THE ASSOCIATION FOR CONSULTING ENGINEERING IN NIGERIA (ACEN)

THE Consulting Engineer

A Four-Monthly Publication of The Association for Consulting Engineering in Nigeria (ACEN)
January - April 2020 | Vol. 7 | No. 1 | Engineering is Development

INSIDE

www.acen.org.ng

INFORMATION & COMMUNICATIONS TECHNOLOGY

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"THE CONSULTING ENGINEER"
is produced three times a year by
SENDINA LIMITED for ACEN

PRODUCER'S OFFICE
Sendina Limited
Plot 22b, Kola Olosan Street,
Ofada (via Mowe)
Ogun State
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ISSN 2360-6824

CONTENTS

FROM THE EDITORIAL SUITE


Engr. Ajibade Oke, FNSE

We are pleased to welcome our teeming readers to the year 2020. This edition is being delivered at this time due to the constraints caused by the COVID-19 pandemic but we hope that normalcy would soon return nationally and globally. The focus of this edition is Information and Communications Technology (ICT) and it has been uniquely crafted to offer you education, excitement and pleasure. We hope that you realize these benefits and even more as you read these materials.

The use of ICT cuts across all classes of people in society. On one extreme, even those without any form of formal education use it as a common tool to reach out to relations, friends and customers. On another front, such as in football matches, ICT is applied as a tool to confirm whether a goal is correctly scored or not. In the aviation industry, it provides the means for safe landing of aircrafts. In education, online learning is gradually taking the entire stage through the application of ICT. The gamut of ICT application is wide and perhaps endless.

In the first article, Dr. Olumide Oyebade, Assistant editor, Transport and Tourism of "The Guardian Newspapers", presents a lucid narrative on sustainable access to information and communications technology for human resource development. He has amplified the nexus. We have from Mr. Adeleye O. Opeyemi of the Federal Ministry of Communication and Digital Economy, an insight into the policies and achievements of the Ministry on ICT.

Other articles presented by various ICT experts cover the following subjects:

- Software Tools and their Applications in Engineering Consultancy by Engr. Lanre Sagaya, Jr., MNSE, Executive Director, YOLAS Consultants
- Internet Connectivity Systems by Mr. Tajudeen Balogun, CEO of Infosol Consultancy Services
- Applications of Cloud Computing Technology by Engr. Adeyombo Adewale, MNSE, CEO of Saralt Supports Limited
- A Discourse on Computer Systems Networking by Engr. Dr. Sunny Orike, Ag. Head of Department of Computer Engineering Department, Rivers State University, Port-Harcourt
- Authentication Technology and its applications by Mr. Segun Tony Akande, MSc, MBCS, CEO of Xown Solutions Limited
- Specialized Certifications in ICT and their Advantages by Engr. Mission Franklin, B. Tech, MBA, MSc, MIEEE, MBCS, MCPN. Lecturer in Computer Engineering Department, Rivers State University, Port-Harcourt.

The personality for this edition is Engr. Hassan Odediran, FNSE, Executive Chairman of IEC Group Company Limited. He is an outstanding professional in electrical engineering and ICT practice. We congratulate him for the successes in his professional practice.

Also in this edition, one reputable ACEN member firm, namely Unecon Associates Ltd headed by Engr. K. O. Adebara, MNSE is recognized for its competence in several years of engineering practice. We congratulate the firm for making the engineering community proud in Nigeria.

ACEN engaged in a series of activities which were captured in various scenic photographs. These are presented in the Photo News column. The information shared in the Tit-bits column reminds us of the modern changing world driven by ICT. Get to know what the columnist, Engr. Enefiok Ubom, MNSE is saying about it.

Finally, we welcome ACEN's 18th President, Engr. George C. Okoroma, FNSE, FNIHTE, FNICE, JP to the saddle and wish him a successful tenure. We also express our appreciation to those who have contributed to the successful publication of this edition.

Relax and enjoy your reading!

Engr. Ajibade Oke, FNSE
(Chairman, Editorial Committee)

A MESSAGE FROM ACEN PRESIDENT

Engr. George C. Okoroma, FNSE, JP

Dear Colleagues and Member Firms,

It was just few weeks after my Investiture as the 18th President of the Association for Consulting Engineering in Nigeria – ACEN that Nigeria and the world in general recorded the unprecedented upsurge of the novel Coronavirus – COVID-19.

This disease knows no bounds and it respects no one. It affects both the rich and the poor, and all humans irrespective of colour and nationality. From cancellation of flights, the closure of airspace, land, and sea borders, to the imposition of curfews and restriction of movements, the upsurge of the COVID-19 pandemic has halted businesses, cancelled global conferences and corporate gatherings, and it is wreaking havoc on national economies as day breaks and night falls. In just 4 months, more than 2.4 million people in 180 countries have fallen sick from the viral illness, while at least 160,000 have died in this public health emergency. As the United Nations would have it, COVID-19 is the world's "most challenging crisis" since World War II.

Despite the havoc that this pandemic hopes to wreck on humanity and businesses, the good news is that it can never lockdown our brains of consulting capacity. Amidst this trying time, we shall step up to the plate as Consulting Engineers, unite with the world in the fight against this disease and simultaneously device innovative initiatives to birth new business opportunities and serve our skills and competences to Governments, Ministries, Departments, and Agencies where necessary. Without the slightest intuition of the current high level of demand and reliance today on robust websites, WFH frameworks, e-meetings, e-learnings, and e-libraries by organizations all over the globe due to the total lockdown of cities and nations necessitated by the unprecedented coronavirus pandemic, I had in my inaugural speech, highlighted that my administration will amongst other activities on my roadmap, focus on redesigning the ACEN website, and launch the ACEN e-library and Engineering Capacity Resource Development Centre.

The ACEN website, I can say with certitude, has been fully redesigned with the inclusion of useful dropdown menus and very necessary materials uploaded. The ACEN e-Library and Engineering Capacity Resource Development Centre site, is fully designed and will soon be ready to be populated with study and research materials. It will, as stated in my inaugural speech, be top-notch for all engineers and aspiring engineers in Nigeria for research, and engineering capacity development. As an Association, our policies, and ideals remain firm, solid, and unshattered. We shall continue to act as independent agents with the highest technical skills and intellectual competence, and take responsibility for finding innovative solutions to technical problems and improve the lives of Nigerians by providing strategic advice on infrastructural development predicated on resilience, safer structure, and climate change mitigation. Over the past 49 years, ACEN has charted a great course and surmounted challenges towards becoming the ultimate reference business association of choice for agencies of government, and the organization providing professional engineering consultancy services with excellence in Nigeria.

As the 18th engineer to take on the responsibility of leading this noble Association to her dream destination, I am on a mission, and my target is clear. My mission is well defined and simple: to hand over to the next administration an ACEN that is richer, fuller, and better. An ACEN where there is an opportunity for each and everyone according to his or her ability. An ACEN that is the powerhouse of infrastructural development consultancy in Nigeria. At the moment, we are in full operation while adhering to the government's order and directives on lockdown and social distancing, and we are working round the clock to deliver on our roadmap and promises. Making this page of the 1st edition of 'The Consulting Engineer' (TCE) Magazine 2020 is a remarkable feat for me.

The magazine stems from the belief that ACEN holds herself responsible to develop and offer real-time spontaneous solutions to the challenges faced in the built environment. The magazine is designed to spur you to duty and diligence in the global response to resilient infrastructural development.

From the pages ahead, it is my firm belief that the ideas here presented are the product of in-depth research and scholarly acumen, and I am convinced that they would serve as tools to assist and better acquaint the masses with requisite information on the roles and works of the Consulting Engineers in national development.

I encourage you to read along, enjoy the moment, and stay safe.

Engr. George C. Okoroma, FNSE, JP

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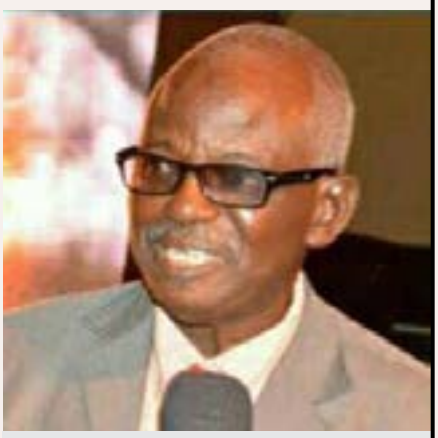

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THE ASSOCIATION FOR CONSULTING ENGINEERING IN NIGERIA (ACEN)

The Association for Consulting Engineering in Nigeria, ACEN, was founded in 1972 and registered in 1979. ACEN is a body of registered independent private engineering consultancy firms and voice of the profession in Nigeria.

MISSION STATEMENT

"ACEN shall build a strong membership that fosters equal opportunities, creates competitive advantage through increased visibility with strategic partners and improves the standards of consulting engineering in line with international best practice".

VISION STATEMENT

"To remain the ultimate reference business association of choice for organisations providing professional engineering consultancy services in Nigeria."

FUNDAMENTAL OBJECTIVES

- Ensure that the highest level of technical competence and business ethics are brought to bear on the practice of the profession in Nigeria.
- Ensure that every State has the highest level of Consulting Engineering practice by having members in every state of the federation and the federal capital.
- Increase the number of engineering firms in the country relative to the size of the nation.
- Ensure that stakeholders in the built environment get maximum value for their investments by monitoring standards of practice within the industry.
- Grow the industry by promoting the growth of large consulting engineering firms.

ACEN MEMBERSHIP

Prior to December 2007, ACEN membership was open to individual and firm members, who possessed the required experience and professional integrity. At the 2007 AGM, a motion was passed limiting ACEN membership to firms. This was to further emphasize the business nature and focus of the association. Membership is therefore now open to Consulting Engineering firms with the adequate experience and commitment to continuous improvement in technical and business integrity. Today, ACEN's member firms numbering about 300 are located in the 6 geo-political zones and the FCT.

ACEN & COREN

TThe Council for the Regulation of Engineering in Nigeria is the statutory body with responsibility for the regulation of all Engineering activities in Nigeria. It is empowered to keep a register of all Engineering craftsmen, technicians, technologists, Engineers and Consulting Engineering Firms who wish to practise in the country. No individual or organization is allowed to practise Engineering in Nigeria without the approval of COREN. Thus, all member firms of ACEN must be registered with COREN and the members of such firms must also be individually registered by COREN.

ACEN has just recently been mandated by COREN to register on its behalf all consulting engineering firms in the country. Furthermore, ACEN President now seats on the Council of COREN. Thus, ACEN is now better positioned within the built industry.

ACEN & NSE

The Nigerian Society of Engineers is the umbrella association of all graduate Engineers in Nigeria and all Engineers employed in ACEN member firms are members of NSE. Conversely, most members of NSE with interest in Consulting Engineering practice are members of ACEN. ACEN focuses only on the business interest of Consulting Engineering Firms and her interest is, therefore, specific and complementary to the scope of COREN and NSE.

ACEN & FIDIC

The International Federation of Consulting Engineers is a 102-member organisation which provides the strongest platform for our international activities. FIDIC is the voice of Consulting Engineering all over the world, and this it does through seven major focus areas: Representation, Business Practice, Ethics/ Integrity, Image, Sustainability, Globalization and Quality.

FIDIC is perhaps best known for its contracts documents, which are used all over the world, especially for international projects in the third world. The documents are used extensively by the Nigerian Federal Ministry of Works. In addition, FIDIC has Manuals on a Guide to Practice that teaches best practice in Consulting Engineering, Business Integrity Management and Quality Management amongst several others.

Two (2) ACEN members, Engrs. J.I. Folayan and Bayo Adeola have served on the FIDIC Executive Committee, the highest level of the organization. Other ACEN members have served on committees and task forces of the organization, and members attend the yearly annual conferences in large numbers regularly.

ACEN & GAMA

FIDIC Group of African Member Associations, GAMA, is a subset of FIDIC to address specifically African concerns. GAMA currently has 18 members, holds regular annual conferences and AGMs, and promotes networking among its members. Nigeria played a very active role in the formation of GAMA and has continued to be very active in the association.

ACEN former President, Engr. (Mrs.) Mayen Adetiba was once Chairman of GAMA while several ACEN members served on the Executive Committee. The current ACEN President, Engr. George Okoroma, is a member of the GAMA Executive Committee.

ACEN ACTIVITIES

ACEN provides a series of activities tailored to deliver service and benefits to our members in these key areas:

- Training through the ACEN School of Consulting Engineering.
- AGM & EGM for effective dissemination of information to members.
- Attending International Conferences.
- Membership / Certifying Standards.
- Advocacy.
- Quarterly Business Evening meetings to discuss topical issues affecting members.
- The Young Professionals Forum.
- Triannual publication of "The Consulting Engineer" magazine.
- Monitoring and follow-up on policies and bills relating to matters of engineering practice.
- Legal retainership program to advise members on legal issues.
- Advancing the practice of consulting engineering for favourable business environment for members.

Setting up of Special Task Forces on:
Collapse of buildings, conditions of engagement/ scale of consultancy remunerations, quackery, Industry study, formation of built industry transparency initiative, local content for the construction industry, etc.

CHALLENGES OF ACEN

Despite the fact that ACEN has been in existence for forty-one (41) years, some of the challenges leading to its formation have remained while new ones have emerged. The most notable current challenges are as follows:

- Unfavourable Government procurement policies especially in the states.
- Private sector perception.
- Loss of Engineers to other sectors due to low remunerations.
- Number, size and scope of ACEN Member firms.
- Delayed payments to members.
- Limited awareness and knowledge of the savings consultants contribute to the overall cost of projects if employed by governments and entrepreneurs.
- Inadequate corporate sponsorship to enhance smooth operations of the organisation.

PROFILE OF ACEN PRESIDENT, ENGR. GEORGE CHUKWULEWA OKOROMA, FNSE, JP

Engr. George Chukwulewa Okoroma is the President of the Association for Consulting Engineering in Nigeria. He also seats at the helm of affairs at **Gambeta Groupe Limited**, a group of companies with major professional interest in Engineering & Technical Consulting Services, Oil and Gas (EPIC) Projects, Transport/Logistics, Information Technology, Hospitality, Contract Staff Management, Manpower Development, and Real Estate.

He has distinguished himself as a professional, a philanthropist and a leader who believes that integrity, honesty and professionalism remains the core value for professional practice. His mission for the industry is to bridge the gap between local companies, best practices and excellence, in Engineering and other Technical Services, for a sustainable development.

Engr. George Chukwulewa Okoroma, FNSE, JP

George graduated as a Civil Engineer in 1981 from the Paul Sabatier University, Toulouse, France. He also holds a Master's of Science Degree in Project Management.

He started his working career with various construction companies as Project Engineer and rose to the position of a project manager. In 1985, he co-founded his first engineering venture - a construction company Gambeta Nigeria Limited and later, established amongst other Companies a Consulting Firm: **Gapec Consultants Limited** and he is the Principal Partner.

George is a prominent and active member and fellow of various professional associations in Nigeria and abroad which includes Fellow Nigerian Society of Engineers (FNSE), Fellow Nigerian Institution of Civil Engineers (FNICE), Fellow Nigerian Institution of Highway and Transportation Engineers (FNIHTE), Member Nigerian Institute of Management (Chartered) (MNIM), Fellow Institute of Management Consultants (FIMC), Member Institute of Safety Professionals, Member American Society of Civil Engineers, Member Institution of Diagnostic Engineers UK (MIDiagE), Council Member and Council for the Regulation of Engineering in Nigeria (COREN).

Engr. George is the Honorable Treasurer for FIDIC AFRICA. He was also the Pioneer Chairman of the Nigerian Society of Engineers, Omoku Branch, Nigeria (2012-2015).

In terms of awards and recognitions, he has received several awards which include; Distinguished Service Award Nigerian Society of Engineers 2007, Justice of The Peace by the Nigerian Government 2010, Distinguished Service Award by ACEN 2013, Presidential Merit Award for Exemplary commitment to the Engineering Profession and support to the Ideals of the Nigerian Society of Engineers 2015, Inducted into the 2015 Construction Industry Hall of Fame by CED Magazine, Recipient of the Distinguished Service Award by The Nigerian Institution of Highways 2016, Leads Africa Merit Award of Excellence 2018, Life time Achievement Award 2019 etc.

Engr. George C. Okoroma is happily married and blessed with children and some of them are professionals in their own rights in various disciplines.

AN INTERVIEW WITH THE ACEN PRESIDENT, ENGR. GEORGE C. OKOROMA, *FNSE, JP* BY 'THE GUARDIAN NEWSPAPER' ON MAY 11, 2020

'Development is suffering for lack of confidence in local professionals'

George Chukwulewa Okoroma is the President, Association for Consulting Engineering in Nigeria (ACEN). The engineer, who is at the helm of affairs at Gambeta Groupe Limited in this interview with BERTRAM NWANNEKANMA, spoke on the challenges of engineering profession in Nigeria among other issues.

Engineering practice in Nigeria has been hampered by lack of government patronage. What do you think is responsible? How can it be addressed?

Since the end of the Civil War, it has been the dreams of our founding fathers to create a pool of independent professionals with the highest technical skills and intellectual competence to provide the springboard to improve the quality of lives of the Nigerian people by providing services in an environmentally friendly manner which would enhance the nation's technology, productivity and also stimulate economic activities in all zones of the federation.

It is disheartening to note, that despite the lofty ideas that birthed engineering as a profession, and consulting engineering as the business of designing, construction, and management of infrastructural projects in Nigeria, this profession has suffered low patronage from her own government and people.

Today, indigenous engineering firms compete rather unfavourably for jobs and contracts with foreign engineers and consulting firms in our own country. In bidding for contracts, our people and government seem to give foreign consultants much preference and treat the ideas of the indigenous engineers and engineering firms with inferiority.
The cause of this is aptly Nigerians' unrepentant penchant for foreign-made goods and imported services. Our people believe that anything that comes from outside the country or done by white men is superior.

This show of lack of trust and confidence in the professional competences of Nigerian engineers have impeded the development of the engineering profession in Nigeria. If our government and people cannot trust us their own to execute projects according to standard, who will?

On the flip side, we have been encouraging and advocating that our engineers and Consulting Firms must, through the knowledge acquired from their training, develop skills and competences required to deliver successful projects; if given opportunities to be involved in project planning, design, and execution. But again, such skills and competences cannot be developed when not challenged progressively; certainly, Nigerians would never know how much we can perform until they give us the chance to work.

Addressing this situation calls for a paradigm shift in the mentality of our people to believe that indigenous engineers have the skills and competences too. We have the training, the exposure, and the capacity.

The Nigerian Government in an attempt to address this situation enacted the Nigerian Content Development Act in 2010. The Content Development Act which focused on the development of indigenous capabilities in the oil and gas industry had however not adequately addressed or closed the gap of lack of government patronage.

It is however heart-warming, to acknowledge the promulgation of the Presidential Executive Order 5 in 2018 by our dear President Muhammadu Buhari. This Executive Order aimed at promoting and involving local content in the planning and execution of projects, in contracts and science, engineering, and technology, should be able to adequately address this patronage issue. Our concern

as Consulting Engineers, however, is the sincerity in the implementation of this Order by Ministries, Departments, and Agencies, multinational and multilateral organizations in Nigeria.

"What percentage of our yearly national budget goes to...engineering development? It is meager."

It is important to emphasize here that Nigeria is a nation rich not only in natural resources but also in human and engineering competences. Nobody would patronize us if our people and government do not patronize us.

Globally construction industry is going digital, do you think the curriculum of tertiary institutions in Nigeria should be revised to grow the educational system?

The engineering curriculum used by most institutions of higher learning in Nigeria is as old as the red rope that hung on the window of Rehab when the wall of Jericho fell.

It is appalling that in an era of Artificial Intelligence, drone surveillance and 3D technology, our schools still teach cathode and diode, pulleys and lever, rotor and battery. There is no better time than now to overhaul the engineering curriculum used by most tertiary institutions in Nigeria and develop a new one that is at par with international standard.

No nation develops without engineering. Development calls for huge investments. And if engineering is development, we must invest massively in engineering in terms of education and practical exposures in order for us to stand tall in the comity of nations.

There is a huge gulf already between the engineering curriculum used in our tertiary institutions today and those used outside the country. The Nigerian University Commission must arise and develop a novel blueprint for engineering tutelage and the Nigerian government must, as a matter of urgency provide the tools and financing needed to drive this process.

What ways can engineering education be improved to make up coming graduates competitive?

Number one, our curriculum needs to be changed. Pick a copy of a 5-year engineering curriculum of a Nigerian university and compare it with that of Massachusetts Institute of Technology (MIT) and you would see the huge gulf.

We are far behind. Don't you feel worried on a yearly basis when not even one out of the over seven scores of universities that we have in Nigeria ranks among the first 50 in the world?

Number two; there must be huge investment in engineering development in Nigeria. What percentage of our yearly national budget goes to education? What percentage goes to engineering development? It is meager.

Without conscious efforts to invest in engineering in terms of recruiting the best and qualified lecturers and professors to teach our students, and without furnishing our labs and research centers with state of the art equipment for practical, we would always take the backbench in engineering matters all over the world.

Finally, our Vice Chancellors, Provosts and Deans of faculties must provide avenues for cross-cultural exchange and field exchange experience for our students. They must create a balance between learning and practical exposure and conscientize efforts to up the competences of our students to compete favourably with their peers in other parts of the world.

In time past, most of the engineering consultancy jobs have been awarded to foreign firms, do you think government policy, local content act has reversed the trend?

As I have mentioned earlier, the Nigerian government's promulgation of the Presidential Executive Order 5 in 2018 to encourage indigenous engineering consultants as key players in the infrastructural development of our nation is a noble step. It is my hope and prayer that the process of implementation of this Order will be internalized in all Ministries, Department, and Agencies of government, international, and private organizations across the length and breadth of our nation.

SUSTAINABLE ACCESS TO INFORMATION TECHNOLOGY FOR HUMAN RESOURCE DEVELOPMENT

BY DR. OLUMIDE O. OYEBADE

Dr. Olumide O. Oyebade, *(Assistant Editor, Transport and Tourism, The Guardian Newspapers)*

ABSTRACT

Information Technology (IT) forms the crux of major breakthroughs in the 21st century, with its imprints in all aspects of modern existence. This essay examines the nexus between IT and human resources towards achieving sustainable growth in the developing world. As a qualitative analysis, it beams the searchlight on information technology culture that propels innovations in more advanced countries, and separates them from their developing counterparts. Suffice to say that man is at the epicentre of development and man has gained mastery over nature through attention to his needs, creativity and consistent investments in the process of development. It is, therefore, our position that the continuous intellectual interplay between man, his emerging needs and innovation is imperative to sustain access and relevance in the dynamic IT space. In this treatise, it is recommended that developing countries like Nigeria and organisations that hope to be relevant must domesticate the information technology culture and steadily invest in human capacity for sustainable development.

Keywords: Development, Human Resource, Information Technology Culture

1.0 INTRODUCTION

The 21st century ushered in a revolution in information technology in a manner that disrupts modern lives and communications. Through the innovations in telephony, multimedia computing, internet and broadcasting via the digital media, every facet of life is touched; from interpersonal relations to how businesses are conducted, to education, governance, entertainment, art, and medicine and so on (Ray & Acharya, 2004). Indeed, it is a revolution born out of the marriage between telecommunication and computing technologies. The implication is that we now live in "a world submerged in an ocean of information that is being gathered at a very fast pace from numerous activities taking place all over the world" (ibid). The deluge of information is huge, and they travel very quickly, such that modern organisations are incomplete without an IT department or equipped human resources to manage the database.

Indeed, since the landmark breakthrough in internet networking, Wi-Fi services and digitisation, the interpersonal or inter-organisational interface has been redefined with computerised gadgets at the centre. Individuals with a smart phone can now make bank transactions, place orders from any merchant or store around the world, and follow the process in real-time from his or her comfort zone. For organisations, there is a heavy dependence on IT for efficient and effective services. This cuts across investments in applications that introduce computing power to the industrial process; the use of digital techniques in communications and manufacturing; office automation including banking, and micro-electronics in consumer products. At the centre of our world today are clever software, novel materials, dexterous robotics, intelligent though unmanned area vehicles or drones, 3D printing and a whole lot of web-based services, which are still unknown to the consumers. Suffice to say that there is a nexus between the revolution in IT and the human

"...modern organisations are incomplete without an IT department or equipped human resources to manage the database."

resources. First, human beings are the brains behind the innovation that supplanted the first industrial revolution and launched mankind into the Information and Communications Technology age. Second, man is at the centre of the ICT revolution as the ultimate customer, consumer or user of the products to ease his daily tasks. That is to say, it is a resource at his or her disposal to continually develop the self for efficiency. While the first nexus underscores the innovative aspect of ICT, the second represents the consumerist component – and a fundamental difference between the developed nations and their developing counterparts.

"To have sustainable development, nations must develop and invest in the IT culture to elevate the human capacity so as to effectively function in global digitisation."

While the consumerists' disposition suffices for individuals and organisations to remain competitive, the flip side has the innovative end of the digital world, where more development-oriented countries are expressing dominance. However, between a country that merely consumes and the other that produces, the latter is bound to achieve sustainability and sustainable development than the latter. This paper, therefore, argues that for Nigeria and other third-world countries to achieve sustainable access to IT for human resource development, they must do more in the area of investment for innovations than in its consumption. To have sustainable development, nations must develop and invest in the IT culture to elevate the human capacity so as to effectively function in global digitisation.

For this purpose, this paper has been sub-divided into three sections. The first is a conceptual clarification of key concepts like information technology, human resources and how they weave into organisational development. The second section is tailored along the dynamics of information technology in the contemporary world. The third, mirrors the state of affairs in developed settings vis-à-vis the imperative of IT culture, both for the development of human potential, and vice versa. This essay concludes with some recommendations for sustainable access to information technology and development in the nation.

2.0 CONCEPTUAL CLARIFICATION OF INFORMATION TECHNOLOGY, HUMAN RESOURCES AND DEVELOPMENT

At the centre of this discussion are information and the technology deployed. By definition, information is a fact, knowledge, message or datum that is provided, communicated, or learned about something or someone. Information signifies an entity and defines both its essence and nature of its characteristics. Indeed, information is representational of entities, factual knowledge based and incomplete until it is shared via communication or learning. It is in the light of this complexity in the nature of information that it has to be systematic or hinged on Applied Science (i.e. technology). Information Technology (IT) has, therefore, been defined as a set of produced thoughts and ideas made available to individuals and organisations through hardware mechanisms which play a major role in the development of human resources. Merriam-Webster's Dictionary defines information technology as "the technology involving the development, maintenance, and use of computer systems, software, and networks for the processing and distribution of data."

The significance is the thoughts and ideas that cascade into information bits (i.e. encoding) about entities for onward use. The continuity is possible via the ability to interpret (i.e. decoding) in an interphase between man and man, man and machine, and machine to machine, in a most efficient and effective manner. It describes the process of collecting, classifying, storing, and retrieving information. In today's world, information technology is the basis for human development in organisation and society. It determines the main axis of human resource development and its nature in accordance with societal or people's needs. In a nutshell, IT "is the art and the technology of acquiring, storing, structuring and managing the information; compressing and transmitting the information; and finally, processing, accessing and interpreting this information" (Ray & Acharya, 2004).

It is important to add that no technology is independent of the mind behind it and of its user. That is to say, that information technology has been developed by man and for the use of mankind. It is both the conceptual and scientific response to human needs in the society. And by adopting it, the end-user simply has his or her abilities developed by information technology, just like other forms of technological innovations. The process is akin to human resource development and productivity, which cuts across all spheres of human existential life – intellect, emotion, physical, spiritual, health, social, and general well-being.

Without doubt, man or the human resource is the engine room of any organisation or nation. It is the asset or capital through which all forms of developments are possible, and they are most effective in the proportion to which they have been endowed by both nature and nurture. By nature comes talents and by nurture are the innate gifts and potential sharpened to become actual skills for innovations. This process of metamorphosing, from latency to actuality, has lately seen IT playing a dominant role in modern work life and industrial operations. It is in this light that human resource development would mean producing thoughts and ideas by staff. It requires employees to be equipped with quality skills and with compassion and commitment, they offer their abilities, energy, expertise and thought in order to fulfill the mission of the organisation (Moghadam & Dastgerdi, 2010).

Therefore, it was the human quest for development that motivated an understanding of nature (i.e. sciences) and the application of the findings of science (i.e. technology) to improve the conditions of human life (Omoregbe, 2002: 179). There is practically no human or social challenge that technology is not either addressing or evolving as a response. However, "the difference between the comfortable life in the developed countries, and by contrast the hardship in the developing countries is in the level of technology," (ibid: 180) and how well it has been deployed to remedy societal challenges.

3.0 INFORMATION TECHNOLOGY IN THE CONTEMPORARY WORLD

Information Technology has evolved in leaps and bounds in the last decade, with both internet and digitisation at the centre of innovation and development. In fact, its development has gone haywire such that no one can ignore it. The reasons are not farfetched. First, our world revolves around technology and now more connected and visible than before. The emerging platforms have dislodged all traditional means of communication, and with it too is the means of relating with our environment. (See Fig. 1). Secondly, in the area of human capacity, IT gadgets present us a new world of possibilities, productivity and efficiency. Thirdly, digital technologies have risen to prominence as a critical determinant of economic growth, national security, and international competitiveness. Fourth and closely linked to the foregoing is the incursion into industries and the amazing future that lies ahead in what has been aptly captured as the third industrial revolution.

Fig. 1: *Global information technology connectivities*

Developments in IT and the industrial sphere are most amazing. Recall that the First Industrial Revolution began in Britain in the 18th century with the birth of mills and factories. The Second Industrial Revolution followed in the early 20th century with the age of mass production of goods via the moving assembly lines. Now is the Third Industrial Revolution,

where not only manufacturing, but its service to customers is so digitally confined. Until recently, creating a small piece of furniture, wares or any item whatsoever required a whole junk yard and man-hours of nailing or welding. Now, such products, with a few mouse clicks could as well be designed on a computer and "printed" on a three-dimensional (3D) printer that creates a solid object by building successive layers of material.

Already, the sophisticated technology is producing hearing aids and high-tech military hardware in customised shapes (The Economist, 2012: 13). It implies that a military engineer in the middle of a desert may not have to await supplies of basic equipment from a nearby city. He would rather download the equipment of choice via the internet and print same in 3D! What is novel is that emerging new materials of

Fig. 2: *Robotics as part of IT Revolution*

production are lighter, stronger and more durable than the old ones. For instance, carbon fibre is replacing steel and aluminum in products ranging from airplanes to mountain bikes. New techniques allow engineers to shape objects to a tiny scale. Nanotechnology is giving products enhanced features, such as bandages that help heal cuts, engines that run more efficiently and crockery that cleans more easily. And with the internet allowing even more to collaborate on new products, the barriers to entry are falling. Indeed, most jobs in the nearest future will no longer be on the factory floors, but in the offices nearby, which will be full of designers, engineers, IT specialists, logistics experts, marketing staff and other professionals. The manufacturing jobs of the future will require more skills, not just to produce things, but to develop software of smarter robot machines that produce customised goods for individual customers. (See Fig. 2)

It is true that Africa and most of the third world countries are yet to fully rise to the level of 3D printing and advanced manufacturing, but the consumption of IT is already disrupting a lot of spheres in modern societies. For instance, with digital technology, social media has overturned mainstream journalism as almost everyone with a smart phone has become a journalist. We no longer wait for the network news hour or the newsstands to get the latest because live feeds are propping on our smart phone devices. In transportation, Uber taxis, motorcyclists and boats that are just a ping away have practically shoved out the traditional operators. The retail sector is not protected in the new and more convenient ways of living – with virtual online stores and home service deliveries forcing real outlets to close down. Telemedicine is fast keeping the queues at consultants' waiting rooms shorter, and a lot more.

Fig. 3: *Multiple application of Information Communication Technology, ICT.*

It is not difficult to understand why things are changing so rapidly. We earlier mentioned that the world is more connected than before with the "Internet of Things" (See Fig.3).

Today, over 50 per cent of the world's population has internet connections. There are more than 700 million monthly users sending over 10 billion messages per day on WhatsApp platform alone (Ehimuan, 2019). At least, there are one billion monthly active users on Facebook, four billion YouTube video views per day, 500 million daily tweets globally, and over 100 billion searches per day on Google (ibid). We are talking about a digital economy that is worth $11.5 trillion; an equivalent of 15.5 per cent of global Gross Domestic Product (GDP) that has grown two and a half times faster than global GDP over the past 15 years" (Huawei & Oxford Economics, 2017). These numbers are astonishing, considering the comparative lifespan of the internet. The adoption and growing use of smart devices, computing hardware and the software that can facilitate connectivity between these devices is increasing significantly. "It is projected that by 2020, we should have four billion connected people, over 25 billion embedded and intelligent systems, and more than 25 million apps. These devices are everywhere and include personal accessories, i.e., wearable gadgets like the FitBit," (ibid).

"It is projected that by 2020, we should have four billion connected people, over 25 billion embedded and intelligent systems, and more than 25 million apps."

The global connectivity notwithstanding, a closer look at the IT space would show a polarity between the producing developed world and their consuming counterparts. Suffice to say that while the West and the Asian Tigers are dictating the pace of technology via innovations, the rest are playing catch-up. It follows that, the power of control and sustainability abounds with the former, rather than the latter. That is to say, the new world of productivity, efficiency, and connectivity has domesticated power and supremacy in the richer nations that own and control the "new means of production" – IT. Besides wealth creation and economic independence of innovating developed countries, the power also manifests in privacy, data ownership, safety and security, standards and regulation through which the super powers maintain dominance to date. The corollary is that, though the third world of consumers may manage to get by effectively adapting IT to tackle indigenous problems, the privacy, control and its security are domiciled elsewhere.

There is no disputing the fact that some developing countries are getting more sophisticated in the IT space and its high-end usage in daily human and manufacturing industries. But the flipside is that some technologies are just not for sharing given their importance in the preservation of competitive edge. More fundamental to this discussion is the phenomenon that tilts the balance more in favour of the developed countries and what the developing world could learn from it to change their status from consumers to producers of IT for sustainability. In the final analysis, the questions such as: who owns the collected data, where does priority lie, what might they be used for, what are the regulations in place regarding the collation and use; and who has rights to the data and how it is kept safe, are very important to sustainability (Ehimuan, 2019).

4.0 INFORMATION TECHNOLOGY CULTURE FOR REAL DEVELOPMENT

The development of IT can hardly be separated from technology generally and the intellectual culture that produced them. By culture, we simply mean the consistent and conscious way of life of a people. It underscores a perception of reality, and how to relate with it, such as is transmitted from one generation to the other. The culture of technology is general to mankind given the evolution of language and communication arts. It is the continuation of the culture that evolved non-verbal arts like signs, symbols, alphabets, numbers, and so on in the early days.

Recall that the ancient man was a tool making animal. By nature, he had used sticks and stones (just like animals also do) to cultivate his environment. Further innovations discovered fire and latter invented iron and other fashionable tools through which he began

"The IT innovations are directly connected to leading economies like the U.S, Germany, UK, China, Japan, South Korea and India that between 2000 to 2015 had individually invested between $500 billion to $1.25 trillion in IT"

to subdue nature. Two things are fundamental in the chequered history of technological culture. The first is the goal of technology itself, that is, man. The second is his quest to dominate nature. Simply put, the essence of technology was to enable man to domesticate and have mastery over his environment. That is why, "the rise and development of technology is an elaborate history of man. More so, technology is defined as the systematic study of techniques for making and doing things. Technology, therefore, arose because of man's need to domesticate his environment for convenience, protection and comfort," (Ndubuisi, 2002: 133).

Ndubuisi (2002) adds that "the development of technology is in most instances tied to the socio-cultural milieu of the environment in which it emerges. Culture determines need" (ibid). That is, it is the needs that stimulated thinking and intellectual culture that leveraged on technological innovations. To meet this, early thinkers realised that nature, by design, was evolving but at its own slow pace. The pace could be quickened by man through the understanding of how nature works and this gave birth to various sciences. The more men are intellectually aware of their immediate environment, the better they can dominate nature to meet the needs. And for technology to advance in any society there must be social need, the social environment, and sympathetic social ethos (ibid). Indeed, it is the zeal of problem-solving that endears innovations that enable human "survival, comfort, and accumulation of wealth – with the hierarchy of needs extending from physical basics of existence to higher-level wants associated with self-actualisation" (Mayo, 1985: 7).

The point is that the culture of intellectual thinking for technological solution has been tailored to human needs. Ditto for IT development that emerged from natural language, and its programming into sophisticated gadgets. Indeed, early programming language involved a series of codes, which were numbers that cascaded into mathematics and developments of hardware. More important to us is the sustenance of the culture that underpins this development over the ages. Today, more advanced courses are now studied in higher institutions to deepen understanding in the area of artificial intelligence, databases, web design, software design methodologies, systems analysis and human-computer interaction. This is development in human capital via the intellect, without which no nation or organisation can make appreciable relevance in the contemporary world.

To complement the significance of intellectual development is the culture of research and development (R&D). According to Mayo, "the force of R&D prowess is the sum of all the contributions of individual laboratories. The prowess of a R&D laboratory is limited by the skills of its scientists and engineers and by the capabilities of its support environment, including both financial and physical resources. Laboratory prowess also clearly depends on the wisdom and judgment of the R&D management team" (Mayo, 1985: 9). The educational institutions are more of the feeder to the research processes and industries. One of those factors that helped innovation is the creation of industrial clusters that simply network firms of similar services, requisite skills, universities and research laboratories within an area (The Economist, 2012: 6). Some of the well imitated examples are the Silicon Valley, and the Boston's biotechnological cluster of pharmaceutical companies. Through clustering, sets of skills are assembled in an area, specialist services are concentrated and a pool of venture capital from investors that have close understanding of their market produce synergistic effect. In fact, manufacturing firms in such a setting are more likely to introduce new and innovative products.

The development does not however, happen without commitments. The IT innovations are directly connected to leading economies like the U.S, Germany, UK, China, Japan, South Korea and India that between 2000 and 2015 had individually invested between $500 billion to $1.25 trillion in IT (see, National Science Board, 2018). In the U.S. for instance, IT investment represents about

25 per cent of all capital investments. Even the service sector, which accounts for about 74 per cent of the Gross Domestic Product and about 79 per cent of national employment leverages on IT (Quinn & Baily, 1994: 28). All of these are done to develop the human resource capacity in pari passu with IT.

The foregoing draws a sharp contrast to the outlook for developing countries in Africa, Middle-East and South America that keep spending between 0.5 to 3 per cent of their GDP on R&D. Research and Development is consistently looking at a better way of rendering services or solving emerging problems. It is such an approach that developed IT and the digital economy to what the world has today. Advanced nations, apparently, understand that what you don't create or domesticate, you cannot own or control. This is why developing nations and entities cannot afford to be bystander consumers of innovations alone but should also invest in R&D for innovations and development of requisite human capacity that can be sold to the rest of the world.

5.0 CONCLUSION AND RECOMMENDATIONS

The point made is that access to information technology and human resource development are mutually interdependent in modern development. The comfort, efficient services and productivity are in the modern sense directly hinged on the level of IT deployed. No individual or organisation can afford to ignore the current digital economy and its emerging tendencies. At the peak of the value chain is the IT culture that consistently promotes intellectual inquiries, R&D and huge investment to achieve technological innovations in accordance with societal needs. Indeed, it is in this circle of producers, rather than of consumers, that contemporary economic development, and its sustainability via ownership and control are possible.

It follows that organisations and nations, in particular, cannot afford to be complacent in reforms that prioritise IT, if their growth must be sustainable. The journey begins with the clear understanding that development is directly proportional to how well the human mind and capacity had been enhanced to proffer solutions to indigenous needs. To this end, educational institutions must be the bedrock of R&D, with laboratories that are directly tailored to specific social and industrial needs. A mutual affinity between researchers and companies will drive innovations that directly respond to local needs. In between is the ample room for apprenticeship and mentorship of the younger generations, who should be groomed to acquire specialized skills from the cradle. Our society must as well realise that the industries of the near future will be more of information packaging and processing offices than sweat shops of yesterday. We must, therefore, give preference, sponsorship and good reward to careers in IT engineering and manufacturing than we are doing to service professions, entertainment and religion.

Lastly, information technology transfer is imperative for human resource development. Conclusively, the process is more sustainable and real development attainable if the technology is locally produced and controlled.

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POLICIES AND ACHIEVEMENTS OF THE FEDERAL MINISTRY OF COMMUNICATIONS AND DIGITAL ECONOMY

BY MR. ADELEYE O. OPEYEMI

1.0 INTRODUCTION

All over the world, ICT has become both an enabler and catalyst for growth and development. Nigeria's journey in ICT dates back to 1886 when the first tele-graphic submarine cable was laid by a British firm called, Cable and Wireless Limited, to connect Lagos and the Colonial Office in London. Since then, the sector has experienced various developmental stages and reforms.

The turning point occurred from year 2000 when the sector began to experience exponential growth arising from deregulation of the Telecommunications sector. The sector started to grow in leaps and bounds and government needed a central coordinating body to ensure that the growth being experienced benefitted Nigerians. This was the genesis of the creation of the Ministry of Communication Technology.

Today, the fulcrum for ICT coordination in Nigeria is the Federal Ministry of Communications which was established by the Government of President Muhammadu Buhari at its advent in 2015 and retains the mandate of its successor, Ministry of Communications Technology. The Ministry was renamed "Ministry of Communications and Digital Economy" in 2019.

2.0 ENABLING ENVIRONMENT

ICT and Policy re-engineering of the policy, legal and regulatory framework of the ICT sector by the Ministry creates a level playing field for all sector players and develops a conducive and enabling environment. Key interventions in this area included the development of policy frameworks and stakeholder engagements.

2.1 POLICY FRAMEWORKS

At the inception of the President Buhari Administration, it was observed that ICT development was approached in silos leading to mixed results. Far reaching consultations were held with stakeholders and the need for integrated frameworks for the sector was recognized. Consequently, three critical instruments were developed to provide an enabling environment for effective development of the sector. These are:

(i) Nigeria ICT Roadmap 2017 – 2020
(ii) Nigeria ICT Strategic Plan
(iii) Nigeria e-Government Master Plan

The Roadmap defines the path that ICT development will take in the medium term while the strategic plan looks at a longer perspective. The e-Government Master Plan articulates the initiatives that will be taken to ensure a well co-ordinated e-government programme delivery.

"The turning point occurred from year 2000 when the sector began to experience exponential growth arising from deregulation of the Tele-communications sector."

The Ministry facilitated, through National Information Technology Development Agency (NITDA), development of ICT policies in 15 States which are now able to establish their own State Information Technology Development Agencies (SITDA)

2.2 STAKEHOLDER ENGAGEMENTS

Apart from the policy frameworks, the Ministry conducted a number of stakeholder engagements which have helped to improve the

environment of ICT in Nigeria. These include the Communication Sector retreat held in Ibadan in 2016, the Ministerial retreat held also in Ibadan in 2018, the meetings of the National Council on Communication Technology held in Kaduna and Katsina States in 2016 and 2017 respectively.

The preparation of the Strategic Policy documents and engagements of stakeholders on ICT development in the country have created the necessary assurance and stability for ICT goods and services production and enhanced utilisation by Nigerians.

3.0 EXPANDING ACCESS TO ICT

Infrastructure is considered the foundation for increasing access, improvement of quality of service, extension of coverage to unserved, underserved and hard-to-reach rural areas and reduction of the cost of services. The goal is to provide cost-effective ubiquitous access to ICT for overall national development. Major initiatives to address these include rural telephony, e-post development and satellite deployment. In order to fast-track affordability, advanced underlying technologies would be advocated. The overarching goal for infrastructure development is to provide cost effective ubiquitous access to ICTs for national development. A telecoms mast doting various towns help to expand access to ICT. (See Fig. 1).

Fig. 1: *A telecoms mast*

4.0 ACHIEVEMENTS

Major achievements were recorded in the provision of telecom infrastructure, e-Government infrastructure and the positioning of NIGCOMSAT and Nigeria Postal Services assets to complement the existing infrastructure strategies.

4.1 TELECOM INFRASTRUCTURE

Broadband has been identified globally as a tool for accelerated socio-economic development. In view of this and in line with the 30% penetration target set from 2013 – 2018, in the National Broadband Plan, the Ministry through its agencies committed resources and efforts towards deployment of services across the country leading to increased broadband penetration. The active mobile broadband penetration released by the Broadband Commission for sustainable development shows that Nigeria reached a penetration of 33.27% as of July, 2019.

Actions taken to achieve these results include the following:

- Development of a Regulatory Framework for Broadband Penetration: The Ministry has articulated a regulatory framework to enable strategic and systematic licensing and deployment of broadband infrastructure across the country. A Broadband Implementation Monitoring Committee was established within the Nigeria Communications Commission to give proper assessment and regular appraisals of the Ministry's plans.
- The bidding and selection process for interested service providers in the remaining five zones (North East, North-West, South-South, South-West and South-East Zones) designed for effective coverage of the nation under the Open Access Model was made known to the public on September 1, 2016.
- Licensing of infrastructure service providers: Phase 1 was successfully concluded with the award of licenses for Lagos and North Central zone, the licensing of five InfraCos in Phase II (South-East, South-West, South-South, North-East and North-West) has also been completed .
- Issuance of Wireless Broadband License: The bidding process for 2.6MHz Spectrum was successfully completed and saw MTN Nigeria Ltd emerge as the winner of six slots.
- More Wireless Broadband Frequency and Services on offer: The Ministry has initiated processes for licensing of more broadband services on the 5.4 GHz Spectrum Band. The Ministry has opened the process for the allocation of frequencies in the 70/80 GHz band (E-Band). NATCOM Development and Investment Limited has also

been given approval for the deployment of 4G Long Term Evolution Technology.

- Deployment of over 1000km of the Backbone Transmission Infrastructure (BTRAIN), a USPF project, to connect the rural and semi-urban areas to the National Transmission Backbone infrastructure through Optic Fiber Cable (OFC), across the six (6) geopolitical zones of the country has been achieved.
- Provisional approval was given for the deployment of 4G LTE by NATCOM Development and Investment Limited, which made the first VoLTE call on February 2016.
- Six (6) out of the fourteen (14) slots of 2.6 GHz band to Mobile Telecommunications Network Nigeria (MTN) were licensed. This band supports capacity spectrum for the deployment of broadband services, especially in urban cities and 4G/LTE services.
- Licensing and optimisation of spectrum bands have been achieved.
- Supply, installation and commissioning of Mobile Radio Monitoring equipment and National Spectrum Management Systems to stem illegal spectrum use have been created.

Fig. 2: *A satellite*

- The Trans-Saharan Optic Fibre Project, covering Abuja, Nigeria - Zinder, Niger – Algiers, Algeria has been implemented.
- The Smart City Initiative: This initiative is receiving attention.

4.2 E-GOVERNMENT INFRASTRUCTURE

Through Galaxy Backbone, the Ministry facilitated the improvement of e-government infrastructure in the country. Key interventions were in the following areas:

- National Broadband roll out under National ICT Infrastructure Backbone – Phase 1 (NICTIB 1) with provision of fibre linking 11 States of the Federation covering about 1,101km, linking of Federal Secretariats and MDAs within the metro net-work with a cumulative coverage of about 939km, data center in Enugu to provide redundancy and guarantee business continuity as well as over 1722mbps of internet to various MDAs.
- Approval of NICTIB II to cover 17 northern states of the country.

4.3 SATELLITE INFRASTRUCTURE

The Ministry has positioned NIGCOMSAT as a veritable infrastructure for complementing existing efforts at providing connectivity to hard-to-reach areas. Nigerian Communications Satellite (NIGCOMSAT) has launched channels satellite TV on the Direct-To-Home (DTH) platform in collaboration with NextTV. The satellite TV service with 140 channels is a partnership between NIGCOMSAT and NextTV under a joint venture arrangement. Fig. 2 shows a typical satellite.

The completion of the Direct-to-Home (DTH) headend infrastructure will maximize the use of the available bandwidth on NIGCOMSAT 1R and provide local DTH operators with flexible capacity needed to compete with foreign DTH operators thereby increasing Nigeria's market share and conserve foreign exchange.

This project when completed will provide the aggregation and transmission of 100 standard definition channels satellite TV programming to subscribers within the coverage of NIGCOMSAT 1R satellite across 38 African countries.

Other interventions on Satellite development include:

- Promotion of the use of Nigerian resources first – building on Executive Orders 003 and 005 to encourage service operators
- Partnerships and collaborations with MDAs and the Private Sector
- On-going strategic partnership for the deployment of a range of broadcast services.

4.4 POSTAL INFRASTRUCTURE NETWORK

The Ministry is championing the modernisation of Nigeria Postal Service (NIPOST) as a key ICT asset for promoting digital inclusiveness.
Traditionally, the Post globally has effectively played the role of a third party between government and its citizens, or between other organizations and their clients or between one individual and another.

Over the years however, the environment has continued to change, requiring the postal service in this country to equally change in line with global trends to become fully utilized. This necessitated a Postal Reform to establish an efficient nation-wide infrastructure for communication and distribution of public interest services like basic financial services, IT services, government services and other third party services to the people and the Nigerian economy.

A viable postal network is a key enabler for the attainment of the developmental goals of any country. In addition to facilitating commerce, a sustainable postal network contributes to social, financial and digital inclusion of the populace by serving as a channel for distributing social benefits as well as facilitating access to financial, digital and logistical capabilities necessary to stimulate a knowledge-based-economy.

Key interventions to optimise the use of Nigeria's postal infrastructure which have earned international recognition such as the 2018 WSIS Prizes Award in Berne, Switzerland include:

- Postal reform strategic plan
- Signing of MOU with Bank of Industry on Banking Agency collaboration
- Ministerial Inter-Agency collaborations
- Public-Private Partnerships
- Diversification into several innovative areas.

As a result of the increasing infrastructure roll out, more Nigerian organisations and Nigerians have access to ICT now making them benefactors of the global ICT economy.

5.0 CAPACITY BUILDING AND NURTURING OF ICT TALENTS

The Ministry takes the issue of capacity building and nurturing talents in the ICT sector seriously. The capacity building efforts are aimed at developing a smart globally competitive workforce and digitally literate population. Through this focus area, the Ministry is looking at the manpower skills and profile and educational sector reforms required in order to support the development of the ICT industry.

Key interventions in the building and nurturing of ICT talents include:

- Issuance of several regulations including IT Project Clearance for MDAs
- Capacity building efforts resulting in PLWDs women youth empowerment
- Sustainable ICT intervention across the country such as digital job creation centres, IT innovation hubs, Wide Area Networks, digital libraries, etc
- Innovation and entrepreneurship programs
- Enforcement of Nigerian content guidelines
- Inauguration of the Digital Literacy Council
- A Digital Literacy Policy and Strategic Plan which is being developed
- Training on Introduction to Free and Open Source Hardware using Single Board Computer (SBC): 100 participants were trained on the following: Arduino, Aguino. Raspberry Pi etc. The training was aimed at developing IoTs solutions.
- Training of youths with disabilities: About 200 have been trained
- Youth Empowerment training in web technology and Open Source Software: Over 200 trained
- Development of an indigenous IoT platform, Amadioha for smart technology applications
- Scholarship: NITDA has sponsored MSc and PhD students from across the country. A new track covering Information Technology Law was also

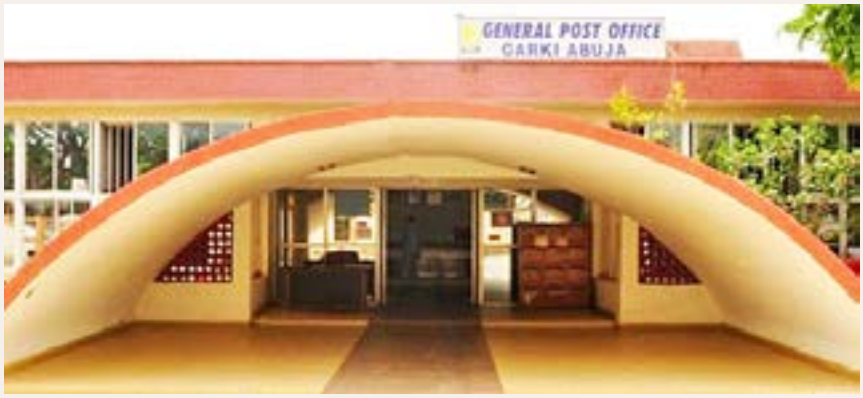

Fig. 3: *NIPOST office, Abuja, Federal Capital Territory*

recently introduced to build the capacity of Nigerians in this area.

- CERRT Awareness and Cyber Drills: Cyber awareness training for MDAs on threats and mitigation was conducted for 55MDAs under the first phase while arrangements have been concluded for the second phase.
- Training on Online Outsourcing: NITDA trained youths on how to secure online jobs through outsourcing platforms. Fifty youths were trained under this programme.
- Training of over one hundred women in the North-West.

S/N	INDICATORS	AMOUNT/ PERCENTAGE	YEAR
1	Broadband penetration	14%	2015
		33%	2019
2.	Foreign Direct Investment	$32Billion	2015
		$38Billion	2017
3.	Public Sector ICT Projects Savings	$0	2015
		$10Billion	2018
4.	Contribution to GDP	8.50%	2015
		10.00%	2019
5.	No. of internet subscribers	97,032,543	2015
		114,206,598	2019
6.	Internet penetration	45.10%	2015
		47.47%	2019
7.	Teledensity	107.87%	2015
		124.29%	2019

Table 1: *Snapshot of achievements*

6.0 GROWING THE ICT INDUSTRY AND LOCAL CONTENT

The rationale for growing the ICT industry and local content is to overcome the paradox that manifests in the sector and at the same time fewer Nigerian companies and individuals participating in the industry. Table 1 shows a snapshot of achievements.

The objectives of the Ministry with respect to growing the ICT industry and promoting local content are:

- To enable the local IT industry contribute meaningfully towards the achievement of national development targets.
- Stimulate and increase the production, sales and consumption of high quality, original and genuine information technology products and services developed by indigenous companies that serve the unique needs of the local and global market.
- Support indigenous information technology companies and provide them opportunities that will improve their ability to provide relevant products and services that amply satisfy the consumer.
- Support efforts to build capacity and equip Nigerians to serve as active workers and participants in the local IT industry.
- Promote the adoption of relevant regulation and legislation on the creation, distribution and use of Information Technology within Nigeria.
- Promote and encourage an environment within Nigeria that is welcoming to foreign investments in Information and Communication Technologies, as well as the export of indigenously made IT goods and services.

Some interventions in this area include:

i. Strengthening the Office of National Content, Office of ICT Innovation and Entrepreneurship;
ii. Strengthening the implementation of the Nigerian ICT Content guidelines;
iii. Support for local computer manufacturers (CMON).

These interventions have advanced the ICT industry in Nigeria and enhanced local content as more Nigerian companies participate in the ICT industry through operations in hardware, networks, software and media.

"The rationale for growing the ICT industry and local content is to overcome the paradox that manifests in the sector"

7.0 ENABLING GOVERNMENT TRANSFORMATION

The role of ICT in transforming governance is already widely recognized. Government is resolute in pursuing an e-government and digital service agenda to improve public service delivery and democratic processes as well as strengthen support to the public.

The advantages to be derived from purposeful implementation of e-Government programs include improved service delivery, cost savings, economic development, enhanced transparency and accountability. Others are improved public administration and growth of the ICT sector, leading to employment opportunities, wealth creation/poverty reduction and considerable reduction in crime rate. It has been established that there is a direct correlation between improvement in e-Government adoption and the national income and economic growth of any country.

Interventions in this area include:

- Development of the e-government Master Plan
- Development of the government service portal
- Training of over 800 public servants in e-government through the assistance of KOICA
- Capacity building for establishment of an IT clearance committee with over 100 projects captured and about 10 Billion Naira saved.
- Draft framework and guidelines for IT projects clearance have been developed
- Enforcement of executive order 001: (MDA websites assessment conducted and report produced for improvement)
- Development of a National Enterprise Architecture
- Development of IT standards, guidelines and framework
- Development of a National Data Exchange Policy and Architecture
- ICT training for CEOs of government agencies and parastatals
- As a result of the interventions, many government services are now online and increasingly more citizens and businesses have access to government Services.

"As at January 2019, internet subscribers were 114,206,598 and teledensity stood at 124.29% (i.e. 174,012,136 active lines)."

8.0 IMPACT OF THE ICT INTERVENTIONS

ICT is now viewed not only as an enabler for delivery of the Economic Recovery and Growth Plan (ERGP) but a catalyst for development. Through Government ICT applications such as the Integrated Personnel and Payroll Information system, the Treasury Single Account (TSA) and the Budget Portal, huge sums are being saved for application to other national needs. Over 113,875,204 Nigerians are now connected to the internet against 97,032,543 in 2015. Active telecom subscriptions have reached 174,012,136 in 2018 as against 151,017,244 in 2015. The ICT sector is currently contributing over 10% of the GDP against 8.50% in 2015 and Foreign Direct Investment (FDI) in the sector has increased from $32b in 2015 to $38b reaching a cumulative of over $70b in 2018.

More Nigerians are having access to government services with the automation and online delivery of services going on in government. ICT has transformed the way Nigerians work, do business and play. As at January 2019, internet subscribers were 114,206,598 and teledensity stood at 124.29% (i.e. 174,012,136 active lines). Broadband penetration in Nigeria has increased from 14% in 2016 to 33% in January 2019, thereby surpassing the proposed target of 30% set for the end of the period under review.

9.0 CONCLUSION

The ICT sector has recorded significant progress since 2015 as a result of various interventions under the current Administration. Efforts are on to sustain and accelerate the tempo of achievements through building greater synergy among the ICT institutions, strengthening the sector policy framework and ensuring greater linkage of sector activities to the overall government agenda. It is hoped that with the planned updating of the ICT legal environment and institutional coordination arrangements along with a stronger Public-Private Partnership Sector framework, the sector will be better put on the trajectory of greater achievements.

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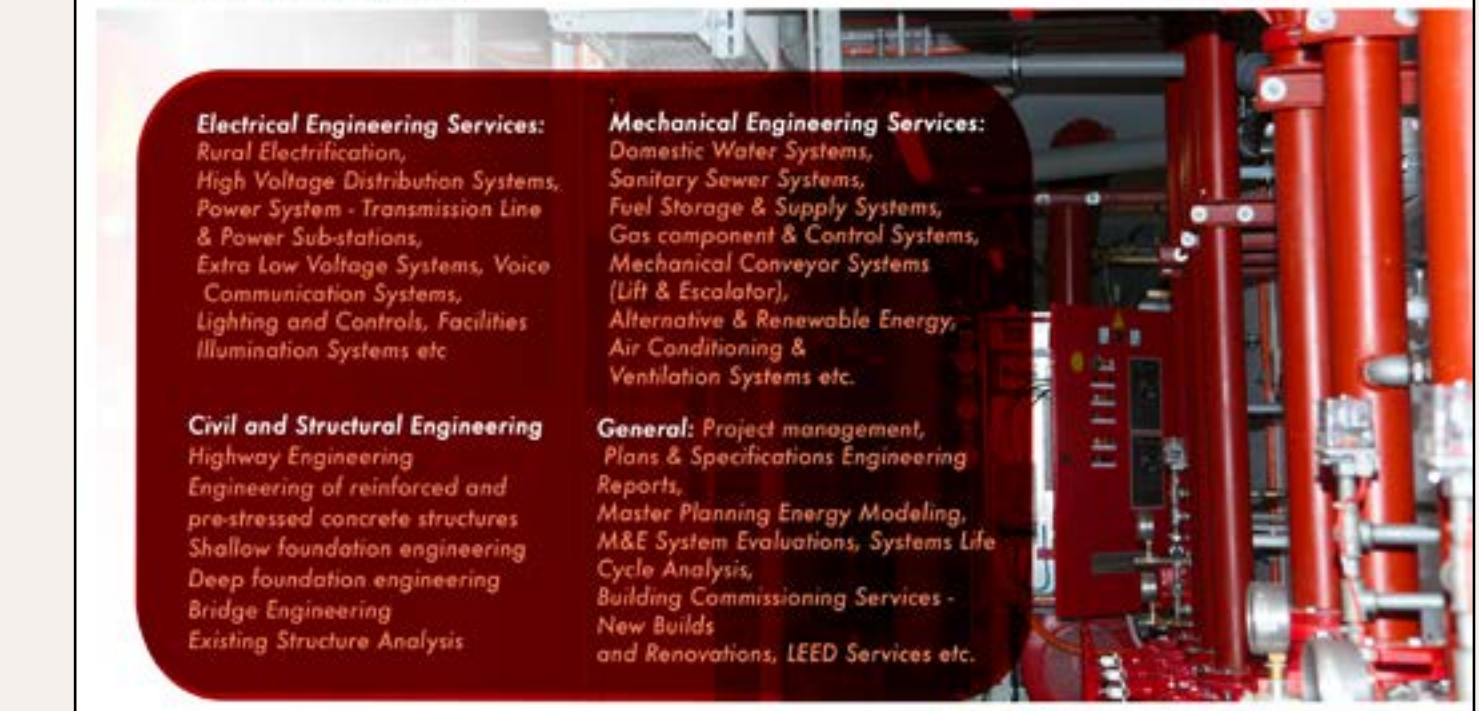

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"THE CONSULTING ENGINEER" PERSONALITY

ENGR. HASSAN ODEDIRAN, FNSE

EXECUTIVE CHAIRMAN, IEC GROUP COMPANY LIMITED

Engr. Hassan Odediran, FNSE

Knowledge and experience remain the keys in the practice of engineering and organizational leadership. Engr. Hassan Odediran's vast experience and quest for knowledge have kept him in excellent disposition for quality service delivery in engineering and leadership of a prominent company, namely IEC Group Company Limited where he leads as the Executive Chairman.

Engr. Hassan Odediran was born on July 13, 1959 in Osun State, Nigeria. He graduated from the prestigious University of Ilorin, Kwara State with B. Eng. (Electrical) in 1988. In his quest for advancement, he has earned the following professional certifications to his credit: Registered professional electrical engineer with the Council for Regulation of Engineering in Nigeria (COREN) in 1996, registered member of the Association of Consulting Engineers, Nigeria (ACEN) in 2005 and Fellow of the Nigerian Society of Engineers (NSE) in 2012.

Engr. Odediran is a well recognized icon in engineering and managerial leadership with evidence in the following qualifications and awards in the years indicated below:

- Registered professional of Financial Reporting Council of Nigeria (2013)
- Founding member of Procurement Professionals Association of Nigeria (2013)
- Fellow, Institute of Corporate Administration of Nigeria (2014)
- Icon of Vision and Development Award of the Institute of Corporate Administration of Nigeria (2016)
- MBA from Metropolitan School of Business and Management, UK (2017)
- Fellow, Institute of Policy Management and Development (2018)
- Fellow, OSHA Association for Occupational Safety and Health Of Nigeria (2019)
- Graduate of London Graduate School with Master Class Certificate in Business and Management and Leadership (2019)
- Doctor of Engineering, PhD (Honoris Causa) of Commonwealth University, UK (2019)
- Fellow of Chartered Institute of Leadership and Governance (2019).

Engr. Odediran's working career spans over 32 years starting from his youth service in Anambra State University of Technology from September 1988 to October 1989 under the National Youth Service Corps Program. At the end of his service year, he was employed as an electrical engineer in Elmek Engineering Nigeria Ltd where he worked for just 3 months from October 1989 to December 1989. His next engagement was with Yaroson & Partners Consulting Engineers, Kaduna where he served as an electrical engineer from February 1990 to January 1993. He left Yaroson to Dolyom Associates Consulting Engineers and served as a consultant from January 1993 to December 2000. Within the period, he also joined Y. Ahmed & Associates Consulting Engineers, Kaduna as Associate Partner and served from April 1993 to December 1997. He was appointed Director/CEO, Cievam Engineering Nigeria Ltd, Kaduna in May 1997 and he served in that capacity till 2008.

Engr. Odediran demonstrated spectacular entrepreneurial skills and business managerial acumen by establishing:

- Interactive Engineering Consult Ltd where he has been serving as the Managing Partner from 1997 to date.
- Koshvo & Associates Nig. Ltd where he has been serving in the position of the Chairman from 1997 to date.
- RME Capital BDC where he has been working as the Executive Chairman from 2017 to date.
- IEC Villa Resort Ltd where he has been serving as the Executive Chairman from 2017 to date.
- IEC Group Co. Ltd where he has been leading as the Executive Chairman from 2018 to date.

Engr. Odediran's professional competences are well manifested in various consultancy services successfully rendered in various executed projects. Some, out of the numerous projects, are listed in Table 1.

PERIOD	ACTIVITY
1995	Member, Special Technical Consultants on the assessment of Federal Government Colleges nationwide
1995-1996	Member, Special Technical Consultants for Petroleum Trust Fund (PTF) on the assessment of general hospitals in the North East
1995-1996	Member, Special Technical Consultants for PTF for the assesskment of Federal universities in the North East
1997	Resource professional for Afri-Projects Consortium on the assessment of the entire Nigerian bulk power supply under NEPA
2000	Member, Special Technical Consultants for CBN on the assessment of upgrading, improvement of fire safety in CBN branches in Kano zones
2004	Consultant in charge of rural electrification of Zamfara State under 2004 ZARECOM covering 200 villages
2006	Electrical Technical Consultant on the assessment of branches of CBN buildings in Benin, Ilorin and Minna plus mechanical consultant on assessment of CBN branch building in Garki, Abuja
2007 - 2013	Mechanical Consultant for CBN International Training Institute, Abuja
2007 to date	Technical Consultant for FAAN for power improvement upgrade international airports in Lagos, Abuja, Port-Harcourt and Kano
2007 to date	Electrical Engineering Consultant for CBN centres of excellence in University of Ibadan, University of Nigeria, Nsukka, University of Jos, Ahmadu Bello University and Police Academy
2008 - 2013	Electrical Services Consultant for the new Government House, Katsina State
2010 to date	Technical Consultant airfield lighting upgrade
2012 to date	Electrical Engineering Consultant for CBN's International Convention Centre, Abuja
2014 to date	Mechanical and Electrical Engineering Consultant for six airport terminal buildings located at Abuja, Kano, Enugu, Port-Harcourt, Asaba and Akwa-Ibom
2015 to 2018	Design and Supervision of 33kv power supply from 330/132/33kv main substation from Lokoja-Okene road to CBN office in Lokoja
2015 to date	Electrical/ICT Consultant, NCDMB Headquarters, 17 Storey building (68.8m high, currently the tallest high-rise building in South-East and South-South Region)
2017 to date	Electrical/Mechanical/ICT Consultant NCDMB Nigeria Oil and Gas Parks in Akwa Ibom, Cross river and Bayelsa States
2019 to date	MEP consulting services for pre-contract and supervision of the construction of the 2nd runway of Nnamdi Azikiwe airport, Abuja

Table1: *Engr. Hassan Odediran's professional engagements and projects*

The milestones in engineering practice enumerated above are full of successes and challenges. Engr. Odediran views challenges and limitations encountered in the course of his career as opportunities to generate new, creative and innovative ideas that can be used in subsequent projects.

"There is no challenge more challenging than the challenge to improve yourself"--Anonymous

Engr. Odediran is very proud of the successful establishment and operation of IEC Group Company Limited whose subsidiaries are Interactive Engineering Consult Ltd, Koshvo and Associates Nig. Ltd and IEC Villa Resort Limited. The Group has been in existence for over 10 years and the consulting subsidiaries are among the top 10 listed consulting firms in Nigeria.

The success is accompanied by challenges which show up everday. According to Engr. Odediran, the challenge is in the management of great individuals with even greater talents, keeping every part of the Group running effectively and ensuring that all employees are able to reach their full potential.

"Teamwork is the ability to work together towards a common vision. The ability to direct individual accomplishments towards organizational objectives. It is the fuel that allows common people to attain uncommon results" – Andrew Carnegie.

Through teamwork, determination and the hunger to create and make a change, the consulting subsidiaries have successfully completed various high-profile engineering projects.

One of the most challenging and successful projects was the design and construction of the airport terminal building, cargo handling facilities and runways in Abuja, Lagos, Kano, Yenogoa and Calabar. According to Engr. Odediran, these projects were challenging due to his limited knowledge of airport systems, air traffic codes and design requirements. He and his team had to embark on extensive research and training in order to prepare for the complicated task of designing the aforementioned projects. The opportunity to handle these projects turned out to be very rewarding in the sense that every member of the team acquired extensive, versatile and in-depth knowledge of all aspects of airport systems design, maintenance and management. The joy of the successful delivery of these projects to world-class quality is still alive in the hearts of the team members.

"The world's greatest achievers have been those who have always stayed focused on their goals and have been consistent in their efforts" –Dr. Roopleen

PICTURES OF PROJECTS SUCCESSFULLY EXECUTED BY INTERACTIVE ENGINEERING CONSULT LTD AND KOSHVO & ASSOCIATES NIG. LTD.

Arial view of Abuja Airport – Electrical/Mechanical consultancy

Airport Terminal Building: Abuja and Lagos Airports (similar design for the two) – Electrical/Mechanical consultancy

Avio Bridge, Abuja Airport- Electrical / Mechanical Consultancy

Terminal Finger, Abuja Airport- Electrical / Mechanical consultancy

Chiller yard farm, Abuja Airport- Electrical / Mechanical consultancy

Electrical room, Abuja Airport - Electrical / Mechanical consultancy

Boarding gate entrance, Abuja Airport - Electrical / Mechanical consultancy

Baggage Handling Area, Abuja Airport- Electrical / Mechanical consultancy

NCDMB Conference hall building, Yenagoa, Electrical / ICT consultancy

NCDMB HQ Building Reception hall, Yenagoa - Electrical / ICT consultancy

Arial view of NCDMB 100KW Solar Farm - Electrical / ICT consultancy

NCDMB Headquarter building project, Yenagoa- Electrical / ICT consultancy

A WORD FOR YOUNG ENGINEERS

BY ENGR. HASSAN ODEDIRAN, *FNSE*

Engineering is visible in every aspect of our lives. The most important trait of a good engineer is the ability to solve problems and think outside the box. There are issues that arise in our day to day lives. It is our job as engineers to create a precise and lasting solution to these issues with the tools available to us.

One of the ways to be a great engineer is to appreciate your small beginnings. Be willing to start from the bottom because that's where you learn the inner workings of this profession. It is at this point that you begin to build your portfolio and peculiar design; this sets the pace for your future. Also, be encouraged to serve without focusing on the rewards because when you focus on the rewards, you focus less on the job at hand and this will reflect on your project quality at the end.

Rewards will always come but the best reward you can receive initially as an engineer is the TECHNICAL KNOWLEDGE which cannot be taken away from you and can be exchanged for any currency anywhere in the world shortly after.

Always be open to new ideas and be willing to learn. I have found out over the years that you can never know too much as an engineer. There is always something new to learn and develop as the world is developing and new ideas and inventions are birthed every day. We must be willing to learn and improve on already acquired knowledge even when it comes from a less experienced engineer.

I always say that engineering is 1+1" meaning engineering should be simple, precise and to the point. This is the attitude to imbibe as you explore the world of engineering; for every solution you recommend to a problem. Do the same for every design, report and presentation. In short, do your best to give a simple and precise solution always.

This should reflect greatly in your work because it will give the client the right impression that you know what you are doing.

The future of engineering belongs to the youth. Technological innovations are improving at a rapid pace but the best knowledge comes from our predecessors and sometimes solutions to present problems can come from past experiences. Thus, my last advice will be to have a mentor(s).

He should be someone or people to guide you and point you in the right direction without making mistakes that you would otherwise have made. He/they should coach you on the inner workings or as our youths say, "inside life" of the engineering profession. This person/they will guide you on how to handle critical problems based on past experiences.

SOFTWARE TOOLS AND THEIR APPLICATIONS IN ENGINEERING CONSULTANCY

BY ENGR. LANRE SAGAYA, JR

Engr. Lanre Sagaya, Jr
(Executive Director, YOLAS Consultant Ltd).

1.0 INTRODUCTION

The impact of Information and Communications Technology (ICT) on the Engineering industry is immeasurable. The impact is manifested in the communication revolution with the internet that has integrated and changed the way work is done including software applications that have become essential and have increased productivity considerably over the last 20 to 30 years. The worldwide web has revolutionized the interface between consultants and contractors with the use of mobile, cloud applications and project management software. Drone usage is making construction works easier and safer. 3D printing is coming to the fore and may soon become more widely used in producing materials. The use of artificial intelligence (AI) in construction works is gaining ground and should become more widespread over time.

In engineering consultancy, software applications are ubiquitous in all disciplines and aspects of the industry. The construction industry is constantly evolving at a rapid pace. Thus, professionals should see it is as essential to keep up to date with its technological advances.

2.0 INDUSTRY SPECIFIC SOFTWARE

The paper focuses on the packages provided by two software development companies namely, Bentley Systems Incorporated and Autodesk Inc. that are industry leaders in developing and managing software for the Engineering Construction industry. These two companies hold the largest market share of the Computer-Aided Design (CAD) software development industry and their software encompasses aspects of infrastructure development. These include civil design, transportation, structural hydraulics and geotechnical engineering. Nowadays, both companies typically offer their software packages as suites with tools that can cover the design process, from project inception to the production of final engineering drawings. Autodesk, for example, has its architecture, engineering and construction collection that consists of REVIT (a software used to plan, design and manage building design); CIVIL 3D (civil and roadway design and modelling); AutoCAD (software for 2D and 3D CAD). However, the option to purchase stand-alone packages individually is available.

2.1 BENTLEY SYSTEMS

Bentley Systems Incorporated develops, manufactures, licenses, sells and provides support for computer software and services for the design, construction, and operation of infrastructure. The company is reported to have 3,800 employees currently and reported revenue in 2018 of 700 Million USD. It develops software products for bridge analysis, building design, civil design, geotechnical engineering, electrical engineering and instrumentation, hydraulics and hydrology, pipe stress and vessel analysis, plant design, structural analysis and detailing and utilities as well as communications and networks.

Widely used software products from Bentley Systems include:

- MicroStation: A powerful, easy to use CAD App.
- InRoads and OpenRoad Designer: A robust software for all aspects of roadway design and modelling.

SOFTWARE	USER AND PURPOSE
Aspen HYSYS Dynamics™	Used by Chemical Engineers among others in the Aspen HYSYS series as an integrated software for dynamic simulation of oil and gas process, petroleum refining and other industry processes.
Geographic Information Systems (GIS)	Used by Land Surveyors in the field to enhance topographical data
Land Development Desktop	Used by Civil Engineers for site grading
STAAD Pro and other structural analysis packages	Used by Structural Engineers for detailing
HEC-RAS	Used by Hydraulics Engineers to determine drainage areas and culvert sizes
Civil 3D and Bentley InRoads and OpenRoad Designer	Used by Highway Engineers to model transportation corridor
AutoCAD	Used by Architects/Draughtsmen to produce design and construction drawings

Table 1: *Selected software tools and their users*

- STAAD Pro: A 3D structural analysis and design software.

2.2 AUTODESK INC.

Autodesk Inc. is a multinational software corporation; It was founded in 1982 and it introduced AutoCAD software to the market in the same year, It has been leading in the technological revolution from manual drawing to CAD. Since then, the company has expanded into providing software services for the entire architecture, engineering and construction (AEC), industry. Autodesk is the developer of AutoCAD, AUTOCAD LT, Civil 3D and AutoTURN software packages to name a few.

Autodesk is a multinational company as opposed to Bentley Systems, which is primarily US based. Autodesk software packages are more available globally and therefore used more in Nigeria. Some of their packages prevalent in the Nigerian consulting industry include:

2.2.1 AutoCAD and AutoCAD LT

AutoCAD is a CAD software that architects/draughtsmen, engineers and construction professionals use to create precise 2D and 3D drawings. Many tasks such as comparing drawings, adding blocks, creating schedules, can be automated or customized with add-on apps. AutoCAD LT is the cost effective 2D version only of this CAD software but still has a comprehensive set of editing, design, and annotation tools. AutoCAD and AutoCAD LT both have a relatively easy to navigate and understand graphical user interface.

2.2.2 Civil 3D

This is a robust civil engineering design software that has the capability for road corridor modelling, highway design, site grading, stormwater and sanitary systems designs, and plan production and documentation. Topography can be analyzed, road corridor layouts can be created, drainage system layouts can be designed, and construction design drawings can be created digitally. Once the land survey is uploaded onto the computer program, experienced engineers and draughtsmen can use the topographical data to organize large scale projects from preliminary to final design. Civil 3D works as an add-on into the AutoCAD platform.

2.2.3 AutoTURN

AutoTURN is a software used to analyse road intersections, roundabouts, bus terminals, loading bays, parking lots etc. involving vehicle clearances, and turn path maneouvers with a high degree of reliability. The software simulates forward and reverse vehicle turns while considering speeds, turn radii, roadway cambers and super-elevation. These engineering software packages are available directly from the developers or various authorized retailers. The preferred mode of purchase these days is subscription based i.e. monthly, yearly, or multiyear software licenses that can be issued over the internet.

3.0 DESIGN DELIVERY CASE

Let us consider a consulting firm that has assumed design responsibilities for a greenfield interstate expressway, that is to include above grade and at-grade interchanges as it traverses urban areas. Once the Right of Way (ROW) is established and the initial topographical survey is completed, the data is uploaded onto the firm's computer network. Design criteria will then have to be established with the client and the appropriate design manual can be adopted. This will stipulate design speeds, geometric standards (curve radii, curve length, lane and shoulder widths) etc.

The design engineers can then use Civil 3D to create an existing digital terrain model (DTM) from the topographical survey. Inputs of the established design criteria will be made into Civil 3D and the engineers can generate a design DTM. This design DTM will be overlaid on the existing DTM to evaluate the effect of the design on the existing topographical conditions. From the existing and design DTMs, the horizontal and vertical alignments can be created. Also, intersections can be designed and modelled. Cut and fill quantities can then be confidently generated to determine earthwork quantities. Cross sections at intervals along the roadway alignment can also be generated for analysis and presentation.

The draughtsman can finalize the drawing production with AutoCAD. Plan and profile drawings showing the horizontal and vertical alignments; typical and generated cross sections; details of roadway furniture etc. can be presented as deliverables to the client either in hard copy and/or soft copy. The engineers would have used AutoTURN to determine turning movements

at the intersections and made design adjustments, as necessary. Microsoft Excel or other spreadsheet software can be used to calculate the construction cost estimates with quantities extracted from the AutoCAD drawings. Engineering expertise along with competent use of these software programs will result in a project completed on time and within budget.

4.0 INVESTMENT DECISION SUPPORT SOFTWARE

Design is the crux of Engineering Consultancy and all the software packages considered so far in this paper are tools to enhance the design process. However, typically there is no funding for design without analysis of financial viability and returns on projects. Therefore, the following description will elucidate on the Highway Development and Management (HDM) system Version 4, an investment software system used for evaluating roadway infrastructure.

4.1 HDM-4 OVERVIEW

The Highway Development and Management System - HDM-4 is a software system for investigating choices in investing in road transport infrastructure. It is a decision support software system for assisting road managers to predict future economic, technical, social and environmental outcomes of possible investment decisions concerning road assets. The HDM-4 system assists managers in making effective investment choices at all levels. The possibilities may range from policy or strategic planning studies through programmed allocation of funds for maintenance or improvement works on a network to the detailed economic and environmental assessments of project options.

4.2 HISTORY AND DEVELOPMENT OF HDM-4

The Highway Design and Maintenance Standards Model (HDM-III) was developed by the World Bank in the mid-1980s. An international study of highway development and management (ISOHDM) was thereafter carried out to extend the scope of the HDM-III model, and to provide a harmonized systems approach to road management with adaptable and user-friendly tools. This produced the Highway Development and Management tool (HDM-4). The development of HDM-4 was undertaken because there was a need to incorporate the results of extensive research that had been undertaken around the world into the model, including variables such as modern vehicle technology. There was a need for a fundamental redevelopment of the software to incorporate a wider variety of pavements, environments and conditions of use and to reflect modern computing practices and expectations.

4.3 THE SCOPE OF HDM-4

- Providing, maintaining, and upgrading urban and rural roads and highways
- Investigating the effect of vehicles, traffic characteristics, road user costs
- Investigating the social and environmental effects of investments
- Investigating long term issues which arise over asset life cycles.

4.4 ANALYTICAL FRAME-WORK OF HDM-4

The HDM-4 analytical framework is based on the concept of pavement life cycle analysis. This is applied to predict deterioration, road works, socio-economic and environmental effects and costs over the life cycle of a road pavement, which is typically 15 to 40 years. An overview of the HDM-4 data flow is given in Figure 1. This identifies the data managers, the analysis tools and the models used for the technical analysis. HDM-4 operates on input data defined by the following four data managers:

- Road Network: Data defining the road network or sub-network that will be the basis of the analysis
- Vehicle Fleet: Characteristics of the vehicle fleet operating on the road network being analysed
- Road Works: Specifications for maintenance and improvement standards i.e. road works that will be applied to road sections being analysed
- HDM Configuration: HDM-4 is designed for use in a wide range of environments.

Technical analysis is undertaken using the following models:

- Road Deterioration (RD): Predicts road deterioration for paved and unsealed roads.
- Works Effects (WE): Implement road works programs and determine works costs.
- Road User Effects (RUE): Determine costs of vehicle operation, road accidents and travel time.
- Social and Environment Effects (SEE): Determine effects of emissions and noise, and predicts numbers of road

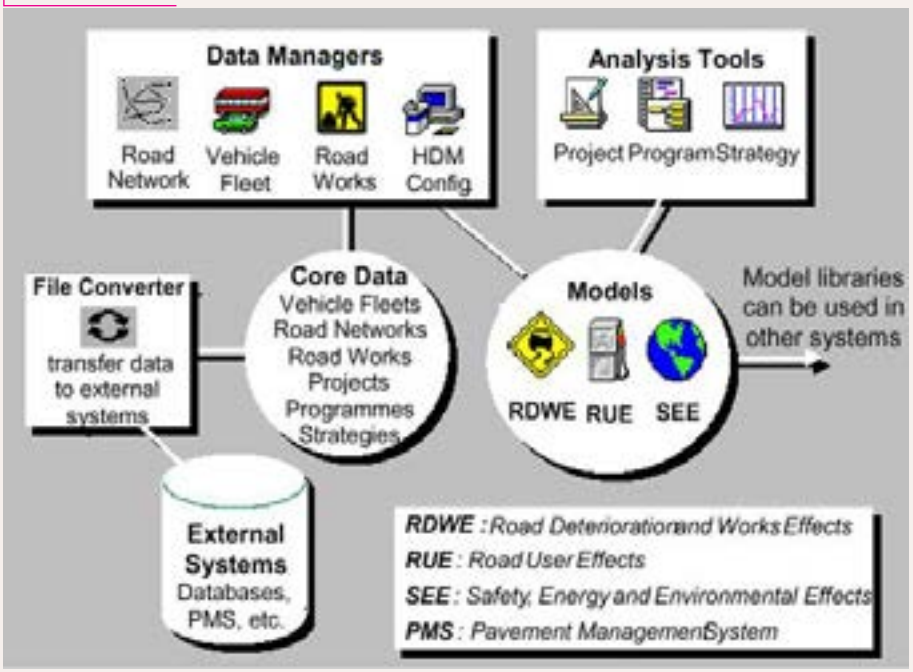

Fig. 1: *HDM-4 flow diagram*

accidents and amounts of energy consumption.

Based on the required input, the HDM-4 computer model simulates physical and economic conditions over the period of analysis, usually a life cycle, for a series of alternatives and scenarios specified by the user. The broad concept of the life cycle analysis is illustrated in Figure 2.

Thus, HDM-4 determines the deterioration and optimum rehabilitation strategy for road sections. Economic indicators namely Net Present Value (NPV), Internal Rate of Return (IRR) and Benefit Cost Ratio (BCR) are outputs determined by HDM-4 for the different investment options, which are the most commonly used criteria for selecting projects. Hence users can assess the economic feasibility of a specified project and compare against a base case, or a "without project" alternative with the aim of determining what alternative is most cost-effective.

5.0 CONCLUSION

Fueled by the uncertain timetables and strict budgets of infrastructure projects, Computer Aided Design (CAD) software can be considered to be the 'de-facto brain' in engineering consultancy industry. Of course, the 'de jure brain' is still the consultant who has to apply the software tools intelligibly. There is a wide variety of software tools available for all engineering disciplines. These cover chemical process design, civil, structural, mechanical, electrical, geotechnical engineering etc. The entire industry is beset with software applications, all with the goal of reducing design time, improving effectiveness and efficiency and providing firms with the capability to handle large scale projects.

This paper has highlighted several industry specific design software, with emphasis on software tools developed by Autodesk Inc and Bentley Systems Inc., two major players in the field. These software packages can be used to deliver a design project, from inception to production of final engineering documents, by a consultancy firm.

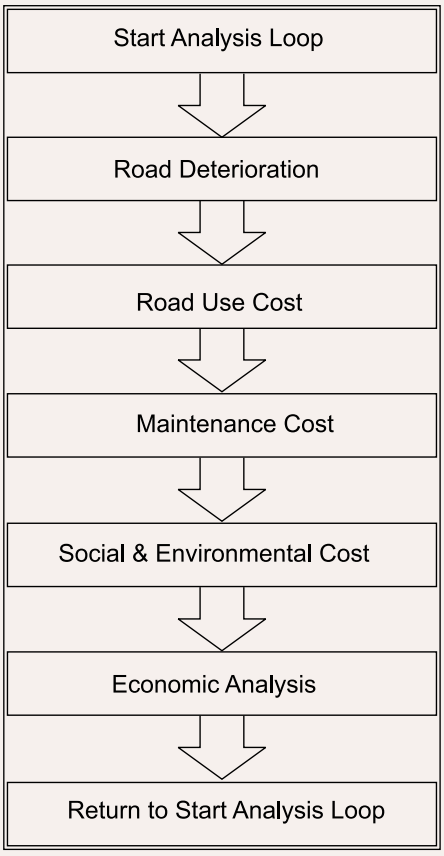

Fig. 2: *Life-cycle analysis using HDM-4*

The paper has also elaborated on an investment support software, HDM-4. This is a very important tool to use because of the role of infrastructure in driving social economic development. The use of software application for engineering design is vital and ubiquitous in the consultancy industry. Leaning on the primary objective of increasing productivity through the use of software tools, it is important that engineering expertise is not compromised in this CAD age.

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* Medical Gases Installations
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* Fume Cupboards
* Steam Generation & Distribution
* Lifts and Escalators or Travellators
* Document Conveying
* Refuse Collection and/or Disposal Systems
* Incinerators
* Industrial Wastes & Management
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* Design of Substations from 11kv to 132kv
* Solar Power Installation System
* Diesel Generator Installation
* Controls & Instrumentation
* Communications
* Internal Telephone Systems
* Closed Circuit Television
* Telex Installations
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* Street Lighting, Rural Electrification
* Fire Protection, Intrusion Prevention
* Outdoor Sport Flood Lighting

Azuri Peninsula, Eko Atlantic, Lagos

Federal Inland Revenue Service (FIRS), Abuja

Conerstone Office Building, Victoria Island

Nigerian Petroleum Development Company, (NPDC) Edo, Benin

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VISION

"To consistently provide sustainable cutting edge solutions in engineering and infrastructural services to individuals and institutions globally."

MISSION STATEMENT

"UNECON ASSOCIATES LIMITED is dedicated to the design of sound engineering systems based on economic capital and running costs compatible with the client's requirements and utilising good quality products, which will provide engineering reliability."

COMPANY PROFILE

The firm, UNECON ASSOCIATES LIMITED was formally registered on May 9, 1969 but did not actively engage in Consulting Engineering Services until January 1970 and became Limited Liability on July 24, 1987.

The Management and Staff of UNECON Associates are dedicated to the design of sound engineering schemes based on economic capital and running costs compatible with the Client's requirements and utilising good quality products, which will provide engineering reliability.

UNECON Associates undertakes full range of Engineering Services, which include feasibility studies, estimates, design, and preparation of contract documents and evaluation of tenders, supervision of construction and commissioning of all types of schemes.

The firm now has 2 Principal Partners, and 2 Associate Partners with considerable Engineering experience. The company presently has 15 Engineers in various fields of Electro-Mechanical Engineering, 3 Technical Officers, 6 Administrative Staff and other supporting staff. The firm has her head office in Lagos and a branch office in Abuja with coordinating offices in Port Harcourt, Abeokuta, Benin, and Ibadan.

UNECON Associates has the privilege of tapping from the rich experience of her 3 retired Principal Partners who now serve the company as Consultants. Each of the three retired Partners has a minimum of 40 years' experience in the industry and always keep themselves updated in the industry through attendance of professional seminars, workshops and conferences both locally and internationally.

Over the years, UNECON Associates has participated in project execution with a number of reputable firms of Planners, Architects, Civil Engineers, Quantity Surveyors, Estate and Project Managers with whom they have shared experience together and worked as a team.
In October, 2018, the firm won an award as the Consultant of the year at the second edition of Real Estate Development Summit, Africa held in Accra, Ghana.

KEY PROJECTS

1. Trinity Towers (Redeemed Christian Church Of God) City Of David, Oniru.
2. Proposed 13-Storey Cornerstone Office Building Project, Victoria Island, Lagos.
3. Proposed 18-Storey Bluewater Lekki (Sapphire Residence) Of 120 Flats (1-Bedroom, 2 & 3 Bedroom-) Luxury Residential Development Scheme.
4. Proposed 2 Nos. 32-Storey & 30-Storey Azuri Pennisula Project, Marina District, Eko Atlantic City, Lagos.
5. Federal Inland Revenue Services, Abuja, Etc.

PHOTOS OF KEY PROJECTS

Trinity Towers (Redeemed Christian Church of God) City of David, Oniru, Lagos

Proposed 18-Storey Bluewater Lekki (Sapphire Residence) of 120 Flats (1-Bedroom, 2 & 3-Bedroom-) Luxury Residential Development Scheme

PROPOSED HEAD OFFICE FOR NIGERIAN PETROLEUM DEVELOPMENT COMPANY AT BENIN-CITY, EDO STATE Detailed Design and Supervision of Mechanical, Electrical and Plumbing Engineering Services

PROPOSED 2 NOS. 32-STOREY & 30-STOREY AZURI PENNISULA PROJECT, MARINA DISTRICT, EKO ATLANTIC CITY, LAGOS - Detailed Design and Supervision of Mechanical, Electrical and Plumbing Engineering Services.

FEDERAL INLAND REVENUE SERVICES, ABUJA - The Consultancy rendered by UNECON Associated Limited Included all the Mechanical Engineering Services associated with the project

PROPOSED 2 NRS. 32-STOREY & 30-STOREY AZURI PENNISULA PROJECT, MARINA DISTRICT, EKO ATLANTIC CITY, LAGOS Detailed Design and Supervision of Mechanical, Electrical and Plumbing Engineering Services.

UNECON MANAGEMENT TEAM

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(Principal Partner)

Engr. Alex N. Obudike
(Principal Partner)

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CICC, Calabar

Zenith Bank, Accra

Lake Point Tower, Lagos

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Committed to Customer Satisfaction and Service Excellence

INTERNET CONNECTIVITY SYSTEMS

BY MR. TAJUDEEN BALOGUN

1.0 INTRODUCTION

Mr. Tajudeen Balogun
(Chief Executive Officer, Infosol Consulting)

Just as steel and steam engines were profound in previous centuries, the single technology that dominated the 20th century was information gathering, processing, and distribution. This ushered in the installation of worldwide telephone networks, the invention of radio and television, the birth and unprecedented growth of the computer industry, the launching of communication satellites and the internet.

Internet is a collection of autonomous computers interconnected by a single technology. Two computers are said to be interconnected if they are able to exchange information. Networks are usually connected together to make larger networks, with the internet being the most well-known example of a network of networks. The connection can be via a copper wire, fiber optics, microwaves, infrared and communication satellites. Computers exchange information through modems. Apart from being the last glue between computers and the connectivity system, modems facilitate the conversion of digital information to analog for transmission to and fro.

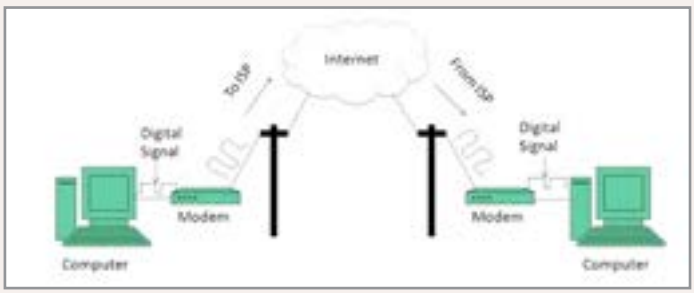

Fig. 1: *Illustration of Cloud Telecommunication Technology*

The connection medium also known as backbone or internet connectivity is a service provided first by internet service providers (ISP) and ultimately by telecommunication companies. Under the hood, the connections are countless industrial grade routers working in a cooperative fashion on a point-to-point basis leveraging old telephone copper wires, telecoms radio networks through towers or microwave radio, undersea and underground fiber optic cables, satellite and laser beams (especially for machines in outer space), to transport data. Each data unit has its own protocols and moves in a channel. The entire orchestra is called backbone or connectivity. Fig. 1 which denotes the cloud is symbolic of the carrier or the telecommunication technology responsible for the information that is exchanged. Fig. 2 shows various devices connected to the internet (cloud).

Fig. 2: *Examples of various devices connecting to the internet*
Courtesy: www.engineering.com

2.0 DATA AS THE KING

At its reduced state, information is data or several data from where information is mined. Each data unit is the content that is transmitted across the internet backbone or connectivity and has been the catalyst for the innovations in carrier technologies on offer today. Data exists in binary, in text-form (string of characters or words), audio (voice), images (pictures), video or a combination of all data forms known as multimedia. As data exchanges expand through services such as digital animations, online gaming, streaming video, database-driven websites, e-commerce and mobile applications (to name but a few), the two internet core technologies, namely, computing and telecommunications will continue to experience further developments.

In computing and computer networks for instance, there have been innovations in computer network technologies and the production and

Fig. 3: *Internet connection methods*

deployment of several network capable devices including, mobile handsets, television, camera, light bulbs, sensors, robots, vehicles, embedded devices and outer space flying objects. The pressure induced by data exchanges is equally driving advances in telecoms carrier technologies towards faster data transmission and increased capacity of the transmission medium. Network technologies continue to reach for more speed while the transmission media capacity (breath) has developed from dial-ups to cable modems, broadband wireless, fiber optics, satellite and now laser beam.

3.0 WHY WE SHOULD CARE

Problems in the universe will always spin up more data exchange solutions which in turn will encourage data intense applications and the need for bigger, better and faster internet connections using available internet connectivity technology.

Internet connectivity has enabled previously impossible activities to be possible now. Some of these include:

- Internet of Things (IoT) based pest control
- Optimizing the power grid
- Online classrooms and learning
- Growing better grapes
- Self-driving vehicles
- Waste management
- Smart home
- Doing away with dangerous police chases

4.0 INTERNET CONNECTIVITY

4.1 DIAL UP

Internet connectivity began as a dial-up. Dial-up is an analog connection because data is sent over an analog, public-switched telephone network. The modem converts received analog data to digital and vice versa. Dial-up access uses normal telephone lines. For this type of access, the quality of the connection is not always good and data rates are limited. Typical dial-up connection speeds are in the range of 2400 bps to 56 Kbps. Fig. 3 shows various internet connection methods.

4.2 INTEGRATED SERVICES DIGITAL NETWORK

The next major upgrade over dial-ups was the integrated services digital network (ISDN), an international communications standard for sending voice, video, and data over digital telephone lines or normal telephone wires. Typical ISDN speeds are in the range of 64 Kbps to 128 Kbps.

Today, ISDN has been widely replaced by broadband cable, digital subscriber line (DSL), radio satellite and fiber optics with speed from 1.5 mb to 100 mb.

4.3 BROADBAND

Broadband communication is a type of telecommunication that supplies multiple channels of data in a single communications platform using some form of wave or frequency division multiplexing. In simple words, internet access at much greater than dial-up speeds is called broadband. The name refers to the broader bandwidth that is used for faster networks, rather than any particular speed. Broadband includes several high-speed transmission technologies such as:

- Digital Subscriber Line (DSL)
- Cable Modem
- Fiber
- Wireless
- Long Distance hot spots
- VoIP
- Satellite
- Broadband over Powerlines (BPL)
- Laser Beam

The broadband technology depends on a number of factors. These may include location (urban or rural), how broadband internet access is packaged with other services (such as voice telephone and home entertainment), price, and availability.

4.3.1 Digital Subscriber Line (DSL)

DSL is a form of broadband connection as it provides connection over ordinary telephone lines. Given the size of the old telephone lines (half a million) in Nigeria, we have very few DSL powering data exchanges directly. DSL-based broadband provides transmission speeds in the range of several hundred Kbps to millions of bits per second (Mbps). The availability and speed of DSL service may depend on the distance from the user's home or business to the closest telephone company facility.

Fig. 4 illustrates internet access using a digital subscriber line modem. The following are types

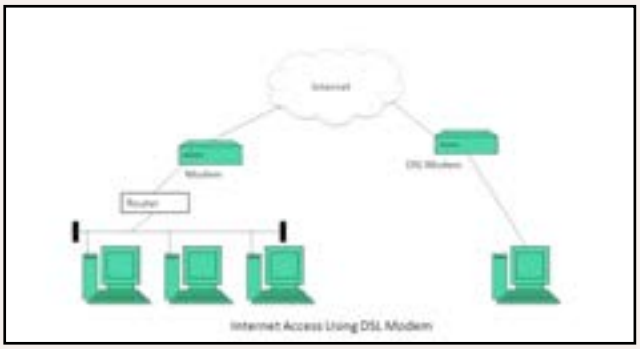

Fig. 4: *Internet access using Digital Subscriber Line modem*

of DSL transmission technologies:

Asymmetrical Digital Subscriber Line (ADSL): This is used primarily by residential customers, such as internet surfers, who receive a lot of data but do not send much. ADSL typically provides faster speed in the downstream direction than the upstream direction. ADSL allows faster downstream data transmission over the same line used to provide voice service, without disrupting regular telephone calls on that line.

Symmetrical Digital Subscriber Line (SDSL): This is used typically by businesses for services such as video conferencing, which need significant bandwidth both upstream and downstream. Fig. 5 illustrates a symmetrical digital subscriber line arrangement.

Faster forms of DSL typically available to businesses include:

- High data rate Digital Subscriber Line (HDSL); and
- Very High data rate Digital Subscriber Line (VDSL).

All types of DSL technology connection speeds are in the range of 128 Kbps to 9 Mbps. ADSL supports data rates of from 1.5 to 9 Mbps when receiving data (known as the downstream rate) and from 16 to 640 Kbps when sending data (known as the upstream rate). ADSL requires a special ADSL modem. SDSL on the other hand, supports data rates up to 3 Mbps. SDSL works by sending digital pulses in the high-frequency area of telephone wires and cannot operate simultaneously with voice connections over the same wires. SDSL requires a special SDSL modem. SDSL is called symmetric because it supports the same data rates for upstream and downstream traffic.

Very High DSL (VDSL) is a DSL technology that offers fast data rates over relatively short distances — the shorter the distance, the faster the connection rate.

4.3.2 Cable Modem

Cable TV internet connection is provided through Cable TV lines. It uses coaxial cable which is capable of transferring data at much higher speed than a common telephone line. Cable modem enables these providers to provide broadband using the same coaxial cables that deliver pictures and sound to TV set. Fig. 6 shows cable modems. Cable operators in Nigeria like DSTV and Startimes both provide cable TV services through internet.

Most cable modems are external devices that have two connections: one to the cable wall outlet, the other to a computer. They provide transmission speeds of 1.5 Mbps or more. Since Cable TV internet connections share a set amount of bandwidth with a group of customers, therefore, data transfer rate also depends on the number of customers using the internet at the same time.

Transmission speeds vary depending on the type of cable modem, cable network, and traffic load. Speeds are comparable to DSL. Thus, the coaxial cable used by Cable TV provides much greater bandwidth than telephone lines. A cable modem can be used to achieve extremely fast access. Cable speeds are in the range of 512 Kbps to 20 Mbps.

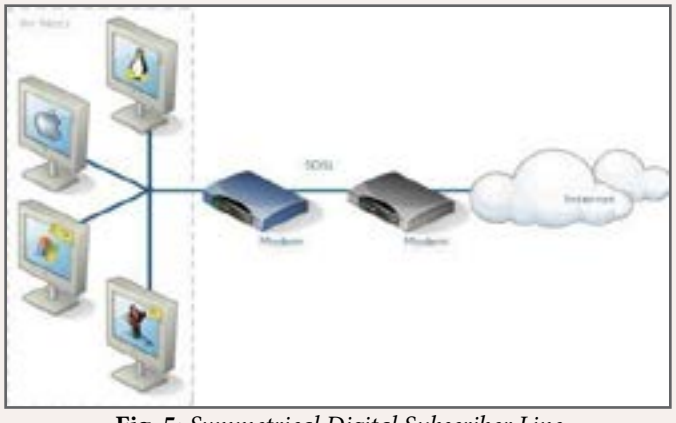

Fig. 5: *Symmetrical Digital Subscriber Line*

Fig. 6: *Cable modems*

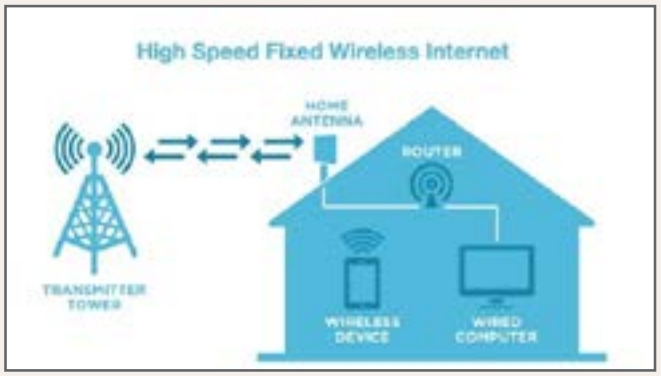

Fig. 7: *High Speed Fixed Wireless internet*

4.3.3 Fiber

Fiber optic technology converts electrical signals carrying data to light and sends the light through transparent glass fibers about the diameter of a human hair. Fiber transmits data at speeds far exceeding current DSL or cable modem speeds, typically by tens or even hundreds of Mbps.

Technology enablers allow current optical systems to transmit a large number of channels (over 160) at 10Gbit/s or 40Gbit/s, and over distances exceeding 4,000km using a single optical fiber pair. However, these enablers have been developed to address the requirements of core and long-haul transmission networks, which have a high level of traffic aggregation, and therefore benefit from significant economies of scale.

The actual speed will vary depending on a variety of factors, such as how close to the user's computer the service provider brings the fiber and how the service provider configures the service, including the amount of bandwidth used. The same fiber providing the broadband can also simultaneously deliver voice (VoIP) and video services, including video-on-demand.

By running optical fiber to residences, faster internet access can be provided at rates in the order of 10 to 100 Mbps. This design is called FTTH (Fiber to the Home). For businesses in commercial areas, it may make sense to lease a high-speed transmission line from the offices to the nearest ISP. For example, a telecommunication line of category 3 rating (T3 line) runs at roughly 45Mbps. Optical Carrier (OC3) is used as a fiber optic backbone for large networks with large voice, data, video, and traffic needs. Speeds are 155.52 Mbps, or roughly the speed of 100 T1 lines.

4.3.4 Fixed Wireless

Wireless broadband connects a home or business to the internet using a radio link between the customer's location and the service provider's facility. Wireless broadband can be mobile or fixed. Fixed wireless access is particularly suited for use over difficult terrain and in remote rural areas where the cost of installation and the effort of meeting the planning restraints associated with establishing wireline infrastructure can be prohibitive. Wireless broadband internet access services offered over fixed networks allow consumers to access the internet from a fixed point while stationary and often require a direct line-of-sight between the wireless transmitter and the receiver. Fig. 7 shows high speed fixed wireless internet connection.

These services have been offered using both licensed spectrum and unlicensed devices. For example, thousands of small wireless internet services providers (WISPs) provide such wireless broadband at speeds of around one Mbps using unlicensed devices, often in rural areas not served by cable or wireline broadband networks.

Wireless local area networks (WLANs) provide wireless broadband access over shorter distances and are often used to extend the reach of a "last-mile" wireline or fixed wireless broadband connection within a home, building, or campus environment. Wi-Fi networks use unlicensed devices and can be designed for private access within a home or business, or be used for public internet access at "hot spots" such as restaurants, coffee shops, hotels, airports, convention centers, and city parks. Fig. 8 shows hotspot internet connection.

Fig. 8: *Hotspot internet connection*

Mobile wireless broadband services are also available from mobile telephone service providers and others. These services are generally appropriate for highly-mobile customers and require a special PC card with a built-in antenna that plugs into a user's laptop computer. Generally, they provide lower speeds, in the order of several hundred Kbps.

Wireless hotspots based on the 802.11 standard constitute another kind of wireless network for mobile computers. Anyone with a laptop computer and a wireless modem can just turn on his computer and be connected to the internet through the hotspot, as though the computer was plugged into a wired network.

Since having a wired connection is impossible in cars, boats, and airplanes, there is a lot of interest in wireless networks. Fig. 9 shows complex wireless networks for various devices. Cellular networks operated by the telephone companies are wireless networks that blanket us with coverage for mobile phones.

Wireless internet uses radio frequency bands. Wireless internet provides an always-on connection which can be accessed from anywhere — as long as the user is geographically within a network coverage area. Wireless access is typically more expensive and mainly available in metropolitan areas. Wireless technologies using longer-range directional equipment provide broadband service in remote or sparsely populated areas where DSL or cable modem service would be more costly to provide. Speeds are generally comparable to DSL and cable modem. An external antenna is usually required.

4.4 LONG DISTANCE HOTSPOT CONNECTIVITY

Long-range wireless fidelity (Wi-Fi) is an example of wireless broadband technology using long range directional equipment. They are generally known as IEEE 802.11 systems and operate in unlicensed, unregulated spectrum bands such as the

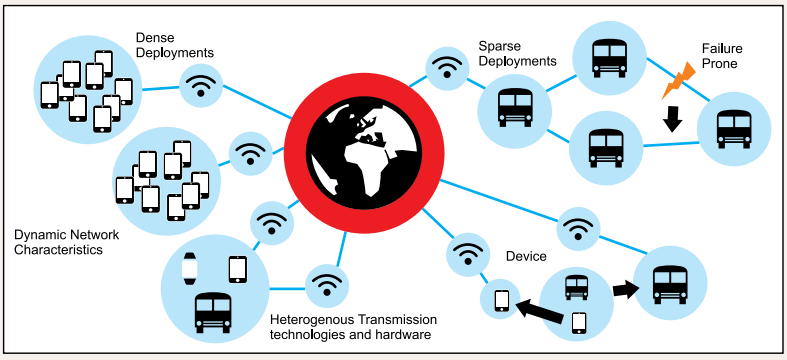

Fig. 9: *Complex wireless networks in organized structure*

Industrial, Scientific, and Medical (ISM) bands defined by the International Telecommunication Union (ITU). Examples are 902-928 MHz, 2.4-2.5 GHz, and 5.725-5.825 GHz (ITU-R1). All devices are allowed to use this spectrum provided they limit their transmitting power to let different devices coexist. These are low-cost, unregulated point-to-point computer network connections, an alternative to other fixed wireless, cellular networks or satellite internet access.

Wi-Fi networks have a range that is limited by the frequency, transmission power, antenna type, the location in which they are used, and the environment. A typical wireless router in an indoor point-to-multipoint arrangement using 802.11n and a stock antenna might operate in a range of 50 meters (160 ft) or less. Outdoor point-to-point arrangements, through use of directional antennas, can be extended with many kilometers between stations.

Since the development of the IEEE 802.11 radio standard (marketed under the Wi-Fi brand name), the technology has become markedly less expensive and achieved higher bit rates. Long-range Wi-Fi especially in the 2.4 GHz band (as the shorter-range higher-bit-rate 5.8 GHz bands become popular alternatives to wired LAN connections) have proliferated with specialist devices.

Fig. 10: *A rooftop 1 watt Wi-Fi amp, feeding a simple vertical antenna on the left*

While Wi-Fi hotspots are ubiquitous in urban areas, some rural areas use more powerful longer-range transceivers as alternatives to the cell (Generalized System Mobile (GSM), Code Division Multiple Access (CDMA)) or fixed wireless applications.

Business Applications achieve the following:

- Provide coverage to a large office or business complex or campus. (See Fig. 10)
- Establish point-to-point link between large skyscrapers or other office buildings or airports.

- Bring internet to remote construction sites or research labs.
- Bring internet to a vacation home or cottage on a remote mountain or on a lake.
- Bring internet to a yacht or large seafaring vessel.
- Share a neighborhood Wi-Fi network.

4.5 VOICE OVER INTERNET PROTOCOL (VoIP)

Voice over Internet Protocol (VoIP), also called IP telephony, is a method and group of technologies for the delivery of voice communications and multimedia sessions over internet protocol (IP) networks. (See Fig. 11)

The terms internet telephony, broadband telephony and broadband phone service specifically refer to the provision of communication services (voice, fax, SMS, voice-messaging) over the public internet, rather than via the public switched telephone network (PSTN), also known as plain old telephone service (POTS).

"Typically, a consumer can expect to receive or download data at a speed of about 500 Kbps and send or upload data at a speed of about 80 Kbps...they are about 10 times faster..."

Fig. 11: *An illustration of VoIP network*

Fig. 12: *A satellite dish*

4.6 SATELLITE

Satellite internet connection offers high speed connection to the internet. There are two types of satellite internet connections: one way connection or two way connection. In one way connection, data can only be downloaded. However, uploading of data through one way connection is possible if a dialup access through ISP over telephone line is used. In two way connection, data can be downloaded and uploaded by the satellite. It does not require any dialup connection. Just as satellites orbiting the earth provide necessary links for telephone and television service, they can also provide links for broadband. Satellite broadband is another form of wireless broadband, and it is useful for serving remote or sparsely populated areas.

Downstream and upstream speeds for satellite broadband depend on several factors, including the provider and service package purchased, the consumer's line of sight to the orbiting satellite and the weather. Typically, a consumer can expect to receive or download data at a speed of about 500 Kbps and send or upload data at a speed of about 80 Kbps. These speeds may be slower than DSL and cable modem, but they are about 10 times faster than the download speed with dial-up internet access. Service can be disrupted in extreme weather conditions. Businesses relying on satellite powered wireless connectivity have to make a choice between a Ku-Band dish and a C-band dish. C-band dishes seem to do well in rainy environments but Ku-band data throughputs are awesome. Fig. 12 shows a typical satellite dish.

Internet over Satellite (IoS) allows a user to access the internet via a satellite that orbits the earth.
A satellite is placed at a static point above the earth's surface, in a fixed position. Fig. 13 shows

the signals while Fig. 14 shows a satellite in space. In view of the enormous distances signals must travel from the earth up to the satellite and back again, IoS is slightly slower than high-speed terrestrial connections over copper or fiber optic cables. Typical Internet over Satellite connection speeds (standard IP services) average around 492 up to 512 Kbps.

It remains a big debate whether satellite powered internet is a better alternative for developing nations because fiber has been too expensive and vulnerable to breaks and power outages. Satellites flying about 22,000 miles (35,700 kilometers) above the equator in geosynchronous earth orbit (GEO) beam signals can cover huge swaths of the planet, nearly 2,000 miles (3,000 kilometers) wide at a time. However, the distance creates a delay or latency. Signals from geostationary satellites can take about 500 milliseconds (0.5 seconds) to travel down to earth and back up again. This amount of latency is not ideal for providing internet services.

4.7 BROADBAND OVER POWERLINE (BPL)

BPL is the delivery of broadband over an existing low and medium-voltage electric power distribution network. Refer to Fig. 15. BPL speeds are comparable to DSL and cable modem speeds. BPL can be provided to homes using existing electrical connections and outlets. BPL is an emerging technology that is available in very limited areas. It has significant potential because power lines are installed virtually everywhere, alleviating the need to build new broadband facilities for every customer.

Increasingly, consumer electronic devices are networked. For example, some high-end cameras already have a wireless network capability and use it to send photos to a nearby display for viewing. Professional sports photographers can also send their photos to their editors in real-time, first wirelessly to an access point, then over the internet. Devices such as televisions that plug into the wall can use power-line networks to send information throughout the house over the wires that carry electricity.

4.8 LASER COMMUNICATION

Modern electronic communication requires a sending device that can encode any data into a transmittable form and a receiver that can distinguish between the message (signal) and its surrounding line static (noise). In principle, laser communication systems resemble the modems that are used in homes since the evolution of the internet.

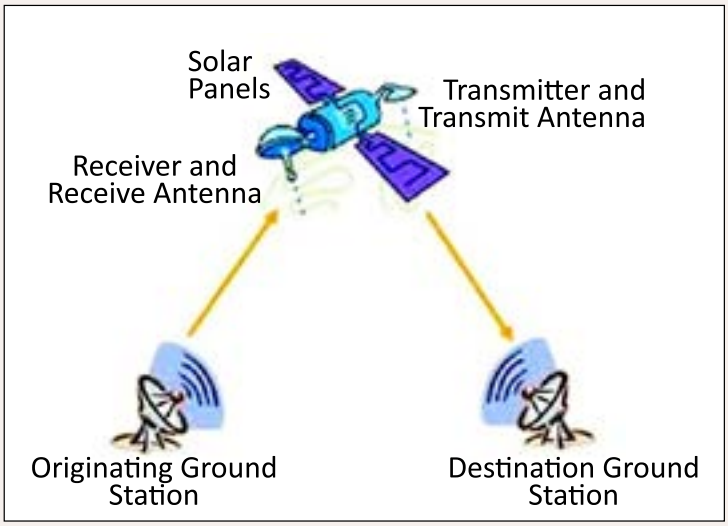

Fig. 13: *Satellite signals*

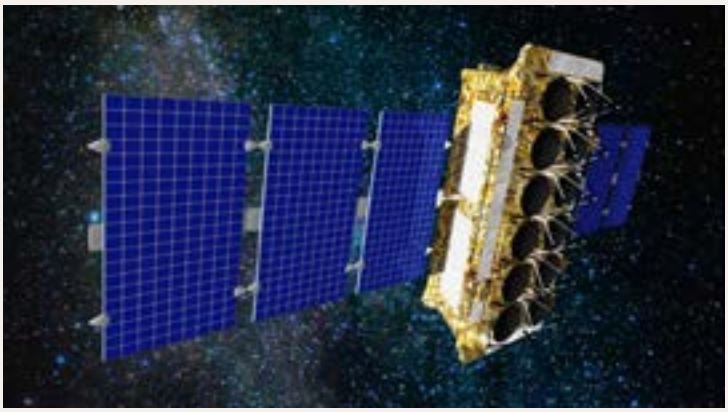

Fig. 14: *A Satellite in space*

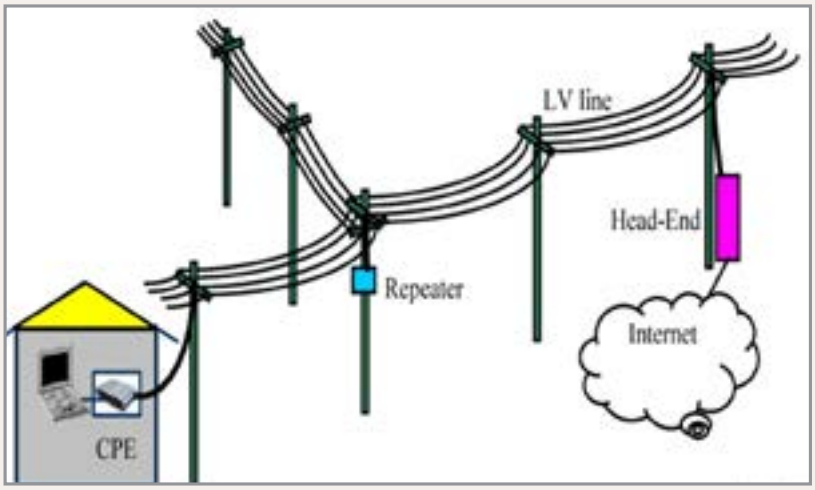

Fig. 15: *An illustration of Broadband over Power-line Connectivity*

Today, lasers have become one of the world's most important technologies, used in industries covering information technology, telecommunications, medicine, consumer electronics, law enforcement, military equipment, entertainment and manufacturing.

From the earliest days of laser development, researchers realized that light could outperform radio in terms of information speed and density. Light wavelengths packed much more tightly than sound waves, can transmit more information per second, and with a stronger signal. Laser communications, once achieved, would be the bullet train to radio's wagon train.[3]

In a sense, lasers have been used in communications for years. Information is transferred via laser every day, whether by reading CDs and DVDs, scanning bar codes at checkout lines or tapping the fiber optic backbone of phone or internet services. Now a more direct approach, one that will allow high throughput point-to-point communication over vast distances, through air or space, with little data loss is on the horizon.

In October 2013, NASA realized and far exceeded this vision when a craft orbiting the moon sent data to an earth station via a pulsed laser beam traversing 239,000 miles (384,600 kilometers) of transmission at an unheard-of download rate of 622 megabits per second (Mbps).

5.0 CONCLUSION

Clearly with data transmission thresholds of 622 megabits per second, the internet is poised to drive growth as we transit into the robotic age with the avalanche of autonomous vehicles, planes and trucks, self-driven tractors and smart cities. We are feeling the pulse of that future.

"In October 2013, NASA realized and far exceeded this vision when a craft orbiting the moon sent data to an earth station via a pulsed laser beam traversing 239,000 miles (384,600 kilometers) of transmission at an unheard-of download..."

"Clearly with data transmission thresholds of 622 megabits per second, the internet is poised to drive growth as we transit into the robotic age with the avalanche of autonomous vehicles, planes and trucks, self-driven tractors and smart cities".

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ACEN ACTIVITIES IN PICTURES

INVESTITURE OF THE 18TH ACEN PRESIDENT

20TH FEBRUARY 2020, PORT-HARCOURT

Engr. George C. Okoroma, FNSE, JP, giving his inaugural address at his investiture as the 18th President of ACEN.

(L – R) ACEN Past Presidents, Engr. Y. O. Sagaya, FNSE, OFR; Engr. Kunle Ogunbayo, FNSE, FAEng and Engr. K.A. Adeola FNSE, FAEng during the event.

ACEN President, Engr. George C. Okoroma decorating Engr. Charles 'Yele Akindayomi as a Past President of ACEN in company of HRM, His Excellency, King Alfred Papaprey eDiete-Spiff, Amayanabo of Twon Brass and First Military Governor of Rivers State and Chairman, Investiture Committee, Engr. (Mrs.) Mayen Adetiba, FNSE, FAEng.

Minister of Science and Technology, His Excellency, Engr. Dr. Chief Ogbonnaya Onu, FNSE, KSJ giving his opening remarks as Chairman of the occasion.

ACEN President, Engr. George C. Okoroma (centre)being decorated by (L-R) his wife, Mrs. Ngozi G. Okoroma, Chairman of the occasion, Honourable Minister of Science and Technology, His Excellency, Engr. Dr. Chief Ogbonnaya Onu, FNSE, KSJ and ACEN Immediate Past President (IPP), Engr. Charles 'Yele Akindayomi, FNSE.

Front row (L – R): COREN President, Engr. Ali A. Rabiu, FNSE, FNICE (2nd left); NSE President, Engr. Babagana Mohammed, FNSE (3rd left); Mr. Emmanuel Chiejina, Chairman/CEO, Ashbard Energy Company Ltd.(4th left) and ACEN Vice President, Engr. Ajibade Oke, FNSE (5th left) at the event.

*ACEN President, Engr. George C. Okoroma flanked by **(L – R)**:NSE President, Engr. Babagana Mohammed; Dr. (Mrs.) Yinka Akindayomi; Mrs. Ngozi G. Okoroma; His Excellency, Engr. Dr. Chief Ogbonnaya Onu, FNSE, KSJ; HRM, King Prof. Anele U. Nwokoma, (Eze Egi Iii) Eze Ogba-Ukwu Of Ogba Land, Rivers State; HRM, His Excellency, King Alfred Papapreye Diete-Spiff; COREN President, Engr. Ali A. Rabiu; ACEN IPP, Engr. Charles 'Yele Akindayomi and ACEN Past Presidents, Engr. J.I. Folayan; Engr. (Mrs.) Mayen Adetiba and Engr. Chief, Sir, Dr. Edet James Amana, FNSE, FAEng, OON*

ACEN President, Engr. George C. Okoroma (3rd from the right), flanked by (L-R): ACEN MD,Engr. Sunday Kalejaiye; Engr. Stanley Idem; Engr. Tony Nwogbo, Engr. (Mrs.) Mayen Adetiba;Engr. Fyne Chima Ogolo and Engr. E. N. Moore.

COREN VALEDICTORY SESSION FOR ACEN IPP, ENGR. CHARLES 'YELE AKINDAYOMI

The event also ushered in the ACEN President, Engr. George C. Okoroma as ACEN's representative on the Council of COREN in Abuja on March 13, 2020.

(L – R): ACEN President, Engr. George C. Okoroma; NSE President, Engr. Babagana Mohammed; ACEN IPP, Engr. Charles 'Yele Akindayomi and COREN President, Engr. Ali A. Rabiu.

(L – R): Engr. Ibrahim A. Maimaje; ACEN Immediate Past President (IPP), Engr. Charles 'Yele Akindayomi; ACEN President, Engr. George C. Okoroma and Engr. Prof. Babagana Mohammed.

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2.	15th – 16th	April	Preparation of Bids & How to Bid for Contracts	Lagos	2 days	15
3.	28th – 29th	April	Building Services Design - Mechanical (Module 2)	Lagos	2 days	15
4.	13th – 14th	May	Structural Design of Buildings to Eurocode 2 (Module 1)	Port-Harcourt	2 days	15
5.	20th - 21st	May	Electrical Engineering Design and Detailing	Abuja	3 days	20
6.	17th	June	Communication for Engineers	Lagos	1 day	10
7.	15th –16th	July	Design & Construction of Flood and Erosion Control Structures	Lagos	2 days	15
8.	19th – 20th	August	FIDIC Course: FIDIC Conditions of Contract for EPC/Turnkey Projects	Lagos	2 days	20
9.	16th – 18th	September	Design & Strategies in the Selection and Adoption of Mechanical Systems: Heating Ventilation & Air Conditioning	Lagos	3 days	20
10.	28th – 29th	October	Electrical Power Distribution System Planning for Medium Voltage Network (Module 1)	Port-Harcourt	2 days	15
11.	25th – 26th	November	Geometric Design of Roads, Intersections and Interchanges	Abuja	2 days	15

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APPLICATIONS OF CLOUD COMPUTING TECHNOLOGY

Engr. Adeyombo Adewale
(Chief Executive Officer, Saralt Supports Ltd.)

BY ENGR. ADEYOMBO ADEWALE

1.0 INTRODUCTION

Cloud computing technology is the practice of using a network of remote servers hosted on the internet to store, manage, and process data, rather than a local server or a personal computer. It is a technology that uses the internet and central remote servers to maintain data and applications. Resources like files, web apps, databases, workloads, web services and any other kind of application can be hosted in the cloud. Cloud hosting services can either be public, private or both at the same time. When combined, it is known as a hybrid. Cloud computing allows consumers and businesses to use softwares without installing such applications on their devices. Such consumers can access their personal files on any computer with internet access. This technology allows for much more efficient computing by centralizing storage, memory, processing and bandwidth.

Fig. 1: *Application of cloud computing technology*

2.0 HISTORY OF CLOUD COMPUTING

At the inception of computer technology, the Client-Server architecture was popular along with the mainframe and terminal application. At that time, storing data in a central processing unit (CPU) was very expensive because the mainframe connected both types of resources and directed them to a small client-terminal. With the revolution in the mass storage capacity, the file servers gained the popularity for storing vast amount of information.

In 1990, the giant connecting concept - internet, finally got enough computers attached to it and the connection of those machines together create a massive, interconnected shared pool of storage that won't be possible by a single organization or institution to afford. There comes the concept of "grid". The term 'grid' has a misinterpretation as a synonym for 'cloud computing' as the two technologies are formed from a lot of computers connected together. 'Grid Computing' requires the usage of application programs to divide one large system processing to several thousands of machines. But there lies the disadvantage; that if a single part of a software node may fail and stop the processing or working, other pieces of that software node may also fail to process. So, this 'grid-based' working concept didn't become so fruitful.

On the other hand, cloud computing involves the concept of 'grid', except that it provides on-demand resource functionality.

On the first milestone of cloud technology, a private company called Salesforce engraved its name in 1999. Salesforce pioneered the technique of delivering enterprise application via a simple website. The firm paved the way for both specialist and mainstream software firms to deliver applications over the internet.

"Cloud computing allows consumers and businesses to use applications... access their personal files at any computer with internet access."

The next development was in 2002 by Amazon's Web Service (AWS). They provided cloud-oriented services including storage, computing power and human intelligence via Amazon Mechanical Turk. Then in 2006, Amazon launched their EC2 (Elastic Compute Cloud) - a commercial web service that allows small organizations and sole proprietors to rent computers which they use to run their computer applications. EC2/S3 became the first accessible cloud technology infrastructure service.

In 2009, another significant milestone engraved the name of Google with Web 2.0. Google and others started to offer browser-based application via Google apps and other apps. Then came Microsoft's Azure - both Microsoft and Google deliver services in a way that is reliable and easy to consume.

3.0 CLOUD COMPUTING DEPLOYMENT MODELS

3.1 PRIVATE CLOUD MODEL

Private cloud is cloud infrastructure operated solely for a single organization, whether managed internally or by a third party and hosted either internally or externally.

3.2 PUBLIC CLOUD MODEL

A cloud is called a "public cloud" when the services are rendered over a network that is open for public use such as the internet. Public cloud services may be free. Technically, there may be little or no difference between public and private cloud architecture. However, security consideration may be substantially different for services (applications, storage, and other resources) that are made available by a service provider for a public audience. This also applies when communication is effected over a non-trusted network.

3.3 HYBRID CLOUD MODEL

A hybrid cloud is a combination of public cloud services and an on-premises private cloud, with orchestration and automation between the two. Companies can run mission-critical workloads or sensitive applications on the private cloud and use the public cloud to handle workload bursts or spikes in demand. The goal of a hybrid cloud is to create a unified, automated, scalable environment that takes advantage of all that a public cloud infrastructure can provide, while still maintaining control over mission-critical data.

3.4 COMMUNITY CLOUD MODEL

Community cloud shares infrastructure between several organizations from a specific community with common concerns (security, compliance, jurisdiction, etc.), whether managed internally or by a third-party, and either hosted internally or externally. The costs are spread over fewer users than a public cloud (but more than a private cloud). In this case, only some of the cost savings potential of cloud computing are realized.

3.5 DISTRIBUTED CLOUD

A cloud computing platform can be assembled from a distributed set of machines in different locations, connected to a single network or hub service.

3.6 MULTICLOUD

Multicloud is the use of multiple cloud computing services in a single heterogeneous architecture to reduce reliance on single vendors, increase flexibility through choice and mitigate against disasters.

3.7 POLY CLOUD

Poly cloud refers to the use of multiple public clouds for the purpose of leveraging specific services that each provider offers. It differs from multicloud in that it is not designed to increase flexibility or mitigate against failures but is rather used to allow an organisation to achieve more than what could be achieved with a single provider.

3.8 HPC CLOUD

HPC cloud refers to the use of cloud computing services and infrastructure to execute high-performance computing (HPC) applications. These applications consume considerable amount of computing power and memory and are traditionally executed on clusters of computers.

4.0 CLOUD COMPUTING SERVICE MODELS

4.1 INFRASTRUCTURE AS A SERVICE (IAAS)

This is the most basic category of a cloud computing service. IaaS involves renting IT infrastructure—servers and virtual machines (VMs), storage, networks, operating systems from a cloud provider on a pay-as-you-go basis.

4.2 PLATFORM AS A SERVICE (PAAS)

PaaS is a platform for programming developers. It is the computer platform that provides the facility to use web applications quickly and with ease, without buying and maintaining web-development services.

4.3 SOFTWARE AS A SERVICE (SAAS)

Software as a service is a method for delivering software applications over the internet, on demand and typically on a subscription basis. With SaaS, cloud providers host and manage the software application and underlying infrastructure and handle any maintenance, like software upgrades and security patching. Users connect to the application over the internet, usually with a web browser on their phone, tablet or personal computer.

4.4 SERVERLESS COMPUTING

Overlapping with PaaS, serverless computing focuses on building app functionality without spending time continually managing the servers and infrastructure. The cloud provider handles the setup, capacity planning and server management for the client. Serverless architectures are highly scalable and event-driven, only using resources when a specific function or trigger occurs.

5.0 BENEFITS OF CLOUD COMPUTING

Clients would be able to access their applications and data from anywhere at any time. They could access the cloud computing system using any computer linked to the internet. Data are not confined to a hard drive on one user's computer or even a corporation's internal network.

It brings hardware costs down. Cloud computing systems reduce the need for advanced hardware on the client's side. Clients need not buy the fastest computer with large memory, because the cloud system would take care of those needs. Instead, client may buy an inexpensive computer terminal. The terminal may include a monitor, input devices like a keyboard and mouse and just enough processing power to run the middleware necessary to connect to the cloud system. Such clients do not need a large hard drive because they would store all your information on a remote computer.

Corporations that rely on computers have to make sure they have the right software in place to achieve their goals. Cloud computing systems give these organizations company-wide access to computer applications. The companies do not have to buy a set of software or software licenses for every employee. Instead, the company can pay a metered fee to a cloud computing company.

Servers and digital storage devices take up space. Some companies rent physical space to store servers and databases because they do not have it available on site. Cloud computing gives these companies the option of storing data on someone else's hardware, removing the need for physical space on the front end. Corporations may save

"It brings hardware costs down. Cloud computing systems reduce the need for advanced hardware on the client's side. Clients need not buy the fastest computer with large memory, because the cloud system would take care of those needs."

money on IT support. Streamlined hardware would, in theory, have fewer problems than a network of heterogeneous machines and operating systems. If the cloud computing system's back end is a grid computing system, then the client may take advantage of the entire network's processing power. Often, scientists and researchers work with calculations so complex that it would take years for individual computers to complete them. On a grid computing system, the client could send the calculation to the cloud for processing. The cloud system would tap into the processing power of all available computers on the back end, significantly speeding up the calculation.

6.0 PRACTICAL APPLICATIONS OF CLOUD COMPUTING

The applications of cloud computing are practically limitless. With the right middleware, a cloud computing system can execute all the programs a normal computer could run. Potentially, everything from generic word processing software to customized computer programs designed for a specific company can work on a cloud computing system.

"...everything from generic word processing software to customized computer programs... work on a cloud computing system."

6.1 CREATING CLOUD-NATIVE APPLICATIONS

Cloud services can be used to quickly build, deploy and scale-up applications—web, mobile and Application Programming Interface (API). Developers can take advantage of cloud-native technologies and approaches, such as containers, kubernetes, microservices architecture, API-driven communication and Development Operations (DevOps).

6.2 STORAGE, BACK UP AND RECOVERY OF DATA

Clients can protect data more cost-efficiently and at massive scale by transferring data over the internet to an offsite cloud storage system that is accessible from any location and any suitable device.

6.3 STREAMING AUDIO AND VIDEO

Clients can connect with their audience anywhere, anytime, on any suitable device with high-definition video and audio with global distribution.

6.4 DELIVERING SOFTWARE ON DEMAND

This is also referred to as software as a service (SaaS), on-demand software. It lets the provider offer the latest software versions and updates to customers anytime they need, anywhere they are.

6.5 TESTING AND BUILDING APPLICATIONS

This practice reduces application development cost and time by using cloud infrastructures that can easily be scaled up or down.

6.6 ANALYSING DATA

Clients can unify their data across teams, divisions and locations in the cloud and then use cloud services, such as machine learning and artificial intelligence, to uncover insights for more informed decisions.

6.7 EMBED INTELLIGENCE

Cloud computing technologies use intelligent models to help engage customers and provide valuable insights from the data captured.

6.8 E-COMMERCE APPLICATIONS

Many organizations bound by complex regulatory obligations and governance standards are still hesitant to place data or workloads in the public cloud for fear of outages, loss or theft. However, this resistance is fading, as the addition of data encryption and various identity and access management tools have improved security within the public cloud.

6.9 PRODUCTIVITY TOOLS HOSTING

Office tools like Microsoft Office 365 and Google Docs use cloud computing, which allow customers to use their most-productive tools over the internet. Users can work on their documents, presentations and spreadsheets - from anywhere, at any time. With data stored in the cloud, clients do not need to bother about data loss in case their device is stolen, lost or damaged. Cloud also helps in sharing of documents and enables different individuals to work on the same document at the same time.

Fig. 2: *A typical business management application interface*

6.10 BUSINESS PROCESS OPTIMIZATION

Many business management applications like Customer Relationship Management (CRM) and Enterprise Resource Planning (ERP) are also based on a cloud service provider. Software as a Service (SaaS) has become a popular method for deploying enterprise level software. Salesforce, Hubspot, Marketo etc. are popular examples of this model. This method is cost-effective and efficient for both the service provider and customers. It ensures hassle free management, maintenance and security of the organization's critical business resources and allows access to these applications conveniently via a web browser.
(See fig. 2).

6.11 COMMUNICATION

The cloud allows users to enjoy network-based access to communication tools like emails and calendars. Most of the messaging and calling apps like Skype and WhatsApp are also based on cloud infrastructure. All messages and pieces of information are stored on the service provider's hardware rather than on the user's personal device. This allows the user to access his/her information from anywhere via the internet.

6.12 TEST AND DEVELOPMENT ENVIRONMENT PROVISION

The cloud can provide an environment to cut expenses and launch apps in the market faster. Rather than setting up physical environments, developers can use the cloud to set up Apps and conduct tests. This saves the technical team from securing budgets and spending critical project time and resources. These dev-test environments can also be scaled up or down based on requirements. LoadStorm and BlazeMeter are popular testing tools.

6.13 SOCIAL NETWORKING

Social Media is the most popular and often overlooked application of cloud computing. Facebook, LinkedIn, MySpace, Twitter, and many other social networking sites use cloud computing. Social networking sites are designed to find people you already know or would like to know. In the course of finding people, we end up sharing a lot of personal information. In addition, in the course of sharing information on social media, personal information is not only shared with friends but also with the makers of the platform. This means that the platform will require a powerful hosting solution to manage and store data in real-time making use of the cloud critical.

7.0 CLOUD COMPUTING SECURITY

Security remains a primary concern for businesses contemplating cloud adoption especially public cloud adoption. Public cloud service providers share their underlying hardware infrastructure between numerous customers, as public cloud is a multi-tenant environment. This environment demands copious isolation between logical computer resources. At the same time, access to public cloud storage and computer resources is guarded by account login credentials. Many organizations bound by complex regulatory obligations and governance standards are still hesitant to place data or workloads in the public cloud for fear of outages, loss or theft. However, this resistance is fading, as logical isolation has proven reliable, and the addition of data encryption and various identity and access management tools have improved security within the public cloud.

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A DISCOURSE ON COMPUTER SYSTEMS NETWORKING

BY ENGR. DR. SUNNY ORIKE

Engr. Dr. Sunny Orike, *BSc, MSc*
(Ag. HOD, Dept. of Computer Engineering, Rivers State University Port Harcourt).

ABSTRACT

This article presents a concise discourse on computer systems networking. First, effective communication is traced from the earliest ancient modes to modern means through the use of computers. A description of a computer network is presented including the architectural and functional types, physical and logical connections called topologies. The various network protocols, models and addressing mechanisms, and transmission media (both guided and unguided) are discussed.

1.0 INTRODUCTION

Computer networking is an engineering discipline that involves the study and analysis of the communication process among various computing devices or computer systems that are linked together to exchange information and share resources. It is the interconnection of multiple devices, generally termed as 'Hosts' connected using multiple paths for the purpose of sending/receiving data or media. Effective communication has been a major challenge throughout history (Abbate, 2009). Modes of communication previously comprised the use of drumbeats, fire and smoke signals and later some form of writing.

Modern telecommunication began with the discovery that electricity can be used to transmit a signal. Along with this discovery came the telegraph, telephone, radio, television, facsimile, and finally the computer (Leiner et al. 1997). Today, almost everybody is connected. People with ideas can communicate instantly with others to make those ideas a reality. New events and discoveries are known worldwide in seconds. Almost everyone has a chance to connect, to share and to make a difference. The human network has changed the way people live, learn, work and play, so also have computer networks.

2.0 COMPUTER SYSTEM NETWORK

2.1 COMPUTER NETWORK

A computer network is a group of computers and other devices connected together for the purpose of sharing resources (Stallings, 2003). It provides three main advantages over stand-alone systems. These advantages include:

1. Sharing of expensive resources such as printer, disk drives, fax, modems, scanners, etc
2. Providing a very convenient means for information exchange among computers
3. Creating new avenues for limited parallel processing.

The following networks exist, depending on the distance between connecting stand-alone computers:

1. Local Area Network (LAN): A small network constrained to a small geographic area (See Fig. 1).
2. Metropolitan Area Network (MAN): A network that connects several LANs with a city (See Fig. 2).

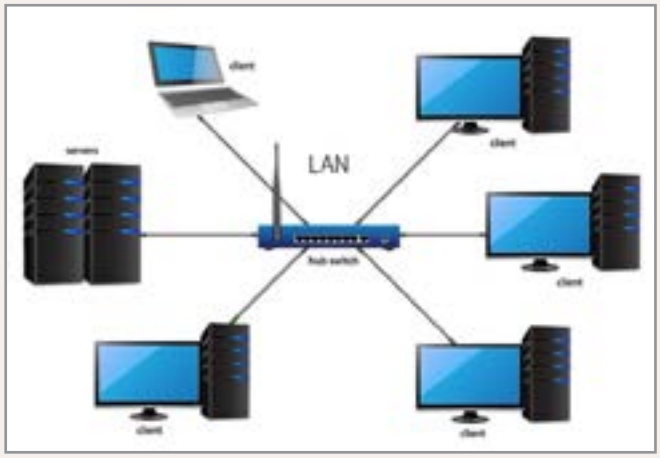

Fig. 1: *Local Area Network (Source: Gomintekno.com)*

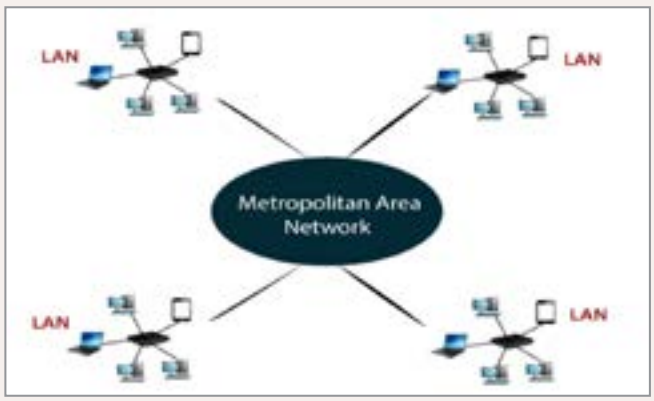

Fig. 2: *Metropolitan Area Network (Source: Javatpoint.com)*

3. Wide Area Network (WAN): A larger network that covers a large geographical area (See Fig. 3).

There are three roles for computers in a network as described below:

1. As clients: They use network, but do not provide network resources.
2. As peers: They use network and provide network resources.
3. As servers: They provide network resources.

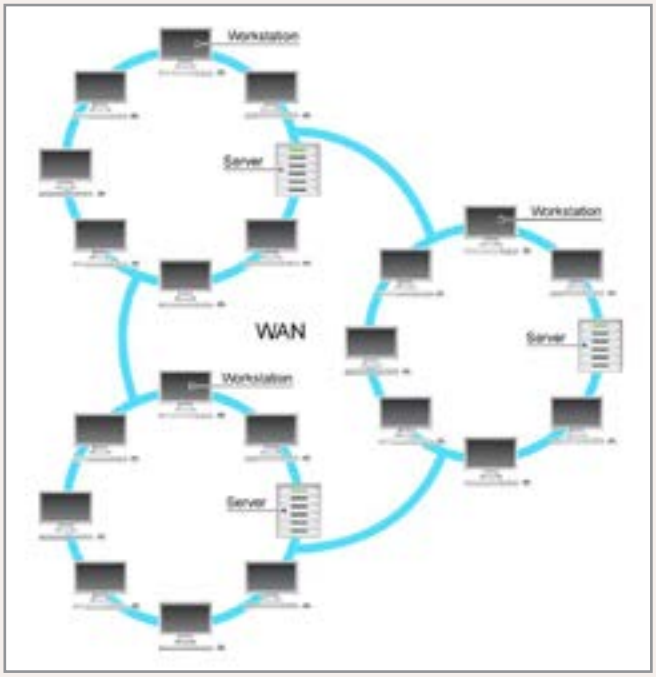

Fig. 3: *Wide Area Network (Source: Router-switch.com)*

Based on these roles, computer networks are divided into the following three types:

1. Server based (also known as client-server): This comprises individual clients and servers that support them.
2. Peer (also called peer-to-peer): This has no servers but use the network to share resources among independent peer machines.
3. Hybrid network: This is a client server network that also has peers sharing resources. Most networks are actually of hybrid types.

2.2 DISTRIBUTED SYSTEM

In the past, most computer applications executed on "stand-alone" system, but today, applications are designed to communicate with hundreds of millions of computers in a "distributed" way. A distributed system is a collection of independent computers that appear to its users as a single coherent system. The processing power is "distributed" among the computers in the network. They use multiple central processors to serve multiple real time application and multiple users. Examples of distributed systems are: internet, intranet and extranet.

Internet is the global system of interconnected computer networks that enables a communication between networks and devices. It is a network of networks that consists of private, public, academic, business, and government networks of local to global scope, linked by a broad array of electronic, wireless, and optical networking technologies. Internet mixes computing and communications technologies. It makes our work easier and information instantly and conveniently accessible worldwide. Internet and the web are not synonymous. While internet is a global collection of networked computers communicating via a common set of protocols, the web is a way of utilizing the infrastructures of the internet.

Intranet is a computer network for sharing information, collaboration tools, operational systems, and other computing services within an organization, usually to the exclusion of access by outsiders. Extranet is a controlled private network that allows access to partners, vendors and suppliers or an authorized set of customers – normally to a subset of the information accessible from an organization's intranet. An extranet provides access to needed services for authorized parties, without granting access to an organization's entire network.

3.0 NETWORK TOPOLOGIES

Topology in computer networks refers to the way in which computers, printers and other components/ devices are connected physically or logically. They are chosen according to: their functions, kind of location, types of physical barriers and types of networking to be done (Enoch et al., 2019). Four most common topologies are: bus, ring, star and mesh.

3.1 BUS TOPOLOGY

This topology is often used when a computer network installation is small, simple or temporary. The cable is just one or more wires connecting the computers This makes the bus a passive topology. When one computer sends a signal, all the computers on the network receive it, but only one with the address that matches the one encoded in the message accepts it, while the rest disregard the message. Only one computer at a time can send a message (See fig. 4).

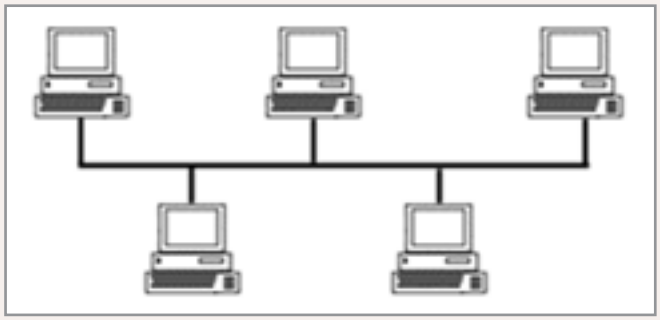

Fig. 4: *Bus topology (Source: Computer Hope.com)*

3.2 STAR TOPOLOGY

The star network features a central connection point called "hub" which may be a switch or router (See fig. 5). Devices typically connect to the hub with cables. Compared to the bus topology, a star network generally requires more cable, but a failure in any star network will only take down one computer network access. On the other hand, if the network hub fails, the entire network fails.

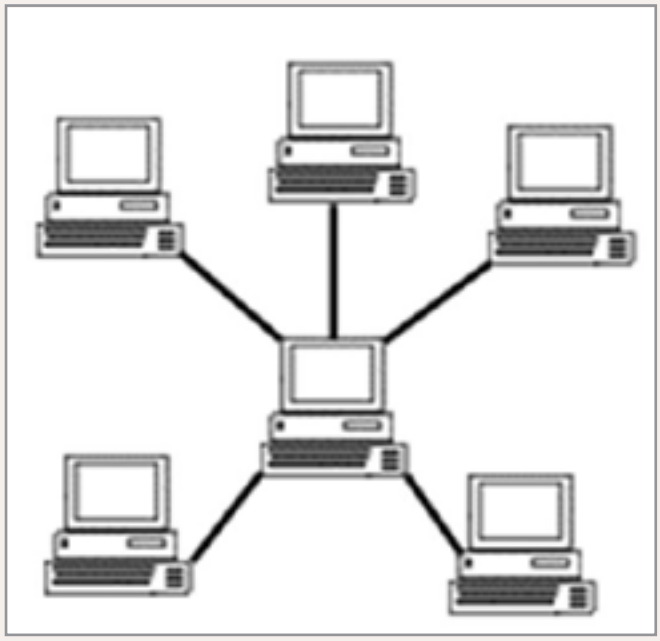

Fig. 5: *Star topology (Source: Computer Hope.com)*

3.3 RING TOPOLOGY

In a ring network, every device has exactly two neighbours for communication purposes (See fig. 6). All messages travel through a ring in the same direction, either clockwise or anticlockwise. A failure in any cable or device breaks the loop and can take down the entire network.

3.4 MESH TOPOLOGY

A true mesh configuration has a link between each device in the network. In other words, each computer is connected via a cable to every other computer on the network (See fig. 7). This may be convenient for small networks, but becomes awkward and expensive as the network grows more than a few nodes. Mesh topology involves the concept of routes. Unlike each of the previous topologies, messages sent on a mesh network can take any of several possible paths from source to destination. Some WANs, especially the internet, employ mesh routing.

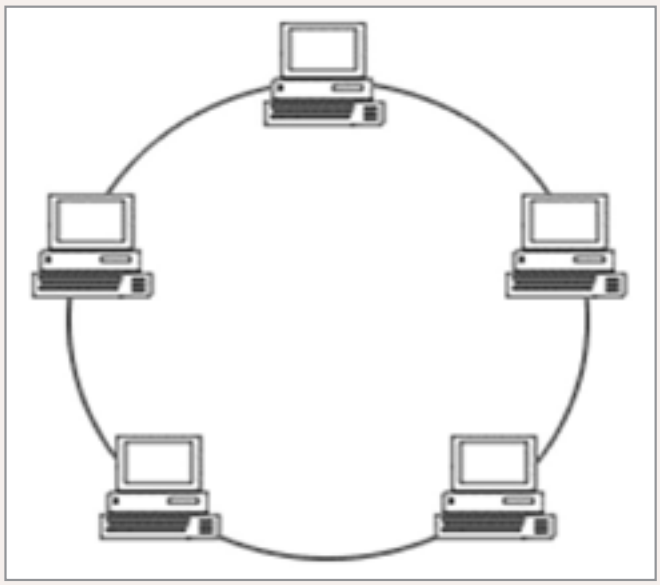

Fig. 6: *Ring topology (Source: Computer Hope.com)*

4.0 NETWORK PROTOCOLS, MODELS AND ADDRESSING

4.1 PROTOCOLS

All communication (both human and computer), is governed by pre-established rules, called protocols. These protocols are determined by the characteristics of the source, channel and destination. Based on the source, channel and destination, the protocols define the details for the issues of message format, message size, timing, encapsulation, encoding and standard message pattern. If everyone in the same

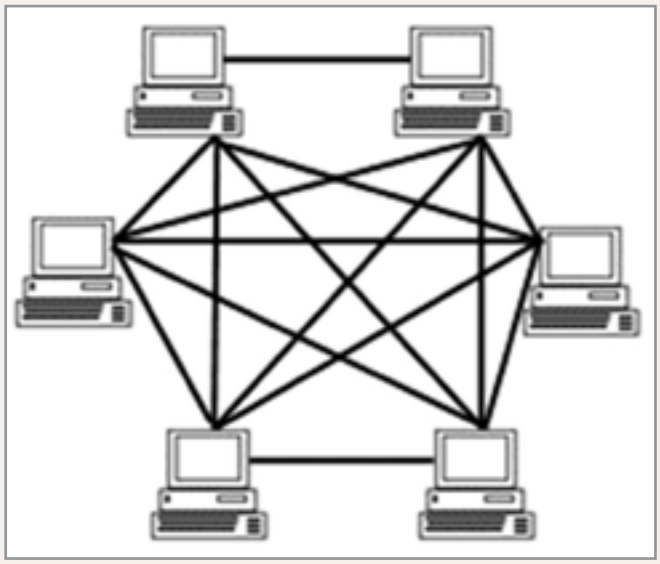

Fig. 7: *Mesh topology (Source: Computer Hope.com)*

room spoke different languages, they would not be able to communicate. Likewise, if devices in a computer network did not use the same protocols they would not be able to communicate. The most common set of protocols used on local wired networks is Ethernet. For a detailed comparison of computer networks and their associated protocols, it is instructive to refer to the paper by Orike and Alalibo entitled "Comparative Analysis of Computer Network Protocols in Wireless Communication Technology" (Orike & Alalibo, 2019).

4.2 TRANSMISSION CONTROL PROTOCOL/INTERNET PROTOCOL (TCP/IP) MODEL

The first layered reference model for inter network communications was created in the early 1970s and is referred to as the internet model (Davies & Bressan, 2010). It defines categories of functions that must occur for communications to be successful. The architecture of the TCP/IP protocols follows the structure of this model. Thus, the internet model is commonly referred to as the TCP/IP model. When sending messages on a network, the protocol stack on a host operates from top to bottom. In the web server for example, a browser on the client requests a web page from a web server on destination port 80. This starts the process of sending the web page to the client. As the web page is sent down the web server protocol stack, the application data is broken into TCP segments. Each TCP segment is given a header containing a source and destination port.

4.3 OPEN SYSTEMS INTERCONNECT (OSI) MODEL

The OSI model was developed by the International Organization for Standardization in 1984 (Russell, 2013). Unlike the TCP/IP model, it does not specify the interaction of any specific protocols. It was created as architecture for developers to follow in designing protocols for network communications. Although very few protocol stacks exactly implement the seven layers of the OSI model, it is now considered the primary reference model for inter-computer communications. The OSI model includes all functions, or tasks, associated with inter-network communications, not just those related to the TCP/IP protocols. Compared to the TCP/IP model, which only has four layers, the OSI model organizes the tasks into seven more specific groups. Each layer covers different network activities, equipment or protocols. The layers starting from the top are: Application layer, Presentation layer, Session layer, Transport layer, Network layer, Data-link layer and Physical layer (Davies & Bressan, 2010; Russell, 2013).

The Application layer marks the spot where users actually communicate to the computer. This layer only comes into play when it is apparent that access to the network is going to be needed soon. The Presentation layer gets its name from its purpose: it presents data to the Application layer and is responsible for data translation and code formatting. This layer is essentially a translator and provides coding and conversion functions. By providing translation services, the Presentation layer ensures that data transferred from the Application layer of one system can be read by the Application layer of another system. The Session layer is responsible for setting up, managing, and then tearing down sessions between Presentation layer entities.

The Transport layer segments and reassembles data into a data stream. It provides end-to-end data transport services and can establish a logical connection between the sending host and destination host on an inter-network with TCP/IP protocols. The Network layer manages device addressing, tracks the location of devices on the network, and determines the best way to move data, which means that the Network layer must transport traffic between devices that are not locally attached.

The Data Link layer provides the physical transmission of the data and handles error notification, network topology, and flow control. The Data Link layer will ensure that messages are delivered to the proper device on a LAN using hardware addresses and translates messages from the Network layer into bits for the Physical layer to transmit. The Physical layer does two things: it sends bits of data and receives bits of data. The Physical layer communicates directly with the various types of actual communication media (Davies & Bressan, 2010).

4.4 NETWORK ADDRESSING

All communication requires a way to identify the source and destination. These are represented by names in human communication. When a name is called, the person with that name listens to the

message and responds. Other people in the area may hear the message, but they ignore it because it is not addressed to them. On computer networks, a similar method exists for identifying source and destination hosts. Each host connected to a computer network is assigned a physical and logical address which serves to identify the host on the network (Enoch et al., 2019).

4.4.1 Physical Address

Every ethernet network interface has a physical address assigned to it when it is manufactured. This address is known as the Media Access Control (MAC) address (Janson, 2013). The MAC address identifies each source and destination host on the network. Ethernet networks are cable based, meaning that a copper or fiber optic cable connects hosts and networking devices. This is the channel used for communications between the hosts. When a host on an ethernet network communicates, it sends frames containing its own MAC address as the source and the MAC address of the intended recipient. Any host that receives the frame will decode the frame and read the destination MAC address. If the destination MAC address matches the address configured on the network interface card (NIC), it will process the message and store it for the host application to use. If the destination MAC address does not match the host MAC address, the NIC will ignore the message.

4.4.2 Logical Address

A host needs an IP address to participate on the internet. The IP address is a logical network address that identifies a particular host (Stevens,1994; Comer, 1995). It is always configured and unique in order to communicate with other devices on the internet. An IP address is assigned to the network interface connection for a host. This connection is usually a network interface card installed in the device. Examples of end-user devices with network interfaces include workstations, servers, network printers and IP phones. Some servers can have more than one NIC and each of these has its own IP address. Router interfaces that provide connections to an IP network will also have an IP address. Every packet sent across the internet has a source and destination IP address. This information is required by networking devices to ensure the information gets to the destination and replies are returned to the source.

4.4.3 IP Address Structure

An IP address is simply a series of 32-bit number (Janson, 2013). It is very difficult for humans to read a binary IP address. For this reason, the 32 bits are grouped into four 8-bit numbers called octets. An IP address in this format is hard for humans to read, write and remember. To make the IP address easier to understand, each octet is presented as its decimal value, separated by a decimal point or period. This is referred to as dotted-decimal notation. When a host is configured with an IP address, it is entered as a dotted decimal number such as 192.168.1.5. To enter the following 32-bit number: 11000000101000000000100000101, if just one bit was mistyped, the address would be different and the host may not be able to communicate on the network.

5.0 NETWORK TRANSMISSION MEDIA

A network transmission medium is defined as the means used to carry signals from one location to another. In order for communication to occur, a source, destination, and some sort of channel must be present. A medium (or channel) provides a path over which the information is sent. The connection between the source and destination may either be direct or indirect, and may span multiple media types (Yeung, 2008). It is characterized by:

- Its physical properties
- The signaling method
- Bandwidth
- Sensitivity to outside interference (noise)

There are two types of transmission media, namely guided and unguided media. Guided media confine the signals physically to a cable. Unguided media broadcast signals openly into space using electromagnetic propagation such as radio, microwave and satellite channels (Agrawal, 2010).

5.1 GUIDED MEDIA

Many different types of cables exist to interconnect the various devices in a LAN. There are three kinds of physical cables, namely: twisted pair cables, coaxial cables and fiber optic cables (Agrawal, 2010).

5.1.1 Twisted Pair Cable (TP)

Modern ethernet technology generally uses a type of copper cable known as twisted pair (TP) to interconnect devices (See fig. 8). This is because ethernet is the foundation for most LANs and TP is

the most commonly encountered type of network cabling (Liu et al., 2009). TP cables consist of one or more pairs of insulated copper wires that are twisted together and housed in a protective jacket. Like all copper cables, twisted pair uses pulses of electricity to transmit data. In twisted pair cabling, the number of twists per unit length affects the amount of resistance that the cable has to interference.

There are three types of twisted pair cables:
a) Unshielded twisted pair (UTP)
b) Shielded twisted pair (STP)
c) Screened twisted pair (ScTP)
UTP is the most commonly encountered type of network cable in the US. STP and ScTP cables are used almost exclusively in European countries (Liu et al., 2009). Unlike STP and ScTP, UTP cable is cost-effective and offers a high bandwidth. It is also easy to install. This type of cable is used to connect workstations, hosts and network devices.

5.1.2 Coaxial Cable

Coaxial cable is usually constructed of either copper or aluminum, and used for connecting the various components which make up satellite communication systems. It provides improved shielding compared to UTP, so has a lower signal-to-noise ratio and can therefore carry more data (Agrawal, 2010). Although coaxial cable has improved data carrying characteristics, TP cabling has replaced coaxial in local area networking uses. This is because coaxial cable is physically harder to install, more expensive, and harder to troubleshoot (Agrawal, 2010; Liu et al., 2009). Fig. 9 shows a typical coaxial cable.

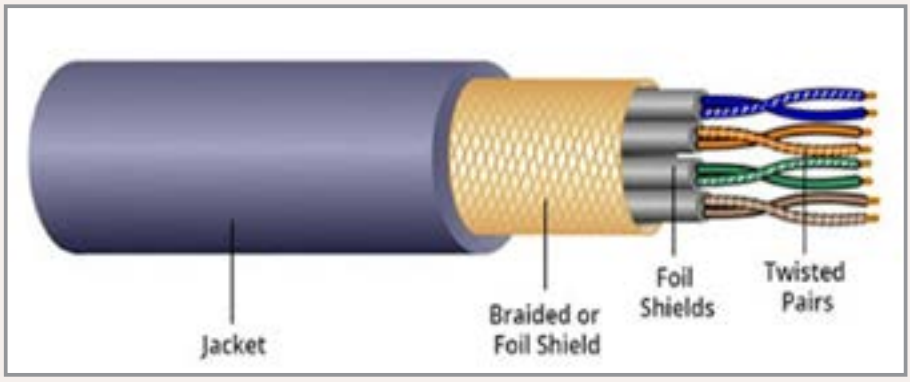

Fig. 8: *Twisted pair cable (Source: Fiber Transceiver Module.com)*

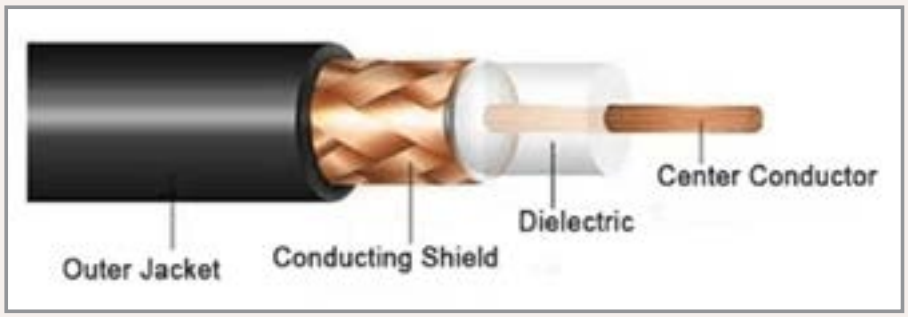

Fig. 9: *Coaxial cable (Source: Everything RF.com)*

5.1.3 Fiber Optics Cable

Fiber optic cables are made of glass or plastic. They have a very high bandwidth, which enables them to carry very large amounts of data (Hecht, 2002). Fiber is used in backbone networks, large enterprise environments and large data centers. Unlike TP and coaxial cables, fiber optic cables transmit data using pulses of light. Fiber optic cables support a large amount of bandwidth making them ideally suited for high-speed data backbones. Fiber optic backbones are found in many corporations and are also used to connect internet service providers (ISPs) on the internet. Each fiber optic circuit consists of two fiber cables. One is used to transmit data while the other is used to receive data. Fig. 10 shows a typical fibre optics cable.

5.2 UNGUIDED MEDIA

Unguided media (or wireless communication) transport electromagnetic waves without the use of a physical conductor (Agrawal, 2010). That is, data signals are not bound to a cabling media. Signals are broadcast through air and thus are available to anyone who has a device capable of receiving them. The transmission and reception are achieved using

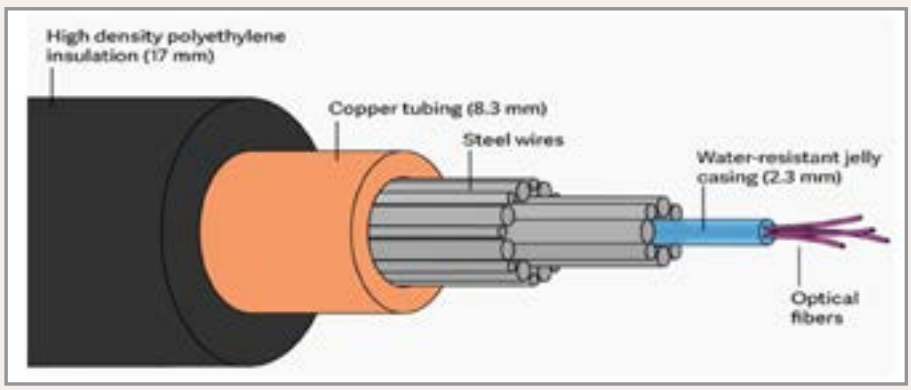

Fig. 10: *Fiber optics cable (Source: Fiber Transceiver Module.com)*

"Life is all about networking, be it for humans or computers. No one can make it as an 'island', hence most computer applications are no longer executed on 'stand-alone' systems."

an antenna. Transmitter sends out the electromagnetic signal into the medium. Receiver picks up the signal from the surrounding medium. Unguided media are divided into three groups, namely radio waves, microwave, and infrared waves.

5.2.1 Radio Waves

Radio wave transmission utilizes five different types of propagation: surface (or ground), tropospheric, ionospheric, line-of-sight, and space. Radio technology considers the earth as surrounded by two layers of atmosphere: the troposphere and the ionosphere. The troposphere is the portion of the atmosphere extending outward 30 miles from the earth's surface. Clouds, wind, temperature variation, and weather in general occur in the troposphere. The ionosphere is the layer of atmosphere above the troposphere but below space.

5.2.2 Microwave

Microwaves have frequencies between 1 and 300 GHz. They do not follow the curvature of the earth and therefore require line-of-sight transmission and reception equipment. The distance coverable by a line-of-sight signal depends to a large extent on the height of antennas. The taller the antennas, the longer the sight distance. A system of repeaters can be installed with each antenna in order to increase the distance.

5.2.3 Infrared

Infrared signals, with frequencies from 300 GHz to 400 GHz are used for short-range communications.

6.0 CONCLUSION

Life is all about networking, be it for humans or computers. No one can make it as an "island", hence most computer applications are no longer executed on "stand-alone" systems. Today, technology at its peak has enhanced communication to a level undreamed of. Information can be conveyed across vast distances within seconds with the introduction of Internet and the World Wide Web. These were made possible through computer networks. Also in this information age, data is the building block on which every organization is built to operate. It takes varied forms and is later manipulated and reorganized to produce information. In a manual system, such data is written within books and registers with all the intricacies involved. But now computers can be used for storing, retrieving and manipulating it in different combinations to obtain the required information very easily through the concept of a database system facilitated by computer networks.

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AUTHENTICATION TECHNOLOGY AND ITS APPLICATIONS

BY MR. SEGUN TONY AKANDE

1.0 INTRODUCTION

With rapid increase in digital impersonation all over the world, virtually all industries take interest in authentication technology. More research is being carried out to ensure the right users or components always have access to the right resources at the right time. This access could be to hardware and/or software resources. Authentication is a process of identifying a user (system or person) in order to authorize the use of a set of resources. According to experts, different sets of technologies or methods are being implemented for authentication which include Static Password or PIN, Dynamic Password or PIN, Biometric Authentication and Time Synchronization Based Authentication (Yu et al, 2018).

Mr. Segun Akande, *MSc, MBCS (Chief Executive Officer, Xown Solutions Limited).*

A lot of organizations, especially financial institutions would rather use a combination of two or more of the authentication technologies to strengthen the security of their system. Majority of banks both within and outside Nigeria have to implement two or three authentication technologies before the user can perform financial transaction on their IT based banking platform such as internet banking, mobile banking, USSD banking and so on.

2.0 BASIC REASONS FOR AUTHENTICATION

Authentication is usually done to effect one or more of the following:

- Access Right – This is to ensure that the end user has right of access to the online resource or system.
- Access Control – The act of granting access to only selected resources among numerous resources.
- Identification– Identifying the personality or user.
- Authorization – Determining the privilege associated with the authenticated identity.
- Privacy – Protecting the private information of users against un-authorized disclosure of same. With General Data Protection Regulations (GDPR), not only do organizations have to ensure that personal data is gathered legally and under strict conditions, but those who collect and manage it are obliged to protect it.

3.0 EFFECTS OF AUTHENTICATION TECHNOLOGY

Arguably, improvement in technology can be both the cause of fraud and the solution to fraud. While many organizations are counting on technology such as authentication technology to prevent frauds, technology could also increase the risk (https://www.ukessays.com). However, this article will focus on the benefits of Authentication Technology for fraud prevention and other forms of digital impersonation.

Neither one or a combination of more authentication technologies seem to be enough to prevent fraudulent activities in today's digital world and some other security measures must be put in place. Such security measures include digital certificates, fraud prevention software and so on. They can be used to strengthen the security of systems or solutions in Internet Banking, Mobile Banking, e-Commerce, Online Betting and so on.

4.0 IDENTITY IN A DIGITAL WORLD

The digital world is a huge virtual environment that represents an element as rich as the physical world itself (Uzun, 2014). Access to any system anywhere all over the world is just at a click with the right authentication credentials. The aim of an authentication system is to ensure that an entity that is trying to access protected online or internet-based resources is genuine. Fraudulent access to such resources can be through manipulated authentication credentials as a result of weakness in the authentication system or identity theft where the victim's authentication credential has been

released through other means such as malware (Adesuyi, 2013; Fenton et al., 2017; FFIEC, 2011).

5.0 EVOLUTIONS OF AUTHENTICATION TECHNOLOGIES OR METHODOLOGIES

5.1 STATIC PASSWORD

The earliest form or method of authentication is the static password. Authentication technology has evolved, still with so much reference and usage of static password authentication methods (Gibbs, 2009)(Yu et al., 2018). Indeed, the use of a static password is still very common today, although in many cases with other methods of authentication and/or more complex algorithm that ensures its complexity to make it stronger. This complex algorithm makes it almost impossible for a third party to rightly predict the password. Most of the time, the password is stored in a database that can be visible to or accessible by an in-house person within a system or organization. This is further protected with the use of an encryption methodology to minimize risk in a case of database breach(Ali et al., 2018; CH, 2017; Fenton et al., 2017; Gibbs, 2009; Yu et al., 2018).

5.2 TWO-FACTOR AUTHENTICATION (2FA)

Another form of authentication is the token also known as one-time password (OTP). This is introduced to the user in the form of hardware token and software token (Zahid & Khan, 2010). We can see this in GT Bank and FCMB in Nigeria. GT Bank and majority of commercial banks in Nigeria and across the globe implement hardware tokens to generate a one-time password for each end user to perform financial transactions on internet banking, mobile banking and so on. FCMB and a few other banks in Nigeria have implemented software tokens to be installed on a customer's/ end user's mobile device so that it can be used to generate a one-time password for the financial transaction (See Figs. 1 & 2).

Two-Factor Authentication (2FA) is an extra layer of protection to ensure the security of the system or resources beyond username and password and it is set to expire after 30 seconds or so. Some parameters about each end user relate to this OTP which is generated and matched with the server. No one must be able to guess the next OTP in the sequence. This necessitates a strong and complex OTP algorithm. The description above explains the connection between the server and the factors which change the OTP within a short time and make it unique to each mobile phone used by the end user.

Fig. 1: *FCMB software token. A mobile APP that generates a one-time password for two factor authentications*

Fig. 2: *GT Bank hardware token*

OTP algorithms are designed in such a way that the password generated at the server is received by the client without third-party involvement. This can be SMS based where such OTP is requested over the phone and is also delivered

via SMS (Pawar et al., 2013). The main challenge is that delayed delivery can render the OTP void once the time limit has expired.

5.3 MULTI-FACTOR AUTHENTICATION

A common Multi-factor Authentication is the Three-Factor Authentication (3FA). It involves the use of a Smart Card, PIN and Smart Card Reader to generate an OTP that can be used to carry out financial transactions. Biometrics is another form of 3FA. This is a technology that analyzes human characteristics for automated personal authentication. In this scheme, behavioral characteristics (i.e. voice signature, gait of a human) as well as physiological characteristics (i.e. fingerprint, hand, iris, retina, face) describing human characteristics are used for authentication (Zahid & Khan, 2010).

Fig. 3: *Fingerprint*

Fig. 4: *Iris recognition*

6.0 COMPARISON OF AUTHENTICATION TECHNOLOGIES

The comparison would be evaluated (as seen in Table 1) from three broad parameters namely:

- Usability: This has to do with the authentication being hassle free.
- Security: Complex enough for the malicious actors to trick the authentication.
- Deployability: Is it easy to

Recommendation: Based on this table, flexible authentication for an Enterprise System or a Network is recommended.

AUTHENTICATION TECHNOLOGIES	USABILITY	SECURITY	DEPLOYABILITY
UserID/Password	End-users may easily forget the password.	It has well known issues in security.	Found everywhere and highly deployable. However, most security experts want it to be discontinued as soon as possible.
2FA OR TOKEN BASED AUTHENTICATION			
Hardware Token		Quite secure	Deployable with additional cost of the hard token for all end users.
Software Token	Majority of end users have smartphones making it easy to download and install.	Quite secure	End-users usually face difficulty setting it up on their mobile device as it requires an authenticator app.
SMS-Based OTP	Usable as all end users have mobile phones that can receive SMS but delayed delivery is a major drawback.	Not so secure as it is prone to SIM Swap attack.	Can easily be deployed as nothing is required to be done at an end-user's device but network issues can cause delayed delivery.
3FA OR BIOMETRIC AUTHENTICATION			
Fingerprint Recognition	All smartphones have a decent fingerprint scanner.	Generally Secure	Generally secure and more deployable than face recognition. More are deployed every year.
Face Recognition	Not available with all devices.	Inconsistent Security	Depend more on hardware devices.

Table 1: *Comparison of different authentication methods along usability, security and deployability*

deploy for users across all platforms? Determine whether the use case is for customers or employee.

Barclays Bank, UK is a typical example. The bank implemented a flexible and multiple factor authentication in such a way that users can decide to use a combination of two or three among various authentication technologies provided by the bank at any given time. With this, when an attempted access to the digital banking system is initiated and the attempt is adjudged suspicious, an additional authentication prompt would be activated to authenticate the end user further. With this, fraud or identity theft is minimized.

"...when an attempted access to the digital banking system is initiated and the attempt is adjudged suspicious, an additional authentication prompt would be activated to authenticate the end user further. With this, fraud or identity theft is minimized."

7.0 CONCLUSION

Authentication has come to stay as a means of ensuring that only genuine transactions are carried out in our digital world.

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SPECIALIZED CERTIFICATIONS IN ICT AND THEIR ADVANTAGES

BY ENGR. MISSION FRANKLIN

1.0 INTRODUCTION

The Information and Communications Technology (ICT) industry is at a speedy growth in the 21st century and has turned out many technology products in the form of devices, equipment, software and services. It cuts across all sectors of the economy globally. Through this veritable industrial sector, many products that support and improve businesses are provided to innovate businesses in all aspects of life. These include manufacturing, agriculture, healthcare services, education, oil and gas, marine services, engineering, logistics, consumer supplies and many more.

Engr. Mission Franklin, *B. Tech,MBA,MSc (Lecturer, Rivers State University, Port–Harcourt, Founder of Intelligence Technologies)*

Technology companies provide the needed technology tools that innovate business processes and meet consumer needs. These products also require qualified, updated and skilled professionals in the ICT industry, to provide the needed services from equipment installation, software installation and networking of devices, configuration of data testing and support for the infrastructure throughout the life cycle of the equipment, software and eventually the entire infrastructure.

2.0 THE PROFESSIONAL SKILL GAP

There exists the challenge of identifying professionals who are qualified to provide services for the businesses that invest in technology tools. They are transiting from employing unqualified personnel who in the course of attempting to operate the equipment and devices either damage the equipment or waste man-hours in trying to understand the functionality of the equipment. In some cases, they are only able to provide the minimal functional settings to enable the equipment to operate, which does not meet the objectives of the business in investing in the equipment, software or the infrastructure.

3.0 BRIDGING THE GAP

In order to bridge the professional skill gap, some technology companies through their feedback mechanism initiate specialized after-sales training packages to equipment vendors and their associated clients who invest resources for the procurement of equipment. Others proactively incorporate training and support services in their business development programs to bridge the professional skills gap that exists between the equipment vendors' support teams and customers' technical staff.

4.0 TECHNOLOGY DEVELOPMENT AND CERTIFICATIONS

Technology development has been rapid for the last 20 years with many industry players rolling out solutions to meet the demand of customers and the general public. Globally, most companies are rolling out technology solutions and upgrade every 2 to 3 years. For instance, Microsoft releases a new operating system or an upgraded version with patches in every 3 years. Oracle, Cisco, Dell, and other Original Equipment Manufacturers (OEM) vendors are also completely overhauling their technology platforms, systems and architecture in the same manner. This trend has led to key industry players establishing certifications for their tools and solutions. Professionals need to take advantage of these training and certification opportunities for available products and solutions, to implement, maintain and support the ICT services.

Key stakeholders in the ICT industry have training and certification programs for the versions of product and equipment in their sales pipeline. Notable among them are Microsoft, Cisco, SAP, Google, Amazon, CompTIA, Web Sense etc. The need for qualified and professionally updated ICT professionals cannot be over-emphasized. Certification opens up a business space for technology training houses and examination administration bodies to partner with the OEMs. This partnership is to provide training curriculum, materials, tools, training programs, examination administration and certification of the professional.

Certification creates opportunities for professionals. According to Tittel and Kyle, "employers frequently look to certification as an important measure of excellence and commitment to quality" (Tittel K.L. and Kyle, M., 2020).

These certifications are quality assurance programmes on the value chain of the OEMs to certify professionals for employment by their customers and consultants. The assurances are that professionals with adequate capacity and valuable product knowledge are available to administer and support infrastructure, including hardware, software, and network equipment or service oriented solutions.

OEMs and ICT solution service providers offer services in several business sectors with specialty in competitively advantageous areas, which cut across aerospace, engineering, manufacturing, healthcare, education, logistics and supply chain management, financial services, telecommunication, etc. Therefore, certifications exist in numerous technology tools and business solutions for professionals to engage themselves, to equip and upgrade their industry skills.

The introduction of certifications for IT specialist areas stimulates confidence in employers, since ICT has been a major business enabler. Business reliance on certification obtained to recruit ICT professionals into departments in their organization has since become normal. In many cases where businesses rely on ICT infrastructure, such organizations must require high-level skill sets of qualified and certified professionals to administer optimally the operations of these equipment and solutions.

As at today, specialized ICT training and certification have become the industry standard for employment into private sector companies mostly in developed countries and some developing economies. For example, the oil and gas, telecommunication, logistics, marine and shipping, finance and banking sectors require certifications as a requisite qualification for employment as well as consulting services.

Although certification is not a mandatory prerequisite in the public sector, it is seen as an added advantage. Recently, most agencies of government in Nigeria specify certification as a necessity. For instance, NNPC, DPR, EFCC, CBN, NPA, Ministry of Finance, and some other frontline agencies and departments whose functions for service delivery depend on ICT infrastructure are taking steps to request certified professionals for employment.

5.0 THE ICT CERTIFICATION PROGRAMMES

The ICT certification programme has become a subsector of the ICT industry where skilled professionals provide training programmes leading to certification in a skilled area. Certification enhances the employability skills of ICT professionals. The necessity in the surge of new products in the market place proves the import of certification. The impact of this surge is that ICT companies are prompted to enhance their support services to be businesses by acquiring adequate ICT certifications.

"...today, specialized ICT training and certification have become the industry standard for employment into private sector companies mostly in developed countries..."

There are many certifications in the ICT technology for which several ICT industry professionals should avail themselves depending on their areas of interest. Some organisations such as Microsoft, Oracle, SAP, Amazon, Cisco, Google, CompTIA, Dell, Huawei, PMI, EC-Council and others provide industry certifications in different skill areas.

5.1 CYBER SECURITY

Koenig states that on learning these skills, professionals add value to the work they do by protecting valuable data/ information (Koenig, 2020). Similarly, Springboards, Global Tech Council and Koenig, all agree that Cybersecurity certification programs are aimed at protecting

systems' integrity and confidentiality of data using advance techniques and tools to protect network and data from malicious cyber attacks (Springboards, 2020, Global Tech Council, 2020 and Koenig, 2020). Cybersecurity skills protect systems' information from malicious attacks of phishing, malware, unpatched software, hijacking faces, hacking an identity, theft and others alike and ultimately avert data breaches and avoid financial losses.

Generally, numerous industry certifications relevant to cyber security exist. These include Certified Ethical Hacker (CEHv10),Certified Information System Security Professional (CISSP), Certified Cloud Security Professional (CCSP), Certified Information Security Auditor (CISA), Computer Hacking Forensic Investigator (CHFIv9), CompTIACyber Security Analyst (CySA+),Certified Network Defence (CND), Certified Advance Penetrators Tester, Cyber Security Practitioner Certification, Certified Lead SCADA Security Manager, Certified Block Chain Professional (CBP), Digital Forensics – Network Investigation , Cisco Network Security Audit, Threat Prevention, Certified Information Security Manager (CISM), CompTIA Security+.

According to Koenig, the security certification helps the professional to provide the defence mechanism to systems that are vulnerable to attack. In addition, the cloud requires protection mechanisms from emerging attack vectors. These defence mechanisms are mitigators that apply artificial intelligence (AI) and machine learning (ML) techniques to hedge the cloud infrastructure. The relevance of a certification is always in tune with current technologies for which implementation, configuration and support may be required.

5.2 MICROSOFT CERTIFICATION

Microsoft is another certification body that has been at the forefront of IT certification since the early days of Microsoft Windows in the 1990s. Microsoft often updates their certification programmes to reflect new skill areas relating to new roll out of their software infrastructure.

An online magazine states that currently, Microsoft has five certification path competency areas which cover:

- Core Infrastructure (IT Pro & Developer): Excellence in workload administration and engineering.
- Productivity (IT Pro): Expertise in deploying Microsoft office cloud and hybrid solution to enterprise customers.
- Data Management & Analytics (IT Pro and Developer): Proficiency in database administration and infrastructure.
- App Builder (Developer): Expertise in app development and quality assurance.
- Business Application (IT pro and Developer): Skills in Microsoft Dynamics Business Application Software (Microsoft learning, 2020, March 20).

These competency areas or certification training will lead to certification from MCSA to MSCE or MCSD, after taking elective courses in specialist areas.

"Microsoft often updates their certification programmes to reflect new skill areas..."

5.3 AMAZON WEB SERVICES

In addition to the few very relevant certifications enumerated, Cloud Academy listed 12 Amazon web services (AWS) certifications, due to the importance of cloud computing that has become a main stream storage space and computing as a service (CaaS). Cloud computing requires a new set of skills to design, deploy and manage applications, which further test the competence of companies providing such services. Larkin commented that despite the multi-coloured strategies, AWS certification will always remain relevant He opined that it is the choice for public adoption due to its usage and features Andrew Larkin, (2020).

AWS certification emphasises hands-on experience and best practices with the necessary skill base to support the AWS. AWS' certification validates the familiarity and understanding of candidate's knowledge in cloud architecture, management and security, which ultimately determine its suitability. The path to certification helps the company and the individual create a valuable knowledge base for the ICT professionals and their organisations.

Koenig, Cloud Academy and Amazon listed 12 certifications in the bouquet of AWS certifications. These include:

- One - Foundational certification (AWS certified cloud practitioner)
- Three - Associate level certification (AWS certificate Solution Architecture, AWS certified Developer, AWS certified System Administrator)
- Two - Professional level certification (AWS Certified Solution Architect, AWS Certified System Engineer)
- Six - Specialty certification: AWS certified Data Analytics, AWS certified Advanced Networking, AWS Certified Security, AWS certified Alexa Skill Builder, AWS certified Machine Learning, AWS certified Database (Koenig, 2020, Cloud Academy, 2020 and Amazon Web Services, 2020) listed.

5.4 COMPTIA CERTIFICATION

CompTIA is another quality ICT training and certification organization that provides continuous education and certification of professionals with updated knowledge in ICT resources of different knowledge levels and ISO standard. CompTIA provides certification in the following categories. These are:

- Cyber security (CompTIA SYSA+, CompTIA CASP+, CompTIAPenTest+)
- Infrastructure (CompTIA Cloud+, CompTIA Linux+, CompTIA Server+),
- Core (CompTIA IT Fundamental, CompTIA A+, CompTIA Network+, CompTIA Security+),
- Additional Professional (CompTIA Project+, CompTIA CTT+, CompTIA Cloud Essentials+) (CompTIA, 2020).

5.4.1 CompTIA Cyber Security certification

This certification aims to equip the professional to identify cyber security policies and frameworks to be implemented, advance level risk management and defence, implement cryptographic techniques, such as block chain, crypto currency and mobile device encryption, penetration testing and vulnerability management, with ISO standard (ISO 17024). It includes CompTIA ISO/ANSI accredited examinations, IT regulatory compliance, automation and threats hunting.

5.4.2 CompTIA Infrastructure certification

This is aimed at training the professional with skills in System administration, to maintain and optimize cloud infrastructure, with ISO 17024 standard, secure network access to cloud resources, manage cloud resources, mobile and web administration, manage data centres or closed environment and server technologies.

5.4.3 CompTIA Core certification

This is targeted at preparing professionals for core IT functions by introduction of basic IT knowledge and skills, setting industry standard on IT for establishing a career, exposure to core technologies from security to cloud, to data management and

many more. This certification creates an industry standard for IT careers in a digital world. It covers troubleshooting, configuring, and management of networks. It validates baseline skills to perform core security functions and pursue an IT security career, as well as meet ISO 17024 compliance requirements.

5.4.5 CompTIA additional professional certifications

These are new areas that CompTIA introduced to their retinue of certification courses. CompTIA plans are that these courses will equip professionals (both IT and non-IT) with the basic concepts to successfully manage small to medium size projects (Koenig,2020c). They are intended by design to validate instructors' attainment of excellent standard in technical training, knowledge, tools. They validate techniques for teaching in modern learning environment so as to provide the needed business insight to make informed cloud service decisions.

5.5 MACHINE LEARNING CERTIFICATION

Artificial intelligence is the latest area in the use of machines programmed to mimic the life of human beings (Koenig, 2020b). The use of machines programmed to learn its environment has tremendously improved human/machine interaction. Thus, machines can carry out human functions to a large extent. The world moves currently in that direction; machines and software are designed now to be artificially intelligent.

According to MIT–Xpro, machine learning and other technologies like cloud computing and big data are revolutionizing how professionals approach work in the new business space (MIT- Xpro, 2020). As a result of the relevance of machine learning in the new work space, MIT Centre for Computational Services and Engineering (MIT–CCSE) introduced a program for understanding computational tools for engineering solutions to problems in the areas of machine learning, modelling, simulation principles and application of machine learning to engineering and science.

While Amazon, the giant e-business company, is not left out of business solutions in the cloud and other web services, Amazon Web Services (AWS) has a track of certifications for its web services. However, the relevance of machine learning tools was not ignored in the integration process of man and machines (AWS, 2020). Amazon introduced AWS certified machine learning 2020 specialty course with knowledge of machine learning. This covers engineering techniques, data engineering with Simple storage Services (S3), Glove, Kinesis and dynamo DB with built-in machine learning algorithm and services. The course which is accessible through a compatible digital infrastructure, exposes professionals to data exploratory services, deep learning, deep neural networks, regularization, automatic model turning and application of security best practices to machine learning pipelines (AWS, 2020).

According to Hackr.io, an online learning website, researching into machine learning certifications needs for the year 2020, Arora stated that the demand for machine learning (ML) engineers is increasing geometrically as organizations now desire to implement and make ML a pivot feature in their products (SimKaurArora, 2020). ML certifications that are in high demand in 2020 include Professional certificate program in ML and AI, ML with Tensor Flow on Google cloud platform specialization, e-Commerce ML and ML with python. Machine Learning certifications will put most ICT professionals at an advantage through preference for new jobs and business consultancy services.

6.0 ADVANTAGES OF ICT CERTIFICATIONS

ICT industry certification is a proven qualifying skill validation process. It provides several benefits to the individual professional, organization and industry. Several benefits exist for professionals, supervisors, managers and human resource recruitment teams through the evolutions and innovations in IT (Professional certifications for Emerging Tech, 2020). The innovations in business processes, customer-centric services delivery and adoption of efficient technology tools to re-engineer systems and processes through the certifications are imperative for businesses and professionals to remain competitive to their advantage.

Instructively, it has become absolutely necessary for organizations to look towards innovative tools, knowledgeable and skilled professionals to team up as a winning workforce to achieve organisational goals.

Therefore, there is a growing trend to have certified professionals to support the goals of these organizations. According to MBO Partners, "continuous thirst for knowledge is a key element in building a growing, thriving business." Undoubtedly, certification provides a basis for recognition of specialized knowledge and skill which are of immense benefits to the professional and the organisation he/she works for.

MBO Partners highlight certificate benefits as follows:

(i) To gain competitive advantage: Certification demonstrates that the professional has the requisite knowledge that can distinguish him/her from other professionals.

(ii) To increase efficiency: Certification helps the professional consultant with a solid foundation and allows him/her to manage all aspects of his/her work effectively.

(iii) To expand knowledge and skills: The trainee acquires new and updated knowledge of modern techniques, processes, tools and strategies to enhance his/her skill set and solve complex issues.

(iv) To increase earning potential: Professional certification can lead to increase in earning capability. The time, money and efforts invested can result in higher earnings. A study by MoneyWise and CIO Africa revealed that certification increased salary by 20 to 40% (MoneyWise, 2020 and CIO Africa, 2020).

(v) To build professional credibility: Several businesses, non-profit, oil and gas companies, government agencies and even international and bilateral agencies when working with consultants and professionals prefer certified professionals. MBO Partners also consider "certification as a demonstration of your commitment to superior professionalism, upholding industry standard, and continued learning".

"A global standard for certification organization with 50 years of certifying professionals" says that "business demands learning new skills and proven competency in the work place and society", and the "world relies heavily on technology to perform vital personal, public and business functions" (Professional Certification for Emerging Tech, 2020). Consequently, it is necessary that professionals, who are to drive these innovative technologies should:

- Uphold ethical practices in their daily activities
- Possess adequate knowledge of the profession
- Maintain confidentiality accessing information
- Provide open and complete information to clients, employers and to the public
- Act in a manner that ensures that IT serves and benefits the society at large.

In addition to the benefits already highlighted, certification has a lot of benefits for professionals, supervisors and managers which is in agreement with Global Tech Council's assertion.

6.1 CATEGORIZATION OF BENEFITS

6.1.1 Certification benefits to the professional (certificate holders)

With certification, self-confidence is assured having been tested against global standard. The professional can seek promotion in the chosen field of practice, command the respect of peers and customers and work ethically in compliance to professional code of conduct and practice that gives the organization confidence in service delivery.

6.1.2 Certification benefits for managers and supervisors of professionals

Managers and Supervisors in this category can achieve cost-effective service delivery, maintain industry knowledge, enhance professional development and confidentiality through ethical code of conduct.

6.1.3 General benefits

These include:

- Better Job Security
- Better Opportunity for a higher paying job
- Networking opportunities with other certified and skilled professionals
- Achievement of Professional credibility is assured through certification with one or more vendor(s). It shows dedication and motivation to professional development. Certification also enables partnership with vendors. Vendors' partnership programs benefit the organization that employs a number of certified professionals
- Earning a certification on a new technology, operating system, platform or application distinguishes the individual

as a subject matter expert (SME). It also meets the goal of personality development program (PDP), which makes the individual a competent and up to date professional in a specific skilled area.

7.0 CONCLUSION

The digital world will continue to grow to support businesses. Artificial Intelligence, Machine Learning, Cloud computing, Cyber security and many more will become the new norm (Koenig, 2020c). Embedded systems will be at the fore front of computing systems even as transmission networks are being enabled by higher transmission rates. These services will continue to create capacity gaps in the industry. More so, these gaps will require training and certifications from accredited training and certification providers. The essence of training and certification is to bridge the knowledge gaps of qualified professionals that would implement, configure, support and maintain these technologies. The need to consistently support these innovations by tech-houses, tech-vendors and tech-professionals necessitates proper validation processes of qualified personnel to support OEMs devices, components, and software vendors which are accomplishable through quality and up to date industry certifications (Koenig, 2020a).

Certification shall remain as an industry standard for employment of IT professionals into higher paying technology jobs (Springboards, 2020, Global Tech Council, 2020 and New Horizons, 2019). Opportunities for consulting firms in ICT to access contracts from private sector companies, public sector ministries, departments and agencies, international donor agencies and non-governmental organisations will be facilitated through relevant industry certification.

The ICT industry has actually opened up for both ICT/non-ICT professionals and for most engineering and science professionals. Those who are interested in supporting, implementing, maintaining and configuring IT service infrastructure should leverage on ICT certification to become stakeholders in the industry. In today's digital business space, the significance of certification to the ICT profession cannot be more accentuated. Every ICT professional must certify in a skilled area to demonstrate relevance in the industry, now and in the future.

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TIT-BITS ON ICT

BY ENGR. ENEFIOK UBOM

1.0 ICT GIRLS' EMPOWERMENT COMPETITION

Engr. Enefiok Ubom, FNSChE

As part of the activities to mark 2019 "Girls in ICT Day" celebration, the Federal Ministry of Communication and Digital Economy organized the 2019 ICT Girls' Empowerment Competition with the theme "MY ICT INNOVATION: ICT FOR SDGs". The competition was targeted at encouraging girls to discover new and innovative ways of using ICT to provide solutions to pressing challenges in attaining sustainable development goals (SDGs) 1 to 8 in their communities (Source: The Punch, June 11, 2019).

The first 8 goals out of 17 set by the United Nations to be achieved by member countries between 2016 and 2030 are:

- Goal 1: No poverty
- Goal 2: Zero hunger
- Goal 3: Good health and well-being for people
- Goal 4: Quality education
- Goal 5: Gender equality
- Goal 6: Clean water and sanitation
- Goal 7: Affordable and clean energy
- Goal 8: Decent work and economic growth.

The prize giving event is yet to be conducted as at the date of this publication. The ceremony is expected to feature ICT Career Fair where guest speakers who are female role models would talk on ICT innovation and entrepreneurship as well as career guidance in ICT. It will also provide opportunity for schools to be acquainted with the procedures of the ICT Empowerment Competition and Digital Girls Club Initiative of the Ministry.

This is indeed a laudable programme for girls to key into. In future, the competition should be for both genders (boys and girls).

2.0 THE CHANGING WORLD

Change is the most permanent phenomenon in the universe. 'Uber' is just a software. Despite not having a single car of its own, it is the largest taxi company in the world. Have you ever seen a high street store called AMAZON, yet AMAZON is the largest retail shop in the world.

Airbnb is the one of the world's largest hotel companies, even though it does not have a hotel of its own. Airbnb Incorporated (Inc.) is an online marketplace for arranging or offering lodging, primarily homestays or tourism experiences. The company does not own any of the real estate listings, nor does it host events; it acts as a broker, receiving commissions from each booking. The company is based in San Francisco, California, United States.

ZOOM: A virtual meeting application

3.0 VIRTUAL MEETINGS AND CONFERENCES NOW IN VOGUE DUE TO COVID-19 PANDEMIC

The first confirmed case in Nigeria relating to COVID-19 pandemic was announced on February 27, 2020 when an Italian citizen in Lagos tested positive to the novel Coronavirus. Being a highly infectious virus, the number of confirmed positive cases has been growing rapidly in the country necessitating the issuance of an advisory on a 'social distance' of at least 2metres, among other safety protocols, to the general public by the government. The current surge of COVID-19 has compelled various bodies to adopt virtual meeting options so as to move on with vital work functions (See table 1).

DATE	TYPE OF VIRTUAL MEETING	COORDINATION VENUE
April 21, 2020	GAMA annual general assembly meeting	Gaborone, Botswana
May 7, 2020	Ogun State High Court proceedings	Abeokuta
May 13, 2020	Federal Executive Council meeting	Aso Rock Villa, Abuja

Table 1: *Selected examples of virtual meetings using ZOOM*

ACEN FINANCIAL MEMBER FIRMS

1 A & A Global Engineering Limited
2 A + O Associates
3 A. A. Nelco Nigeria Limited
4 Abdaz Consult
5 Abiss Associates Limited
6 Ad-Team Limited
7 Adebab Associates
8 Adstruc Associates
9 AIM Consultants Nigeria Limited
10 A.K.W. Engineering Limited
11 Amana Consortium
12 AME Consulting Engineering Limited
13 Ancelk Integrated Consultants Limited
14 Ankabut Engineering Limited
15 Annodium Consulting Engineering
16 Ansel Consults Limited
17 Apex Design Associates
18 Apex Frames Engineering & Consultancy Ltd.
19 Ariosh Limited
20 Aroes Engineering Nigeria Limited
21 Asonic Associates
22 Aurecon Consulting Engineers Nigeria Ltd.
23 Ayo Franklin Consultancy Limited
24 Basewatch Global Consult Limited
25 Boab Engineering Service Limited
26 Bolcon Associates
27 Bradfield Engineering Consultants
28 Building Services Design Consultants Limited
29 CA Consultants Limited
30 Cafmeg Consulting Engineers Limited
31 CDR Engineering Consultancy Nigeria Ltd.
32 Civ-Struct Associates
33 CKW Environment Limited
34 Coastal and Reclamation Engineering Services Limited (CARES)
35 Comprehensive Project Management Services Limited
36 Consem Associates
37 Curves And Straight Designs Limited
38 Cyno - Lawrence Nigeria Limited
39 Danelec Limited
40 Dean and Partners
41 Debs Foundation Limited
42 Dehize Nigeria Limited
43 Delkem Associates
44 Deltec Engineering Limited
45 Diyokes Consultants Limited
46 Dokter Consult Nigeria Limited
47 Domtech Consult Limited
48 E + D Multi Consult Design Limited
49 ECMC Engineers Limited
50 Eco Project Services Limited
51 El - Tojje and Associates
52 Enjosen Consult
53 Enplan Group
54 Envest Engineering Limited
55 Escher Silverman Global Limited
56 Famas Global Consulting
57 Fasad Engineering Nigeria Limited
58 Femak Associates Limited
59 Find Associates
60 FN and Associates
61 Francoz Engineering Solution Concepts Ltd.
62 Funlad Consult
63 Fuse Engineers Limited
64 Fyne Chima Ogolo and Company Limited
65 Gaiwan and Associates Nigeria Limited
66 Gama Professional Consulting Engineers Ltd.
67 Gapec Consultants Limited
68 Garfield Marine Engineers Limited
69 Ghazanfar Engineering Limited
70 Gigaplus Plc
71 GIS Transport Limited
72 Global Ecological Consultants Nigeria Ltd.
73 Global Oceon Engineers Nigeria Limited
74 Global Works Consultants
75 Gosslink Engineering Limited
76 HaskoningDHV Nigeria Limited
77 Havilahtrend International Limited
78 Hecon Consultants
79 Index Engineering Consultants
80 Infratech Consultants Services Nigeria Ltd.
81 Intecon Partnership
82 Intedeco Nigeria Limited
83 Integrated Advance Quest Engineering Ltd.
84 Interactive Engineering Consult

85 Ivory Link International Limited
86 Japavisca Engineering Company Limited
87 Jibok Engineering Limited
88 JIL Engineering Associates Limited
89 JOD Partnership Limited
90 Jojo and Partners
91 Jol Associates and Multi - Dimensional Services Limited
92 Jopark Engineering Limited
93 Kay Hay Milla Services Limited
94 K.S Trust and Associates
95 Kanni Samab Consultants
96 Katlego Engineering Limited
97 Kay-Dek Associates
98 KOA Consultants Limited
99 KOA Oil and Gas Limited
100 Kohasa Engineering Company Limited
101 Kolpakov Engineering Ltd.
102 Koshvo and Associates
103 Krinoll and Partners
104 Kruggerbrent & Co Nigeria Limited
105 Kubson-Jay Engineering Consult
106 Kuntech and Associates Limited
107 Litebrine Consulting Engineering Limited
108 McAdog Associates
109 McBey Nigeria Limited
110 Melcon M Nigeria Limited
111 MFA Partnership
112 Micek Consult Limited
113 Moks Engineering Consults Limited
114 Multibase Consultancy Service Limited
115 New Horizons
116 Nexant Consulting Limited
117 Nin Engineering & Consultancy Service Ltd.
118 Odiagtech Engineering Services Limited
119 OJ and T Consulting Limited
120 Olabenjo & Associates Consulting Engineers
121 Olutemcon Associates
122 Optimal Designs Associates Nigeria Limited
123 Oska-Jo and Partners
124 Ove-Arup and Partners Consulting Nigeria
125 Ozi Projects and Consultancy Limited
126 Petrotema Engineering Limited
127 Pheman Peniel Consultants
128 Phoenix Associates
129 Pinconsult Associates Limited
130 Planover Engineering Consulting Limited
131 Plusmann Associates
132 Prelim Consulting
133 Premium Engineering Project Consult Ltd.
134 Primetech Design and Engineering Nigeria Limited
135 Progress Engineers
136 Project Plus Potentials Engineers and Project Manager and Company Limited
137 Pro-M Limited
138 Pro - XL Civil Engineers
139 Pullad Global Consultant Nigeria Limited
140 Pure Tech Engineering Consulting Limited
141 Qubeesh Integrated Services
142 Rowland Adewumi & Partner
143 Samabot and Associates Limited
144 Sandmash Consultants Ltd
145 Sani Mustapha and Associates
146 Sanni Ojo and Partners Consulting
147 SAO Associates
148 Sapientiae Engineering Limited
149 Siraj Nigeria Limited
150 Sitech Engineering Limited
151 Steag Encotec West Africa Limited (SEWA)
152 Sudelettra Nigeria Limited
153 Sybag Global Solutions Limited
154 Tamilore Associates
155 Tam-Sok Nigeria Limited
156 Teayork Nigeria Limited
157 Terracorn Engineering Company Limited
158 Transglobal Environmental & Engineering Limited
159 Transurban Signature Solutions Limited
160 Toroskylinks Engineering Limited
161 Ultikonsults Limited
162 Unecon Associates Limited
163 Vaastrop Nigeria Limited
164 Vasons Concept Consultants Limited
165 Vaya Energy Solutions Limited
166 VC Consulting Service Limited
167 Victory Consult
168 Waltech Engineering Service Limited
169 Watech Services Limited
170 Wilkriss Nigeria Limited
171 Yubar Consultant Limited
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To use the company as a source of employment and to meet the electrical and mechanical engineering needs of Nigerians and citizens of neighbouring West African Countries.

MISSION

To be a major brand name for electrical and mechanical engineering works in Nigeria and West African Countries.

STRATEGIC OBJECTIVES

- To service the Construction Industries in Nigeria and West African Countries
- To be a reference point and a major brand in electrical and mechanical engineering in Nigeria and West African Countries
- To contribute significantly to the infrastructural development in Nigeria and West African Countries

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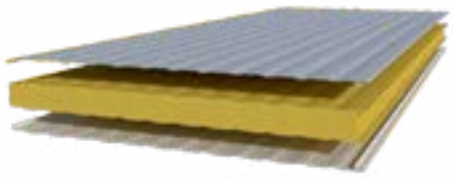
Vitapur Sandwich Panels consist of exterior and interior facings of relatively thin metal sheets encasing a core of rigid polyurethane.

The aluminium or steel facings themselves are surface-coated and can be manufactured with profiles of various depths leading to a higher load-bearing capabilities.

Vitapur Sandwich Panels come complete with specially-formed joints ensuring a perfect fit and maximum integrity. They are also available as Polyurethane (PUR) and Polyisocyanurate (PIR) foam.



Benefits

Energy Efficient
Ecologically Clean
Architecturally Adaptable
Cost Efective
Air Tightness
Low Maintenance
Easy Installation
Cost and Time Savings

PUR & PIR

32 Kg/m3 - 50 Kg/m3

Lock Types

Camlock, PVC Interlock, Tongue & Groove (Male & Female), Hidden Screw Interlock

Applications

Cold Rooms, Freezers, Chillers, mass-housing units, Site Offices, Clean Rooms, Kiosks, Telecom Shelters, Prefab Structure, Portakabins, Partitioning, Warehouses, office Blocks, Exhibition Halls, Fair Pavillions, Schools, Sport Halls, Drop Temperature Ceiling e.t.c

Contact

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