

## Application of ICT in the Construction Industry in Kampala

Ednah Tinah Mutesi<sup>1</sup>, Michael Kyakula<sup>2</sup>

<sup>1</sup>Trainee Engineer, UNRA, Kampala, Uganda

<sup>2</sup>Senior Lecturer, Faculty of Engineering, Kyambogo University, P. O.1, Kyambogo, Uganda  
Corresponding author email: mkyakula@gmail.com

### ABSTRACT

ICT covers any product that will store, retrieve, manipulate, transmit or receive information electronically. Construction projects involve; clients, consultants, contractors, local authority; residents; workers and suppliers, all with differing interests in the project which demands heavy exchange of data and information. Thus the construction industry is one of the most information-intensive industries, and requires close coordination of a large number of specialized interdependent organizations / individuals to achieve cost, time and quality goals of a project. The industry is characterized by inaccurate and untimely communications that often result in costly delays. ICT is a potential solution to this problem. This paper highlights the level of ICT penetration, its impact and constraints to its adoption in Uganda's construction industry. Questionnaires were distributed to suppliers, engineers, quantity surveyors and architects. The study revealed that the most commonly used software are; Microsoft Word (88%), MS excel (87%) and PowerPoint (59%). AutoCAD is most popular at (53%) for Architectural/ Engineering design and drawing, Master Bill (30.8%) for quantity surveying, Microsoft Project (76%) for project planning. Among other operations, 76% of the firms use computers for bookkeeping. Mobile phones (87%), intranet (68%) and internet (64%) are used for employer employee communication. The benefits derived from use of ICT are reduced mistakes in documents (82%), easing of complex tasks (80%), time saving and increased productivity (79%). However, the use of ICT is constrained by; high cost of investment (86%), system malfunction / virus attacks (82%), and high cost of professionals to employ (78%).

**Keywords:** Constraints Construction Industry, ICT application, ,

### 1.0 INTRODUCTION

ICT can be broadly defined as technologies that provide an enabling environment for physical infrastructure and services development of applications for generation, transmission, and processing, storing and disseminating information in all forms. The sustainability of both the high economic growth and efficiency in operations of both private and public institutions, are dependent on the adoption and effective utilization of ICT. Information is a stimulus that has meaning in some context for its receiver while communication is a process whereby information is enclosed in a package and is discretized and imparted by sender to a receiver via a channel/medium. Communication requires that all parties have an area of communicative commonality.

Construction projects involve a large number of direct stakeholders (clients; professional design teams and construction companies), indirect stakeholders (local authority; residents; workers and customers) and suppliers. All these have differing levels of understanding and interests in the project. Thus managing construction projects consists of planning, coordinating and controlling many work processes, that span different stages or phases involving many different participants, each often utilizing different information and communication exchange systems. This makes the construction industry one of the most information-intensive industries, and requires close coordination among a large number of specialized but interdependent organizations and individuals to achieve the cost, time and quality goals of a construction project. The industry is characterized by inaccurate and untimely communication that often results in costly delays to the progress of the project. Thus one of the most significant problems presently facing the construction industry is communication. ICT is seen by many as a poten-

tial solution to this problem. ICT can provide unifying modelling, management and communications systems to bring the unique talents of project participants together in a more productive and integrated manner. Despite advances in computing and IT, the construction industry is making insufficient use of transferring project data and information electronically. McCaffer et. al. (1991) argues that data exchange between project participants is still largely undertaken on paper. On the other hand, (Boyd and Paulson 1995) comments that leading consulting and construction firms are increasingly recognizing computers as a strategic technology, and it is very probable that these firms will be the ones who will ensure the industry's success in the future.

The construction industry in Uganda has continued to grow at an average rate of 8.8% per annum since 1995/96, well above the overall GDP annual growth rate. This has been attributed to Uganda's rehabilitation efforts as well as new investments in structures and buildings. As the economy of the country continues to grow, there will be increased opportunities for investment in the sector. Systematic utilization of ICT may make the construction industry perform even better. This study set out to investigate the level of ICT penetration in the construction industry in Kampala, its impact and constraints to its adoption in Ugandan construction industry. Table 1 gives the development of ICT from 1996 to 2003;

**Table 1: Growth in ICT infrastructures since 1996 (UCC 2003)**

<b>SERVICES PROVIDED</b>	<b>Dec 1996</b>	<b>Oct 1998</b>	<b>Dec 1999</b>	<b>July 2001</b>	<b>July 2002</b>	<b>June 2003</b>
Fixed lines connected	45,145	56,196	58,261	56,148	54,976	60,995
Mobile Subscriber	3,000	12,000	72,602	276,034	393,310	621,082
National Telephone Operators	1	2	2	2	2	2
Mobile Cellular Operators	1	2	2	3	3	3
Internet/Email subscribers	504	1,308	4,248	5,999	6,600	7,024
VSAT International Data Gateways	2	3	7	8	8	8
Internet Service Providers	2	3	9	11	17	17
Private FM Radio Stations	14	28	37	112	115	119
Private Television Stations	4	8	11	20	22	22
National Postal Operators	1	1	1	1	1	1
Courier Service Providers	2	7	11	10	11	14

### 1.2: Investment in ICT Industry and Training

Apart from, limited financial resources other barriers to ICT investments are: commitment to use ICT by decision makers, obtaining the necessary human resources, instituting appropriate regulatory environment, and developing the capacity to cope with rapid change. "Countries which are able to seize the opportunities of these (ICT) technologies will be able to leapfrog into the future, even though they lack a developed communications infrastructure today. The key will be visionary leadership and the ability to mobilize nations around an attractive and realizable vision of their citizens' future". (Knight, and Boostrom, 1995), " Also There is need to assess the national requirement for ICT skills, establish how much of this is available, and then determine the best strategy of meeting the appropriate ICT skills requirements. Currently in Uganda, uncoordinated ICT training takes place in Universities, and on job (Mutesi 2006)

### 2.0: METHODOLOGY

A questionnaire survey of contractors, architectural, engineering and quantity surveying consultants, and academic researchers was carried out between May and June 2009 in Kampala. The entire research project's questionnaire used was a close ended, which had questions like

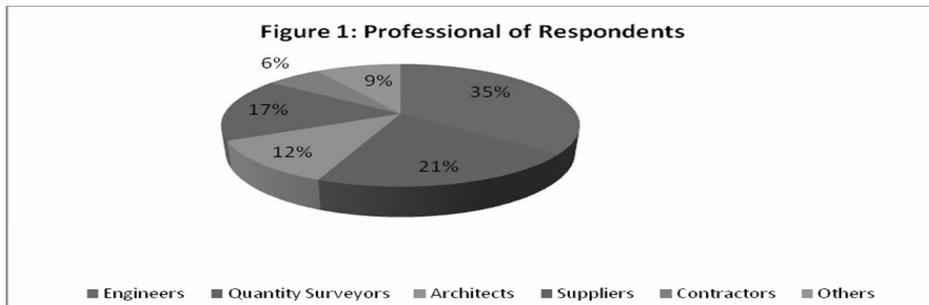
dichotomized response with yes and no options, list of possible responses, list of possible categories and lastly measurement scale. The item provided quantitative data that was analyzed using MS Excel. After design the questionnaire was pretested by administering it to a small group of people to ensure that; It does not take too long to complete, respondents understand all items, measurement scale is appropriate and provides sufficient data for analysis, it is easy to read and understand, it is related to the topic in question, asks for information that respondents can provide with some degree of accuracy and is free from bias and does not lead respondents to any particular answer.

**3.0: ANALYSIS AND DISCUSSION OF SURVEY RESULTS**

A sample size of 140 comprising construction firms, architectural, engineering and quantity surveying and consultants randomly chosen were used to ensure a confidence level of at least 99% in accordance with the recommendations of Rea & Parker (1997). Out of the 140 questionnaires distributed by hand, 122 were retrieved. Two (2) of the returns were found to be too badly completed to be useful for the analysis and were therefore discarded. This brought the responses effectively to 120 representing a response rate of 86%. The data were analyzed using MS Excel.

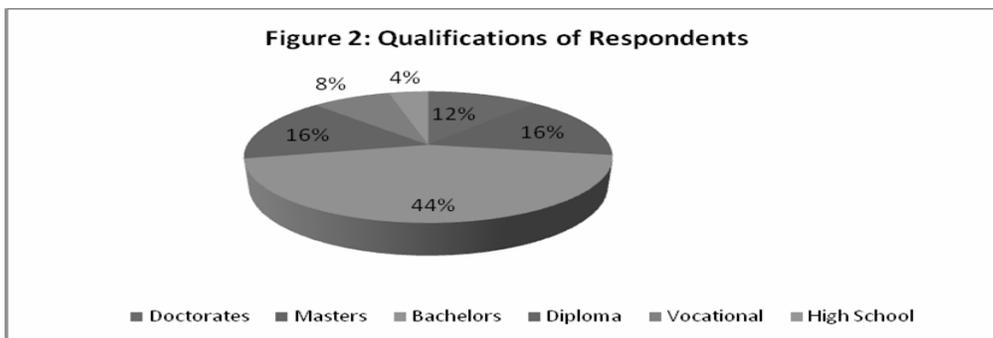
**3.1: Respondents by work type**

Figure I shows respondents profiles by their professional background. Of 120 respondents, 35% were Engineers, 21% Quantitative surveyors, 12% Architects, 17% Suppliers, 6% Contractors and 9% Others.



**3.2: Education level of Respondents**

From Figure II, 44% of respondents had bachelors 16% masters' holders, 16% diploma, 12% doctorate, 8% vocational and 4% secondary leavers.



**3.3: Use of computers and communication systems**

The use of ICT in design and construction management is classified into communication systems and technical decision support systems. According to Doherty (1997), the communication domain involves computerized communication, while the technical decision support in-

volves computer applications other than for communications. In this section, operating systems and software used by the respondent firms are examined and is given in Table 2

**Table 2: Computer software in use**

<b>Software</b>	<b>% using it</b>
<b><u>Word Processing and Accounting software</u></b>	
MS word	87.5
MS Excel	86.7
<b><u>Presentation software</u></b>	
MS PowerPoint	58.3
MS Outlook	7.5
Adobe Pagemaker	5.0
<b><u>Architectural/Engineering Design and Drawing software</u></b>	
CorelDraw	10.8
AutoCAD	53.3
ArchiCAD	48.3
Prokon	17.5
Staad Pro	13.3
Mx Road	20.0
HDM -4 model	19.2
UKDCP	12.5
<b><u>Quantity Surveying Measurement and Estimating</u></b>	
WinQS	28.3
CataPro	7.5
MasterBill	30.8
QS Elite	10.8
Snape Vector	8.3
In-house software	10.0
<b><u>Project Planning and management software</u></b>	
MS Project	75.8
Pathmaker	45.0

#### **3.4: Level of Computer utilization**

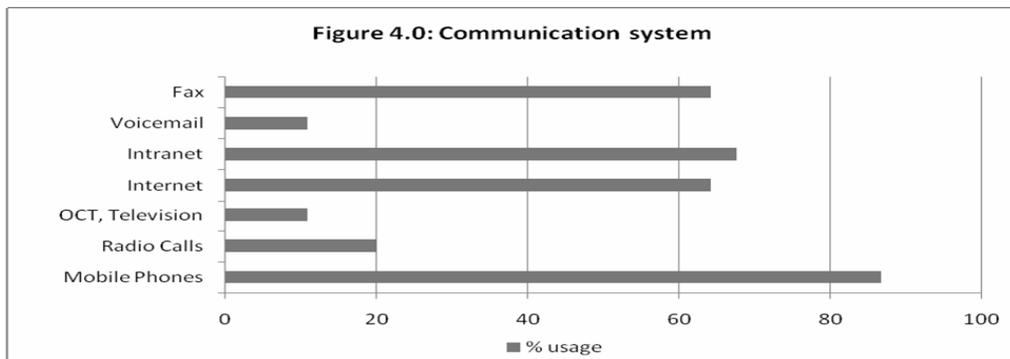
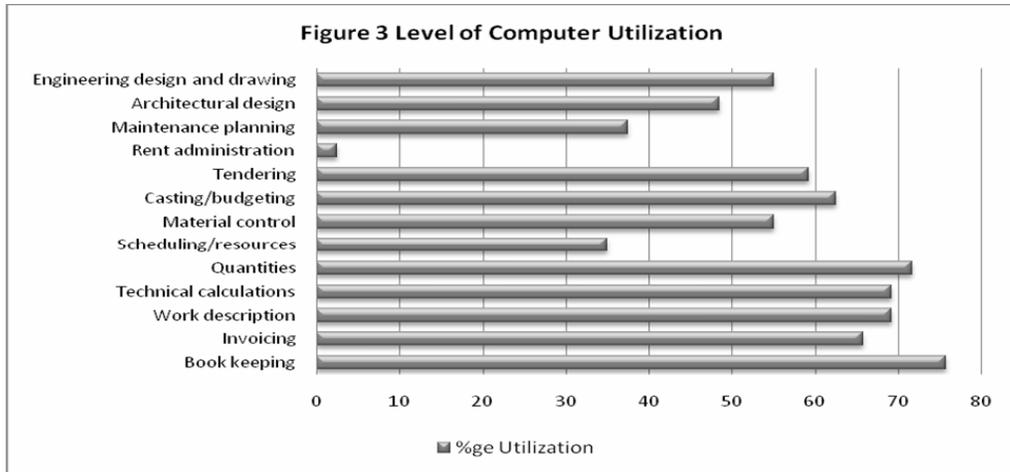
The respondents were asked to rate the use of computers in 13 operations. The major use of the computer is book keeping at 76%. as shown in Figure 3

#### **3.5: Communication systems**

Figure 4 shows that 64% of the firms surveyed are connected to internet which they use mostly for e-mail. 87% use mobile phones. Firms find it more convenient and efficient to communicate using mobile phones especially when it is a one-on-one communication. Intranet (68%) is commonly used within the firms and Fax (64%) are also fairly used by firms to communicate with their employees and clients

#### **3.6: The Benefits and impacts of ICT**

The respondents were asked their opinions on the benefits of the use of ICT to their organizations with various options like increased output, no difference, do not know, no difference, not relevant and reduced benefit. Table 2 shows the ranking of the benefits using the method of importance index.



The most important benefits derived from the use of ICT are reduced mistakes in documents (82%), ease of doing complex tasks (80%), time saving and increased productivity (79%). The formulae for importance index given by El-Haram & Horner (2002) is:

$$\text{Importance Index} = \left( \frac{\sum w_i f_{xi}}{5n} \right) 100$$

Where  $w_i$  is the weight given to  $i^{th}$  response;  $i=1, 2, 3, 4$  or  $5$  is response frequency  $f_{xi}$  = very weak/low, and  $f_{x5}$  = very strong/high and  $n$  is the total number of responses.

**Table 3 Benefits of ICT**

Benefit	Importance Index	Rank
Reduces mistakes in documents	81.7	1
Ease of doing complex tasks	80.0	2
Time saving	79.2	3
Increased productivity	78.3	4
Reduces degree of difficulty	76.7	5
Increases speed of work	75.8	6
Increases document quality	74.2	7
Reduces proportion of new work	70.0	8
Reduces construction errors	54.2	9

Also the respondents indicated impact of ICT on productivity in the last two years as percentage improvement in; General administration (78%), material administration (62%), design (57%), site management (56%) and property administration (51%). Purchase and selling registered the least score (28%).

### 3.7: Constraints to the use of ICT

The respondents were asked to express their opinions on the impact of 13 factors as obstacles to the use of ICT in the Ugandan construction industry on scale ranging from “very weak” to “very strong”. The Table 4 shows the analysis of their responses using the importance index. The top three constraints to the use of ICT in the Ugandan construction industry are high cost of investment, system and computer malfunction and virus attacks, and high cost of professionals to employ, leading to high production costs for companies.

**Table 4: Constraints to ICT use**

Constraints	Importance index	Rank
High cost of investment	85.8	1
System and computer malfunction and virus attacks	82.5	2
Poor security and privacy	78.4	3
Continual need to upgrade	69.2	4
Inefficiency from ICT	69.1	5
High cost of professionals to employ	64.1	6
Mass ob losses in the industry	48.4	7
Incompatibility in software packages	37.5	8
Management commitment to ICT	37.5	8
Personal abuse	25.8	9
Poor return on investment	20.9	10
ICT making professionals redundant	20.0	11
Inadequate power supply	14.2	12

Many respondents (86%) did not consider inadequate power supply a big obstacle because firms seem to have generators

### 3.8: Suggestions for Improved use of ICT

The respondents were asked their opinions on the possible solutions to the use of ICT to their organizations on a scale ranging from “strongly agree” to “not relevant”. Table 5 shows the analysis of their responses using the importance index. The top three possible solutions to the use of ICT in their organizations are; Loans from Government for ICT development in the private sector, Improving and employing professionals with ICT skills and Staff training on job in the use of ICT for work.

**Table 5: Possible suggestions for improved ICT use**

Solution	Importance index	Rank
Loans from Government for ICT development	77.0	1
Improving and employing professionals with ICT skills	76.5	2
Staff training on job in the use of ICT for work	76.0	3
Relevant ICT courses in schools at early stages	72.0	4
Increase the development of internet in workplace	49.0	5
Seminars on ICT to refresh skills	41.0	6
Remove ICT investment obstacles	40.0	7
Incompatibility in software packages	39.5	8

#### 4.0: CONCLUSIONS

The study assessed the level of application of ICT in design and construction management in Kampala via a questionnaire survey of 120 organizations comprising suppliers, construction companies, architectural, engineering and quantity surveying consultancies. It examined the current status of ICT use, benefits of ICT use, Constraints and possible solutions to the constraints. The most commonly used software are; Microsoft Word (88%), MS excel (87%) and PowerPoint (59%). Thus it can be concluded that the computer is mainly used as a word processor. AutoCAD is most popular at (53.3%) for Architectural/ Engineering design and drawing, Master Bill (31%) for quantity surveying, Microsoft Project (76%) for project planning. Among other operations, 76% of the firms use computers for bookkeeping. Mobile phones (87%), intranet (68%) and internet (64.2%) are used for employer employee communication. The top three benefits of ICT as perceived by the respondents were “reduction in mistakes in documents (82%)”, “making complex tasks easier to perform (80.%)” and “saving time (79%)”. Three main constraints to the use of ICT in the Ugandan construction industry are; high cost of investment (86%), system and computer malfunction and virus attacks (83%), and high cost of professionals to employ (78%) Three possible solutions leading to improvement in the use of ICT in Ugandan construction industry are; Loans from Government for ICT development in the private sector (77%), Improving and employing professionals with ICT skills (77%) and Staff training on job in the use of ICT for work (76%).

#### 5.0 REFERENCES:

- Adebayo A. O., (2007), *An investigation into the use of ICT in the Nigerian Construction industry* <http://itcon.org/2007/18/>.
- Amor. R, Betts.M, Coetzee. G and Sexton. M, (2002), *Information technology for construction: recent work and future direction*, Journal of Information Technology in construction, 7: 245 – 258 [http://WWW.itcon.org/cgi-bin/works/show\\_2002-16](http://WWW.itcon.org/cgi-bin/works/show_2002-16) (12 Sept 2007).
- Arif A. A and Karam A.H. (2001). *Architectural practices and their use of IT in the Western Cape Province, South Africa*, Journal of Information Technology in Construction, 6, 17-34, at <http://www.itcon.org/2001/2>.
- Boyd, C. and Paulson, J.R. (1995), *Computer Applications in Construction*. McGraw- Hill, Inc, Singapore
- Doherty J.M. (1997). *A survey of computer use in the New Zealand building and construction industry*, Journal of Information Technology in Construction 2:45-57
- El-Haram, M. A. and Homer, M. W. (2002) Factors affecting housing maintenance cost. Journal of Quality in Maintenance Engineering, 8(2), p. 115-123.
- Knight, P. and Boostrom, E. (1995), "*Increasing Internet Connectivity in Sub-Saharan Africa: Issues, Options, and World Bank Group Role*", Online World Bank Publications
- Maqsood T., Walker D.H.T. and Finegan A.D. (2004). *An investigation of ICT diffusion in an Australian construction contractor company using SSM*, Proceedings. of The Joint CIB-W107 and CIB-TG23 Symposium on Globalisation and Construction, Bangkok, Thailand, 485-495.
- Marshall S, and Taylor, W (2007), *Using ICT for rural development* International journal of Education and development. <http://ijedict.dec.uwi.edu/2007>
- McCaffer, R, Baldwin, A, Carrillo, P and A Thorpe,(1991) "*The future of IT in construction – an academic viewpoint*", Chartered Institute of Building, Technical Information Service, No 132.
- Murray M., Nkado R. & Lai A. (2001). *The integrated use of information technology in the construction industry*. Proceedings of the CIB 78 Conference: IT in Construction i Africa, Pretoria, South Africa, 39-1 to 39-13.
- Mutesi E.T. (2009) *An Investigation in to the application of ICT in Civil Engineering Industry in Kampala*, A final Year BEng Project, Kyambogo University
- Rea LM & Parker RA. (1997) *Designing and Conducting Survey Research A Comprehensive Guide 2<sup>nd</sup> Edition*. Jossey-Bass. San Francisco