INFORMATION AND COMMUNICATION TECHNOLOGY APPLICATION IN CONSTRUCTION

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1.0 INTRODUCTION

Information & Communication Technology (IT) describes technologies and equipment that can be used to store, retrieve, transmit and manipulate data. It is a specialist application of Information Technology that has some aspect of communication. It includes areas such as; software development, mobile devices, cloud computing, data centres, cyber security, research networks, support and so on.

In the construction industry the term is used both in relation to the ICT adopted by the project team to design, construct, operate and manage the development, and in relation to the inclusion of ICT in the completed development itself. Technological developments have been progressing fast in other industries, but construction for a long period has lagged behind other industries in terms of adoption of new technologies.

Design and construction are information intensive activities, involving a great number of people collaborating to produce complex, one-off developments. For all contractual purposes, hardcopies for documents were still required and email communications not recognised by any party as a contractually-valid form of information exchange and communication. This has made the industry to be characterized by inaccurate and untimely communications that often result in costly delays. ICT is a potential solution to this problem.

Whilst historically, information may have been managed and communicated using paper-based systems and verbal instructions, the integration of the supply chain, the introduction of computer aided design (CAD) and building information modelling (BIM) and the development of mobile computing (MC) means that ICT is becoming a fundamental part, not just of the design office, but also of the construction site.

There is also increasing potential for automation of construction processes using ICTA, (Information and Communications Technology and Automation), off-site manufacturing, pre-fabrication and the use of technologies such as 3D printing.

The major setback has been the construction industry's traditional reluctance to embrace innovation.

In completed developments, the potential uses of ICT can be overwhelming, with developments such as airports and hospitals having very complex and intensive demands. The development of smart buildings is now taking this intensive demand for ICT to other building types, with requirements for; automated systems, intelligent building management, adaptive energy systems, assistive technologies, remote monitoring and so on.

This presents particular difficulties, as the design life of a building may be 50 years or more, whereas ICT may become redundant within a very short period, sometimes even before the construction has been completed and the development occupied. Conventional appraisal techniques may not be adequate to deal with this complexity.
As a consequence, there is a need for buildings and the wider built environment to be both future-proof and flexible. Designers need to ensure that every opportunity is taken to identify the most efficient solutions and take advantage of the new opportunities offered by technology, whilst also creating a resilient and adaptable infrastructure capable of many years of operation without costly upgrades. This requires that designers work across a number of different timescales, devising short, medium and long-term strategies for ICT.

2.0 BENEFITS OF ICT

- Makes the job easier
- Facilitates decision making
- Saves operating cost
- Improve public image of users
- Gives users competitive advantage
- Enhances productivity
- Saves time
- Improves document presentation

3.0 TYPES OF COMPUTER

- Desktops
- Laptops
- Notebooks
- IPAD

4.0 SOME RELEVANT SOFTWARE FOR USE IN CONSTRUCTION INDUSTRY

Word Processing

- Ms Word
- Ms Excel

Presentation

- MsPowerpoint
- Adobe PageMaker

AEC Drawings

- AutoCAD
- CorelDraw
- ArchiCAD
- Revit Architecture
- Revit Structure
- Revit MEP
- Robot Structure
- Autodesk Quantity Take Off
- NavisWorks Manage

Project Planning and Monitoring

- Ms Project
- Project Plus
- Primavera Solutions

5.0 EVOLVING TRENDS IN CONSTRUCTION WITH ICT APPLICATION

I. Integrated Project Delivery

Construction project procurement is immense in scope because it involves the gathering and organizing of varieties of separate individuals, firms and companies to design, build and manage construction products for project sponsors. The need to improve the procurement process led to the introduction of Integrated Project Delivery concept and it is inspired by the strong desire of the building industry for more cohesive, predictable, correct and responsible outcomes and it is already in use in some form on many projects and the source of intense discussion for everyone in the building industry.

IPD is a comprehensive process which addresses the entire sequence of programming, design, construction and building operations. Here, there is an early creation of a project focused integrated team, collaboration with cross functional teams and alignment of goals among team members. In view of this, IPD has been seen to reduce a project cost by 10% and sufficient save of delivery period.

Appreciable characteristics and measurable benefits of this concept have given high potential for it to become the industry standard. Although, the IPD concept is not yet popular around the world, it is likely that the clients will demand for it in future due to economic and managerial advantages it brings. Thus it is important that an industry be prepared to adapt the system as and when the need arises. One major advantage of IPD for the Builder is the ability to enable early procurement of time- and cost-variable materials and services.

Characteristics of IPD

- Early Involvement of Key Participants; Owner, Architect, and Builder, Sub-Contractors and Consultants.
- Shared Risk and Reward
- Multi-Party Contract arrangement
- Combined Decision Making and Control during the process
- Liability Waivers Among Key Participants
- Jointly Developed and Validated Project Goals
  Mutual respect and trust among project participants is needed to set up an Integrated Project Delivery process. Other things needed are; Collaborative Innovation, Intensified Early Planning, Open Communication within the Project Team, Building Information Modeling (BIM) used by Multiple Parties, Lean Principles of Design, Construction, and Operations and locating team members in same place.

IPD is most successful when Owners, Architects, Engineers, and Builders step outside the boundaries of traditional roles into a more fluid, interactive, and collaborative process. It encourages value engineering which is an aspect of Buildability and Maintainability Analysis since early involvement in design and transparency of the collaborative process overcomes much of the uncertainty in correctly pricing projects. It further breaks the professional boundaries between team members, making their activities seamless.

The benefits are;

- Reduces construction and design costs
- Reduces change orders, and saving time and money
- Quality improvements
- Well informed and improved decision making due to availability of early information.
- Less risk due to better information being available during all phases of the project.
- Overall reliable and consistent project results

Integrated Practice will not succeed if all parties are not devoted to IPD principles, since it collaboratively uses the talents and insights of all participants in the design, construction and fabrication process. Collaboration requires freely soliciting and sharing information and ideas as equals, not as master and subordinate. To achieve this, all team members are expected to approach collaboration as a process by which they have the opportunity to share with and learn from the talents, experiences and performance of others. If there is no trust amongst the team members, collaboration cannot happen.

The IPD approach like construction management recognizes that increased effort in planning results in increased efficiency and savings during execution. Thus the thrust of the integrated approach is not to reduce design effort, but rather to greatly improve the design results, streamlining and shortening the much more expensive construction effort.

II. Building Information Modeling

A Building Information Model (BIM) is a digital representation of physical and functional characteristics of a facility. It is founded on open standards for interoperability and has a shared database of information accessed by all project team.

BIM solutions enable IPD and can deliver dramatic advances in building technology, but the full potential of BIM will not be achieved without adopting structural changes to existing project delivery methods as stated earlier about IPD. It is an integrated process built on coordinated, reliable information about a project from design through construction and into operations. By adopting BIM, Architects, Engineers, Builders and Owners can easily create coordinated, digital design information and documentation; use that information to accurately visualize, simulate, and analyze performance, appearance and cost; and reliably deliver the project faster, more economically and with reduced environmental impact.

The use of BIM in an integrated environment enables new ways of working that result in more predictable, accurate and responsible building outcomes. It involves transitioning to collaborative processes built on the use of digital models to inform and progress the project design and to aid construction. These processes are characterized by increased involvement of project planning, communication, and risk management in a comprehensive and open manner during design and construction.

As such it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its lifecycle from inception onward. A basic premise of BIM is collaboration by different stakeholders at different phases of the life cycle of a facility to insert, extract, update or modify information in the BIM to support and reflect the roles of that stakeholder. Documents generated from a single BIM model may be used for permitting, analysis, bidding, fabrication, and more. Appropriate information for the task is exported from the model as required and when needed. Architects are able to informally convey design intent without having to draw or model details that will be drawn or modeled again by fabricators. Builders and suppliers are able to share their knowledge and expertise when it is most valuable in the design process. And owners are able to participate in a more involved and "hands-on" fashion than is usually the case with traditional project delivery.

It entails the following;

a. BIM design tools - providing platforms for integrated processes built on coordinated reliable information and resulting in enhanced coordination, fewer Request ForInformations and change orders, and less rework.
b. 3D and 4D visualization - enhancing scope definition, stakeholder engagement, and decision making.
c. Model-based analysis - using BIM-based data and digital analytical tools to understand project energy consumption, structural performance, cost estimates and other inferential reasoning from the design while it is underway.
d. 4D modeling - coordinating construction and increasing the reliability of schedules.
e. Fabrication from 3D models - resulting in elimination of shop drawings; better tolerance, lead time, and safety; and faster field assembly.
f. Model-based bills of materials (BOMs) - providing faster, more accurate takeoffs for cost estimating, energy analysis, etc.
g. Laser scanning - capturing existing (as-built) conditions that can be combined with BIM to provide reliable as-built models.

Advantages of BIM

a. It helps transform the archaic quality of closeout documents, particularly traditional as-built/record drawings
b. It helps with the transition of the digital model generated during design and construction to facilities management
c. It allows the owner/operator to use it for building lifecycle management.
d. It diminishes the risk of design errors and omissions.
e. They are used in design and construction to increase communication and team efficiencies.

f. Only BIM can facilitate to have more than one person working in a project model simultaneously and the ability to have the entire project team work on the same model. This helps the work get done faster and prevents against duplicating information and conflicts in the building design.

g. BIM adds additional value when used to integrate project delivery processes as it serves as a catalyst for the IPD process

III. Building Management Systems (BMS)

Building services are systems installed in buildings to make them comfortable, functional, efficient and safe. They can be controlled by simple mechanisms such as manual switching, clocks or detectors such as thermostats or motion detectors, or they can be controlled by more complex building management systems (BMS).

Building management systems are computer-based systems used to monitor and control building services such as:

a. Lighting.
b. Heating, ventilation and air conditioning (HVAC).
c. Fire, smoke detection and alarms.
d. Motion detectors, CCTV, security and access control.
e. ICT systems.
f. Lifts.
g. Industrial processes or equipment.
h. Shading devices.
i. Smart meters.

They may also be used to monitor and control power distribution, energy consumption and uninterrupted power supplies (UPS) and may be referred to as Building Energy Management Systems (BEMS).

Building management systems help building managers understand how buildings are operating and allow them to control and adjust systems to optimise their performance. As well as collating data and allowing ease of control, BMS can help; visualise data, automatically generate reports and create alarms and alerts when parameters are exceeded, failures occur, or with prognostic systems, when failures are likely to occur. They can also allow comparison between spaces, buildings and benchmark data.

Intelligent building management systems bring together information and controls relating to a number of different systems operating using a range of different software applications and allow them to be controlled form single interface. This makes monitoring and analysis more straightforward and comprehensive and allows information from one system to influence the controls for another.

The effectiveness of BMS will depend on the range and quality of the information it receives from sensors and the programming of how this information is used. For example, information about external and internal conditions can be used to determine the level of heating required so that plant can be activated and a building pre-heated before occupants arrive.

Historically, BMS has been associated with large commercial buildings, however as equipmenthas become easier to control, monitoring and detection has become less expensive, and wireless technology has become available, buildings of all sizes are having increasingly complex control systems installed. This can for example allow home owners to connect to their home and switch on devices such as lights and heating before they arrive. See internet of things and smart buildings for more information.

BMS can help:

a. Give better control of systems and conditions.
b. Data gathering and report generation.
c. Increased productivity.

d. Allow better informed response to complaints.
e. Allow allocation of operating costs within a business or to tenants.
f. Allow more targeted use of resources for replacement and maintenance of equipment.
g. Early detection of issues.
h. Reduced operating costs and carbon emissions.
i. Improved equipment life.
j. Improve safety.

Building Management Systems may now be integrated with building information models (BIM) to allow performance in use to be compared with design criteria and design simulations. This can help identify potential problems in operation or design and can help validate modelling techniques. Building information models might also include information about the operation and maintenance of building components.

IV. Building Energy Management System (BEMS)

Building Energy Management Systems is sometimes used interchangeably with Building Management Systems (BMS), however, strictly speaking, Building Management Systems can be used to monitor and control a wide range of building systems whereas Building Energy Management Systems relate specifically to energy-related systems such as HVAC, lighting and power systems.

It is a computer based approach that help to monitor, optimize, control and measure building technical services and the energy consumption used by such services. Its primary aim is to save energy by reducing the energy consumption of equipment. In this system, a single and central platform for energy management is created to connect every other energy consuming device. It is also possible to connect sites and locations centrally such

that the energy data of all devices and appliances can be collated for insight into energy usage.

V. Use Of Drones In Construction

Another innovation sweeping the construction industry is the use of drones which is also known as **Unmanned Aerial Vehicles (UAVs).** As a tool, it improves communication, safety and marketing while capturing real-time images from field. Drones are particularly important for;

- Land Survey
- Data collection and reporting from sites
- Maintaining constant contacts at worksites.
- Maintaining security at job sites and safety of workers
- Transportation and Inspection

6.0 ICT APPLICATION IN PREPARATION OF BUILDERS DOCUMENTS

As part of the contract documents, Section 2.32 of the **National Building Code** requires that a Registered Builder Provides;

a. Construction Programme

- It is used to manage time and resource deployment and utilization on the project.
- As part of the contract documents, it is a legal document.
- It gives all stakeholders an appreciation and understanding of the time programmed for the job.
- It helps financiers make appropriate decisions on the tenor of their loan and other financing agreements. It indicates the sequence and logic of the construction work
- Defining roles and responsibilities of the proposed construction team
- Periodic reports and reviews of construction program during construction

b. Project Quality Management Plan

- The quality management plan the well thought out procedure and ways necessary for a quality delivery of a project in line with client expectation.
- It is project specific, so it is different from a quality policy
- To meet statutory, regulatory, or customer requirements
- To optimize the use of resources
- To minimize the risk of not meeting quality requirements
- Necessary for quality monitoring and assessment to ensure compliance with the requirements.

c. Project Health and safety Plan

- According to Section 2.32(C), a health and safety plan is expected to be prepared before a work commences.
- Keeps the contractor at alert on all factors that might affect the work
- Helps in the reduction of loss of work hour.
- Reductions in workers` compensation costs
- Eliminating potential permanent disabilities
- Minimising the loss of properties and equipment

Builders` software was developed by the Council of Registered Builders of Nigeria (CORBON) for the production of Quality Management Plan and Health & Safety Plan. The procedure for its usage has been properly documented by CORBON and has been on sale to members.

In the same vein, Microsoft project has been used for guiding Builders on how to prepare construction program. Recently, Primavera Solutions has been introduced.

Finally, It is expected that Builders acquaint themselves with the use of these software for our personal development and the growth of the institute.