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Technology Transfer and Entrepreneurial Development in the Value Chain System of the Nigerian Oil and Gas Industry

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ABSTRACT

Since the discovery of oil and gas in Nigeria, the government over the years has endeavored to improve indigenous participation in the oil and gas industry through various instruments such as Indigenous Participation policies, Local Content policy, and the Marginal Field Development program. However, despite these interventions, it is observed that the industry is largely dominated by multinationals due to their expertise in technology. In a globalized business environment, technology transfer is a vehicle for bridging knowledge gaps and innovation deficiencies, especially in an industry with a rich value chain as with the oil and gas industry. This paper examines historical perspectives of technology transfer viz-a-viz the entrepreneurial development opportunities and challenges in the value chain of the Nigerian oil and gas industry (upstream, midstream and downstream).

By engaging a qualitative approach using content analysis, the study serves as a pivot upon which the extent of technology transfer could be assessed, and the connection between technology transfer and entrepreneurial development in the Nigerian oil and gas industry, while recommending a tri-dimensional framework for entrepreneurial pursuit in the value chain of the Nigerian oil and gas industry.

(Keywords: technology transfer, oil and gas entrepreneurship, value chain)

INTRODUCTION

The Nigerian oil and gas industry is pivotal to the economy. With the commercial discovery of oil in 1956, the then colony-nation depended totally on foreign technology to extract the natural resource for export and local use. Technologically, the industry is operated by subsidiaries of multinational firms such as Nigerian Bitumen Company, British Colonial Petroleum, Shell D'Arcy (later Shell-BP), Mobil Oil, Elf, Agip, and Phillips through foreign direct investment and multinational partnerships, especially after the independence of Nigeria from Britain.

The role of technology transfer in this all-important sector of the economy needs to be established for a number of reasons including developmental, operational, and policymaking. Hence, transfer of technology has been a subject of keen interest to researchers and policy makers due to the perceived close relationship between technology transfer and entrepreneurial development.

The objective of this study is to establish a relationship between technology transfer and entrepreneurial development in the value chain system of the Nigerian oil and gas industry. It has been established that expatriates have prerequisite knowledge that they may transfer to the indigenous engineers and investors to broaden their skills and open up investment opportunities. While not advocating for a full transfer of Western technology and knowledge to a developing nation (also an emerging economy) like Nigeria, in terms of policy development, the study proposes to establish a symbiotic approach

using the value chain system. This study adopts qualitative approach using content analysis of themes such as multinational dominance, technology transfer, value chain, and entrepreneurial development, as a pivot upon which the extent of technology transfer could be assessed.

TECHNOLOGY TRANSFER AND ENTREPRENEURIAL DEVELOPMENT

Technology Transfer

Technology transfer as a branch of knowledge transfer may be described as the process of transmitting and/or sharing skills, knowledge, innovation, technologies, and methods among governments, firms, research agencies and other institutions (Areish and Bardai, 2013). It ensures that scientific and technological developments are accessible to a wider range of users, who can then further domesticate, develop and exploit the technology into new products, processes, applications, materials or services (Liu, Yuan, and JiaqiXue, 2009).

Globalization, as a worldwide phenomenon, is also evident in the oil and gas industry's output and operations due to its technological sophistication and universal demand, hence the need for technology transfer. The oil and gas industry today is largely driven by modern technology that challenges the status quo and also pushes the boundaries of research. Today, the industry is so technologically developed such that actors never really "see" the product from the oil well to the refinery and to the vehicle tanks of the end user. Petroleum products are safely and efficiently produced and transported in a totally enclosed environment, (Liu, Yuan, and JiaqiXue, 2009).

In today's era of globalization, technology transfer is an operational vehicle for closing the gap in knowledge, ideas and innovations from one part of the world to the other, especially from developed to developing economies. Okeke and Ayonmike (2015) submitted that indigenous oil and gas firms must establish significant partnerships with international supply and service companies, with whom the international oil companies mostly do business, in order to provide goods and services with appropriate quality, pricing and reliability.

They further opined that in the process, the local industry will also obtain for itself the gradual transfer of comparable capacity and capabilities (that is local technical and vocational skills and competence) with its international equivalents, which will lead to the development of local capacity, skills, technology which can compete with its international equivalents locally and internationally and then optimally utilize the transfer of jobs to the local industry. Also, the substitution of local technology for foreign ones, and the reservation of certain industry operations will contribute to greater value to local craft and technology thereby adding greater value to the larger economy (Appendix II).

Clearly, mastery of the phenomenon of technology transfer and entrepreneurial development in Nigeria oil and gas sector is a desideratum as it were for navigating the various challenges indigenous operators face in areas such as the Nigerian content policy, the new modular refineries policy, environmental impacts of oil exploration and exploitation, fabrications of tools and even services such as insurance, legal, training, etc.

Momoh (2013) submitted that the necessary human resource capital required to achieve the 70% target of the Nigerian Content Government Policy, as at 2010, must include: stimulation of technology transfer, training in skills, mentoring and apprenticeship and upgrade of existing organizational and educational facilities. However, despite the passage of the Local Content bill into law in 2010, there exist some challenges in implementation.

Ozoro (2016), identified challenges such as uncertainties in the provisions of the Act, insufficient sanctions for breach, and exploitable lacunae in the Act. He submitted that Nigeria should focus on the development of indigenous technology and the requisite infrastructure needed to drive the industry and not rely completely on technology transfer from International Oil Corporations. Furthermore, efforts should be made to domesticate whatever technology that is imported. This will be in concordance with the United Nations Centre for Trade and Development (UNCTAD) code of conduct for the Transfer of Technology.

The Sino-Nigerian Experience

Research has established that foreign firms can act as catalysts for manufacturing development in domestic economies. China has emerged as a force to be reckoned with in technology, commerce, manufacturing, and construction. This fact is also enhanced by the non-alignment trade policy of the Chinese. China's potential as a development model for Africa and as an alternative source of trade and finance from Africa's traditional trade and development partners has influenced a growing literature and research. Chen, Sun, Ukaejiofor, Xiaoyang and Brautigam (2016) opined that China's African engagement and the mechanisms by which technology transfer can occur remain underexplored. They submitted that there is extensive evidence for the potential for poor countries to catch up with rich countries through the manufacturing sector.

With respect to China, there was no established systematic technology transfer, though the researchers saw evidence of technology and skills transfer in some of the firms observed. However, a number of cases were observed where foreign firms directly promoted skills transfer through both formal and informal trainings. Specifically, the automotive and construction showed significant practice of technology transfer. However, evidence of backward linkages between Chinese firms and the local economy was relatively low, which means this is not a promising mechanism for technology transfer (Chen, Sun, Ukaejiofor, Xiaoyang and Brautigam, 2016).

Multinational Dominance

The recent and ongoing discovery of crude oil in commercial quantities across the world portends grave danger for economies like Nigeria that are not only oil dependent, but also depends on the west and emerging Asian tigers for expertise in managing and tooling various industrial sectors. Akinwale (2016) observed that in order to tackle the impending danger, Nigerian government has already came up with local content policy and marginal field development that encourages the local investors and entrepreneurs to participate in the exploration and production of oil and gas resources.

At Independence, Nigeria lacked the required manpower, technology know-how, and diplomatic connections to independently explore crude deposits. Therefore different Multinational Firms such as Nigerian Bitumen Co. & British Colonial Petroleum, Shell D'Arcy (later Shell-BP), Mobil Oil, Elf, Agip, and Phillips dominated in the Nigerian oil and gas industry until 1973, when the Federal government signed the first participation agreement which ensures the acquisition of 35% shares in oil companies and subsequent increase in 1974 to 55% (Olopade, 2013) (Appendix I).

One would expect that after about six decades post-independence, Nigeria would become self-sustaining, however, factors such as policy summersault, military interruption in governance and corruption has ensured that the status quo remains and dependence on expatriates for the survival of the oil and gas industry continues (Iledare, 2008).

Akinwale (2016) stated that “once international oil companies (IOCs) discover oil which is easily and cheaply exploited with better fiscal regimes and friendly host environment in another country, they may abandon some of their fields in Nigeria so as to produce that of other oil provinces in another country that are more favorable to them. This will definitely affect the level of oil production, oil reserves, government take and developmental project execution” (Appendix V).

Intellectual Property

An important issue in entrepreneurial development in the oil and gas industry is that of intellectual property rights and patents. As it is with other sectors, issues of rights and patents are like the proverbial double edged sword. In the first instance, it protects indigenous technology from infringements while on the other hand it inhibits the use and adaptation of foreign technology.

Today, many companies, universities and governmental organizations now have an Office of Technology Transfer (OTT) dedicated to identifying research, which has potential commercial interest and strategies for how to exploit it, by working with and/or on behalf of research institutions, universities, governments and multinationals. (Areish and Bardai, 2013).

Due to the potential complexity of the technology transfer procedure, technology transfer firms are multidisciplinary, including researchers, economists, business analysts, engineers,

lawyers, marketers and scientists. To date, most indigenous firms in the oil and gas industry, and indeed, in the general economy of Nigeria are at the patent application stage (Appendix III).

Technology Acquisition Capability

Technology capability according to Marcelle (2005), in (Akinwale, 2016) is a collection of equipment, skills, knowledge, aptitudes and attitudes that offer a firm ability to operate, understand, change and create production processes and products. Zahra and George (2002) further opined that technology and innovation capability form the basis of absorptive capacity. They described absorptive capacity as consisting of four distinct capabilities:

A. Acquisition – the search for new knowledge;
B. Assimilation – understanding new knowledge;
C. Transformation – seeing how new knowledge can be used in the context of the firm's issues and existing knowledge; and
D. Application – implementation of actions enabled by the new knowledge.

The ability of indigenous entrepreneurs in the oil and gas industry in Nigeria to acquire modern technology rests on several factors including technical know-how, finance, maintenance ability and indigenous research. The capital intensive nature of the oil and gas industry makes technology acquisition in the industry a gigantic task and an exclusive preserve of the rich. However, while this is understandable, the poor maintenance culture and abysmally low research output in terms of patentable discoveries in technology raises questions and doubts on our acquisition capability (Appendix III).

Unlike what obtains in Higher Educational Institutions (HEIs) across the globe, Akinwale (2016), opined that the level of interaction between the academia and the oil industry in Nigeria was low due to factors such as poor funding, low commercialisation potential of university research and lack of entrepreneurial spirit amongst researchers. Akinwale (2016) further submitted that "for a country or an organisation to develop technology capability, such a country or organisation needs to firstly search for new knowledge, assimilate the knowledge, transform and apply the knowledge to solve local problems".

Findings by Abu (2014) revealed that inter-industry linkage among firms especially in the export processing sector is very low. In particular, the links between industry and universities was found to be dismally low in his study. He observed that key players in the academia and the industry strongly agreed that collaboration between the two was necessary, if the country were to catch up with foreign technology. Trust was reported to be a key factor for the poor linkage.

ENTREPRENEURIAL DEVELOPMENT

Entrepreneurship can be described as the cornerstone of the free enterprise economy (Popoola, 2014). Entrepreneurship can be described as including activities such as discovery, innovating, and exploitation of opportunities in other to overcome challenges, introduce new goods and services, develop better, efficient and effective ways of managing resources.

Bogoro (2015) stated that global development has entered a phase where entrepreneurship will increasingly play a more important role, adducing at least three reasons for this, with peculiarities to certain types of countries. Firstly, he identified the West, where the managed economy of the 1970s-2000s, characterized by dependence on big business and mass production, has given way to a perceived entrepreneurial economy. He stated that knowledge-driven goods and services are now more provided by smaller firms, and the emergence of a creative class.

Secondly, he identified the emerging countries, notably the BRICs – Brazil, Russia, India, and China where impressive growth was driven by a strong entrepreneurial revolution. He opined that "the need in these economies to sustain growth through sustainable access to resources, knowledge, markets, and low-carbon industrialization puts a premium on innovative entrepreneurship".

He concluded with the underdeveloped countries with a high aid dependency rate, stating that international donors have shifted the emphasis in development cooperation towards private sector development.

Nnadi (2014) opined that developed economies brought small-scale businesses to the front

burners of their national development at the critical phase of their respective developments. This can be attributed to the stable political climate in those countries and their greater receptiveness to change. He further stated that the policies and actions of their governments and their peoples were centered on the real sectors of agriculture and manufacturing whose development and growth were necessarily anchored on their small and medium scale enterprises- the SMES (Appendix IV). Nnadi (2014) also identified the strong political foundation of advanced nations that was defined by inclusivity and accountability, with the participation of their citizens as combined factors that propel entrepreneurial development.

Oil and Gas Entrepreneurship

The structure of the Nigerian economy resonates that of an underdeveloped country. More than half of the gross domestic product (GDP) is accounted for by the primary sector with agriculture playing a prominent role (Appendix IV). However, the oil and gas sector, in particular, continues to be a major driver of the economy. Chete, Adeoti, Adeyinka, and Ogundele (2013) opined that the sector accounts for over 95% of export earnings and about 85 per cent of government revenue between 2011 and 2012. In contrast, the industrial sector in Nigeria (comprising manufacturing, mining, and utilities) accounts for an insignificant proportion of total economic activity (6%) while the manufacturing sector contributed only 4% to GDP in 2011, Chete, et al. (2013).

Unlike the other forms of entrepreneurial pursuit, Oil and Gas entrepreneurship is largely capital intensive, especially in the upstream sector of the industry. Ihua, Olabowale, Eloji and Ajayi (2011), identified a general level of indifference by Nigerians to the entrepreneurial benefits inherent in the local content policy, with respondents prioritizing job opportunities and special quota arrangements to benefit indigenes of oil producing host communities. They further recommended judicious implementation of the local content policy for the benefit of indigenous entrepreneurs, host communities and multinational oil companies.

An important aspect of oil and gas entrepreneurship is that of Renewable Energy resources. Emphasis over the years has been on fossil fuel; however focus is gradually shifting toward renewable energy resources in the foreseeable future. Renewable resources imply sustainability of the natural environment. Non-renewable resources such as petrol, coal, oil and natural gas, diesel, and other commodities derived from fossil fuels cannot have a sustainable-yield, unlike a renewable resource.

As industries pay attention to renewable energy imperatives, as an off shoot of environmental concerns and agitations, it is important for countries that are oil dependent, like Nigeria, to have a strategic reappraisal. Using Canada as a case in point, the country cannot afford to be the follower in the Canada-U.S. As the case is with Canada, United States has always been the largest single buyer of the Nigerian crude, hence, the need for strategic reappraisal.

Value Chain

Petroleum is a key input in a wide variety of alternate industries, including plastics, fertilizer (agriculture), cleaning and laundry, and equipment manufacturing. Asides petroleum (popularly referred to as oil), gas is another fertile area in the Nigerian petroleum industry. Nigeria is an emerging gas super-power, having the world's ninth largest gas reserves, which if properly harnessed will bring forth growth, diversification and development to Nigeria through improved power generation, efficient gas-based industrial activities such as fertilizer plants and dams to boost agriculture and high value exports to bring revenue to the nation.

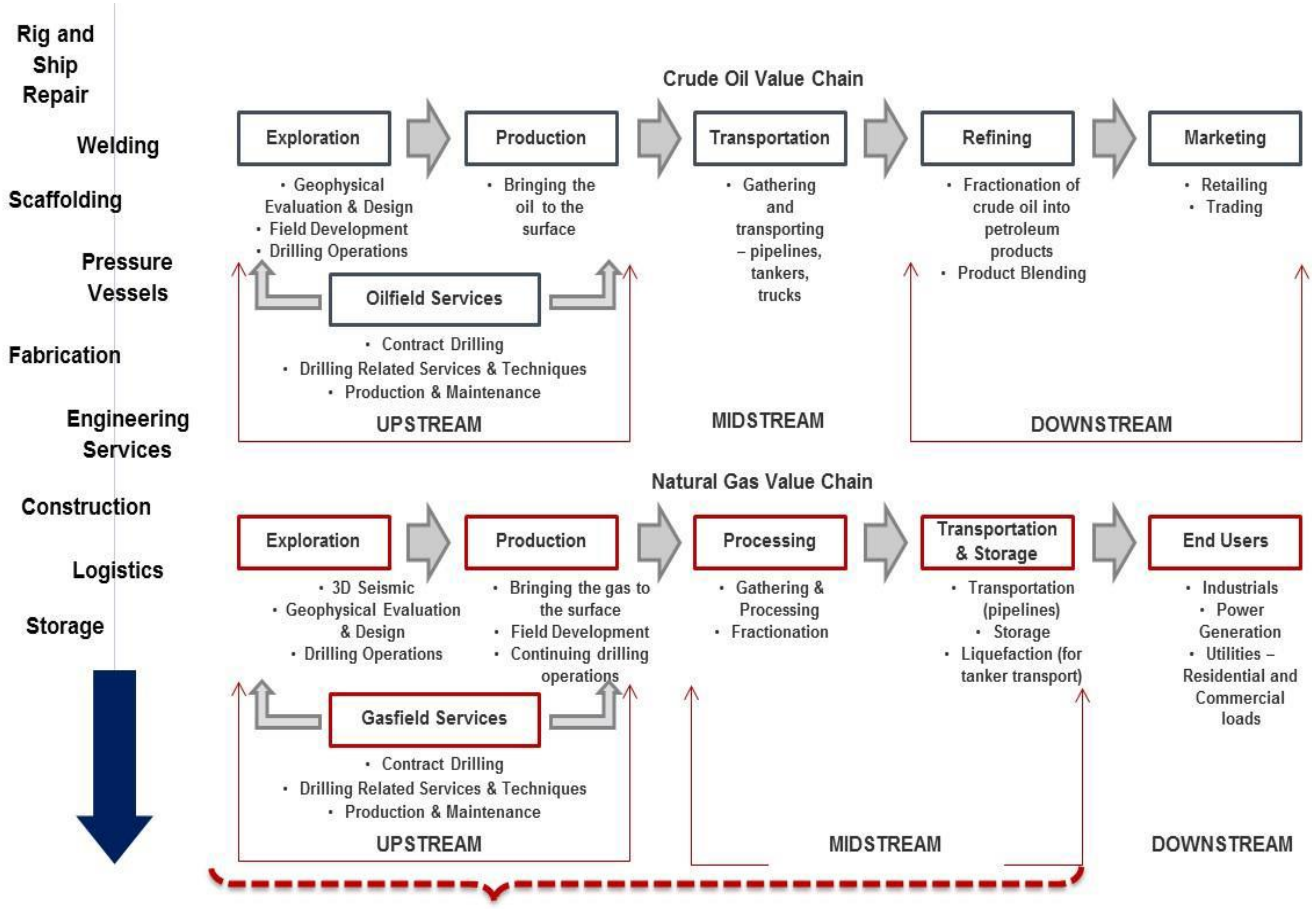
Melton, Hudson, and Ladislaw (2015) stated that most petroleum is consumed in its product form, and primarily in the transportation sector. The transportation sector accounts for about half of the oil consumed globally and 72% in the United States in 2013. Beyond the transportation sector, oil-derived fuels are sometimes used for electric power generation (oil accounted for 6% of electricity generation globally in 2013, but only about 1% of U.S. electricity generation in 2013), as well as in the petrochemicals, buildings, and agriculture sectors.

Melton et al. (2015), described crude oil as a fossil fuel which is the most widely used energy source in the world, accounting for 31% of total primary energy demand in 2012. Refined crude results in several products alternatives, including gasoline, diesel, kerosene, jet A4, and asphalt, among other products. Given its relevance as an

input resource in many industrial processes and its role as the world's primary transportation fuel, crude is extremely important to the global economy.

Further, the long-term pivotal role of oil prices to the economy (i.e., the causal effect of a change in oil price on a change in GDP) has been the subject of significant academic research and debate, but there is no gainsaying that crude oil influences and is influenced by economic growth, development, consumer spending, income, and inflation. Hence, given this background and the relativity of the objective of this study, an understanding of the value chain of this all important resource is necessary.

The oil and gas sector can be divided into upstream, midstream, and downstream segments. Upstream activities includes exploration and production; the midstream includes transportation from production wells to refineries through pipelines, trains, tankers, and trucks; while the downstream is comprises refining and marketing refined petroleum products. All segments of the petroleum value chain are capital intensive. Some companies specialize in just one component of the value chain, while others, called integrated companies, participate in all of them, (Melton et al., 2015).



Source: www.saoga.org.za

Figure 1: Oil and Gas Industry Value Chain.

OPPORTUNITIES AND CHALLENGES

Opportunities for Entrepreneurial Development in the Value Chain

Upstream Sector: This sector deals with exploration and production of crude oil and natural gas. The land-based operations in this sector are usually referred to as onshore, while operations on the sea are commonly referred to as offshore. As stated earlier, International Oil Companies (IOC's) are the major operators in the Nigerian Upstream Sector. They include Shell, ExxonMobil, Chevron, Total and Agip. Collaborative efforts of the Federal Government of Nigeria (FGN), through the Nigerian National Petroleum Corporation (NNPC) are carried out through Joint Ventures (JV's). Areas of opportunity for indigenous entrepreneurs in this sector include Geophysical evaluation and design, field development, Drilling operations, well to surface exploration, contract drilling and facility maintenance.

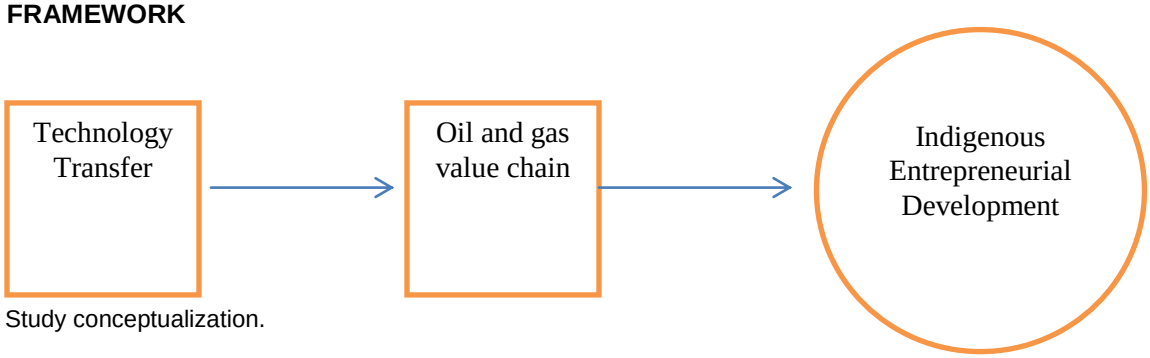
Midstream Sector: The midstream sector is the bridge between the upstream and the downstream sectors. It comprises of processes such as storage and transportation. The produce is transported from the production fields to the tank farms or ports for export, or alternatively to the refineries for processing. Areas of opportunity for indigenous entrepreneurs in this sector are largely in logistics such as gathering and transportation, tank farm management, liquefaction and fractionalization.

Downstream Sector: The major activities in this sector include refining of crude and marketing of the refined products. The Nigerian National Petroleum Corporation (NNPC) is the dominant player here through its government refineries and subsidiaries such as Pipelines and Products Marketing Company (PPMC). There are other investors who are categorized as either major or independent marketers depending on the volume of product they handle. Also, with the deregulation of the downstream sector, indigenous refineries such as Dangotes' are under construction. Areas of opportunity for indigenous entrepreneurs in this sector are largely in trading and retailing of petroleum products and by-products. Other entrepreneurial opportunities in the industry include Rig and Ship repair, Welding, Scaffolding, and fabrication.

Challenges for Entrepreneurial Development in the Value Chain

In addition to the primary challenge of technology transfer as discussed in this study, other problems mitigating entrepreneurial development in the value chain of the Nigerian oil and gas industry include policy inconsistency, funding, overregulation, security, refined fuel imports, underutilization and gas flaring. Ogundele and Abiola (2006) opined that the wide-spread unemployment in the Nigeria could have been minimized if Nigerians of varying age groups and backgrounds were exposed to entrepreneurial education, training and development. For Nigeria not to be behind the rest of the world in the 21st century, all hands must on deck to produce entrepreneurial education, training and development for the general populace.

STUDY FRAMEWORK



Source: Study conceptualization.

Figure 2: Tri-Dimensional Framework for Oil and Gas Entrepreneurship.

The study framework suggested above implies that where appropriate technology transfer is affected in the Nigerian oil and gas industry value chain, indigenous entrepreneurial development is bound to occur.

CONCLUSION

Despite the huge investment made by successive Nigerian government in the petroleum sector of the economy, the GDP growth has remained insignificant. The local content in the sector is still very low as over 65% of work value in the sector is carried out abroad, and where done locally, it is carried out by expatriates. This has directly led to dearth in skills development and competence with the attendant consequence on entrepreneurial development in the sector (Appendix II).

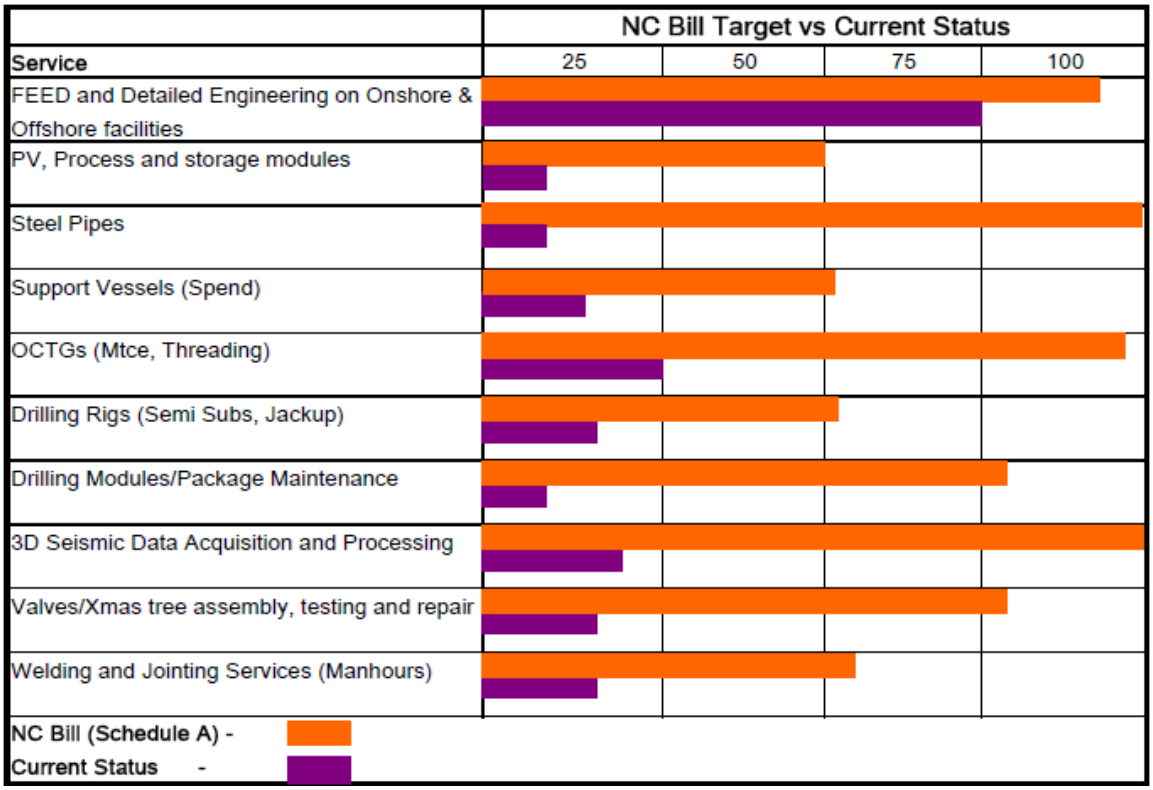
Technology and knowledge transfer in the various sectors of the industry will ensure a more robust value chain, and also translate into entrepreneurial growth for indigenous investors who are currently handicapped. Compliance with the local content act is a matter of legislation, which the enforcement may be unnecessary tedious. However, a symbiotic approach where multinationals see benefits of technology transfer may be more appropriate.

APPENDIX I: Equity Ownership in the Oil Industry.

Consortium	Shareholder	Operators	Production Barrels/daily	%
Shell Petroleum Development Company of Nigeria	NNPC (55%), Shell (Neth./GB (30%), Elf (France, 10%), Agip (Italy, 5%)	Shell	895,000	42.2%
Mobil Producing Nigeria Unlimited	NNPC (58%), Mobil (U.S.42%)	Mobil	450,000	21.2%
Chevron Nigeria Limited	NNPC (58%), Chevron (U.S.42%)	Chevron	395,000	18.6%
Nigeria Agip Oil Company (NAOC)	NNPC (60%), Agip, (Italy, 20%), Phillips (US, 20%).	Agip	160,000	7.5%
Elf Petroleum Nigeria Limited	NNPC (60%), Elf (France 40%)	Elf	130,000	6.1%
Texaco Overseas (Nigeria) Petroleum Company	NNPC (60%), Texaco (US, 20%), Chevron (US, 20%).	Texaco	55,000	2.6%
Other Producers	Ashland (US), Deminex (Germany), Pan Ocean (Switzerland), British Gas (GB) Sun Oil (US), Conoco (US) BP (GB), Stetoil (Norway), Conoil (Nigeria), Dubri Oil (Nigeria)	Various	35,000	1.7%
Total Nigeria			**2,120,0000**	**100%**

Source: Ekwere K. U. (2010)

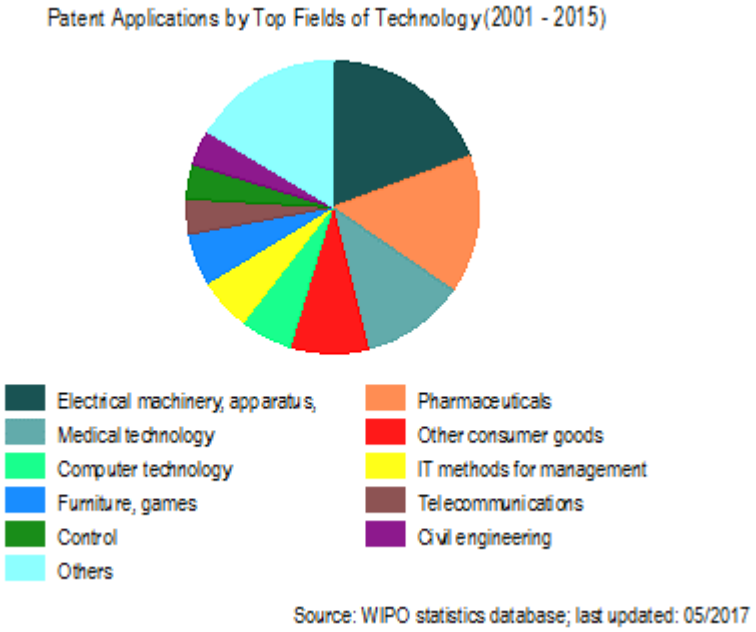
APPENDIX II: Current Status of Selected Nigerian Content Targets.



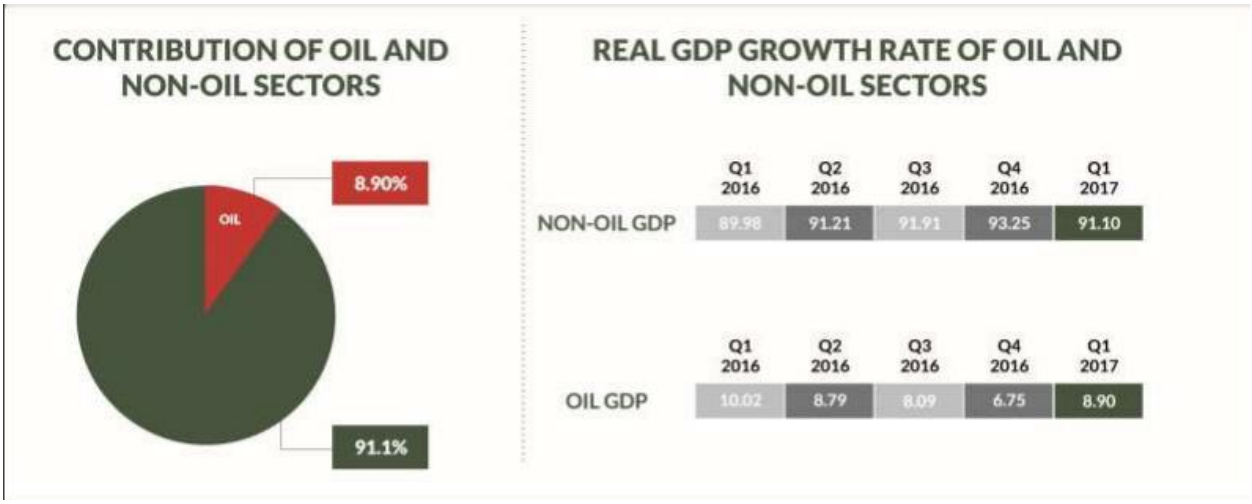
Source: Ovadia J. (2013)

APPENDIX III: Patent Applications by Top fields of Technology (2001-2015).

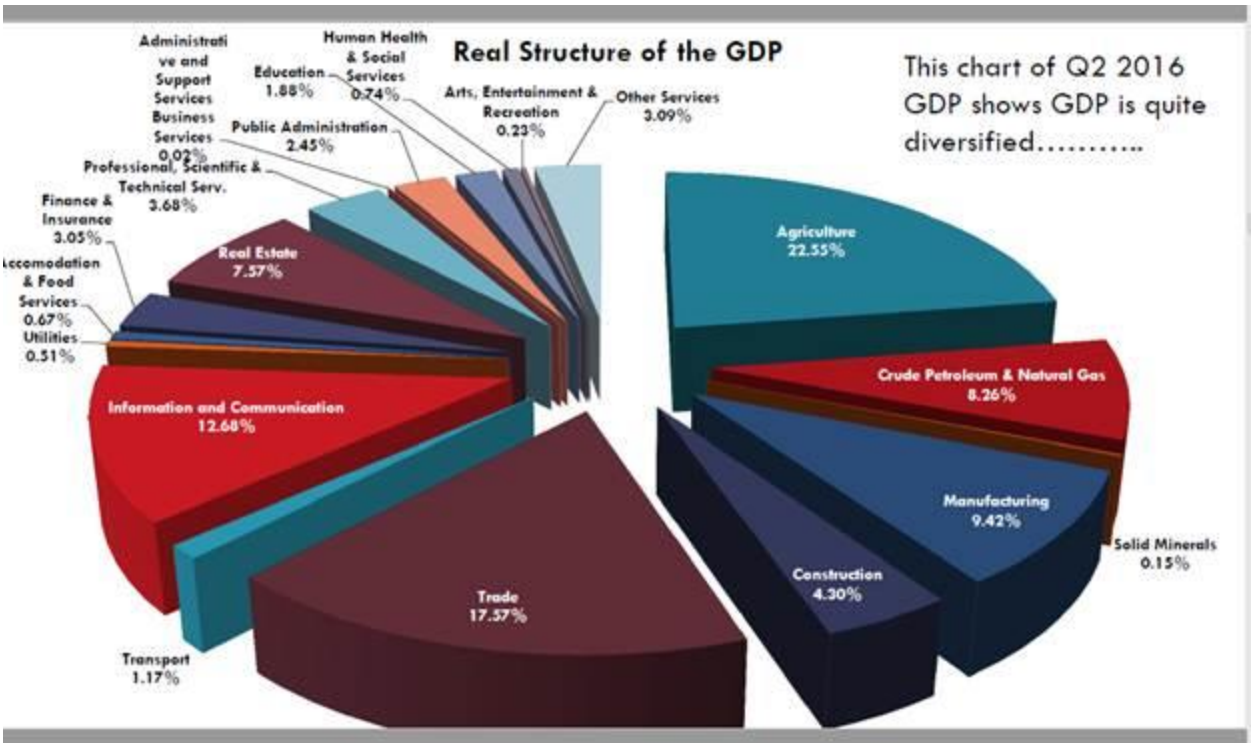
Field of Technology	Share
Electrical machinery, apparatus, energy	19.23
Pharmaceuticals	15.38
Medical technology	11.54
Other consumer goods	8.65
Computer technology	5.77
IT methods for management	5.77
Furniture, games	5.77
Telecommunications	3.85
Control	3.85
Civil engineering	3.85
Others	16.34



APPENDIX IV: Contribution of Oil and Gas to the GDP

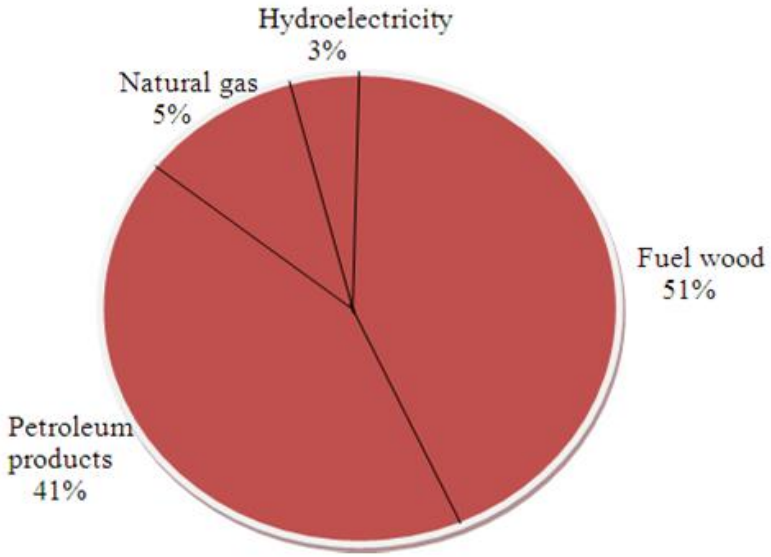


Source: Ventures Africa (2017).

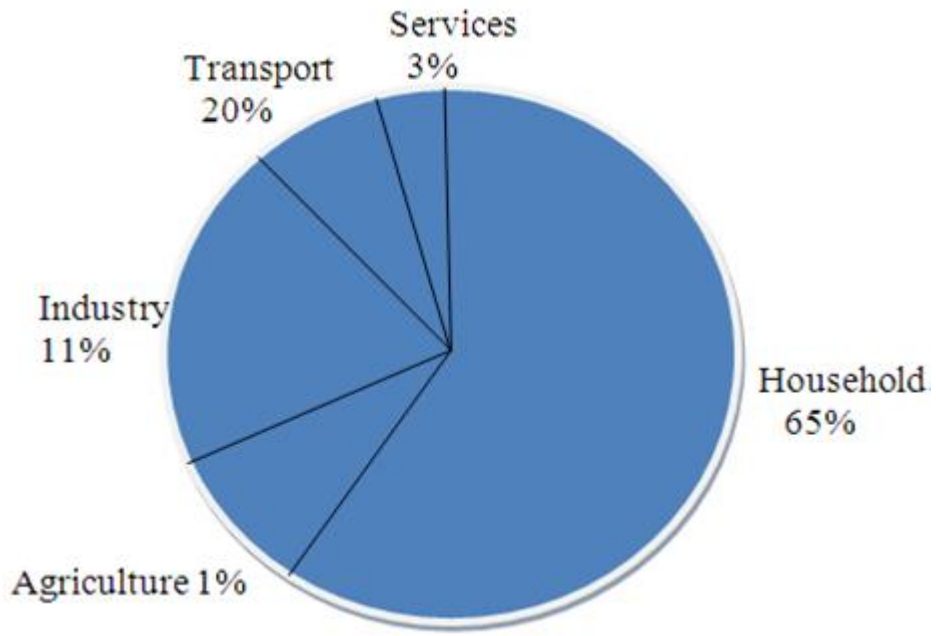


Source: Proshare (2017).

APPENDIX V: Contribution of Various Energy Sources to Energy Consumed in Nigeria.



Source: Oyedepo S.O. (2013)



Source: Oyedepo S.O. (2013)

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