]	[]	[]	[]	[]

12. Modélisation et visualisation (par exemple, 3D-CAD, 4D-CAD, etc.) - <i>Modeling and visualization (eg.3D-CAD, 4D-CAD etc)</i>	[]	[]	[]	[]	[]
13. Systèmes de gestion électronique de documents (EDMS) - <i>Electronic document management systems (EDMS)</i>	[]	[]	[]	[]	[]
14. Logiciel intégré (par exemple, Progiciel de Gestion Intégré ; ERP) - <i>Integrated software (e.g. Enterprise Resource Planning; ERP)</i>	[]	[]	[]	[]	[]

(Remarque : 1 = jamais ; 2 = pas toujours ; 3 = moyen ; 4 = presque toujours ; 5 = toujours.)

(Note: 1= Never; 2=Not always;3=Average; 4=Quiet always; 5=Always.)

3. Utilisation générale et technique des logiciels - *General and Technical Software Usage*

3.1.Veuillez indiquer l'utilisation du logiciel suivant disponible dans le commerce dans l'organisation. (Veuillez cocher la ou les cases correspondantes)

Please indicate usage of the following commercially available software in your organization. (Please tick relevant box/es)

Administration générale / systèmes d'entreprise <i>General Administration/Business Systems</i>	Jamais utilisé	Usage quotidien
Traitement de texte - <i>Word Processors</i> (e.g. Pages/Ms Word)	[]	[]
Feuilles de calcul - <i>Spreadsheets</i> (e.g. Numbers/Ms Excel)	[]	[]
Présentations - <i>Presentations</i> (ex: /Keynote/Power Point)	[]	[]
Bases de données - <i>Databases</i> (ex: Ms Access)	[]	[]
Autres (Veuillez spécifier) - <i>Other (Please Specify)</i>	[]	[]

Planification et ordonnancement de projet <i>Project Planning and Scheduling</i>	Jamais utilisé	Usage quotidien
Microsoft Project	[]	[]
Primavera	[]	[]
Power Project	[]	[]
PMSystems	[]	[]
Autre (veuillez préciser) - <i>Other (Please Specify)</i>	[]	[]

Métré, estimation et calcul des coûts <i>QS, Estimating and Cost calculations</i>	Jamais utilisé	Usage quotidien
WinQS	[]	[]
Esti-mate	[]	[]
Manifest	[]	[]
Buildsoft	[]	[]
Masterbill	[]	[]
Autre (veuillez préciser - <i>Other (Please Specify)</i>	[]	[]

Conception assistée par ordinateur (CAO) <i>Computer Aided Design (CAD)</i>	Jamais utilisé	Usage quotidien
AutoCAD	[]	[]
ArchiCAD	[]	[]
Revit	[]	[]
Autre (veuillez préciser - <i>Other (Please Specify)</i>	[]	[]

3.2. Votre entreprise dispose-t-elle de logiciels propriétaires ou internes conçus pour votre propre usage professionnel ?

Does your firm have some proprietary or in-house software designed for your own office use?

Oui [] Non []

3.3. Votre organisation serait-elle intéressée à soutenir une société informatique congolaise souhaitant offrir de tels services logiciels propriétaires ?

Would your organisation be interested to support a Congolese IT company that want to offer such proprietary software services?

Oui [] Non []

SECTION D: Facteurs affectant l'utilisation des TIC dans votre organisation

Factors affecting use of ICT in your organisation

1. Laquelle des affirmations suivantes, selon vous, décrit le mieux les facteurs qui affectent l'utilisation des TIC dans votre organisation (cochez la/less cases suivante)

(Remarque : 1 = très faible ; 2 = faible; 3 = moyen; 4 = fort; 5 = très fort .)

Which of the following statements in your opinion, best describe reasons hindering the use of ICT in your organization. (Please tick)

(Note: 1 = Very Weak; 2 = Weak ; 3 = Average ; 4 = Strong ; 5 = Very Strong)

Facteurs financiers - <i>Financial factors</i>	1	2	3	4	5
01. Contrainte budgétaire pour les investissements dans les TIC - <i>Budget constraint for ICT investment</i>	[]	[]	[]	[]	[]
02. Coût de la formation des professionnels aux TIC - <i>Cost of training professionals in ICT</i>	[]	[]	[]	[]	[]
03. Avantages limités / retour sur investissement faible dans les TIC - <i>Limited benefits/Low return on investment in ICT.</i>	[]	[]	[]	[]	[]
04. Coût élevé de l'emploi de professionnels des TIC - <i>High cost of employing ICT professionals</i>	[]	[]	[]	[]	[]

Facteurs humains – <i>Human factors</i>	1	2	3	4	5
05. Contenu TIC inadéquat de l'enseignement de la construction - <i>Inadequate ICT content of construction education</i>	[]	[]	[]	[]	[]
06. Manque d'engagement de la direction de l'entreprise envers les TIC - <i>Lack of commitment by firm's management towards ICT</i>	[]	[]	[]	[]	[]
07. Connaissance insuffisante du retour sur investissement des TIC - <i>Inadequate knowledge about return on ICT investment</i>	[]	[]	[]	[]	[]
08. Manque de personnel possédant les compétences et connaissances appropriées en TIC - <i>Lack of staff with appropriate skill and knowledge in ICT</i>	[]	[]	[]	[]	[]
09. Peur des pertes d'emploi / licenciement de	[]	[]	[]	[]	[]

professionnels - <i>Fear of job losses /making professionals redundant</i>					
10. Satisfaction avec la méthode de travail existante - <i>Satisfaction with existing method of working</i>	[]	[]	[]	[]	[]

Facteurs techniques – Technical factors	1	2	3	4	5
11. Changements rapides dans les technologies des TIC - <i>Rapid changes in ICT technologies</i>	[]	[]	[]	[]	[]
12. Problème d'intégration / de compatibilité des TIC dans l'organisation - <i>Problem of ICT integration/compatibility in the organization</i>	[]	[]	[]	[]	[]
13. Problèmes de fiabilité logicielle et matérielle - <i>Software and hardware reliability problems</i>	[]	[]	[]	[]	[]
15. Préoccupations liées à la sécurité / craintes concernant la vie privée - <i>Security concerns/privacy fears</i>	[]	[]	[]	[]	[]
14. Taux d'obsolescence élevé des produits TIC sur le marché Congolais - <i>High rate of obsolescence ICT products in the Congolese market</i>	[]	[]	[]	[]	[]
15. Accès à une main-d'œuvre relativement bon marché - <i>Access to relatively cheap work force</i>	[]	[]	[]	[]	[]

Facteurs environnementaux – Environmental factors	1	2	3	4	5
16. Majorité des clients non intéressés par la base informatique des entreprises - <i>Majority of client not interested in firms ICT base</i>	[]	[]	[]	[]	[]
17. Manque d'emplois adéquats sur le marché Raisons juridiques - <i>Lack of adequate jobs in the market</i>	[]	[]	[]	[]	[]

Facteurs légaux – Legal factors	1	2	3	4	5
18. Risques de responsabilité - <i>Risks for liability</i>	[]	[]	[]	[]	[]
19. Manque de soutien juridique pour l'utilisation des TIC - <i>Lack of legal support for use of ICT</i>	[]	[]	[]	[]	[]

20. Conséquences des transactions TIC sur la sécurité –	[]	[]	[]	[]	[]
<i>Security implications of ICT transactions</i>					

SECTION E: Impact of ICT usage in the winning of tenders

1. Votre organisation a-t-elle émis / reçu des documents d'appel d'offres par voie électronique?

Has your organisation issued/received tender documents electronically?

Oui [] Non []

2. Votre organisation a-t-elle déjà retourné (ou soumis) des documents d'appel d'offres par voie électronique?

Has your organisation been returned or submitted tender documents electronically?

Oui [] Non []

3. Si la réponse est "oui" quel pourcentage de l'ensemble de vos offres a été reçu ou envoyé par voie électronique?

If 'YES' to above what percentage of your overall tenders has been received or sent electronically?

0 à 25% []	26 à 50% []	51 à 75% []	76 à 100% []	N/a []
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4. Veuillez indiquer votre état de conscience actuel des opportunités qu'offrent e-Tendering (appels d'offre électroniques) dans l'industrie de la construction.

Please indicate your current state of awareness of the opportunities for e-Tendering in the construction industry

Pas conscient - <i>Not aware</i>	Un peu conscient - <i>Somewhat aware</i>	Conscient <i>Aware</i>	Moyennement conscient - <i>Moderately aware</i>	Tres conscient - <i>Very aware</i>
[]	[]	[]	[]	[]

5. Veuillez indiquer à quel pourcentage de votre entreprise attribue aux TIC le succès d'appels d'offres

Please indicate what percentage of your company attribute the winning of tenders to ICT

0 à 25% []	26 à 50% []	51 à 75% []	76 à 100% []	N/a []
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Je vous remercie – *Thank you*

Vos commentaires (S'il y en a) – *Your comments (if any)*

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Landry M. Mitima

landrymtm3@students.uonbi.ac.ke

+243 89 44 24 294

+254 71 30 46 249