

UNIVERSITY OF IBADAN

IBADAN

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2020 CONVOCATION LECTURE

TOPIC:

**NIGERIA @ 60: Challenges and Opportunities for Moving from
an Oil & Gas Sustained to a Knowledge-Based Economy**

Convocation Lecturer:

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1. Protocol

I salute all the distinguished ladies and gentlemen that are gathered here today in this auditorium. Good Afternoon! It is a great honour and privilege for me to stand before you to give this Convocation Lecture in this important and great university. As you all know, the University of Ibadan is unique in many ways and occupies a special position among tertiary educational institutions in this country. This is the premier university; this really is the place where higher education started in Nigeria.

I will like to use this opportunity to congratulate members of the Governing Council, the Vice-Chancellor and his management team, and members of the Senate of the University for the commendable efforts they have made in repositioning the university in the last five years as a centre of excellence in higher education in Nigeria. The Vice-Chancellor, whose term I hear will soon end, deserves special commendation for ensuring that this university remains rated very highly not only in Nigeria, but also on the continent of Africa. Congratulations, Mr. Vice-Chancellor, for the great strides made under your watch, even amid dwindling resources and industrial unrests that have plagued our universities in recent years. Let me also congratulate all the graduating students who will be receiving their degrees, certificates, and diplomas during the week.

2. Introduction

Nigeria with a population of about 200 million people, is the most populous black nation and the largest economy in Africa. For well over fifty years our nation's economy has depended

on revenues generated from crude oil and gas exports, with the oil sector contributing anywhere between 70 and 90 percent of the country's foreign exchange earnings. During this period, the oil and gas sector has consistently been the main source for funding the annual budgets of the nation. It therefore follows that oil price fluctuations always have a direct bearing on the revenues that accrue to the Nigerian Government at any time (Onuoha, 2005). We have witnessed periods when oil prices remained fairly high for extended periods of time and the nation was better off for that, reaping a windfall in the process. On the other hand, a downturn in oil price usually spells trouble and can impact negatively on budget performance. The windfalls for the nation in terms of foreign exchange earnings occur when crude oil prices are much higher than the national benchmark price for oil adopted during the preparation and adoption of the budget for the year in question.

The fall in oil price that occurred in the middle of 2014 created a huge problem because of the negative impact it had on Nigeria's economy and on the economies of other developing countries that are heavily dependent on oil exports. The implications for our nation included a fall in GDP from over \$500Billion in 2014 to about \$480Billion in 2015, and \$405Billion in 2016, representing continuous falls of about 15% in both years.

Nigeria unarguably has the most extensive economy in the African continent, but because of the petroleum resources-based mono-economy that we operate, the country's progress both in terms of economic growth and development has been hindered. What makes the country's case more pathetic when compared with that of other oil exporting countries is the fact that other natural resources of economic significance also occur within the country, e.g. coal, iron ore, lead/zinc, gold, columbite and tantalite, etc. The export of commodities like cocoa, timber, cotton, groundnuts, and oil palm products in the past used to significantly contribute to the nation's revenue. Today these commodities and goods have collectively largely lost their place as important foreign exchange earners.

With continuous, unpredictable downfall of oil prices, and the desire of many industrialised nations to switch from oil and other fossil fuels to alternative sources of clean energy, the call for economic diversification in our nation has now become long overdue. Food and raw material production are popular the topics of discussion among many concerned citizens and experts, with the major argument being that Nigeria should at least, be able to feed herself from food produced locally rather than importing rice, grains, sugar, etc., from abroad. Adequate production of staple foods locally would also ease the regular demand for the foreign currency required to import food items from abroad. This would thereby reduce the

unsustainable pressure on the Naira, our local currency. There is an urgent need to diversify Nigeria's economy because our economic future in the 21st century clearly lies beyond revenues from crude oil and gas exports. Based on recent trends in the oil market, it has become imperative to harness Nigeria's total potentials to build a sustainable economy.

2. Major Problems of Nigeria's Oil and Gas Sector

1. Oil price volatility

There are a plethora of factors that affect the price of crude oil in the global oil market and these include OPEC quotas and the usual demand-supply scenarios, natural disasters (e.g. hurricanes, tornadoes, earthquakes, etc.), production costs, political instability, geopolitical tensions and events, and global pandemics (e.g. COVID-19). The first quarter of 2020 witnessed an unprecedented oil glut in world crude oil market due to the COVID 19 pandemic. Oil tankers loaded with unsold crude from Nigeria were stranded at open seas because of the fall in demand. In response to the market forces, the Federal Government of Nigeria revised its crude oil budget benchmark from \$57 to \$30 per barrel to accommodate the anticipated low-price regime. The revision meant a reduction in estimated revenue from the oil and gas sector falling by approximately 50% from over \$30 billion to approximately \$15 billion (Blazquez-Lopez, 2020).

Multinational oil companies operating in Nigeria in response to the low-price regime have also reviewed their capital expenditure (CAPEX) and operational costs (OPEX) to reflect current realities. Consequently, we have in the last many months been experiencing a significant reduction in rig counts, including exploration and production activities in Nigeria. The current volatility witnessed in crude oil prices since the onset of the COVID-19 pandemic is also leading to delayed or suspended final investment decisions (FIDs), particularly investments in exploration and development leading to new production. Several Nigerian deepwater offshore projects planned by some of the multinational companies, e.g. ExxonMobil, Total, and Shell are already being significantly delayed because of the drastically reduced profit margin or outright loss that their shareholders may suffer if the sub-\$50 a barrel crude oil price remains unchanged.

2. Problems Arising from the Non-Passage of the Petroleum Industry Bill (PIB)

The Petroleum Industry Bill (PIB) which seeks to promote best practices in the extraction and management of Nigeria's oil and gas is one of the oldest bills in the Nigerian Legislature and was first introduced in 2008 by the then President Umaru Musa Yar'Adua. Even the version eventually passed by the Nigerian Senate in May 2017, and by the House of Representatives in January 2018, and rechristened as the *Petroleum Industry Governance Bill (PIGB)* failed to get the assent of the Head of State, President Buhari. Though the President subsequently wrote to the National Assembly to provide the reasons for not assenting to the bill, the point being made here is that the remedies and gains that the passage and subsequent operation of the bill sought to provide to the industry and to the nation still remain elusive. The transparency and accountability in the administration of the petroleum resources of Nigeria which the PIB is expected to bring about, and the more conducive business environment for petroleum industry operations that should come into being with the bill remain costly dreams left for the future.

3. Oil Theft and Pipeline Vandalism

Crude oil theft and the sabotage of crude oil, facilities and installations in the form of illegal bunkering, fuel scooping, illegal refining and transport, and pipeline vandalism are also serious problems facing the oil and gas sector in the country. Revenue from oil exports has continued to dwindle in recent times due to these activities which sometimes can culminate in the loss of up to 400,000 barrels of oil per day. These challenges are forcing some of the multinational companies to consider divesting due to the deteriorating security situation in Nigeria, higher costs and exploration charges, as well as the lack of certainty due to the lack of passage of the Petroleum Industry Bill. Furthermore, the discovery and subsequent production of shale oil and shale gas in the United States of America in the last decade have shattered the once impregnable notion that Nigeria would always have a viable market for its crude oil exports in the US.

3. Nigeria's Economic Recovery and Growth Plan (ERGP) 2017-2020 – A Positive Ameliorative Action with Limited Results

Successive governments in Nigeria have in the past tried to introduce measures aimed at improving the resilience of the nation's economy and making it less vulnerable to external shocks, especially those that occur when crude oil prices drop sharply in the international

market. Previous attempts to diversify the economy of the country and wean it away from over-dependence on revenues from the oil and gas industry have so far yielded little results. Some of these previous attempts or programmes include President Obasanjo's *Vision 20-20*, the *Seven-Point Agenda* of the Umar Musa Yar'Adua administration (2007), the *National Industrial Revolution Plan* (2014) and the *Nigeria Integrated Infrastructure Master Plan* (2014) both of the Goodluck Jonathan administration, the Muhammadu Buhari government's *Strategic Implementation Plan for the Budget for Change* (2016), and their recent *Economic Recovery and Growth Plan* which was launched in 2017. Whilst some of these initiatives achieved varying degrees of success, implementation across board has always been challenging.

The need for an economic recovery plan for Nigeria's development became imperative when the country's economy entered into a recession in the second quarter of 2016 and continued throughout 2016 to the first quarter of 2017, with data from the *National Bureau of Statistics* (NBS) Q1 2017 showing GDP growth of -0.91%. The sharp decline in oil prices and production volumes were responsible for the recession and the inability of most State Governments in the country to pay workers' salaries and meet up with other key expenditure/investment needs. The recession was made possible because of the nation's economy is heavily dependent on crude oil sales, which as stated earlier account for over 90 percent of our foreign exchange earnings and close to 70 percent of all government revenues.

Nigeria's slump into recession for the first time in 25 years following the sharp fall in oil prices from highs of about \$112 a barrel in 2014 to below \$50 in 2016, made it imperative for the government to roll out an economic plan targeted at propelling Nigeria back to sustainable, accelerated development and restoring economic growth. In response to the need to lay a solid foundation for the economy and to get it out of recession, and restore economic growth, the government of President Muhammadu Buhari on 7th March 2017 released the *Economic Recovery and Growth Plan (ERGP)*, a medium term plan (2017- 2020) designed to build on the *Strategic Implementation Plan (SIP)* earlier developed for the government's 2016 budget.

The *ERGP* was developed for the purpose of restoring economic growth while leveraging the ingenuity and resilience of the Nigerian people. At the time the country entered into an economic recession in 2016, the government recognized that the economy was likely to

remain on a path of steady and steep decline if nothing was done to change the negative trajectory. It was in this context that the plan was developed to tackle the causes of the recession and ultimately change the national economic trajectory in a fundamental way.

The *ERGP* in my opinion was well thought out and was aimed at strengthening economic diversification by focusing on three broad objectives: -

- i. Restoring sustainable growth;
- ii. Building a globally competitive economy;
- iii. Investing in human capital development.

The plan was structured to leverage private sector participation through the creation of an enabling policy and business environment to attract private sector capital targeted at infrastructure development and industrialization (Onuoha, 2018).

In order to achieve these objectives, the *ERGP* was expected to utilize **Science, Technology and Innovation** to drive growth. It also provided a blueprint for laying the foundation for future generations by focusing on building the capabilities of the youths of Nigeria to be able to take the country into the future. On paper, the plan had provisions for tackling impediments to economic growth in Nigeria, especially *fuel scarcity, unstable power supply, high cost of transportation, scarcity of foreign exchange, unfriendly business regulations, and shortage of requisite skills and appropriate technology.*

The plan prioritised job creation through the adoption of jobs and skills programmes and encouraging procuring made-in-Nigeria goods produced using local content and labour-intensive production processes. It was envisaged that capacity building and skills acquisition interventions would be targeted at youth-dominated sectors such as ICT, creative industries, and services. Moreover, concerted efforts were to be made to encourage youths to venture into other labour-intensive sectors such as agriculture and construction. With the year 2020 almost coming to end it can be seen that a good number of the objectives of the of the *ERGP* are yet to be attained. The youth restiveness of recent times has many remote and immediate causes, some of which include unemployment and under employment, issues that the *ERGP* was supposed to help address.

Following up with the launching of the ERGP, the President of Nigeria issued an *Executive Order No. 5* in February 2018 which can be summarized as follows:

- (i) Nigeria has to move away from being a nation whose economy depends nearly totally on imported technologies and industrial goods (capital, consumer items and industrial materials) to a technology/industrial goods producing and manufacturing nation for both domestic use export;
- (ii) Nigeria's domestic Science and Technology activities should become instruments for transforming our economy from one based on the export of primary agricultural and commodity/primary raw materials (including solid, liquid, and gaseous minerals) to a globally competitive Industrial Economy, capable of producing, manufacturing and exporting modern technologies and industrial goods; and
- (iii) Nigeria should now be in a position to use domestic **Science, Technology and Innovation** (STI) activities as a key instrument for realizing the nation's Economic Recovery and Growth Plan, 2017-2020.

Even as the Government's ERGP comes to an end with a good number of the objectives yet to be fully realised, the President's *Executive Order No. 5* issued in 2018 underpins the importance of STI in positively impacting the economic development of a country.

4. Knowledge-Based Economy as the Way to a Prosperous Future for Nigeria

The New Generation of Entrepreneurs

The month of October 2020 will be remembered in Nigeria for many of the events that took place within that month, particularly for the #EndSARS protests and the fallouts therefrom. An important and cherry news that many Nigerians may have missed within the same period has to do with the acquisition of a relatively young, but vibrant Nigerian start-up company called *Paystack* by an American company *Stripe* for an amount reported to be in excess of \$200Million. *Paystack* is a technology company solving payment problems for business enterprises. The company enables their clients to accept payments from customers using different payment channels such as cards, mobile money accounts, QR codes, directly from their bank accounts and currently has around 60,000 customers (Lunden, 2020). Their customers include small businesses, larger corporate organisations, fintechs, educational

institutions, and online betting companies. The acquisition of *Paystack* by its new owner is presently the biggest start-up deal to date to come out of Nigeria.

The important point to note here in this story about *Paystack* is that this online payment processing start-up was co-founded in Lagos just about five years ago by two young Nigerian software developers and long-time friends, Shola Akinlade and Ezra Olubi who have now made history through this deal. There are many other young entrepreneurs in Nigeria today who are doing very well especially in ICT development with their own start-ups that are not only also attracting international attention but are also gradually becoming quite profitable as business enterprises. It is therefore possible through the creation of the right political, fiscal and educational environment in the country to diversify our economy and generate revenues to fund our national budgets even in the midst of dwindling incomes from crude oil and gas sales. This is certainly one important way of moving away from the commodity sale/raw material mentality and reversing the so called “resource curse” that the nation seems to be locked under.

Generally speaking, the global economic history has witnessed transformation from agriculture based to manufacturing based economics over time with the new global economic trend being towards the knowledge-based economy. This component of the economy relies greatly on intellectual capabilities instead of natural resources or physical contributions. In the knowledge economy, products and services that are based on intellectual expertise advance technical and scientific fields encouraging innovation in the economy of a nation. Nigeria’s greatest asset to champion an economic revolution lies in our growing young population. The country has all it takes to be at the forefront of knowledge economy in Africa. Many other developing countries have moved beyond the era of economic dependence on natural resources, so it is time for Nigeria to maximize the knowledge and thinking skills of the young population to move the economy forward. Our political leaders need to recruit strategic and competent thinkers who will properly map out ways and means to improve the knowledge and skill of Nigeria’s large young population. This is particularly true because of the problems besetting the Nigerian oil and gas industry today which if they remain unresolved will continue to adversely affect revenues accruing to the country from this sector.

The Crucial Role of Science, Technology and Innovation (STI)

It is safe to conclude from what we know today that the active integration of a national culture of **Science, Technology and Innovation** (STI) will facilitate an era of economic growth and development, driven by technological advancement. For Nigeria, in spite of our overarching potentials in STI and the availability of more than 100 R&D Institutes and Centres, some 173 Universities with Faculties of Science, Engineering and Technology, and some 110 public and private Polytechnics, Nigeria has not attained any appreciable capacity to translate the outcomes of its R&D in these institutions into desirable outcomes.

We have in recent times continued to witness a sharp decline in economic growth resulting in large scale unemployment, excruciating poverty and an almost comatose manufacturing sector. Our industrial manufacturing sector now contributes only a mere 8.55 per cent to the GDP while many technologies that we require to sustain our domestic economic activities are presently imported from the industrialized nations like China and South Korea. The total reliance on imported foreign developed technologies and foreign consultants and contractors for executing Nigeria's infrastructure project such as road, power and water supply, transportation, besides being extremely costly is also responsible for our inability to maintain them.

The United Kingdom and France benefited immensely from the industrial revolution in the 19th century while the United States of America emerged from an agrarian economy in the 19th century into an industrial superpower in the 20th century through science and technological adaptation and innovation. More recently, Taiwan and South Korea have exploited advances in microelectronics to emerge as leaders in that area while China and India have become industrial leaders in manufacturing and information technology, respectively.

Malaysia and Singapore have also followed in the footsteps of these later Asian successes, demonstrating clearly that STI do really provide an escape from the limitations of being a country that is poor in natural resources endowment to one with much larger increases in productive power. Indeed, the "developed countries" in a sense can be said to be those that have tended to successfully confront their environmental problems and deficiencies in the endowment of natural resources to their own advantage through the effective use of STI. On the other hand, underdeveloped and poor countries, like many in South-Saharan Africa, are today still marked by low levels of STI-driven development and the absence of effective

control over their physical environment. Most of these countries are still harbour some of the poorest populations in the world despite being rich in natural resources and exporting various commodities required by the developed nations.

It is important to note that the achievements of nations like China, India, Brazil, South Korea, Singapore, and Malaysia in the last 50-70 years were made possible through massive investments in people, factories and infrastructure. The successes achieved were all based on carefully designed roadmaps of plans and strategies. Unfortunately, in many African nations, technology is more often seen or viewed as a consumable item, and not something that can be produced or created, a notion that is clearly incorrect as is being shown now by our smart young entrepreneurs. Essentially, technology is the primary engine of economic growth and is the key and fundamental requirement for value addition to raw materials and people and provides the key to unlocking any country's potential in terms of decreasing overhead costs and creating employment opportunities. Therefore, the need for countries with the intention of developing to invest significantly in science and technology cannot be overemphasized. This is achieved by developing the human capacity required to compete in a globally competitive world of today.

The whole purpose of national development is to continuously build up the capacity of a nation to grapple with the whole gamut of national problems attendant on human existence, e.g. poverty eradication, provision of productive employment, and satisfaction of the basic needs of the people like food and shelter, basic education and health facilities, provision of clean water for the people, etc. The recent history of most developed and some developing countries around the world, has confirmed that STI constitute the organic link that connects all the various sectors of the national economies such as Agriculture, Health, Education, Commerce and Industry, Environment, etc. STI tools provide the platform that drives the potentials within these sectors through Research and Development (R&D) programmes, modern product techniques and processes, development of pilot plants, commercialization of research results, etc. It was the famous Chinese leader, Jiang Zemin, who in an address to his people in 1999 said and I quote: *"In today's world, the core of each country's competitive strength is intellectual innovation, technological innovation, and high-tech industrialization."*

In the knowledge economy which is where we should be heading into, the production of goods and services is based primarily on activities that are knowledge intensive; activities

that contribute to a rapid pace of advancement in technical and scientific innovation as displayed by the young men who founded Paystack. The key element is the greater dependence on human capital and intellectual property for the source of the innovative ideas, information, and practices. In such an economy there is less reliance on physical input and natural resources, like oil and gas. A major feature these economies is a highly skilled workforce within the microeconomic and macroeconomic environments with institutions creating jobs that demand specialised skills in order to meet the global market needs. A knowledge economy stands in contrast to an agrarian economy, in which the primary economic activity is subsistence farming for which the main requirement is manual labour or an industrialized economy that features mass production in which most of the works are relatively unskilled (Wokutch, 2014).

In a recent news report the Honourable Minister of Science and Technology, Dr. Ogbonnaya Onu, FAS, said, and I quote: "It has become clear that a nation that desires to develop, modernise her economy and remain competitive, must embrace knowledge, especially, scientific and technological knowledge". What then is the challenge? You might want to ask. Dr. Onu went on to say, "The need to move from resource-based economy (oil-based) to knowledge-based economy is necessary now more than ever before, considering the dwindling crude oil prices that has put the Nigerian economy at risk." This is situation has made it important and urgent for Nigeria to diversify her economy to help her withstand any future collapse arising from the decline in commodity prices at the international market". Nigeria needs to use its oil proceeds to develop other sectors of the economy, while also building a knowledge-based economy.





















Building a Knowledge-Based Economy: Lessons from other nations

Building a knowledge-based economy for any country begins with the vision of its leaders. Visionary leaders will create enabling environments that will enable ideas and innovation to grow. Below is an excerpt from a speech that captured the vision of the Dubai Leader, His Highness Sheik Mohammed bin Rashid Al Maktoum, Vice-President and Prime Minister of the UAE on Saturday, December 14th 2019 who said that the year 2020 would be "the turning point" in his country's history. "In the next fifty years, we will prepare all sectors of the economy for the post-oil phase. We will build a true knowledge economy based on innovation and creativity" (Katampe, 2020).

The successful transition to knowledge-based economy and developing the country as a knowledge-hub depends on the key contribution from higher education institutions. For this, special emphasis needs to be placed on the development of educational infrastructure, curriculum, research, innovation, as well as on the improvement of generic skills (e.g. communication, teamwork, leadership, planning and organising, self and stress management, analytical thinking and enterprise skills) and enhancement of the use of technology in teaching and learning process, including online and distant learning.

An important indicator of a nation's capacity for innovation is the number of patent applications. These patents in turn drive innovation and translates to the knowledge-based economy. The Table below shows the number of patents by African countries between 2015 and June 2020.

Table 1 Patents from Major African Countries (2015-June 2020)

| TOTAL PATENTS IN USPTO (PATENT) | | | | | | | | |
|---------------------------------|--|---|---|---|---|---|---|---|
| | | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 [June] | |
| 1 |  South Africa | 145 | 147 | 136 | 129 | 149 | 62 |  |
| 2 |  Egypt | 13 | 13 | 11 | 16 | 10 | 9 |  |
| 3 |  Angola | | | 3 | 1 | 6 | 3 |  |
| 4 |  Morocco | 5 | 0 | 2 | 8 | 1 | 1 |  |
| 5 |  Nigeria | 0 | 1 | 3 | 0 | 0 | 1 |  |
| 6 |  Algeria | 1 | 1 | 1 | 2 | 0 | 0 |  |
| 7 |  Tunisia | 2 | 2 | 3 | 0 | 2 | 0 |  |
| | |  |  |  |  |  |  | |

(Source: United States Patent and Trademark Office, USPTO)

Tables 1 and 2 reveal the gap between Nigeria and leading African countries like Egypt and South Africa in terms of R&D efforts and production or filing of intellectual property rights. In Table 2 the difference is also clear when we consider strides made by countries like South Korea, Singapore, India, Thailand, Iran, the UAE, Malaysia and Vietnam.

Table 2 Patents from Major Asian Countries (2015-June 2020)

TOTAL PATENTS IN USPTO (PATENT)

| | | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 [June] | |
|----|-------------|--------|--------|--------|--------|--------|-------------|--|
| 1 | Japan | 55,351 | 52,961 | 53,365 | 50,944 | 57,465 | 27,862 | |
| 2 | China | 8,706 | 10,975 | 14,038 | 16,101 | 22,294 | 12,400 | |
| 3 | South Korea | 20,703 | 22,618 | 23,539 | 22,764 | 24,743 | 12,288 | |
| 4 | Taiwan | 13,179 | 12,823 | 12,603 | 11,618 | 12,412 | 6,038 | |
| 5 | Australia | 1,534 | 1,405 | 1,536 | 1,549 | 1,764 | 918 | |
| 6 | Singapore | 1,662 | 1,865 | 1,905 | 1,791 | 2,029 | 916 | |
| 7 | India | 897 | 909 | 1,045 | 1,036 | 1,218 | 601 | |
| 8 | New Zealand | 280 | 274 | 299 | 319 | 375 | 182 | |
| 9 | Thailand | 57 | 52 | 73 | 74 | 115 | 73 | |
| 10 | Iran | 31 | 29 | 40 | 54 | 87 | 60 | |
| 11 | UAE | 52 | 65 | 93 | 85 | 116 | 55 | |
| 12 | Malaysia | 93 | 106 | 99 | 102 | 77 | 49 | |
| 13 | Indonesia | 7 | 10 | 5 | 3 | 6 | 7 | |
| 14 | Vietnam | 7 | 13 | 10 | 15 | 15 | 6 | |
| | | | | | | | | |

(Source: United States Patent and Trademark Office, USPTO)

Lessons from South Korea

South Korea utilized STI through R&D to grow from one of the world's poorest countries to one of its most promising industrial powers within the span of a generation. Korea's metamorphosis from a stagnant agrarian society in the 1960s to become one of the thirteen largest economies in the world today stems from the country's ability to carve out a niche for itself in such technology areas as semi-conductors, LCD, telecommunication equipment, automobiles, ship-building among others. The country launched the *First Five-Year Economic Development Plan* in 1962 in which a huge demand for new technologies was among the key strategy (Akinwale, et al., 2012). They sponsored a lot of their citizens to study science and technologically related courses abroad after which they returned to Korea to develop domestic absorptive capacity to digest, assimilate and improve upon the transferred technologies.

South Korea also opted for long-term loans to finance industrial investment which engaged in crucial R&D activities. The government created so many research institutes, such as the *Korea Research Institute of Chemical Technology (KRICT)*, the *Korea Ocean R&D Institute (KORDI)*, the *Korea Institute of Machinery and Metals (KIMM)*, the *Electronics and*

Telecommunications Research Institute (ETRI) among others, to work with private industries in building technological and innovation foundation for industrial development. In 2011, the country's R&D allocation was US\$ 52.7 Billion which was approximately 3.95% of the World's expenditure on R&D for that year. This figure represented 3.4% of R&D expenditure as percentage of the national GDP. Little wonder that South Korea was No. 24 on the 2011-2012 Global Competitive Index (GCI), No. 14 in Scientific Publications and had several universities listed among the world's top 500 universities. The GCI for Nigeria during the same period (2011-2012) was 127! In 2018 South Korea's R&D expenditure as a percentage of the GDP had gone up to 4.81 per cent, making it one of the highest in the world.

Lessons from the Case of Israel.

The modern Israel has invested heavily since it was established in 1948 in human capital development, particularly in higher education with the following outstanding results: -

- The Middle East has been growing date palms for centuries. The average tree is about 18-20 feet tall and yields about **38 pounds** of dates a year. Israeli date trees are now yielding **400 pounds/year** and are short enough to be harvested from the ground or a short ladder (Shevel, 2012).
- The cell phone was developed in Israel by Israelis working in the Israeli branch of Motorola, which has its largest development centre in Israel.
- Most of the Windows NT and XP operating systems were developed by Microsoft-Israel. The Pentium MMX Chip technology was designed in Israel at Intel (Research Centre of Intel in Israel).
- Both the Pentium-4 microprocessor and the Centrino processor were entirely designed, developed, and produced in Israel.
- Twenty-four percent of Israel's workforce holds university degrees, ranking third in the industrialized world, after the United States and Holland, while 12 per cent hold advanced degrees.
- Israel has the highest ratio of university degrees to the population in the world.
- Both Microsoft and Cisco built their only R&D facilities outside the US in Israel while Google and Intel also have established major research centres in Israel.

Israel is a country located in a particularly challenging geographical environment and has consistently suffered diplomatic isolation in the Middle East since independence (1948). The

isolation of the country from her neighbours became beneficial since they had to search for new business opportunities outside the Middle East. Increased competition with developed economies in Europe and North America led to intense technological investments in Communication, Computer Science, Engineering and Software, with clearly visible results. Today, Israel's economy is larger than that of all of its immediate neighbours put together. A country that is so deficient in natural resources (gas discoveries were only recently made - Shevel, 2012) and acute shortage of fresh water successfully tackled these disadvantages by investing heavily in education and in capacity building and developed strong and well financed R&D activities and institutions.

A Closer Look at the Nigerian Situation

Despite Nigeria's huge population, the largest on the continent with over 200 million people and high earnings from crude oil export, our nation ranks low in terms of investment in STI, while our higher education sector, one of the foundation areas for Science, Technology and Innovation research, have over time degenerated in quality, forcing many of its citizens to seek for higher knowledge outside the shores of the country. The nation's commitment to STI has been perceptibly extremely low. R&D activities have not been given any serious attention by successive Nigerian governments. The poor devotion of government expenditure to R&D can be attributed to abundant of natural resources in the country. The country shifted from agrarian economy in the 1960s to the current petroleum economy while the country's R&D allocation has remained relatively insignificant when compared with the R&D expenditure profiles of the advanced countries of America, Europe and some parts of Asia, e.g. South Korea as earlier discussed. Consequently, the national R&D capabilities have been undermined by chronic underfunding. The 2019 budgetary allocation to the Federal Ministry of Science & Technology with seventeen R&D agencies under its supervision was a paltry N68.8 Billion which was 0.057% of the nation's budget for the year. The bulk of that allocation as in most other Government establishments was for personnel emoluments with little left for capital expenditure. As a result of the weaknesses and constraints that the Science and Technology sector has suffered, the Federal Government through the Ministry of Science and Technology developed a more concise, robust and workable STI policy which is expected to respond to the dictates of globalization, changing business environment and new/emerging technologies and thus provide for effective funding of R&D. The result of this relatively new policy shift should hopefully be seen to be beneficial in the years to come.

Recently, the Nigerian government decided to establish the long-awaited National Science and Technology Research and Innovation Fund for the development of science and technology in the country. This was the fallout of the National Science Technology and Innovation Policy earlier approved for the country by the government as a way of addressing the shallow funding for STI. This policy is fostered on a similar policy for the IT sector which eventually laid the foundation for the creation of the National IT Fund fed by law by 1% of after profit contributions of all operating IT companies in the country. If eventually backed by an Act, the NSTRIF is expected to provide funding for STI in much similar way as the National IT Fund. The need for the creation of this Fund was championed by the Nigerian Academy of Science along with organized science related bodies and the National Office for the Technology Acquisition and Promotion (NOTAP).

Advances in STI can help to diversify the economy, by improving productivity in sectors like agriculture, while defining new ones. Productivity in Nigeria's agricultural sector – which contributes about 40 percent of our GDP and employs more than half our workforce – remains low. Yield per hectare is 20 to 50 percent of what is obtained in similar developing countries. In fact, Nigeria is food insecure since we spend more than \$10 billion annually on food imports. According to the *National Planning Commission* (2017) the “*Nomura Food Vulnerability Index*” ranks Nigeria as the 4th most vulnerable country to global food price shocks, out of 80 countries. We lack the right plant varieties and storage systems to be efficient. Yet global experience shows that with the right investment in STI for agricultural processes, output can rise quickly.

Malaysia, for example, laid emphasis on R&D to develop higher yielding oil palm varieties. Today, they control 40 percent of world oil palm products trade valued at \$18 billion. Thailand leveraged agriculture to backward-integrate into value-adding manufacturing processes and achieved one of the world's lowest unemployment rates at 1.2 percent in 2010. With aggressive investment in agriculture, Vietnam and China took 40 percent of their population out of poverty in 10 years. These achievements can and should be replicated here in Nigeria.

The World Bank's Road to a Knowledge-Based Economy

There is a wide spectrum of factors, which are relevant to the knowledge economy. The World Bank has identified four key aspects of an economy, which are regarded as the pillars

of the knowledge economy (World Bank, 2007). It is expected that these pillars would help countries like Nigeria articulate strategies for their transition to a knowledge economy.

- i. The first is a conducive environment that provides the needed regulatory framework to stimulate and promote enterprise development through knowledge creation, dissemination, and use. The process of knowledge creation and diffusion in a knowledge-based economy heavily depends on appropriate government policies that are usually the outcome of economic incentives and institutional regimes. By implication, improving regulatory quality, and improving the rule of law will influence how quickly individuals can identify and exploit market opportunities to create wealth, jobs, and economic growth.
- ii. A proper, well-educated and skilful population (as we have seen from the case of Israel) is very important in the creation, acquisition, spreading and utilization of important knowledge, that tends to increase the total factor of production which result in economic growth. Basic education is important to increase people's capacity to learn and use the information for knowledge-based economy development. Technical education at the secondary school level and higher education in engineering and scientific areas is inevitable for technological innovations. The production of new knowledge and technology is a product of teaching and research and university research usually accounts for large share of domestic R&D in most countries.
- iii. Access to ICT infrastructure facilitates the effective communication, dissemination, and processing of information. The infrastructure strength and coverage of the telecommunications sector is revealed in the number of people with ability to use computers, with access to internet and the mobile telephony subscriber base. Number of internet users serves as an indication of how well a population has advanced to the level of adapting and using advanced communication channels to serve its priorities.
- iv. An effective innovation system that allows for close relations among knowledge institutions (R&D institutes and universities) and firms with which they can tap into the growing stock of global knowledge, adapt it to local needs, and create new technological solutions.

How prepared are we now as a nation to follow these well-articulated guidelines? I believe that we can start with making every effort possible to lay better emphasis on education than is being done presently. According to the late Professor Ukeje (who with the legendary

educationist, Prof. Babatunde A. Fafunwa founded the first Faculty of Education in the country at the University of Nigeria, Nsukka some sixty years ago), I quote: “Education is power, it is a process of acquiring knowledge and ideas that shape and condition man’s attitude, actions and achievements; it is a process of developing the child’s moral, physical, emotional and intellectual power for his contribution in social reform; it is the process of mastering the laws of nature and for utilizing them effectively for the welfare of the individual and for social reconstruction; it is the art of the utilization of knowledge for complete living”.

According to Nelson Mandela, former President of the Republic of South Africa, “Education is the most powerful weapon which you can use to change the world”. Let me add another final quote here from Kofi Annan, former Secretary General of the United Nations, who in 2003, speaking about our universities said: “The university must become a primary tool for Africa’s development in the new century. Universities can help develop African expertise; they can enhance the analysis of African problems; strengthen domestic institutions; serve as a model environment for the practice of good governance, conflict resolution and respect for human rights, and enable African academics to play an active part in the global community of scholars’.

These quotations have been reproduced here to emphasise the importance of education generally in the life and development of any nation. A nation that pays the right attention to science education among her young citizens will obviously be laying a solid foundation for the growing of a future population that will embrace a science-based culture and a knowledge economy. The challenge before our nation, Nigeria is how to meaningfully embark on human capital development and through the improvement of our educational system and training, particularly in science and mathematics, develop a high quality labour force that can prosper in the global information economy. The quality of our educational system is sadly not good enough. Our educational system has deteriorated to a point where students cannot acquire the necessary skills that they need to become employable or innovative in an ever-changing world, upon graduation.

Our higher educational institutions are plagued with inadequate science and technology facilities and materials for practical skills development. Many laboratories lack the basic equipment for thorough scientific research. How, for example, can a computer science graduate not understand the basics of writing software codes? Nigeria is churning out

thousands of science and technology graduates each year, but several of them are under-employed, going into banking and other non-scientific sectors. The problems of the university system in Nigeria constitute a story for another day and so cannot be dealt with here. It is common knowledge that virtually all publicly owned universities (which in Nigeria harbour the bulk of the country's university students) have remained closed to students for over seven months. We must leave no stone unturned to resolve the issues at stake that have brought this situation about.

On the issue of creating the right regulatory framework to spur innovation, we must also take a critical look at how other nations established their own in order to bring about the system that they now have in operation in their own countries. During the late 1970s a technological malaise appeared to have befallen the United States of America with a nation like Japan virtually snuffing out the famous steel mills of Pittsburgh, driving the established car makers of Detroit off the road, and beginning a serious assault on Silicon Valley. The sale of Japanese cars and electronic wares boomed all over the world threatening markets previously dominated by the Americans, who suddenly woke up as it were from a trance and introduced legislations that within a decade turned things around for them.

The *Bayh-Dole Act* introduced in 1980 is what appeared to have pulled the trigger, giving rise to a new environment for innovation and intellectual property (IP) exploitation that ushered in quick results. The Japanese industry was beaten back in retreat while many European companies suddenly found it necessary to begin investing massively in many sectors of the U.S. economy. The Bayh-Dole Act of 1980 allowed universities and government owned research institutes to claim ownership of the IP developed from U.S. federally funded research and to retain the royalties. The new law also allowed universities and similar R&D centres to grant licenses including exclusive licenses which produced significant results for the U.S. economy. The results came through increases in patents filed by universities with millions of dollars raked in as royalties, and many company start-ups and spin-offs.

The Bayh-Dole Act has been a tremendous success considering the fact that between 1996 and 2015, the licensing activity that the act spurred in the USA contributed close to \$591 Billion to the U.S. GDP and supported an estimated 4.2 million jobs in that country. In 2016 alone, more than 1,000 start-up companies were formed and nearly 800 commercial products stemming from university research were introduced just in the area of medical care to patients alone (Wilbur, 2019). *The Economist*, in its opinion page on the 14th of December

2002 described the Act as America's "Innovation's Golden Goose", and "possibly as the most inspired piece of legislation to be enacted in America over the past half-century". Together with amendments made in 1984 and augmentation in 1986, this piece of legislation unlocked all the inventions and discoveries that had been made in laboratories throughout the United States with the help of taxpayers' money. According to the *Economist* this single policy measure helped to reverse America's precipitous slide into industrial irrelevance.

Urgently Needed: Propper Funding and Environment for R&D in Nigeria

The Hon. Minister of Science & Technology, Dr. Ogbonnaya Onu, about two years ago announced that the *National Research and Innovation Council* (NRIC) which was set up many decades ago has at last finally started holding meetings after being moribund or existing only on paper for nearly thirty years. What remained according to the Hon. Minister was the process of formalizing the body through a bill passed by the National Assembly. We are still waiting for such a bill to be passed into law because what Nigeria needs is a well-funded national body that gives grants for R& D purposes to those who need them and who meet the conditions required for such research grants. This is an issue that has repeatedly been canvassed over the years by Prof. Suleiman E. Bogoro (e.g. Bogoro, 2014, 2015) who is currently the Executive Secretary of the Tertiary Education Trust Fund (TETFund). The good news is that in partnership with regulatory bodies (National Universities Commission - NUC, National Board for Technical Education – NBTE, and the National Commission for Colleges of Education - NCCE), TETFund under Prof. Bogoro is currently midwifing the birth of the National R&D Foundation that will ensure a coordinated national framework for the sustenance and implementation of R&D. When established the Foundation will be expected to promote an effective interface between universities, Government, and the private sector in line with the "Triple Helix Innovation Model" (Bogoro, 2020).

Concluding Remarks

Our government must strive to maximize the social benefits from its investment in R&D and promote the commercialization of the R&D results in order to generate economic growth. Government through the establishment of the National R&D Foundation can create the policy space and enabling environment which would balance support for entrepreneurship at the universities and our research institutes and public access to research generated with public funds. The right balance is also needed for the management of Intellectual Property (IP) generated with government funding. The entrepreneurial activities of the universities should

not compromise the academic obligations of researchers. We need a coherent and consistent policy on publicly funded research. We need to channel public resources towards government's policy priorities for science, technology, education, and development of indigenous technological capacity in priority areas. There is need to also allow each university or research institution to develop its own policy on commercialization of research and distribution of benefits from patenting.

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