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X-Raying the Role of ICT in Building Sustainable Knowledge-Based Economy in Nigeria

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ABSTRACT: For countries in the vanguard of the world economy, the balance between knowledge and resources has shifted so far towards the former that knowledge has become perhaps the most important factor determining the standard of living – more than land, than tool and even than labour. Today's most technologically advanced economies are truly knowledge-based. This means that knowledge and information economy, generation and exploitation of knowledge are the center of the economic processes. Such on economy effectively acquires, creates, disseminates and uses knowledge as the main driver for economic growth. Knowledge becomes the prime source of competitive advantage. Over the years in Africa, transformation has taken place in every sector of our economy which required knowledge as an asset for implementation of projects in the different sectors of the economy. However, ICT has played a huge role in the different sectors of our economy. The essence of this paper is to examine the role of ICT in building a knowledge based economy particularly in Nigeria.

KEYWORDS; Knowledge-based, Information, ICT, Transformation, Technology etc.

I. INTRODUCTION

Member nations of Organization for Economic Co-operation and Development (OECD) are gradually transforming into knowledge economies. There are several companies in these nations that have launched knowledge based products (KBPs) and have shared with their customers through mobile apps, interactive knowledge portals and other education websites. More recently, online payment services or direct consumer payment services have also been introduced to switchover to cash less transactions. These are outputs of various skills in subjects like computer programming, R&D, business systems and processes and engineering — most of which generate employment and new jobs to build a strong human capital with superior technical knowhow. In short, knowledge economy is the future vision of several developing countries, but it all depends upon ICT infrastructure and its integration with human knowledge. For this it also has to depend upon organizations that are willing to prioritize organizational learning activities in their organizations and willing to be called learning organizations. This study focuses on these aspects of ICT and highlights a connection between ICT, knowledge economy and learning organization.

Due to the proliferation of ICT, knowledge based economies have played an important role in the economic activities of this country. New economic theories include directly more knowledge as a factor in the production facilities, because investments in knowledge embodied in people and technology increase the productivity of labour and capital and result in new products and processes. The importance of the new information is well established in the economic studies [1]. However, when we look at the new competing landscape, development seems to be based mainly on the technological revolution, and also on the globalization increase. To govern economic system in this new competing landscape and establish a flexible development maintained by the competitive advantage, a new type of organizational model and an innovational process should be developed [2]. ICT has played a huge role in different sectors of our economy. ICT entail computer hardware, software, electronics, computer networks and many more. These industries have played a huge role in the implementation of business ideas in the different sector of our economy. These sectors may include agriculture, automobiles, banking, clothing and textiles, education, energy, pharmaceuticals, transportation etc. they have been experiencing the positive impact of ICT in terms of economic growth. A continuous, consistent and updated use of ICT in the Nigeria economy would lead to higher profits and increased market share.

Since knowledge based systems came into existence in the early 1980's, Nigeria and many other African countries are yet to maximally explore the tremendous benefits and uses of these technologies. Investigations and surveys have revealed that most practitioners in the ICT industry are much concerned about the business risks in terms of

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profitability, investment risks, advertising capital management instead of using their ICT capabilities to build knowledge based economy which would also serve as synergy to foster national development [3]

II. BACKGROUND

In an increasingly globalized economy, ICT is one of the key feature of competition and growth of firms and countries. Firms are becoming more and more competitive to their knowledge, rather than to the natural endowments or the low labour costs. It is becoming increasingly clear that the role of the traditional source of comparative advantages, (a large labour force and abundant natural resources), in determining international competitiveness, in diminishing. The competitive advantage of countries is gradually being determined by the access to information, innovation and evolutional knowledge creation process. The only comparative advantage that really counts is the man-made-one (education and skills). It is engineered by knowledge through the use of information [4]. The recent advances in economic information are becoming essential in the process of the socioeconomic development. Information technology offered new ways of exchanging information and transacting businesses. It changes the nature of the financial and other service sector and provides efficient means of using the human and institutional capabilities of countries in both the public and private sector. The World is rapidly moving towards knowledge-based economic structures and information societies, for instance network of individuals, firms and countries that are linked electronically and having common business [4]. The universalization and the advent of new technologies of transmission fo information place the knowledge and the information in the heart of the regulation in the economic development. The fast increase in the exchanges of goods, services, capital and the new idea reinforce today the interdependences between the economics. The context of information and communication technology (ICT) is that of the new economy which is characterized by the evolution of the process of the globalization and development of the information companies. Thus, with the standardization of international information, such as international network, and the acceleration of the exchange in widened spaces of the Common Markets (following regional integration) have created more opportunities for the diffusion of technology [18][4]. Moreover, this last international environment managed by new information technology exacerbated the race of competition at the international level. Knowledge creation in planning a major role in the capitalist economics. Therefore, business organizations must constantly create new knowledge to guarantee their survival. To be a competitive firm in the contemporary economy, it is necessary to continue innovating industries and firms that were formerly and comfortably protected and with slowly evolving market, are being swept by the accelerated change. [1] were the first authors to focus on how knowledge is created. They also stated that the fundamental importance of today's firms is to create new knowledge and activate the innovation process. To be competitive a firm must be transformed into an organization mobilized by the knowledge creation. The products released from the knowledge creation process become static while the firm rushes into the future. With knowledge its various aspects such as the increasing arbiter of value, innovation(i.e., new knowledge creation), has become they key to successes in the global market place. The increase of the number of organization encouraging continuous innovation has profound effects on the World economy. Actually [12], states that innovation has to contribute it successful production, assimilation and exploitation of novelty in the economic and social spheres.

III. WHY KNOWLEDGE-BASED ECONOMY IS IMPORTANT?

The importance of knowledge based economy cannot be overemphasized, this is because it emergence produced idea and technologies ingredients, made intellectual property merchandise, people expect smarter products with more convenience and technology leader fuel the innovation. Therefore there is no doubt that knowledge based economy is generating opportunities across all sectors in a number of developed and developing countries. It is a new source for the creation of quality jobs, wealth generation, income redistribution and poverty alleviation, as well as rapid economy development, prosperity and a source for facilitating global competiveness[5] Knowledge as the most powerful engine of production and the extraordinary progress in information and communication technology, coupled with the increased speed of scientific, technological advance and global competition along with changing demand is the reason why knowledge is becoming more important. It is important to be a part of the knowledge based economy because information and knowledge are replacing capital and energy as primary wealth-creating assets. We are moving from the industrial revolution to globalization and liberalization in international trades where there is free flow movement of capital, information and worker. Major changes such as in workforce diversity, would require the human, resources development strategy to meet the needs of the industries in both public and private sectors. People are the ultimate

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resource. And they must be given the fullest emphasis possible for development towards the highest standards of skills, knowledge upgrading, competencies, work attitudes and motivation [5]

IV. BULIDING A KNOWLEDGE-BASED ECONOMY: THE ROLE OF ICT

Information and communication technology plays a pivotal role towards building knowledge based economy of any nation and Nigeria is not excluded. It is a new technological, informational and communication change we have seen in recent decade that have marked the transition from natural resources-based economy to knowledge-based economy in the developed nation. ICT is a core engine of an information based economy, universalize access to social services, and create a knowledge-based online society [6] Therefore to build Information technology literacy and capability among the people in Nigeria. ICT will be crucial to building the knowledge based economy as well as envisage to produce transformational effects across all sectors of the economy, ICT will facilitate on going social and political reforms, and firmly establish Nigeria as a developed nation. In Nigeria, there are good ICT infrastructures, if utilized judiciously, Nigeria, can even compete with developed countries like U.S.A., UK, France, China, Singapore among others in terms of economic growth and prosperity. The Internet is simply a large global network created by the acceptance of standards. In practice, the Internet capabilities have the power to change both individuals and society. The next wave is the wireless access, both high-speed connections within a company and Internet access to cell phones wherever you travel. These changes offer new ways of doing things. So, in Nigeria five satellites have been launched by the Nigerian government into outer space so as to provide internet accesses to all Nigerians with a view to build the knowledge based economy [7][9].

The NigerSat-1 was the first Nigerian satellite and built by a United Kingdom-based satellite technology company, Surrey Space Technology Limited (SSTL. Ltd) under the Nigerian government sponsorship for $30 million. The satellite was launched by Kosmos-3M rocket from Russian Plesetek spaceport on 27 September 2003. One of the primary objectives of the Nigersat-1 was to provide the technology needed to bring education to all part of the country through distant learning. NigerSat-2 and NigerSat-X, Nigeria's third and fourth satellite, were built as a high-resolution earth satellite by SSTL for DMC system also. The NigerSat-2/X spacecraft was built at a cost of over £35million. This satellite was launched into orbit by Ukrainian Dnepr rocket from a Yasnymilitary base in Russian on 17 August 2011. On 19 December 2011, a new Nigerian communication satellite was launched into orbit by China in Xichang. The satellite would have a positive impact on national development in various sectors such as communication, internet, services, health, agriculture, environment protection and national security. To build successful knowledge based economy, Nigeria should be conscious not only about building and development of the knowledge based economy but also the maintenance of the knowledge base [8,9].

V. THE KNOWLEDGE-BASED ECONOMIC MODEL

In the new vast world, which is characterized by an international economic openness, by common market and by international diffusion of information and communication technology (ICT), competition between countries is increasing and the search of competitive advantages and intelligence is the best solution to maintain these market parts and economic growth and development in an area of knowledge-based economy. The most important sources of competitive advantages developed in the literature of economic growth are Business, Organizational, Knowledge and Competitive intelligence. Information, as the crucial resource of effective innovation, produces the competitive intelligence which is a result of business, organizational and knowledge intelligence as a consequence of the use of ICT. In the new economy, moving into new markets provides many opportunities and multiple challenges. For example, entering global markets increases incentives for innovation and helps gain returns on innovation because of the expanded marketplace[7]

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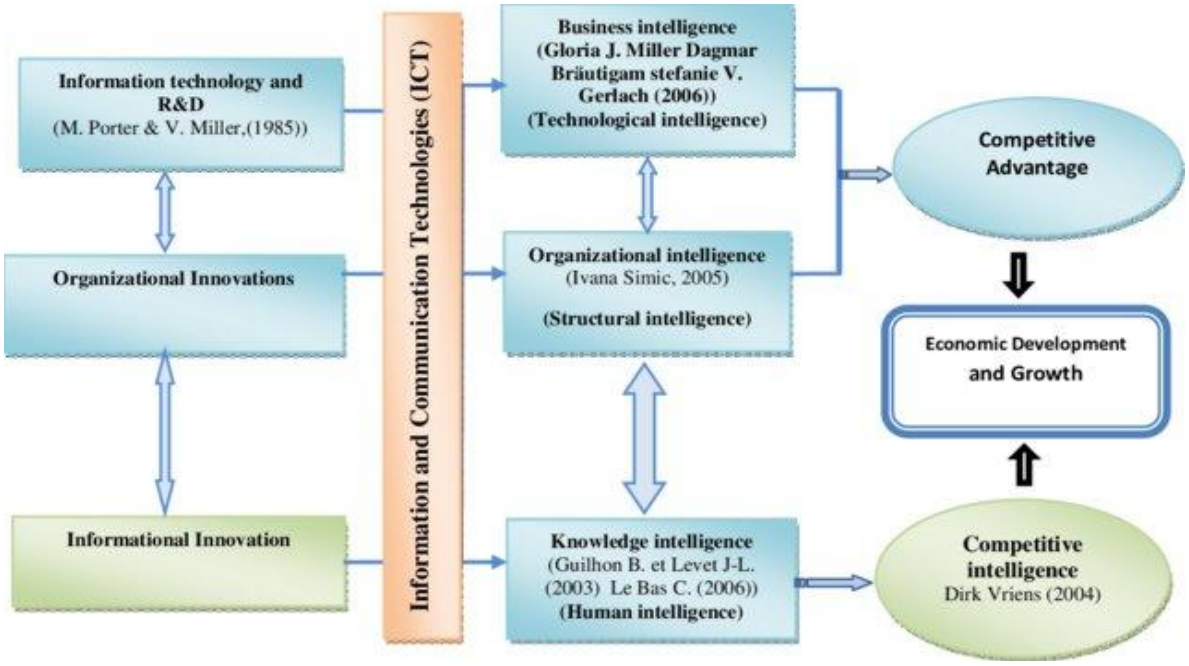

Figure 1: Knowledge-Based Economy Model [2]

In this model, ICT offers many opportunities to support intelligence activities. To make sure that these activities can be carried out properly, an organization should implement a "Knowledge-based economy". Three parts of infrastructure have been distinguished according to Vriens [3]:

- A *technological intelligence*, comprising the ICT applications and ICT infrastructure that can be used to support the (stages in the) intelligence cycle,
- *A structural intelligence,* referring to the definition and allocation of competitive intelligence tasks and responsibilities and
- A *human resource intelligence,* which has to do with selecting, training and motivating the personnel that should perform the intelligence activities. ICT generates more data when a company performs its activities, as it enables it to collect or capture information that was not available before. Citizens, consumers and governments can create, re-use and distribute information that adds maximum value.

Information consists of two types: codified and non-codified. It can easily gain access to codified knowledge. But to innovate, a lot of non-codified knowledge is often require [9]**.** This non-codified knowledge comes mainly through people. The scarcity of good technical and human resources in Asia is perhaps an important hurdle for this transfer. Without the appropriate human resources, creative entrepreneurs will not be able to achieve their objectives. They may be stopped if they do not have quantitative and qualitative of technical infrastructure, engineering, design and management skills, and creative employees. The availability of these resources depends on the government initiatives [12].

VI. SECURITY CHALLENGES FOR BUILDING KNOWLEDGE-BASED ECONOMY IN NIGERIA

To build knowledge-based economy in Nigeria, some challenges must be identified Knowledge based Economy, perhaps faces two levels of security challenges issues. Security challenges at Critical ICT infrastructure level and at information level.

A. Security Challenges at ICT Infrastructural Level

ICT infrastructure used to process, store and disseminate information and knowledge thus knowledge based economy. These infrastructure include computers, media, storage and backup devices, network communication facilities and

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educational institutions among others infrastructures have become highly interconnected, and interdependent. Intrusions and disruptions in one infrastructure might provoke unexpected failure to others. However, how to handle interdependencies becomes an important problem. The potential security challenges of knowledge based economy at critical ICT infrastructure level include the following [12]

Terrorism: this is a main infrastructural potential security challenge to knowledge based economy where a person or groups deliberately targeting critical infrastructure for political or extremism gain. For example what is happening in North East, North West, North Central, in Nigeria where telecommunication antennas and educational institutions were deliberately targeted by insurgents for extremism gains. In the southern part of Nigeria, Niger Delta militants have vandalized several oil and gas equipment, claiming marginalization of their area by the central government.

- **Sabotage**: Sometime a person or groups such as, jobless youths, militants, banditry, ex-employee, political groups against governments may sabotage the government efforts towards building the effective knowledge based economy by destroying the infrastructures which are critical for building knowledge based economy.
- **Information warfare**: Hackers might hack the knowledge based economy infrastructures for private gain or countries initiating attacks to glean information and also damage a country's infrastructure. For example, data breach in Canada, USA, cyber-attacks on Estonia and cyber-attacks during the South Ossetia war, yahoo, facebook etc.

Natural disaster – hurricane or natural events which could damage critical infrastructure such as gas pipelines, oil pipelines, water and power grids. The above mentioned potential infrastructural security challenges could be addressed by:

- Establishing the government agency, which will be responsible for managing the security of critical ICT infrastructure.
- The agency should be committed on critical ICT infrastructural security and protection.
- Fiber optic perimeter intrusion detection security systems, should be utilized because it will enable us detect the location of intrusions over many kilometers of deployed fiber. Critical infrastructure law should be in place.
- As a matter of urgency, national assembly should pass the bill into law for building effective and efficient knowledge based economy. The bill will address the designation of ICT infrastructure as Critical National Information Infrastructure because having such as law in place will certainly serve as a major deterrent to individuals who are perpetrating atrocious crime in cyber space.
- NITDA should be up to expectations from stakeholders in IT.
- Ministry of Communication and Digital economy should be roll out programme that will enable the youth explore their potentials towards building knowledge-based economy[12]

B. **Security Challenges at Information Level**

Knowledge based economy heavily depends on information. Without information security, the knowledge based economy could be at stake. On the other hand, information security depends on technology development. Developed and least developed countries like Nigeria faces significant challenges in meeting the requirements of the knowledge based economy without information security [14].The lack of technology development in information security, therefore, may constitute a serious infrastructure deficiency that is enlarging the digital divide. The potential security challenges of knowledge based economy at information level include the following:

- Disclosure of information to non-entity or entities
- Alteration of the critical information for illegal gain,
- Unauthorized access of the critical information,
- Unavailability of the critical information to stakeholders whenever the need arise.

The above mentioned potential information security challenges could be addressed by establishing the government agency, which will be responsible for managing the security of critical information. The agency should be committed on critical information security and protection. The measures to address above mentioned potential information security challenges include the following [17]:

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- **Confidentiality:** information related or associated with the knowledge based economy in Nigeria should be prevented from disclosure to unauthorized individuals on systems. So the system that will be used to process, store and disseminate will enforce confidentiality by encrypting the critical information during transmission, by limiting the places where it might appear (in database, log files, backups, printed receipts, and so on), and by restricting access to the places where it is stored.
- **Integrity:** to build effective and efficient knowledge based economy in Nigeria, critical information associate with the knowledge based economy should be maintained and assured with accuracy and consistency throughout its entire life-cycle. This means that data cannot be modified in an unauthorized or undetected manner. This is not the same thing as referential integrity in databases, although it can be viewed as a special case of consistency as understood in the classic ACID model of transaction, processing. Integrity is violated when a message is actively modified in transit. Information security systems typically provide message integrity in addition to data confidentiality.
- **Availability:** for any information system to serve its purpose, the information must be available when it is needed. This means that the computing systems that will used to store and process the information related to knowledge based economy knowledge based economy in Nigeria, the security controls used to protect it, and the communication channels used to access it must be functioning correctly. High availability systems aim to remain available at all times, preventing service disruptions due to power outages, hardware failures, and system upgrades. Insuring availability also involves preventing denial-of-service attacks, such as a flood of incoming messages to the target system essentially forcing it to shutdown.
- **Authenticity: F**or effective knowledge based economy in Nigeria. It is necessary to ensure that the data, transactions, communications or documents (electronic or physical) are genuine. It is also important for authenticity to validate that both parties involved are who they claim to be. The security systems to be used incorporate authentication features such as “digital signature”, which give evidence that the message data is genuine and was sent by someone possessing the proper signing key.
- **Non-repudiation:** In law, non-repudiation implies one’s intention to fulfill their obligations to a contract. It also implies that one party of a transaction cannot deny having received a transaction nor can the other party deny having sent a transaction. It is important to note that while technology such as cryptographic systems can assist in non-repudiation efforts, the concept is at its core a legal concept transcending the realm of technology [12][13]

It is not, for instance, sufficient to show that the message matches a digital signature signed with the sender’s private key, and thus only the sender could have sent the message and nobody else could have altered it in transit. The alleged sender could in return demonstrate that the digital signature algorithm is vulnerable or flawed, or allege or prove that the signing key has been compromised. The fault for these violations may or may not lie with the sender himself, and such assertion may or may not relieve the sender of liability, but the assertion would invalidate the claim that the signature necessarily proves authenticity and integrity and thus prevent repudiation. Therefore, system that would implement the concept of non-repudiation should be installed so as to tackle the issue of potential security challenges for efficient knowledge based economy building in Nigeria [12]

VII. PROMOTING THE ICT SECTOR TO MEET THE CHALLENGES OF THE KNOWLEDGE ECONCOMY

While growing at a healthy pace during the last few years, the ICT sector as a stand-alone economic sector in Nigeria remains under developed, especially when compared to the countries which are part of the knowledge economy. Even when implementing projects which target the development of a knowledge-based economy in Nigeria, the pubic and the private sectors are still consumers of existing technology instead of being creators and innovators. However, relevant stakeholders should intensify efforts in creating awareness on the benefits of ICTs in every facet of our system. The future vision of ICT according to UN SDGs should not be jeopardized for any nation who wants to grow its economy [19][20]. To promote future vision of ICTs:

- Governments and business communities must leverage their economy growth on the ICTs.
- Promoting and Benchmarking the ICT Sector.

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- Reviewing the status of the ICT sector in the region, including obstacles and challenges that the ICT sector is facing in the current economic situation.
- Assessing of the role of governments and pinpointed the gaps hindering the building of needed enabling environments.
- Identifying the socio-economic priorities related to the ICT sector in Nigeria.
- Proposing actions to increase the contribution of the ICT sector to the socio economic development EMCs.
- Preventing case studies from selected EMCs with regard to the contributions of the ICT sector to economic growth
- Highlighting methodologies and indicators to measure the contributions of the ICT sector in national economy.

VII. FUTURE VISION TO PROMOTE THE ICT SECTOR

Taking into consideration the main findings of the ICT sector status analysis and based on the World Bank's Knowledge-based Economy Framework, the future vision consists of four pillars:

- **Education and Training:** Educated and skilled populations that can create, share, and us knowledge well.
- **A dynamic information infrastructure:** that can facilitate the effective communication, dissemination, processing of information and sharing knowledge.
- **An economic and institutional regime:** that provides incentives for the efficient use of existing and new knowledge and promotes investment and entrepreneurship in the ICT sector.
- **An efficient innovation system** of firms, research centers, universities, think tanks, consultants, and other organizations that can tap into the growing stock of global knowledge, assimilate and adopt it to local needs, and create new technology making effective use of knowledge in any country requires developing appropriate policies, institutions, investments, and coordination across the above four functional areas.

IX. CONCLUSION

Knowledge has always been central to development, but new technologies have made it globally accessible. Countries such as the Republic of South Korea, India, and the United States that have exploited new technologies and know-how have pushed their innovation and productivity frontiers. Countries that have failed to do so risk remaining mired in poverty. In order to achieve sustainable goal according to UN, Nigeria must move beyond the stop-start patterns of oil-based development that have characterized it since independence. It must create a stable and prosperous economy based on a critical mass of knowledge workers. ICT offers tremendous opportunities to support intelligence activities. However, to make sure that these activities can be carried out properly, an organization should implement a so-called "intelligence infrastructure". Three parts of infrastructure have been distinguished by Vriens [3]: (i) a technological intelligence, comprising the ICT application and ICT infrastructure that can be used to support the intelligence cycle. (ii) a structural intelligence, referring to the definition and allocation of competitive intelligence tasks and responsibilities and (iii) a human resource intelligence, which has to do with selecting training and motivation the personnel that should perform the intelligence activities. ICT generates more data when a company performs it activities, as it enable it to collect or capture information that was not available before. Citizens, consumers and governments can create, re-use and distribute information that adds maximum value. Without the appropriate human resources, creative entrepreneurs will not be able to achieve their set objectives. Only through these that Nigeria can diversify its economy and thereby compete to attain sustainable development goals as stipulated by UN-SDG.

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