

THEME: How can the Triple Helix enhance universities as interactive partners in our innovation systems, and what are the challenges to the absorptive capacity of academic knowledge within firms and by other users?

**EXTERNAL KNOWLEDGE, ABSORPTIVE CAPACITY AND PHARMACEUTICAL
INNOVATION IN NIGERIA**

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Abstract

The global pharmaceutical industry is a multibillion dollar, knowledge-driven sub-sector; where firms' innovation and competitiveness depend greatly on external knowledge. The firm's ability to recognize, acquire and utilize external knowledge for commercial ends depends on its absorptive capacity. Information on the capability of Nigerian pharmaceutical firms to identify, assimilate and exploit external knowledge is scarce. This study therefore examined the external knowledge sources, absorptive capacity and innovation in Nigeria's pharmaceutical industry. A purposive sampling of key players comprising MD/CEOs and Chairman/Captains of industry in 5 out of 8 listed pharmaceutical firms and 3 out of 6 industry associations was conducted in 2013. Information was elicited using questionnaires and semi-structured interview guide. The study found that pharmaceutical firms in Nigeria invested 0.2 to 15 % of their annual sales on R&D. The external knowledge sources for the industry were basically through

seminars/conferences, internet, customers and suppliers of input. Others included journal publications, technical reports, training/skill acquisition, workshops and the Pharmaceutical Group meetings. Qualitative assessment of the absorptive capacity of firms in the subsector revealed a medium-to-high level rating. The major determinants of absorptive capacity of the firms included experience, informal interactions, training and educational qualification of staff. Pharmaceutical innovation was majorly in the area of new product and new process developments of generic drugs. No new drug moiety development was recorded in the subsector. The major technology acquisition strategies utilized for new product and process development were in-house R&D, tapping tacit knowledge of staff, and sourcing knowledge from other firms in the industry. Strategic partnership was deployed by foreign-owned and multinational firms as knowledge acquisition strategies for drug discovery and delivery.

Keywords: External knowledge, absorptive capacity, pharmaceutical industry, research & development, innovation

1.0 INTRODUCTION

Pharmaceutical industry with its high research intensity of about 22% in the OECD countries (OECD, 1998) invests heavily on research for the development of new drugs. Engagement in in-house Research and Development (R&D) activities notwithstanding, industrial firms still depend on external sources of knowledge. External knowledge could be derived from a firm's own industry, other industries and research institutions (Schmidt, 2005). It is important for the firms to develop capacity to effectively acquire and utilise the knowledge for commercial purposes. The ability of firms to exploit external knowledge is therefore critical to their innovativeness and consequently their competitiveness in the global market. Absorptive capacity is explained as the ability of a firm to evaluate and utilize outside knowledge, which is largely a function of the level of prior related knowledge Cohen and Levinthal (1990). Firms endowed with higher levels of absorptive capacity will be able to extract greater benefits from similar stocks of external knowledge, and therefore outperform rivals in their innovation activity.

UNESCO (1992) reported that one of the main causes of weak demand and low absorptive capacities in the industrial sector in developing countries is a great lack of information, resulting from insufficient technical personnel in this sector. Learning is a key input in the development of absorptive capacity both at the national and firm levels. Absorptive capacity of a firm measures its ability to successfully utilize the ideas embodied in existing scientific knowledge and technologies, and translate them into new products and processes. Mytelka (2001) opined that absorptive capacity of a firm depends heavily upon the level of education and training; by extension a company's absorptive capacity similarly would depend upon the level of education and training of its personnel. Therefore, any company that fails to build capabilities that would enable it exploit new knowledge would fall behind others. Using

new technologies efficiently requires creating additional absorptive capacity, while a continuous effort has to be made to keep up with technical change (UNCTAD, 2005).

Brief Profile of Nigeria's Pharmaceutical sub-Sector

The Pharmaceutical industry is multibillion dollar industry – global spending on prescription drugs was US\$954 in 2011 while the global pharmaceutical industry is estimated to reach US\$1.1 trillion by 2014 (TMS Health, 2008). There are about 128 local drug manufacturers in Nigeria, which represent between 60- 70% of the total pharmaceutical manufacturing companies in the West Africa subregion (UNIDO, 2011). The pharmaceutical manufacturing sub-sector has an aggregate investment of over N300 billion and employs over 600,000 people. Between 2000 and 2008, the sub-sector received foreign direct investment of about US\$1.5bn. The domestic pharmacy market was worth about US\$ 600million in 2009 and was projected to grow substantially at about 12% annually to reach US\$ 717 million by 2011 (UNIDO, 2011). The estimated market for prescription ethical pharmaceuticals is US\$ 500 million and that for over the counter (OTC) pharmaceuticals about US\$ 900 million. The Pharmaceutical Manufacturing Group of the Manufacturing Association of Nigeria (PMG-MAN) estimates the market for biological products to be worth US\$ 100 million according to (UNIDO, 2011) report on Nigeria's Pharmaceutical sector profile. Out of the 61 companies registered as active members of the Pharmaceutical Manufacturing Group in 2012 only eight (8) are listed on the Nigerian Stock Exchange. These attributes were major considerations in purposively selecting the subsector for an assessment of the external knowledge sources, absorptive capacity and pharmaceutical innovation.

In an earlier study on pharmaceutical subsector, Oyewale (2010) reported that Nigerian Pharmaceutical industry has higher interactions with universities and research institutes than

other industries. The sustainability of the interactions would depend on the ability of the firms to utilize the research outputs of the institutions. What could be responsible for the weak interactions of the pharmaceutical firms with the knowledge institutions? This study investigated the external sources of knowledge that Nigerian Pharmaceutical firms are using and their absorptive capacities in acquiring and utilizing the knowledge for their productive activities and innovation.

The paper provides information on external knowledge sources for pharmaceutical innovation in Nigeria, the absorptive capacity and its determinants. The paper concludes with a short summary and suggests policy options.

2.0 STATE-OF-THE-ART

2.1 *External knowledge*

External knowledge is knowledge external to the firm. It is the outcome of a series of processes such as information generation, information dissemination and information interpretation (Sinkula 1994). Firms leverage on external knowledge as a key tool for maximizing competitive advantage and achieving robust innovative performance. Several theoretical and empirical studies (Schmidt, 2005; Lane and Koker, 2006; Vega-Jurado *et al.*, 2008; Liao, 2009) examining the relationship between knowledge and firm performance affirmed that the higher the level of knowledge acquired or accumulated, the greater the level of firm performance. Moenaert *et al.* (1990) and Nonaka (1991) emphasized the critical importance of knowledge to sustainable competitive advantage of the firm in view of uncertainties pervading the business environment. B Uncertainties arise from emerging competition, new technologies,

rapidly changing consumer preferences, social values and demographics. Firms are constrained by uncertainties to make changes in their core practices or risk failure or decline.

Moenaert *et al.* (1990) submitted that the innovation process is defined by "consumer uncertainty", "technological uncertainty" "competitor uncertainty", and "resource uncertainty". The four elements constitute an "innovation uncertainty" or "capability gap" at the organisational level (Welsch *et al.*, 2002). Gaps in the firm's current knowledge base and the information required to develop and commercialize a new product/service give rise to uncertainties. Researchers are of the view that the acquisition of new knowledge by an organisation is critical for filling the capability gap, increasing the research knowledge base, maintaining the distinctiveness of products/services and reducing the level of innovation uncertainty. The requisite capability gap-filling knowledge must be valuable, rare, imperfectly imitable and without a substitute. To innovate and perform significantly in the milieu of environmental uncertainties, firms must develop capacities and competencies in the acquisition, intra-firm dissemination and organizational adaptation of external knowledge (Welsch *et al.*, 2002). In Pederson *et al.*'s view, a firm needs to constantly source or acquire new knowledge in order to renew capabilities, innovate, and guard against technological obsolescence and competitive imitation (Pederson *et al.*, 2002).

Acquisition of external knowledge is obtainable from external knowledge resources or through cooperation with external agents, such as consumers, suppliers, competitors, universities, technology institutes, research institutions and consultants (Czarnitzki and Wastyn, 2009). A study of the impact of external knowledge on manufacturing firms observed that new product and process development conducted in conjunction with external customers and suppliers was positively related to expected market performance (Andersson *et al.*, 2002). In the

area of pharmaceutical research, Henderson and Cockburn (1994) reported that the ability to encourage and maintain an extensive flow of information across the boundaries of the firm is important to the productivity of drug discovery.

2.2 Absorptive Capacity

Absorptive capacity is defined as a firm's ability to recognize the value of new external information, assimilate it and apply it to commercial ends. Zahra and George (2002) expounded this subject further by suggesting that absorptive capacity is a dynamic capability (embedded in a firm's routines and processes that promotes organizational change and evolution), comprising potential absorptive capacity (PACAP, i.e. knowledge acquisition and assimilation) and realized absorptive capacity (RACAP, i.e. knowledge transformation and exploitation). The construct is predicated on several and diverse antecedents (including knowledge stocks, knowledge flows and organisational routines), components, outcomes and definitions. Several studies (see for example, Cohen and Levinthal, 1989, 1990, 1994; Zahra and George, 2002; Van Den Bosch et al., 2003; Schmidt, 2005; Lane and Koker, 2006; Vega-Jurado *et al.*, 2008) have identified the process and develop the concepts that link external knowledge flows to firm performance. This process is moderated by a firm's absorptive capacity. Absorptive capacity enables the firm to effectively acquire and utilize external knowledge, which, in turn, affects the firm's ability to innovate, adapt to its changing environment and be competitive. In this regard, higher level absorptive capacity is reported to increase the firm's ability to use more basic (as opposed to applied) external knowledge while the firm's absorptive capacity is greatly influenced by the nature of external knowledge (i.e. its complexity and applicability) (Vega-Jurago *et al.*, 2008). Absorptive capacity gives the firm the ability for pro-action and competence- building instead of

reacting to the industry's dynamism (Abdelkader, 2004). Absorptive capacity is useful in analyzing diverse, significant and organizational phenomena (Zahra and George, 2002), ranging from technology transfer among nations to the efficiency of strategic international alliances. The relevance of absorptive capacity has also been extended to the organizational level, where it is used to analyse innovation processes and the effect of organisational learning on creation of sustainable competitive advantage (Vega-Jurado *et al.*, 2008). Indeed, Cohen and Levinthal (1990) affirmed that it is imperative for a firm to develop its absorptive capacity in order to be innovative.

2.3 *Absorptive Capacity and Pharmaceutical Innovation*

Pharmaceutical firms focus on a variety of business drivers that help them gain competitive advantage and remain profitable. They build absorptive capacity by investing in R&D and marketing (Cohen and Levinthal, 1990). It is established that pharmaceutical innovation is driven by scientific knowledge (Cohen and Levinthal, 1990; Cockburn, 2004; Hassanlou, 2007). Research and Development (R&D) underpin new drug discovery, generates technical knowledge and capabilities that enable drug development. The challenges of meeting global health needs, in the face of international competition, have compelled pharmaceutical firms commitment to enhancing productivity through R&D in order to meet patients' demands for safe and effective drugs. Pharmaceutical industry therefore invests substantially on R&D to the tune of an average 15-20 percent of sales revenue (Hassanlou, 2007). In advanced countries context, pharmaceutical firms perform continuous R&D to develop and maintain core knowledge and capabilities (Stone and Flamm, 2003) and also depend on external sources of knowledge. This has influenced the scale of public and firms' R&D investments and returns in these

countries. The scenario is different in developing countries, where pharmaceutical firms R&D capability is limited and R&D investment poor. Many firms are therefore relying on external knowledge sources, especially from the universities and research institutes, for their innovative activities. However, information on the capability of firms in Nigeria's pharmaceutical sector to identify, assimilate and exploit external knowledge is scarce.

An earlier study carried out by our group on “**Academia-Industry Interactions in Nigeria Pharmaceutical Innovation System**” reported workshop participation, staff exchange/fellowship programmes, consultancy and knowledge flow to be the predominant channels of interactions (Siyanbola *et al.*, 2012). However, the intensity of interactions with firms was limited to only 20% of pharmaceutical researchers from universities and 7% from research institutes while only 16% of firms surveyed had interactions with the researchers. This poor statistics was attributed to the mutually expressed limited awareness of R&D activities being carried out by researchers and firm's R&D personnel. The weak interactions and lack of awareness could have contributed to the poor innovation performance of the sector with the attendant costly, heavy reliance on large scale importation of essential drugs to meet local demands. What is the level of absorptive capacity and its effect on firm's innovation in this sector? This paper therefore examined the absorptive capacity of firms in Nigeria's pharmaceutical industry for R&D output (new knowledge) from the universities and public research institutes (URIs).

2.4 Determinants of Firms' Absorptive Capacity

The firm absorptive capacity is determined by a set of factors: R&D activities (including measuring the ratio of R&D expenditure and sales volume); related prior knowledge and

individual's skills; the nature of external knowledge (complexity and applicability); the nature of the competitive environment (whether stable or turbulent); organizational structure and human resource management practices (including the quality and efficiency of internal mechanisms for fostering communication and relationships among staff) (Schmidit, 2005; Vega- Jurado, 2008), number of patents and publications, usages of patents (Liao, 2009). Studies show that R&D expenditure plays a role in building absorptive capacity (Cohen and Levinthal, 1989) and a dual role in the innovation process of firms: building absorptive capacity & generating new knowledge and innovations. R&D-related measures and approaches have been used to model absorptive capacity at the firm level. These include: R&D intensity (R&D expenditure/total sales), level of R&D investment, continuous R&D activities and existence of an R&D laboratory, related prior knowledge and individuals' skills; organization's strategic posture and links with the environment (networks) constitute other factors influencing absorptive capacity. Absorptive capacity is path-dependent because experience and prior knowledge facilitate the use of new knowledge. The cumulative nature of knowledge has also been related to employees' level of education, another determinant of absorptive capacity. It is observed that the more education and training an employee receives, the higher his or her individual ability to assimilate and use new knowledge will be. As firms' absorptive capacities depend on those of their employees, the general level of education, experience and training their employees have, has a positive influence on firms' level of absorptive capacity.

3.0 METHODOLOGY

A purposive sampling of key players in 5 out of 8 listed firms on the Nigerian Stock Exchange and 3 out of 6 industry associations in the pharmaceutical industry was conducted in

2013. Information was elicited using questionnaires and semi –structured interview guide. Respondents included Chief Executive Officers of the firms and Chairmen of Board of Fellows of Pharmacists, Nigerian Association of Industrial Pharmacists and Nigerian Representatives of Overseas Pharmaceutical Manufacturers from industry associations. A qualitative assessment of the data retrieved was then used to assess external knowledge sources, absorptive capacity and innovation in the pharmaceutical sector.

4.0 FINDINGS AND INTERPRETATION

4.1 Profile of Pharmaceutical firms

A profile of the firms surveyed showed that 2 firms were indigenously-owned, 1 was foreign-owned while 2 were multinationals. These firms realized an average annual sales ranging from N450 million to N4.5 billion. The firms' years of operation, staff strength and qualifications are shown in Table 1. The data indicate that the foreign and multinational firms targeted have more years of operational experience in the industry than the indigenous firms.

Table 1: Staff Qualification and Years in Operation of Pharmaceutical firms surveyed.

	Indigenous	Foreign	Multinational		% of Total no of staff
			A	B	
Doctorate Degree	-	-	-	-	0
Masters' Degree	2.75	3.44	2.58	1.55	10.32
Bachelor's Degree	10.67	9.98	6.89	1.55	29.09
Others	7.22	44.75	3.44	5.16	60.58
Total	20.65	58.18	12.91	8.26	100
Years of firm's operation	16	37	51	58	

The average staff strength in the indigenous firms was 120- , foreign-owned firm, 338- and multinationals, 377- members. The foreign and multinational firms also have more staff with master's degrees than the indigenous firms. In terms of staff quality, the data reveal that the highest academic qualification in the sub sector was a Masters' degree, which represents about 10 % of the work force. A significant number (61%) of the staff had other professional qualifications such as MBA, ACCA, etc. The lack of staff with PhD degree might have limited pharmaceutical firms' absorptive capacity for external knowledge and reduced their capacity for innovation since the number of staff with PhDs significantly influences the level of innovation a firm can achieve (Oyelaran – Oyeyinka and Adebowale, 2012).

4.2 External Knowledge Sources

In terms of sourcing for external knowledge to support production activities and address industry challenges, all the firms surveyed depended on experienced industry professionals as primary knowledge sources. The respondents also admitted to obtaining external knowledge/information from the internet, seminars/conferences, customers and suppliers of input. In addition, the industry managers claimed to have formal and informal interactions with universities & research institutes and other firms in the industry at the organizational and individual levels. In order of preference, the industry executives often contacted other firms and industry professionals for external knowledge before considering the academia. Lack of relevance to addressing industry problems and high cost implication of knowledge from the academia were adduced for the secondary status given to sourcing for knowledge from academic sources. Common to the indigenous and foreign firms was their reliance on ‘other Business Associates’ for external knowledge. This data corroborates previous studies which identified ‘other Business Associates’ as a crucial source of knowledge that can result in open innovation (Egbetokun *et al.*, 2012). Specifically, the foreign and multinational firms acknowledged that they obtained additional information from journals/other publications, technical reports, trainings/skill acquisition & development workshops and Pharmaceutical Manufacturing Group meetings.

4.3 Absorptive Capacity

A qualitative assessment/perception of staff absorptive capacity by CEOs, captains of industry and industry professionals indicated that indigenous firms’ exhibited medium level absorptive capacity while foreign and multinational firms displayed relatively high level

absorptive capacity. This is strongly supported with the respondents' claims of the availability of in-house R&D facilities, R&D personnel staff strength of 13 with an average of 9 years' work experience.

All the firms reported that they engaged their staff in active training both locally and foreign on a regular basis; the industry can therefore be regarded as knowledge- driven.

R&D investment of the pharmaceutical firms surveyed was in the range of 0.2 to 15 % of annual sales. Comparatively, this range is substantially lower than the R&D investments of 15-20 percent of sales revenue committed to R&D in developed countries (Hassanlou, 2007).

4.4 *Pharmaceutical Innovation*

The firms claimed innovation in new product and new process developments. In addition, all the firms reported to have developed a range of 1 to 4 new products and 4 new processes each in the last three years. Furthermore, the foreign firm reported innovation achievement in drug discovery in addition to new process and new drug developments while one of the multinationals of the firms achieved innovation in drug delivery. Evidences from oral interviews supported that R&D activities of Pharmaceutical companies were limited to new product and process developments starting from existing generic formulations. These developments involved rebranding, re-tooling and packaging of generic drugs with proven efficacy.

Table 2: Innovation areas of Pharmaceutical firms in Nigeria

	Indigenous	Foreign	Multinationals	
			A	B
New Product Development	√	√	√	√
New Process Development	√	√	√	√
Drug Discovery		√		
Drug Delivery			√	

4.4.1. Operational Technology Acquisition Strategies used by Pharmaceutical Firms in Nigeria

The surveyed firms in the industry achieved innovation in different facets of drug production through the adoption of diverse technology acquisition strategies for the different operational aspects of drug production. In the development of new products and processes, the technology acquisition strategies utilized by all the firms are tapping tacit knowledge of staff, in-house R&D, and sourcing knowledge from other firms in the Industry (Table 3). The strategy adopted for drug discovery and drug delivery by the firms was strategic partnership. In addition, Technology transfer was observed to have an enormous impact on the firms' business activities as a provider of new ideas and processes, for market expansion.

Table 3: New Technology Acquisition Strategies Adopted by Pharmaceutical Firms in Nigeria

		Indigenous	Foreign	Multinationals	
				A	B
New Product Development		i. Strategic partnership ii. Tapping tacit knowledge of staff	i. Tapping tacit knowledge of staff ii. In-house R&D iii. Strategic partnership	i. In-house R&D ii. Tapping tacit knowledge of staff	i. Tapping tacit knowledge of staff ii. Contract R&D iii. In-house R&D
New Process Development	Strategic partnership		i. Tapping tacit knowledge of staff ii. In-house R&D iii. Reverse Engineering iv. Technology transfer agreement v. Strategic partnership vi. Sourcing knowledge from other firms in the Industry	i. Reverse Engineering ii. Imitation iii. Tapping tacit knowledge of staff iv. In-house R&D v. Sourcing knowledge from other firms in the Industry	i. Reverse Engineering ii. Imitation iii. Tapping tacit knowledge of staff iv. In-house R&D v. Sourcing knowledge from other firms in the Industry
Drug Discovery			Strategic partnership		
Drug Delivery				Strategic partnership	

4.5 Conclusion and Policy Recommendations

4.5.1 Conclusion

The study observed that the firms in the Pharmaceutical sector preferred to seek knowledge from other firms in the industry before contacting the University and Research Institutes. The main sources of external knowledge were the Internet, seminar/conferences, customers and suppliers of input. The foreign-owned firm and the multinationals – who engaged in drug discovery and drug delivery – further obtained external knowledge from patent

documents/records, journals/other publications, training/skills development workshops and the Pharmaceutical Manufacturing Group meetings.

The Pharmaceutical sector was characterised by medium-to-high level absorptive capacity with experience, informal interactions, training and qualification of staff as the major determinants of absorptive capacity. R&D was not a major determinant of absorptive capacity in the sector. The R&D and Innovation capabilities were mainly in the area of new product and process development, especially in excipient development and generic drug production.

The major technology acquisition strategies utilized in the sector for new product and process development were obtained from in-house R&D, tapping tacit knowledge of staff, sourcing knowledge from other firms in the industry. Strategic partnerships were the main technology acquisition strategies utilized by foreign-owned and multinational firms in drug discovery and drug delivery.

4.5.2 Policy Recommendations

The pharmaceutical sector has capabilities in the development of new products and processes from existing generic formulations. Thus, it is recommended that:

- i. Government should develop the political will to protect the sector by regulating the importation of manufactured drugs into the country. This will enable the industry to expand to meet domestic pharmaceutical drug demand.
- ii. Government should strengthen the capability of firms to source for and use external knowledge for the development of the industry.
- iii. Government should provide necessary infrastructure to enable pharmaceutical firms acquire capabilities in drug discovery and drug delivery.

- iv. Government should foster robust interactions between the pharmaceutical firms, universities & research institutes by effectively implementing the new National STI policy.

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