

INFORMATION TECHNOLOGY AND THE BUILT ENVIRONMENT: IMPLICATION FOR SUSTAINABLE DEVELOPMENT

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ABSTRACT

The rate of urban growth and current waves of natural disaster has necessitated the use of appropriate technology to generate data that would enable right decision. Information technology tools are require in the data acquisition and analysis. The built environment data needs are complex and therefore required more than human effort. The target of the paper was to explore available information technology tools and software that could contribute to sustainable development of the built environment. The data collections for the study were mainly from secondary source, observation and experience. The finding of the study shows that, the application of information technology in the built environment improve upon job delivery, enhance accuracy and precision of design, time saving in operation and eventually lead to sustainability of the built environment. Conclusively, sustainable development from built environment perspective every professionals must find better ways of balancing development objectives with the need for environmental sustainability. This is made possible through the use of information technology tools or software. The study recommends IT training in specific area of interest for the different professional in the built environment

Keywords: *Environment, Computer aided design, Information Technology and Professionals.*

INTRODUCTION

The rate of urban growth and the waves of human and natural disaster has necessitated the generation and sourcing of volumes of data that would enable right decision. Information technology provide means of gathering data and analysing the same. This are made possible through information technology tools and software. The development of information technology has

contributed to the improvement of complex designs among the built environment professional especially the architect and urban planners. Recent development in information technology are providing means and methods for improvement of current practices to respond to these changes [1]. In the pursuit of sustainable national growth, it is imperative to develop appropriate information technology system which would improve on existing practices. The Nigeria development goal objectives acknowledged the important of information technology as stated in Vision 2020 document; to promote ICT driven approaches and information management for human settlement in the country [2]. noted that Information has been described as "*the basic resource in all decision making*"; however, in the practice of Urban and Regional Planning in the developing nations most decision are being made on the basis of inadequate information and in a disjointed and incremental way [3].

Many Architect in the developing countries may not fully be aware of the application of computers in architecture except for the application of computer aided drafting, modelling and visualisation. [4] The evolution of information technology will have a profound impact on how organisations in the architectural, engineering and construction industry operate [5]. For instance the success of any design by an Architect depend largely on; spatial organisation and material organisation. Information as "*the basic resource in all decision making*", however, in the practice of urban planning in the developing nations most decisions are being made on the basis of inadequate information and in a disjointed and incremental way [6]. [3] Stated that if public planners had more information, they will make better plans and perhaps arrive at better decisions, more so, that more and faster information would improve efficiency in government operations. In achieving sustainable national growth, professionals in the built environment professionals must find ways of balancing development objectives with the need for environmental sustainability. As pointed out by [7] 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. [5] States that the ability of Quantity Surveyors to avail themselves

with the emerging opportunities provided by the advent of Information and Communication Technology depends on the adoption of new technologies.

Information plays an important role in the built environment by empowering the professional with appropriate datasets and with tools that enhance productivity on projects. Information needs of the different professional in the built environment with specific relevance to environmental sciences takes different dimensions. Increasingly it has been recognized that policy makers, built environment professionals and the public have need for information to take appropriate decision on matters relating to the built environment. Individual, public or private organization have significant need of the use of spatial data on a day to day basis. This information need and its analysis is critical to successful delivery of job by the different professional in built environment. The paper provides an overview of some available information technologies tools, for the built environment professional.

Methodology

The methodology adopted for the paper is the qualitative approach. The main sources of data used consisted of review of relevant literature and publication on information technology tools and software. Database searches using the internet and related web form part of the source of material for the paper.

THEORETICAL FRAMEWORK FOR THE STUDY

Information Technology (IT)

Literature has shown that humans have been storing, retrieving, manipulating, and communicating information since the Sumerians in Mesopotamia developed writing in about 3000 BC [8]. Information technology is a broad term which covers all aspects of the use of computer technology. IT is the use of computers to store, retrieve, transmit, and manipulate data [9]. It includes not only hardware and software, but also communication technology applied to linking computer systems, software engineering, and the administration and use of computer system. It provide an enabling environment for physical infrastructure and services development of applications for generation, transmission, and processing, storing and

disseminating information in all forms [7]. Information technology tools and software are designed to meet the need of the different professional in the built environment industries. The manual processes of producing design is cumbersome due to the rigor of analysis, synthesis and evaluation. The generation of automated 3D drawing and other computer assisted task is possible by the use of computers. Based on the storage and processing technologies employed, it is possible to distinguish IT development has passed through different stages over the years. Four distinct phases of IT development have been identified to includes; pre-mechanical (3000 BC – 1450 AD), mechanical (1450–1840), electromechanical (1840–1940), and electronic (1940–present), [8]. The traditional approach to design, planning and management cannot cope with the current data need.

The Built Environment

The environment is an asset, a stock of available wealth but if the present generation spends this wealth without investment for the future then the world will run out of resources. [10] rendered the definition of environment as; The complex of physical, chemical, and biotic factors (such as climate, soil, and living things) that act upon an organism or an ecological community and ultimately determine its form and survival or the aggregate of social and cultural conditions that influence the life of an individual or community. The built environment consist of the physical structures where people carry out activities and the supporting infrastructures, such as transport, water and energy networks. The built environment includes all buildings and living spaces that are created, or modified, by people [11]. This also includes the buildings and spaces themselves, infrastructural elements such as waste management, transportation and utility transmission systems put in place to serve this building space.

The built environment can be defined by four interrelated characteristics [12];

- i. It is *everywhere* and *everything* humanly created or made, modified, or constructed, arranged, or maintained,
- ii. it is the creation of human minds and the result of human purposes intended to serve human needs, wants, and values,

- iii. It is created to help to protect human from, the overall environment, to mediate or change this environment for comfort and well-being, and
- iv. Every component of the built environment is defined and shaped by context; each and all of the individual elements contribute either positively or negatively to the overall quality of environments.

The Concept of Sustainability

Sustainability is about the study of how natural systems function, remain diverse and produce everything it needs for the ecology to remain in balance. Sustainability is defined as achieving a dynamic equilibrium in interaction between a population and the carrying capacity of its environment such that the population develops to express its full potential without producing irreversible, adverse effects on the carrying capacity of the environment upon which it depends [13]. Sustainable development (SD) is development that meets the needs of the present without compromising the ability of future generations to meet their own needs [14]. SD contains two key concepts: the concept of 'needs', in particular the essential needs of the world's poor, and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs. The concept of sustainable development is about the integration of economic, social and environmental consideration in decision making that directly and indirectly influence the urban quality of a life over the long term.

IT TOOLS/SOFTWARE RELEVANT TO THE BUILT ENVIRONMENT

There are wide range of information and technology tools/software in use among the built environment professional. Some of the tools/software are general in application while some are package to meet specific professional requirement.

a) **Computer-Aided Design (CAD):** CAD is the use of computer systems to assist in the creation, modification, analysis, or optimization of a design (Narayan, 2008). It is the application of computer software for drawing two dimensional (2D) designs of development schemes, layout plans, master plans, regional plans, building and facilities design, including 3D modelling. A CAD system is a combination of hardware and software that enables

the users to design desired object. In addition to the software, CAD systems require a high-quality graphics system, light pen, or digitizing tablet for drawing; and a special printer or plotter for printing design specifications. Autodesk's is a leading CAD software manufacturer and the notable products are AutoCAD. There are different types of Autodesk CAD software; Autodesk Cad Overlay AutoCAD, ArchiCAD, AutoCAD Land Development Desktop and Autodesk infrastructure modeller, Scan CAD, and 3D Max etc. The output of CAD is often in the form of electronic files for print or machining operations. It uses either vector based graphics to depict the objects of traditional drafting, or may also produce raster graphics showing the overall appearance of designed objects.

b) **Building Information Modelling (BIM):** Building Information Modeling (BIM) is a digital representation of physical and functional characteristics of a facility [6]. Building Information Modelling (BIM) is an intelligent 3D model-based process that equips architecture, engineering, and construction professionals with the insight and tools to more efficiently plan, design, construct, and manage buildings and infrastructure. Traditional building design was largely reliant upon two-dimensional technical drawings (plans, elevations, sections, etc.). BIM goal is to provide a common structure for information sharing that can be used by all agents in the design process and construction, as well as the facility management after a building is constructed and occupied [1]

c) **Satellite Technology:** A satellite is an artificial object which has been intentionally placed into orbit [17]. There are different types of satellite in the orbit for different use; example includes communication, environmental monitoring, or navigational purposes. Within the built environment earth observational satellites is useful in earth monitoring, meteorology, map making etc. [18]pointed out that approximately 500 operational satellites are in low-Earth orbit, 50 are in medium-Earth orbit (at 20,000 km), and the rest are in geostationary orbit (at 36,000 km). A few large satellites have been launched in parts and assembled in orbit. With the use of satellite technology data on the natural environment could be collected with ease.

d) **Geographic Information Systems (GIS):** A geographic information system (GIS) is a computer system for capturing,

storing, querying, analysing, and displaying geospatial data [19]. It also referred to as a computer system for capturing, storing, checking, and displaying data related to positions on Earth's surface [20]. The following software are GIS software packages; ArcGIS, ArcView, Map Info, Arc Globe, Autodesk Map, SIS-spatial information system, TransCAD, GRASS, DIVA-GIS, PostGIS, Quantum GIS, among others; are used for geospatial data analysis, design, computations on land information and socio-economic attributes of an area. The general functions of GIS software include; data acquisition data processing data analysis, data management and product generation. One major use of GIS as identified by [21] digital terrain model; is a topographic model of the bare earth –terrain relief - that can be manipulated by computer programs. This is a product of GIS tool which present elevation of the earth surface in its real life.

e) **Autodesk Infrastructure Modeller Software (AIMS):** Autodesk Infrastructure Modeller software is a software design for construction professionals such as urban planning, civil engineering, and transportation planning professionals to create, evaluate, and communicate infrastructure proposals. Infrastructure modeller can help to drive stakeholder buy-in and inform decision making with visually rich proposals for transportation; land, water, and energy infrastructure projects. It is a powerful sketching tools—Sketch conceptual designs directly into a model. The software is used to communicate visually rich infrastructure proposals—Shift between design proposals and evaluate alternatives, and capture rendered images or recorded videos. AIMS model existing infrastructure and bring 2D CAD, GIS, Building Information Modelling (BIM), and raster data into a 3D model. It has the capacity to import detailed models—incorporate detailed models from AutoCAD, Civil 3D, AutoCAD Map 3D, and other software. It overlay GIS data to create 3D thematic maps to help inform decisions. More so it manage infrastructure proposals, create and manage multiple alternatives in a single model.

f) **Deed-Check 10 Software:** Deed-Check 10, program facilitates the layout of a subdivision complete with streets, cul-de-sacs, setbacks, easements, parking spaces, utility lines, lot numbers, lot size and annotation.

g. **Land Sketch for Subdivision:** Land Sketch for subdivisions is designed to eliminate the inefficiencies in the planning stage for land development projects. Its main purpose is to for quick layout conceptual residential designs electronically and then passes that data to the designer to complete the final engineering design.

h. **SketchCAD:** SketchCAD software is use for 3D sketch models, artistic presentation tools including hand-drawn sketch, painted, blueprint, instant shadow calculation and analysis, image handling tools to map directly onto a model or even create a model from, parametric design tools for multiple iterations of the same model driven by numbers or dimensions and camera motion animation to create stunning presentations from multiple viewpoints.

i. **Cost Estimation Software for Quantity Surveyors Professional:** There are different forms of software available for the quantity surveyors; QS Plus- quantity surveying software for estimating and cost engineers; Win QS- estimating and QS software (evaluation construction pricing software for quantity surveyors); BuildSoft estimating software/Take-off Software and Qsing Software.

RESULTS OF THE FINDINGS

- i. **Computer Aided Design (CAD).** There different CAD software available for use in built environment assignments. CAD software facilitate and enhance efficiency in design. It allow a designer to view a design from any angle with the click of a button and to zoom in or out for close-ups and long-distance views.
- ii. **IT facilitate effectiveness:** The use of information technology tools or software guarantee effective operation in an organisation. It enhance the quality of decision making due to available information on a particular aspect of the environment. The use of satellite imagery and Google earth or other related provider gives details on existing situation of physical environment. The analysis of this imagery by computer software provide standard and accurate information that guide decision making.
- iii. **Time Saving and energy:** The application of information technology tools save time and energy invested in project.

- The time investment through manual processes of handling drawing is much compared to when using computer.
- iv. **Accuracy and precision:** Application of information technology tools/software lead to accuracy and precision in design. This is vital in the built environment as inaccuracy of design could lead to disaster on the long run. Accuracy and precision in producing structural drawing for built project is achieved with a good hand use computer software to produce structural design.
 - v. **Reproduction of design:** Design carried out by the computer system could easily be duplicated. The output of the job could be printed in different scale which is not possible through the analogue method.
 - vi. **Storage capability:** It offers portable mean of storage of data. Computer system have different media for storage of data and end product for every design. The use of IT tools preserve valuable data or information.

DISCUSSION BENEFITS OF IT APPLICATION FOR NATIONAL GROWTH

There are array of software and tools available for the built environment professional. The existing literature has shown the relevance of information technology tools and software in advancing the development built environment leading to sustainable national growth. The following area among other have been identified as critical area of the application of information technology in the built environment that have contributed to National growth.

1. **Fiscal cadastre:** Is inventory of land parcels that provides the information necessary to determine the value of each parcel and the tax due on it? The functions of fiscal cadastre include; information base for property taxation, support in financial allocation programmes, monitoring and support for land market, aid to land use development control and provision of land information. Land and property taxation are used in raising revenue from land. Government raise revenue using property rating system by assessing and taxing buildings and the uses to which they are put. The property record is made possible through the use of CAD / GIS software.
2. **Land Administration and Management:** Land administration

and management challenges have been reduced to the barest minimum by the introduction of computerisation of land records in some country of the world. The operational component of the land management paradigm is the range of land administration functions that ensure proper management of rights, restrictions and responsibilities. In Nigeria example abound with Abuja geographical information system, Nassarawa geographical system etc.

3. **Enhancing Layout design, building design and costing:** Planning layout had been simplified by the use of computer aided design software. It has greatly reduced the cumbersomeness in the design of layout, plans, and general master plan. Initial drafting is manually carried out by a planner which is transfer into the computer environment either by scanning or through digital transfer to the computer. Architectural design software has also contributed to the quality of building design. Structural details and costing software has improved upon job delivery.
4. **Digital terrain model (DTM):** Digital terrain model is a topographic model of the bare earth –terrain relief - that can be manipulated by computer programs. The DTM data sets are extremely useful for the generation of 3D renderings of any location. The main applications are: planning, engineering, visualisation, height analysis, environmental impact analysis, sight lines, wind flow and pollution dispersion, soil erosion modelling, flow direction and accumulation and watershed delineation
5. **Monitoring and Control of changes in built and natural environment:** The monitoring and control of land use change forms an integral part of the urban planning process. This process enable policies and strategic plans to be periodically reviewed and updated. The use of satellite imagery is a vital tool for monitoring and control of development in a city. Considering the dynamic nature of the built environment it is important to have a well-conceived information system that would serve as guide for decision making. Adequate monitoring and control of development require up-to-date planning data which could be collected through IT tools.
6. **Computer simulation:** The use of a computer to represent the dynamic responses of one system by the behaviour of another

system modelled after it. A simulation can also take the form of a computer-graphics image that represents dynamic processes in an animated sequence. Computer simulations are used to study the dynamic behaviour of plans in response to conditions that cannot be easily or safely applied in real life. Simulations are useful in enabling observers to measure and predict how the functioning of an entire system may be affected by altering individual components within that system.

7. **Conceptual Urban design of Urban Environment:** Urban design deals with the complexity of form and functions of the physical environment. The outputs are presented as a combination of visual and descriptive information that show how to change the shape of the cities. Such information includes two-dimensional (2D) plans, maps and drawings, as well as three dimensional (3D) drawings and models of proposed interventions. The presentation of such information, due to its visual nature, dictates the need for an effective way for visually communicating it to the stakeholders involved. The urban design work present the urban environment in a real world state thereby removing difficulty in understanding the complex spatial relationships of physical form when portrayed by limited presentation capabilities of the 2D traditional media.
8. **Landscaping:** Landscapers use CAD software to conceptualize stunning outdoor creations and determine the best placement of various landscaping components such as trees, fences, gardens, patios and more. These are just a handful of the many versatile uses of computer-aided design software. It's also used to design consumer electronics, furniture, circuit boards, jewellery, theatre and movie sets, product packaging and much more. Such ubiquity across a vast array of industries ensures the longevity and necessity of CAD software in today's technology-driven world.

CONCLUSION

Application of information technology is a boost to the built environment professionals as it offered varied range of opportunities in project design and implementation. The time saving, energy, accuracy, data storage and management capability make the whole processes to facilitate effective job

delivery. The rate of urban growth and corresponding challenges of managing the urban centres has defied traditional approach. The volume of data needed, spatial coverage and analysis has made it a necessity for adopting information technology. For the built environment professional to be relevance in the 21st century, there is need for knowledge advancement in the area of information technology.

RECOMMENDATIONS

Relevant knowledge is required in information technology if sustainable national growth is to achieve by any nation. Information technology development is an essential tool for data capturing, monitoring and forecasting. Strategic option could be adopted in developing information technology to meet the needs of the built environment. The paper therefore recommends;

- The need to define appropriate technology requirements to meet sustainable national objectives.
- Identifying and developing cross-cutting technologies that reduce risk and provide new opportunities
- General computer appreciation course to familiarise with the use of computer which is a great challenge to some individuals.
- Database management packages-(Microsoft Access, Excel, & SPSS etc.), this is necessary because data integration is fundamental in creating a database for a neighbourhood or city or design that has socio-economic attributes. Data generated in any of the above package can be link to either CAD or GIS packages.
- Training on design oriented packages that are user friendly.

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