Advances in Management & Applied Economics, vol. 6, no. 2, 2016, 49-70
ISSN: 1792-7544 (print version), 1792-7552(online)
Scienpress Ltd, 2016

Indigenous Technology and Innovation Capability Building in Nigerian Upstream Oil and Gas Subsector: The Academia Perspective

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Abstract

Nigeria's government has made certain efforts to improve the participation of indigenous players in the oil industry through local content policy and marginal field development initiative. To what extent these policies have been implemented and fruitful is yet to be known. This study assessed the technology and innovation capability building in the oil industry from the university academia perspective. Questionnaire was administered on 120 university academia across the country to elicit information from them. The study found that majority (66.3%) of them ranked the state of equipment in their laboratory to be low compared to the state-of-the-art, 47.1% of them claimed to engage in Developmental research, and 66.3% of them opined that R&D funding in their departments were not adequate. The level of interaction of the academia with the oil industry was also found to be low. Factors such as high interest rate charged by banks, low commercialisation potential of university research and lack of entrepreneurial spirit among others are hindering the interaction of academia with other stakeholders in the oil industry.

JEL classification numbers: L71, O13, O32, O33, P48, Q34
Keywords: indigenous players, academia, oil and gas, technology, innovation, capability

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Article Info: *Received*: October 21, 2015. *Revised*: January 12, 2016.
Published online: March 15, 2016.

1 Introduction

The Nigerian oil and gas sector has been the mainstay of the economy since crude oil was discovered in commercial quantities and being sold in the international market. This sector engendered the shift of Nigerian economy from agriculture to oil in late 1960s. The sector is presently contributing mostly to the country's income as well to the country's foreign exchange earnings. Despite the huge income this sector generates for the government, the sector is termed to be volatile as many of the stakeholders operating the oil and gas fields are international expatriates who may decide to leave the shore of the country due to their portfolio rationalisation (Akinwale, 2015a). This means 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 favourable to them. This will definitely affect the level of oil production, oil reserves, government take and developmental project execution. In order to tackle such crisis, Nigerian government has already came up with local content policy and marginal field development initiative with the main aim of encouraging the local players to participate in the exploration and production of oil and gas resources.

There are few studies which have shown the status and activities of indigenous oil and gas firms (Ozigbo, 2008; jegede et al, 2012; Falode and Nebeife, 2013; Akinwale et al., 2015b) towards the development of oil and gas fields; however, there are limited studies on the role which the university academia has played in building technology capability towards the development of oil and gas fields by the indigenous oil firms in Nigeria. This study seeks to fill such gap by assessing the status of technology capability in the development of oil and gas field from the Nigeria's university academia perspective.

2 Technology and Innovation Capability in the Economy

It is well documented that Science, Technology and Innovation (STI) are the keys to growth and industrial development in today's increasingly knowledge-driven world. This implies that any organisation, industry or country risks its continuous survival and growth if it fails to change its offerings (product/service innovation)and the ways it creates and delivers those offerings (process innovation). Technology plays a significant role in economic development as well as providing companies with strategic advantages (Price, 1996; Mytelka, 2000). Some studies such as Akinwale (2015a), MacBryde (1997) and Mian (1994) among others have showed that there has been a considerable interest in technology transfer from higher education institutions (HEIs) to industry across the world in the last two to three decades. Since the early 1980s, HEIs in many

countries such as those in the USA, UK, Germany, France, and Japan have witnessed a transformation by broadening their traditional mission of teaching,research, and public service and becoming a more active participant in their regions' economic development(Main, 1997; Liu and Jiang, 2001).

Most countries devote an increasing proportion of their talent and resources to STI and to the associated Research and Development (R&D) in an attempt to attain a competitive edge, or to catch up with others (Egbetokun, Adeniyi and Siyanbola, 2007). According to Prusak (1996), researchers in the areas of sustainable competitive advantages have come to the conclusion that the only thing that endows a competitive edge on an organisation or a nation, is what it knows, how it uses what it knows and how fast it can know something new. This presents what emerged as a "knowledge-based economy" which highlighted the importance of technological innovation and its underlying R&D activities as the engine of growth. It can be simply put that the cause of the competitive gap between nations and organisations is knowledge. Innovation in the industrial perspective can be better understood as a process in which the organisation creates and defines problems and then actively develops new knowledge to solve them (Nonaka, 1994). The process of innovation represents the long wave of value creation which is the main powerful driver of future economic outcomes of nations and organisations. This implies that for any nation or organisation to compete favourably, such a nation or organisation must be able to continuously innovating which requires building new competencies, new capabilities and new knowledge (Akinwale et al, 2012a).

Ogbimi (2013) opined that it is learning through education and training that promotes sustainable economic growth and industrialisation (SEGI).He stated that achieving SEGI is a learning and capability-building process. The economy achieves industrial maturity or technological puberty when many people learn and acquire skills in breadth and depth up to a point when each skill type begins to enjoy the support of others, and the relevant linkages which improve productivity become established (Ogbimi, 1999).This can be revealed by Ogbimi's theory of 'industrialization as a learning man' which postulated that technological growth is a learning process. He identified five variables critical to the economic strength of a nation. This includes the number of people involved in productive work in a nation; the level of education and training of those involved in productive activities in the economy; the linkages among the knowledge, skills, competences and sectors of the economy; the learning rate or intensity in the economy, especially that of workforce and the experience of the workforce and the learning history of the society. The five variables are relevant and related to the learning – man and they are directly related to the strength of the economy, or sector as the case of this study. The higher the value of these variables, the healthier is the economy or sector and vice versa (Ogbimi, 2013).

Technology capability according to Marcelle (2005)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)argue that technology and innovation capability form the basis of absorptive capacity. This absorptive capacity consists of four distinct capabilities, viz:

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

This shows 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. While the ability to acquire, assimilate, transform and apply (or exploit) new knowledge is necessary for all successful organisations, firms differ in their awareness of the need to change and their abilities to effect such changes. In addition to this, Martin, Massy and Clarke (2003) refer technological and innovation capability as the ability to find and use technology to secure and sustain competitive advantage.

There is no doubt that the situations that the indigenous firms in less developed countries (LDCs) face are quite different from that of the firms in developed countries (DCs) in terms of knowledge support, regulatory, infrastructural and institutional environments, nature of production processes in use, the quality of the factors of production, and the ease of doing business among others.

3 The status of STI and R&D in Nigeria

Majority of the developed nations today metamorphosed from their poor level of mainly arable farming to their industrialised state. This was not arrived at from mere wishes but rather through conscious efforts of their government and the people of such nations. Science, Technology and Innovation (STI) as well as research and development (R&D) have been attributed to their success. Many studies have showed why the impact of labour and capital alone cannot bring about the development of a nation but rather to be complemented with STI. STI which involves the use of law of nature to investigate the challenges facing the different sectors of the economy, application of the knowledge to solving the challenges and transforming R&D results into useful products or processes which are then diffused through to the end-user. STI involves various processes from

idea generation to commercialisation, and the capability to execute and manage activities involve in this process is refer to as technology capability. This technology capability has to be acquired through conscious efforts with the objective of acquiring, assimilating, adapting and modifying existing technologies or developing new ones (Lall, 1992). Until recently, Nigeria has been drafting science and technology policies without taking innovation into consideration.

Nigeria shifted from agrarian economy in the 1960s to the current oil-based economy. Petroleum accounted for approximately 97% of the country's foreign exchange and 76% of the total government revenue (CBN, 2015). This has prevented the country from engaging in R&D exploitation believing that the revenue of the petroleum products is sufficient for the government. The Nigeria's R&D allocation was US$ 0.582 Billion (PPP) in 2007 which is approximately 0.0004% of the World's expenditure on R&D as at 2011. This figure represents 0.2% of R&D expenditure as percentage of the national GDP (AIO, 2010). These figures are relatively insignificant when compared with the R&D expenditure profiles of the advanced countries of America, Europe and some parts of Asia as shown above. Consequently, the national R&D capabilities have been undermined by underfunding of research activities. More so, Nigeria's government has not been able to compute recent data on R&D and innovation which may not be unconnected with poor funding of the Agency that are expected to conduct such survey. For Nigeria to achieve macroeconomic development and assume its rightful position among the committee of emerging economies, it needs to reorder its priorities by committing more funds to R&D activities to meet UNESCO standards of having at least 1% of GDP committed to R&D as well as creating a National R&D Fund(Siyanbola, 2011).

Majority of the inventions carried out in the academic laboratories and research institutes have not been patented and commercialised for industrial usage for onward transfer into the market (Akinwale et al, 2012b). As a result of the weaknesses and constraints that the science and technology policy suffers, Nigeria government through the Ministry of Science and Technology has developed a more concise, robust and workable Science, Technology and Innovation (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. However, the status of implementation of this new STI policy is debatable.

3.1 The Academia Perspective of the Indigenous Technology Capability in Nigeria's Oil and Gas upstream Sub-sector

Until recently, higher education institutions and research institutions in Africa were mostly separated from industry (Mansfield, 1998; Oyewale, 2003; Vidican, 2012). However, most technology is developed in universities and research institutions in the industrialised economies. Developing and transferring

technology from universities and research institutions have lately been a strategic issues for the government in Sub-Saharan Africa, and specifically Nigeria. Although there has been considerable research on technology transfer from HEIs to industry in the developed countries, little has been understood about the pattern and nature of such activities in Nigeria. To fill this gap, this paper provides the perception of the academia on the nature and evolution of technology and innovation capability, determinants and factors that influence of its transfer to the oil and gas industry. This section will cover methodology of the study and analysis of data collected.

4 Methodology

The study was carried out in the 5 geo-political zones out of the 6 geo-political zones in Nigeria. Rivers and Delta States were chosen from the South-South Zone; Kwara, Kogi and Plateau States were selected from North Central Zone; Kaduna and Kano from North West Zone; Enugu and Imo States from South East Zone; and Osun, Oyo and Lagos States from South West Zone. The choice of the aforementioned States was informed by the need to capture the Universities that offer petroleum related courses required to serve as a knowledge support for the petroleum industry. The North East Zone of the country was exempted as a result of insurgency happening in that Zone at the period of this study.

The universities considered were mainly Federal and State Universities that offered oil and gas related courses as most Private Universities in the country are recently established. Data was collected from both primary and secondary sources. The research instrument used for primary source was questionnaire, personal observation and interviews. A set of questionnaire was administered on 120 University Faculty members that are in oil and gas related Departments specifically Geology/Geophysics and Petroleum/Chemical Engineering in 12 universities. Cluster sampling technique was used to divide Universities into six geo-political Zones. Purposive sampling and random sampling techniques were used to elicit information from the Faculty members on the extent of technology capability building in oil and gas related research, nature of knowledge sharing with the indigenous oil companies, factors influencing knowledge sharing, and sources of R&D funding. All these were expected to influence oil and gas field development in their universities and departments. Data obtained were analysed using descriptive and appropriate inferential statistics.

5 Analysis of Data

From the total of 120 copies of questionnaire that were administered on the University faculty members, 104 were completed and found useful for the analysis which represents 86.7% response rate.

5.1 Proportional Distribution of Respondents by Universities

Table 1 showed that 83.7% of the respondents were from the Federal Universities while the remaining 16.3%were from the State Universities. The Federal Universities include Ahmadu Bello University (ABU), Bayero University Kano (BUK), Federal University of Petroleum Effurun (FUPE), ObafemiAwolowo University (OAU), University of Ibadan (UI), University of Ilorin (UNILORIN), University of Jos (UNIJOS), University of Lagos (UNILAG), University of Nigeria Nsukka (UNN), University of Portharcourt (UNIPORT); while the State Universities include Kogi State University (KSU) and LadokeAkintola University of Technology (LAUTECH). The response rates from each of these universities were also shown in Table 1.

Table 1: Proportional Distribution of the Respondents by Universities

Respondents Characteristics	**Frequency**	**%**
Nature of Universities		
Federal Universities	87	83.7
State Universities	17	16.3
Total	**104**	**100**
Location of respondents by Universities		
OAU	10	9.6
UI	8	7.7
LAUTECH	9	8.7
UNILAG	10	9.6
UNIPORT	8	7.7
KSU	8	7.7
ABU	10	9.6
UNILORIN	9	8.7
UNN	8	7.7
BUK	8	7.7
FUPE	8	7.7
UNIJOS	8	7.7
Total	**104**	**100**

Authors' survey, 2015

Figure 1 showed that most (90.4%) of the University respondents have Ph.D degree while the rest (9.6%) of the respondents have MSc degree. The high number of PhD degree holder sampled in this study was as a result of the importance of PhD degree towards the successful execution of any research activities in the University.

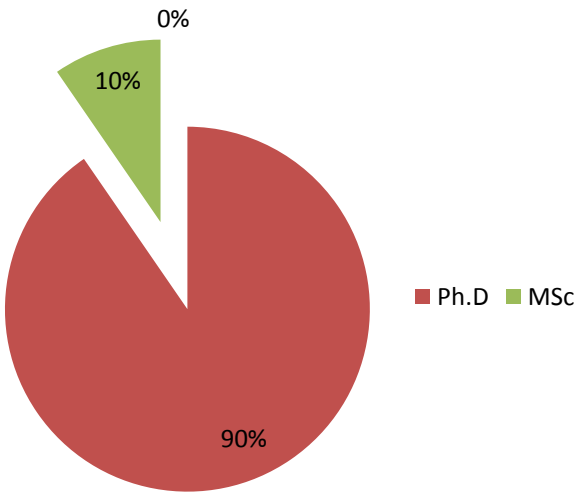

Figure 1: Highest Academic Qualification of the Respondents

Table 2 showed that 50% of the respondents were from Petroleum/Chemical Engineering Department and 48% were from the Geology/Geophysics Department. Also, 77% of the respondents were from the rank of Senior Lecturer and above. This implies that the survey captured a number of University academicians who are expected to have the capabilities to conduct research that could be relevant in the oil and gas industry.

Table 2: Educational Background and Rank of University Faculty Members

Respondents' Characteristics	**Frequency**	**%**
Educational Background		
Geology/Geophysics	50	48.1
Petroleum/Chemical Engineering	52	50
Oil&Gas Management/ Economics	2	1.9
Total	**104**	**100**
Rank of University Faculty Members		
Lecture II	7	6.7

Lecturer I	17	16.3
Senior Lecturer	32	30.8
Associate Professor	25	24
Professor	23	22.1
Total	**104**	**100**

Source: Authors survey, 2015

5.2 Technology Capabilities and Research Engagements of the Universities

This section investigated the current status of the technological capabilities and innovation activities in the Nigeria's federal and state universities. There are literatures which had established various factors influencing and determining technology capability of firms (Parhi, 2005; NACETEM, 2010; Dada, 2014; Akinwale, 2015b).However, this study enquired from the university faculty members to rank their university laboratory equipment compared with the state-of-the-art required in the industry. Figure 2 revealed that majority (66.3%) of the faculty members ranked the state of equipment in their laboratory to be low compared to the state-of-the-art. While 24% of the respondents ranked the state of their laboratory equipment to be at medium level compared to the state-of-the-art, others (9.6%) perceived it to be very low. None of the sampled university faculty members ranked their laboratory equipment high compared to the state-of-the-art.

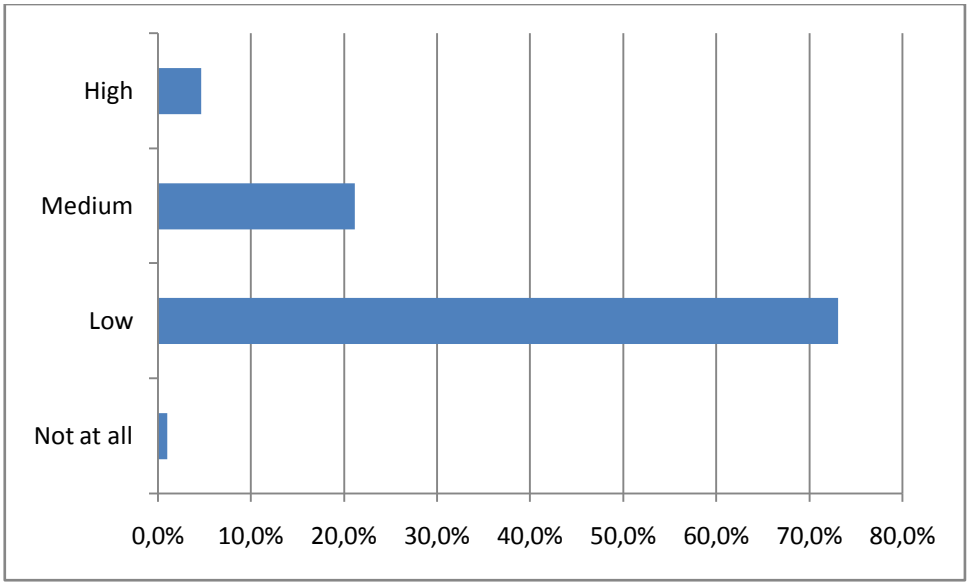

Figure 2: Ranking of University laboratory equipment compared with the state-of-the-art in the industry

Table 3 shows the nature of research engagements that the university faculty members frequently engaged in as related to indigenous oil and gas operations. Their perceptions were also captured through multiple response frequency. Majority (93.3%) of the respondents engaged in Teaching and Training research. This was followed by 83.7% of the respondents who engaged in Basic and Scientific research while the least of the respondents (47.1%) claimed to engage in Applied and Developmental research. This shows that the level of effort directed to Applied oil and gas research by the Academia in the Nigerian University is averagely low. This is in line with some other studies (Etzkowitz and Leydesdorff, 2000; Akinwale et al, 2012b; African Innovation Outlook, 2014) where Applied and Developmental research is the least form of research being conducted in the Nigeria's university unlike what is obtainable in China, South Korea and South Africa among others.

Table 3: Research and Development (R&D) Engagements of the Academia

Oil and gas R&D Engagements**	**Frequency**	**%**
Teaching and Training Research	97	93.3
Basic and Scientific Research	87	83.7
Applied and Developmental Research	49	47.1

**Multiple responses

5.3 Sources and Adequacy of oil and gas R&D fund in Nigerian Universities

Majority (81.7%) of the responding Academia got their oil and gas research funds from the Federal Government (Table 4). This may be due to the fact that most of the Academia sampled were from Federal Universities. Table 4 also shows that 76.9% of the respondents were Self-sponsored; 25% got their R&D fund from the Donor Agencies; 24% got their fund through internally generated revenue by the University; 15.4% got their fund from the State Government; and 4.8% got their fund from financial institution. This clearly showed that most of the Academia usually self-sponsored themselves and also that they rarely got fund from financial institution within the country.

Adequacy of R&D funding of oil related research was also observed in the Nigerian Universities for the last 5 years. Table 4 also shows that most (66.3%) of the respondents opined that R&D funding in their departments were not adequate. While 30.8% and 2.9% of the respondents perceived the R&D funding in their Departments to be fairly adequate and just adequate respectively, none of the responding Academia perceived the level of oil and gas R&D funding to be very adequate.

Table 4: Sources and Adequacy of R&D fund in Nigerian Universities

Sources and Adequacy of R&D fund	**Frequency**	**%**
Sources of R&D fund**		
Federal Government	85	81.7
State Government	16	15.4
Financial institution	5	4.8
Donor Agencies	26	25
Internally Generated Revenue	25	24
Self-Sponsored	80	76.9
Adequacy of the level of R&D funding in the Academia department in the last 5 years		
Not Adequate	69	66.3
Fairly Adequate	32	30.8
Just Adequate	3	2.9
Very Adequate	-	-
Total	**104**	**100**

******Multiple responses

Table 5 shows the nature of oil firms that the Academia got R&D support from in the last 5 years. While majority (64.1%) of the responding Academia claimed not to have gotten R&D support from any oil and gas firms, 31.1% and 4.8% have gotten R&D support from multinational oil firms and indigenous oil firms respectively. Consequently, travel fellowships, workshops and conferences dominated (56.8%) the nature of support that the Academia have received from the oil and gas firms. This was followed by research grant (27%) and staff exchange (16.2%).

The study also enquired about the factors that could be responsible for the majority of the Academia not to have gotten R&D support from the oil and gas firms. The result revealed that majority (66.2%) of the responding Academia did not contact the oil and gas firms for any oil related R&D support (Table 5). While 24.7% of the respondents claimed to contact the oil firms but did not get any response, 9.2% claimed to have contacted the oil firms but their requests were declined. Most of those that were declined opined that the oil and gas firms believed that Nigerian Universities do not have the state-of-the-art facilities that will satisfy their research needs. Similarly, Table 6 shows that most (91.3%) of the responding Academia claimed not to have gotten any fund or credit from any Nigerian financial institutions on oil and gas related research. While majority (68.1%) of them did not apply for any fund, 17% applied but did not get any response and 14.9% applied but declined.

Table 5: Level of Oil firms supporting R&D in the Universities

Oil firms support for R&D in the Universities	**Freq.**	**%**

Nature of Oil firms supporting R&D in Academia department		
Multinationals	32	31.1
Indigenous	5	4.8
None	66	64.1
Total	**103**	**100**
Forms of Oil firms' support		
Research Grant	10	27
Staff Exchange	6	16.2
Travel Fellowships, Workshops and Conferences	21	56.8
Total	**37**	**100**
Factors responsible for poor R&D support from the oil and gas firms		
The oil firms were not contacted	43	66.2
The oil firms were contacted but no response	16	24.6
The oil firms were contacted but declined	6	9.2
Total	**65**	**100**
Basis of Academia application decline		
They believe Nigerian Universities do not have the state-of-the-art facilities that will satisfy their research needs	4	66.7
Fear of possible loss of confidentiality on the research results	2	33.3
Total	**6**	**100**

Table 6: Access to Credit and Fund from Nigerian financial institutions on oil and gas related research by the Academia

Accessibility of fund from financial institutions	**Frequency**	**%**
Fund or credit obtained from Nigerian financial institution		
No	94	91.3
Yes	9	8.7
Total	**103**	**100**
If No- Reasons for poor access to fund		
No application was made for assistance	64	68.1
Application was made but there was no response	16	17
Application was declined	14	14.9
Total	**94**	**100**

5.4 Factors driving oil and gas R&D and Invention in the Nigerian Universities

Table 7 shows the factors driving oil and gas R&D and invention in the Nigerian Universities. Majority (96.2%) of the responding Academia opined that most of their research works were driven by Knowledge. This means that the inquisitiveness for additional knowledge in oil and gas dominate the major driving factor of the Academia. 76%, 50% and 16.3% of the responding Academia also perceived Career enhancement, Technology and Demand/Market as the factors driving their oil and gas research/innovation activities respectively. It can be inferred from this that market driven accounted for the least reason for engaging in oil and gas R&D by the Academia.

Table 7: Factors driving oil and gas R&D in Nigerian Universities

Factors**	**Frequency**	**%**
Knowledge Driven	100	96.2
Career Enhancement Driven	79	76
Technology Driven	52	50
Demand/Market Driven	17	16.3

**Multiple responses

5.5 Level of Interaction between the University Academia and Oil and Gas Upstream Subsector

The diffusion of technology and knowledge is a salient feature in the recent literature on technology capability and innovation (Loof and Brostorm, 2006). Much attention has been given to the role of universities in the modern industry at the industrialised and emerging economies. Figure 3 shows the extent at which the University Academicians interact with the oil and gas upstream subsector in Nigeria. The result revealed that most (73.1%) of the respondents claimed that their extent of interacting with the oil and gas upstream subsector in Nigeria was low as the radar of the polygon skewed towards low level. 21.2% of them believed that they have medium level of interaction with the oil companies, while 4.7% and 1% of the respondents claimed to have high level and no interaction at all with the oil and gas upstream subsector respectively.

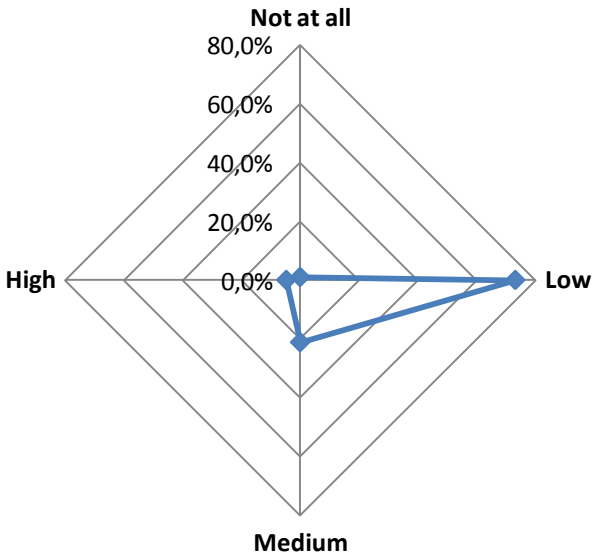

Figure 3: Extent of University Academia interaction with Upstream Oil and Gas Firms

5.6 Factors influencing the extent of interaction between the University and the Upstream oil subsector

Table 8 shows the factors influencing the extent of interaction between the University and the indigenous firms in the upstream oil subsector. The degree of relationship between each of the variables (or factors) and the path of interaction with the indigenous firms in the upstream oil and gas subsector was captured by the correlation analysis. Also, the mean ranking of each of the factors further revealed the extent at which the respondents rated each of the factors towards interaction with the upstream oil and gas subsector. It is evidenced that all the factors – Academic papers prepared by the academia published and presented in oil and gas related conferences (APP), Attendance of training program, workshops and conferences organised by the academia(ATP), Consultancies (CST), Prototypes developed by the academia that are relevant in the oil and gas upstream subsector (PRT), Technical Services/Joint research between University and Oil company (TSJ), Use of University laboratory facilities (LAB), Cooperative R&D Agreement (CRD), Licensing arrangement between academia and oil company (LIC), Spin-off companies emanated from research activities (SPC), Patent granted to the academia invention in the area of oil and gas upstream subsector (PAT) – were positively related with interaction with the oil and gas firms.

At 1% level of significance, the correlation shows that all the factors were also significant to the extent of interaction between the university and the

upstream oil subsector except Prototypes developed by the academia that are relevant in the oil and gas upstream subsector (PRT) which was not significant since its probability value (P-value) is 0.165 which was above 0.01 significant level.

Table 8: Factors influencing the Extent of Academia interaction with Upstream oil and gas subsector

Factors	**Correlation Coefficient and p-value**	**Mean Rank**
Academic papers prepared by the academia published and presented in oil and gas related conferences	0.318** (0.001)	3.32
Attendance of training program, workshops and conferences organised by the academia for other stakeholders	0.444** (0.0001)	2.37
Consultancies	0.381** (0.0001)	2.35
Prototypes developed by the academia that are relevant in the oil and gas upstream subsector	0.137 (0.165)	2.16
Technical Services/Joint research between University and Oil company	0.564** (0.0001)	2
Use of University laboratory facilities	0.604** (0.0001)	1.81
Cooperative R&D Agreement	0.479** (0.0001)	1.73
Licensing arrangement between academia and oil company	0.524** (0.0001)	1.63
Spin-off companies emanated from research activities	0.331** (0.001)	1.28
Patent granted to the academia invention in the area of oil and gas upstream subsector	0.353 (0.0001)	1.22

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)
Mean Rank: Not at all/ Very low= 1,Low= 2, Medium= 3, High= 4

The mean ranking ranging from 1 (Not at all/ Very low extent) to 4 (High extent) also showed the result of the factors that influence the extent of interaction between the University Academia and the Engineers/Scientists in the upstream oil subsector. None of the factors listed in Table 8 indicates a high extent of university interacting with the oil and gas firms. More so, it is only the mean ranking of 'Academic papers prepared by the academia published and presented in oil and gas related conferences' that was rated medium (3.32). Factors such as Attendance of training program/workshops and conferences organised by the academia for other stakeholders, Consultancies, Prototypes developed by Academia that are relevant in the oil and gas upstream subsector, Technical Services/Joint research between University and Oil company, University laboratory facilities usage, Cooperative R&D Agreement, Licensing arrangement between academia and oil company were rated low with mean rank of 2.37, 2.35, 2.16, 2, 1.81, 1.73 and 1.63 respectively. Meanwhile, Spin-off companies emanated from research activities and Patent granted to the academia invention in the area of oil and gas upstream subsector were rated very low with mean rank of 1.28 and 1.22 respectively.

However, from the perspective of economic development, universities are expected to take the lead in patenting and licensing from which spinoffs had been established (Wright et al., 2008). These had generated an approximately US$30 billion of economic activity and 250,000 jobs each year as academic innovations are being commercialised in United State of America (Mansfield, 1998; Decter, Bennett and Leseure, 2007). The feedbacks from the responding Academia as shown by the outcomes of this study indicated that there is generally low level of interaction between the Universities' faculty members who engage in oil and gas related activities in Nigeria and the Engineers/Scientists in the upstream oil and gas subsector.

5.7 Constraints preventing the Academicians from interacting with Other Stakeholders

Table 9 revealed the factors or constraints preventing the University Academicians from interacting with other stakeholders in the petroleum innovation system (PIS). The result showed that 'High interest rate charged by banks' and 'Low commercialisation potential of university research output' were the major factors preventing the Academicians from interacting with the other stakeholders in the PIS with weighted mean rating of 3.06 (medium) each. Most of them argued that they could not get credit to commercialise their research outputs from the banks as a result of high interest rate usually charged by most of these banks, and which their salary is small to take credit at such interest rate. Also, some of the research outputs might not even be relevant in the industry since the Academia do not get substantial fund to carry out their research activities in the state-of-the-art laboratory. It was observed that there are few incentives for academics to engage

in commercialisation and collaboration with the industry. This is in line with the study of Vidican (2012) and Falode and Nebeife (2013).

Some other factors which were also ranked medium by the respondents apart from the two mentioned above include Lack of entrepreneurial spirit among the academics, Financial institutions are not interested in sponsoring academia research, Lack of adequate research and laboratory facilities to conduct industrially oriented research, No policy in university towards interacting with the oil industry, No adequate mechanism to interact with oil industry, Oil companies are not interested to interact with the universities with mean rating of 3.03, 3.02, 2.94, 2.74, 2.73 and 2.54 respectively. The culture of academic entrepreneurship that builds on stronger ties between the University and industry is still relatively weak among the Nigerian Academicians. According to Stahler and Tash (1994), many academicians still attribute the use of laboratories only for teaching and scientific studies to conduct routine tests and analysis, and not perceived the laboratories as unit contributing to the university mission to produce new knowledge relevant in the industry. Also, most of the Academicians do not see any reason to go beyond their regular teaching and publishing since there is no policy in their universities which encourage their interaction with the industry. Their promotion was not based on product commercialised or interaction with the industry but rather on paper publications.

Table 9: Constraints preventing the University Academicians from interacting with Other Stakeholders

Constraints	**Mean Rank**	**Standard Deviation**
High interest rate charged by banks	3.06	0.54
Low commercialisation potential of university research	3.06	0.74
Lack of entrepreneurial spirit among the academics	3.03	0.74
Financial institutions are not interested in sponsoring academia research outputs	3.02	0.56
Lack of adequate research and laboratory facilities to conduct industrially oriented research	2.94	0.59
No policy in university towards interacting with the oil industry	2.74	0.65
No adequate mechanism to interact with oil industry	2.73	0.75
Oil companies are not interested to interact with the universities	2.54	0.61
Time constraints to the academics due to heavy teaching and academic work	1.98	0.78

The Academia scholars are not competent enough to undertake developmental research which is industrially oriented base	1.29	0.53

Mean Rank: Not at all/ Very low= 1, Low= 2, Medium= 3, High= 4

It was perceived that 'Time constraints to the academics due to heavy teaching and academic work' was ranked low (1.98) while 'The Academia scholars are not competent enough to undertake developmental research which is industrially oriented base' was ranked very low (1.29). This implies that the time constraints and competency of the academic scholars were not seen as factors impeding the academicians from interacting with the industry.

6 Recommendation

The upstream oil and gas subsector in Nigeria is of strategic importance that the development of highly skilled manpower for the industry is of utmost significance. Despite the local content policy to promote the indigenous technological capacity building, the role that the Nigerian Universities is playing can be said to be weak. The study makes some recommendations so as to build the indigenous technology and innovation capabilities among the University academicians.

Nigerian government should improve the level of building local technology capabilities in oil and gas sector through adequate training of the academicians by partnering with some foreign companies and universities as well as ensuring that those that were trained transform and diffuse such knowledge appropriately in their universities and research institutes. Government should monitor those that are sent abroad through government fund to return to Nigeria after their education and training so as to diffuse the knowledge learnt from the developed nations into the local economy. There is also the need for a concerted national effort to integrate industrially-induced and developmental oil and gas research in the educational curriculum in related discipline sat all educational levels.

Government should provide an environment where public-private partnership is fosteredto adequately fund R&D in the relevant universities so as to improve the status of the laboratories to be able to provide the technologies and equipment that are relevant in the industry. The petroleum industry bill when pass to law and the local content policy should be fully implemented as these will encourage the Academicians to participate in providing locally-made equipment.

Government through policy should foster interactions among the stakeholders in the oil and gas sector. This requires providing incentives for academics to engage in commercialisation and develop entrepreneurship culture that build on stronger ties between the university and the industry. The creation of 'Industry-University Champion' who will encourage the linkage between the University and the industry should be encouraged in the University. Furthermore,

financial institutions should make funds more accessible to indigenous stakeholders in form of loans with minimal interest rate and special funds in the oil sector to enhance the capability and innovations of the industry.

7 Conclusion

The significance of technology in national economic development and in the creation of a competitive edge for companies can never be over emphasised. It is well documented that HEIs have been a major source of technological advancement in many developed and developing countries. This study has been able to reveal the current status of indigenous technology and innovation capability building in the oil and gas upstream subsector from the Academia perspectives.

The study revealed that majority of the faculty members ranked the state of equipment in their laboratory to be low compared to the state-of-the-art required in the industry and that the level of oil and gas R&D funding is inadequate in the universities. The extent of interaction between the university and upstream oil & gas firms is low. Some of the factors expected to influence the extent of interaction of university academicians and the upstream oil sector were rated low. High interest rate, low commercialisation of research outputs and poor entrepreneurial culture of the academicians among others accounted for the factors impeding the university Academicians from interacting with the oil and gas firms. It is evident that conscious efforts need to be taken to improve the level of technology and innovation capabilities in the Nigerian universities. This includes but not limited to adequate funding of university research through public-private partnership, adequate training of the academicians to carry out applied/developmental research and fostering interaction among the stakeholders in the petroleum innovation system.

References

[1] African Innovation Outlook, 'Research and Experimental Development'. *AU–NEPAD (African Union–New Partnership for Africa's Development)*, (2010).Pretoria, South Africa.

[2] African Innovation Outlook, 'Research and Experimental Development'. *AU-NEPAD (African Union–New Partnership for Africa's Development)*, (2014).Pretoria, South Africa.

[3] Y. Akinwale, 'Techno-economic Assessment of Mrginal Oil and Gas Fields Development in Nigeria', Anunpubished thesis submitted in partial fulfilment of the requirement for the award of the degree of Doctor of philosophy in

Technology Management, (2015a). Obafemi Awolowo University, Ile-Ife, Nigeria.

[4] Y. Akinwale, 'Empirical Analysis of Technology and Innovation Capabilities of the Indigenous Oil and Gas Firms Towards the Development of Oil Fields in Nigeria', *A paper presented at National Centre for Technology Management (NACETEM) Seminar Series,* No 08/017,(2015b). Obafemi Awolowo University, Ile-Ife, Nigeria.

[5] Y. Akinwale, A.Dada, A.Oluwadare, O.Jesuleye, and W. Siyanbola, 'Understanding the Nexus of R&D, Innovation and Economic Growthin Nigeria'. *International Business Research,* 5(11), (2012a), 187-197.

[6] Y.Akinwale, I.Ogundari, O.Olaopa, W. Siyanbola,'Global Best Practices for R&D funding: Lessons for Nigeria'. *Interdisciplinary Journal of Contemporary Research in Business,* 4(2), (2012b),908-925

[7] A. Dada,'Evaluation of Technological Capability and Innovations in the Nigerian Cassava Processing Industry'. An unpubished thesis submitted in partial fulfilment of the requirement for the award of the degree of Doctor of philosophy in Technology Management, (2014), Obafemi Awolowo University, Ile-Ife, Nigeria.

[8] M. Decter, D.Bennett,and M.Leseure, 'University to business technology transfer –UK and USA comparisons', Technovation, 27(3), (2007), 145 – 155

[9] A. Egbetokun, A. Adeniyi, and W. Siyanbola, 'Indigenous Innovation Capability in Sub-Saharan Africa: A Review of the Nigerian Situation', *The 5th International Symposium on Management of Technology (ISMOT'07)*, (2007), 1018-1022

[10] H.Etzkowitz, and L.Leydesdorff,'The dynamics of innovation: from National Systems and "Mode 2" to Triple Helix of university-industry-government relation',*Research Policy,* 29 (2), (2000), 109-123.

[11] O.Falode, and P. Nebeife, 'Promoting Effective University-Oil Industry Research Collaboration in Nigeria',SPE paper 167540 presented at the Nigeria Annual International Conference and Exhibition organized by Society of Petroleum Engineers held in Lagos, Nigeria, 30 July- 1 August,(2013).

[12] O. Jegede, H.Aderemi, O.Jesuleye, and W.Siyanbola, 'Status of Technological Capacity Building in the Indigenous Oilfield Servicing Firms in Nigeria vis-a-vis Innovation Capability', *Greener Journal of Science Engineering and Technological Research,* 2(1), (2012), 11-16

[13] Lall, S. (1992). 'Technology Capabilities and Industrialisation', *World Development,* 20(2),165-168

[14] H. Liu and Y. Jiang, 'Technology transfer from higher education institutions to industry in China: nature and implications', *Technovation,* 21(3),(2001), 175-188

[15] H. Loof, and A. Brostrom, 'Does Knowledge Diffusion betweenUniversity and Industry Increase Innovativeness?', *Centre of Excellence for Science and Innovation Studies Working Paper Series,* No 21, (2006), 1-27.

[16] G. Marcelle,'How do telecom firms build capabilities? Lessons from Africa', *Telecommunications Policy*, 29(7),(2005), 549
[17] J. MacBryde, 'Commercialisation of university technology: a case in robotics', *Technovation*, 17(1),(1997), 39–46.
[18] E. Mansfield, 'Academic research and industrial innovation: an update of empirical Findings', *Research Policy*,26(7-8), (1998)773–776.
[19] mm G.Martin, J.Massy, and T. Clarke, 'When absorptive capacity meets institutions and (e)learners: adopting, diffusing and exploiting e-learning in organizations', *International Journal of Training and Development*, 7(4), (2003),228–244.
[20] S.A.Mian, 'Assessing and managing the university technology business incubator: an integrative framework', *Journal of Business Venturing*, 12(4),(1997),251–285.
[21] S.A. Mian,'US university-sponsored technology incubators: an overview of management, policies and performance', *Technovation*,14(8), (1994), 515–528.
[22] L. Mytelka, 'Local systems of innovation in a globalized world economy', *Industry and Innovation*, 7(1), (2000), 33-54.
[23] National Centre for Technology Management, 'The Nigeria National Innovation System: Issues on the interaction of the key elements', *Monograph Series 1, NACETEM*,(2010), Obafemi Awolowo University. Ile-Ife, Osun, Nigeria.
[24] I. Nonaka, 'A dynamic theory of organizational knowledge creation, *OrganizationScience'*,5(1),(1994), 14-37
[25] F. Ogbimi, 'Towards Increasing the Permanent Benefits of the Nigerian Oil and Gas Industry in Nigeria', *SPE paper 167541 presented at the Nigeria Annual International Conference and Exhibition organized by Society of Petroleum Engineers held in Lagos*, Nigeria, 30 July- 1 August,(2013).
[26] F. Ogbimi, 'The Concept of Technological Framework and Its Relevance in Planning for Developing Nations', *Proceedings for the 1999 Annual Conference of the NSE*, in Ilorin, Nigeria,(1999), 228-245.
[27] A. Oyewale, 'Evaluation of the Interactions among the Key Components of Science and Technology and Innovation System in Nigeria', *Unpublished Ph.D thesis, Technology Management, Technology Planning and Development Unit, Faculty of Technology*, Obafemi Awolowo University, Ile-Ife, Nigeria, (2003).
[28] N. Ozigbo, 'Technological Capacity Building in the Nigeria's Oil and Gas Industry', *Proceedings of the 19th Annual International Information Management Association held between 13 and 15 October*, (2008),San Diego, USA.
[29] R.M.Price, 'Technology and strategic advantage', *California Management Review*, 38(3),(1996), 38–56.
[30] L. Prusak,'The knowledge advantage', Strategy and Leadership, 24(2),(1996), 6-8.

[31] M.Parhi, 'Diffusion of new technology in India auto component industry: an examination of the determinants of adoption', UNU-INTECH Discussion Paper Series, No.8,(2005).
[32] Mm W. Siyanbola, 'Progress Report On Nigeria's National Science, Technology And Innovation Policy', A paper Presented at the Experts meeting on Science, Technology and Innovation Policy Review, 10th May (2011)
[33] G.Stahler and W. Tash, 'Centers and Institutes In The Research University: Issues, Problems, and Prospects', *The Journal Of Higher Education*, 65(5),(1994), 540-554.
[34] G. Vidican, 'Building Domestic Capabilities in Renewable Energy. A case study of Egypt', German Development Institute / Deutsches Institut für Entwicklungs politik (DIE),(2012).
[35] M. Wright,B. Clarysse, A. Lockett, and M. Knockaert, 'Mid-Range Universities Linkages With Industry: Knowledge Types and The Role of Intermadiaries', Research Policy, 37(8),(2008),1205-1223.
[36] S. Zahra and G. George, 'Absorptive capacity: a review, reconceptualisation, and Extension', Academy of Management Review, 27(2), (2002), 185–203.