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What Drives Innovation?: Inferences from an Industry-Wide Survey in Nigeria

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Abstract

This chapter seeks to make some contributions to the literature on firm-level innovation in Africa by attempting to identify the significant factors that explain the capability of firms in Nigeria to innovate using the results of an industry-wide study. We focused on the product and process innovation activities of firms between 2003 and 2006 and found differences in the factors that drive them at the firm level. Our results further show that interactions matter more than most innovation-related variables and that the most important actors that influence a firm's innovation efforts are its customers and suppliers. We conclude that product and process innovations are not mutually exclusive and that a major key to successful innovation is how and with whom a firm collaborates. The implication of this for firms and policy makers is that an effectively wired innovation system where all stakeholders are active is critical for firm-level innovation capability.

Keywords: innovation, drivers, manufacturing industry, Nigeria, determinants

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1. Introduction

The specific aim of this chapter is to throw some light on the drivers of innovation among manufacturing firms in Africa, using the results of a survey carried out in one of the most important economies of Africa, Nigeria. We define innovation as a process by which firms master and implement the design and production of goods and services which are new to them, irrespective of whether they are new to their competitors, their countries or the world (Mytelka, 2000 cited in UNU-INTECH, 2004). This is to say, according to OECD (2005) and UNCTAD (2007), that innovation takes place when products and processes that are new to a country or to an individual enterprise are commercially introduced, whether or not they are new to the world.

It is widely accepted that innovation is highly essential for firms to grow and remain competitive (Zaltman *et al*, 1973; Hitt *et al*, 1997; Tidd, 2001; Souitaris, 2003) and that innovation is connected to economic growth (OECD, 1997). According to UNIDO (2002), innovative activities introduce new products, create new demand and substitute for old products more rapidly than do stable activities. Unfortunately, majority of firms have been globally observed not to be adequately innovative (Storey, 2000).

OECD (2005) showed that the characteristics of innovative firms are strongly influenced by economic development and the management culture in the region of operation. For these and other reasons such as systemic weaknesses and huge research-industry disconnect (Oyewale, 2005; Ilori *et al,* 2000; Oyebisi *et al,* 1996), a sharp contrast exists between firms in the developing nations of Africa and their counterparts elsewhere. Thus, using the findings of innovation studies in technologically advanced countries to explain the innovative behaviour of these firms may be inappropriate.

Identifying the main factors that allow firms to innovate and the factors that enhance their ability to innovate is of great importance for policy (OECD, 2005), especially within the developing country. However, while there has been much study on the factors that influence firms' propensity to innovate, few of this has been in developing countries (Bala-Subrahmanya, 2005; 2006) especially in Africa. This chapter is premised on the need to close this gap in development-relevant knowledge using results from Nigeria. This country study would be particularly useful in providing methodological and empirical directions as far as the key determinants of industrial innovation in Africa are concerned.

The rest of the chapter is structured as follows. Section 2 presents a brief review of the manufacturing sector in Nigeria. This is followed in Section 3 by a review of the extant literature on firm-level innovativeness. The section highlights, from the literature, the key determinants of innovation capability at the firm level. In Section 4, the method employed by the study is detailed. The content of the section also includes a description of all the variables that the study considered. The results are presented and discussed in Section 5. Strategic implications for practice and policy making are drawn in Section 6 before the chapter concludes in Section 7.

2. The Manufacturing Sector in Nigeria

Players in the Nigerian industrial and manufacturing sector can be classified into four groups, namely: multinational, national, regional and local. Apart from the multinational operators, most of the other players have disappeared in the last two decades, due to unpredictable government policies and lack of basic raw materials, most of which are imported (BPE, 2007). The local players in the nation's industrial sector comprise

manufacturing firms of various scopes and sizes. These have over the years ordered themselves into a central industry association - the Manufacturers Association of Nigeria (MAN) - which comprises several smaller industry associations. MAN is organised into 10 sectors which are further disaggregated into 75 sub-sectors and one export group made up of firms with export products (MAN, 2007). Of the 5 constituent groups of the engineering sector, only 3 are regarded as economically significant; and only 22 sub-sectors out of these are recognised. The sectoral groups are:

i. Basic metal, iron/steel, fabricated metal products sectoral group
ii. Electrical and electronics sectoral group
iii. Motor vehicles and miscellaneous assembly sectoral group

Today, the Nigerian Industrial & Manufacturing sector accounts for less than 10% of Nigeria's GDP, with manufacturing capacity utilisation having fallen from over 70% in 1980 to about 46% in 2003 (CBN, 2004) and remaining below 35% for the most part of the last decade (BPE, 2007). Manufactured exports in Nigeria only accounted for 0.2% of total exports in 2000, declining from already low 1.5% in 1985. This is among the lowest manufacturing propensity ratios in Sub-Saharan Africa, and is the result not only of declining manufactured exports but also an increased dependency on primary exports; particularly oil. In fact, Nigeria's share of oil exports in total exports increased from 95.4% in 1996 to almost 99.6% in 2000 (Albaladejo, 2003). These make Nigeria one of the less export-oriented economies and one of the less diversified economies within the region and in the world.

Scholars have identified some major constraints faced in the Nigerian manufacturing sector (Biggs *et al*, 1995; Tyler, 2002). These include:

- Infrastructural inadequacies leading to high production costs

- High interest rates
- Unpredictable government policies
- Non–implementation of existing policies
- Lack of effective regulatory agencies
- Dumping of cheap products
- Unfair tariff regime
- Low patronage

3. On the propensity of firms to innovate: the key determinants

Innovation capability is defined as the skills and knowledge needed to effectively absorb, master, and improve existing technologies, and to create new ones (Lall, 1992). Thus, innovation capabilities consist of the potential of a firm to seek out new ways of carrying out its key activities and the capacity to internalise the outcome of such searches within the firm (Wangwe, 1995). The innovation activities of a firm are, therefore, direct manifestations of its innovation capability.

The literature on innovation provides several directions about various factors that could possibly contribute to the build-up of innovation capability (Romijn and Albaladejo, 2002). Factors internal to the firm include first of all, the knowledge and skills brought into the firm by the entrepreneur(s)/top management – who will provide leadership - and the workforce, which they obtained through formal qualification and earlier experience. The centrality of firm-level leadership to innovation was emphasised by Raward (2004) and Leifer (1997). Of the seven correlates of radical innovation reported by Leifer (1997), four are directly people-centred and three of these deal with leadership at different levels of the organisation – from top management to the shop floor.

Firms require an adequate stock of technically qualified manpower to learn effectively, that is, to absorb new technologies, modify them, create and transfer new technological information (Hoffman et al., 1998; Wignaraja, 1998). In this regard, Romijn and Albaladejo (2002) as well as Teixeira and Natércia (2003) established that scientists and engineers are particularly valuable, more so if they have had prior experience in a scientific environment. Besides, Teixeira and Natércia (2003) have shown in their study of innovation capability build-up in Portugal that knowledge stock can also be approximated by patented inventions. Firms can further enhance their human capital stock over time through internal staff training through both formal and informal means (Bell, 1984). Another major internal activity is 'learning-by-doing' through involvement in R&D, both as a formally organised activity (Malerba, 1992; Cohen and Levinthal, 1989; Hitt et al., 2000) and as informal technological efforts closely allied to production, directed at incremental problem solving and experimentation on the shop-floor (Bell, 1984; UNCTAD, 1996; Kim and Nelson, 2000).

External interaction with certain actors can provide missing external inputs into the learning process which the firm itself may not be able to provide. Intermediary organisations like trade organisations, public assistance agencies, industry associations, foundations, chambers of commerce, higher education and the like are also helpful sources of information for the firm's innovation activities (Romijn and Albaladejo, 2002; Albu, 1997; Meeus et al, 1999a, 1999b). Meeus et al (1999a) found customers and suppliers as additional actors involved in innovation processes.

Interaction with these actors may occur for several reasons. For instance, Meeus et al (1999a) particularly identified resource deficiencies within an organisation as precursors of external relationships. These authors found that the higher the resource deficits/shortages and the lower the alignment of innovative activities within the firm, the more likely the search for complementary resources externally, which increases the likeliness of external relationships. Several other scholars have identified key reasons to include gathering information about technologies and markets, obtaining various other inputs to complement the internal learning process, such as external staff training, parts and components, consulting services, and R&D grants (UNCTAD, 1996; Dodgson, 1993; Lundvall, 1988, 1992; Edquist, 1997; Freeman, 1991, 1995; Panda and Ramanathan, 1996). Intensive interaction with customers and suppliers is thought to be particularly beneficial (von Hippel, 1988; Lundvall, 1988; Håkansson, 1989). Access to laboratory and library facilities and scientific contacts also represent particularly effective support mechanisms (Romijn and Albaladejo, 2002). Within the African context, Goedhuys et al (2006) presented evidences on the particular importance of institutions, especially industry associations, in boosting enhanced performance through innovativeness.

Besides firms' knowledge bases, workers' abilities and academic backgrounds, as referenced above, the use of information and communication technologies (ICTs); technology transfer through equipment procurement; linkages and quality assurance systems were identified by Polcuch *et al* (2005), OECD (2005) and UNU-INTECH (2004) as having received less attention elsewhere but very important in the developing country context. It has been shown that ICT is having substantial impacts on economic performance, the pace of innovation and the success of individual firms, in particular when it is combined with investment in skills, organisational change and innovation

(OECD, 2004; Dodgson et al, 2001). In fact, ICT can change - and improve - innovation by integrating diverse production systems and formerly unrelated technologies (Cantwell and Santangelo, 2000). According to UNIDO (2002), they can also change the geography of industrial activity, bringing together locations once separated by high communication and transport costs. In addition, they can create new opportunities for learning in developing countries, using electronic links to access global knowledge on an unprecedented scale.

UNU-INTECH (2004) also identified the location of the firm, ownership structure, sector, size of the firm and its habits and practices reflected in past innovation activities as important determinants of firm-level innovation propensity. Specifically, location within or close to a major urban area guarantees greater proximity to sources of new knowledge and ease in participating in knowledge flows. The ownership structure influences the choice of products and processes as well as their subsequent modification or change and the sector of activity provides a measure of the stimulus to innovation resulting from the higher R&D intensity of the sector and nature of competition within the sector. Firm size is related to its access to resources to and opportunities for knowledge scanning to support a process of innovation.

In all of these, it comes out clearly that very few of the literature on the drivers of firm-level innovation is from the developing world. An implication of this is that the empirical knowledge that is at present available on firm-level innovation determinants in this group of countries is not so extensive. Also, it does not come out clearly whether or not there are differences in the factors that explain the propensity of firms to engage in different types of innovation.

4. Research Methods

a. Research Design and Sample

To achieve our objective, we use the first set of results from a recent survey on innovation capability in Nigeria's manufacturing sector. The method and types of questions used in the survey are described in UNU-INTECH's (2004) *DESIGNING A POLICY-RELEVANT INNOVATION SURVEY FOR NEPAD* - a 2004 study commissioned by the New Partnership for Africa's Development (NEPAD) as part of the efforts to design and implement a long overdue unified innovation survey for Africa.

The study reported here was designed and implemented by the National Centre for Technology Management (NACETEM), an agency of Nigeria's Federal Ministry of Science and Technology. NACETEM is the only Science, Technology and Innovation training and policy research agency in Nigeria and it is particularly active locally and internationally in STI-related issues. NACETEM's study on which this work is based was initiated in 2006 and data collection commenced in September, 2007. The main instrument was a structured questionnaire, supplemented with interviews in a number of cases where this was deemed necessary. This survey is particularly useful in that it represents the very first attempt to carry out an industry-wide innovation survey in Nigeria.

The study sample was based on the Business Directory of the Manufacturers Association of Nigeria (MAN). A total of 300 firms were randomly selected from the different industrial sectors, classified according to the 3-digit ISIC Rev. 3. Questionnaire was delivered by hand to the sampled firms. Some of these were also collected by hand and a

few were returned by post. In the first set of results that came in, a total of 105 firms had returned usable questionnaires, putting the response rate at 35%. All the statistical analyses were carried out using version 13 of the Statistical Package for Social Sciences (SPSS). The descriprive analyses carried out were mainly frequency and percentage distributions as well the evaluation of major measures of central tendency (i.e. mean and standard deviation). The specific drivers of innovation were evaluated using the Spearman's rank correlation coefficient since the variables were mainly discontinuous in nature.

b. Variables and Measures

Table 1 describes the construction of the variables that were used in the statistical analysis and their descriptive statistics. The dependent variables are measures of the firm's innovation activities during the 2003-2006 period. The adopted questionnaire asks firms directly whether they were able to introduce an innovation during the specified period.

Our discussion here deals with only product and process innovations and each of them was measured as the count of all activities that amount to each type of innovation. The total score was then recoded as 1 if the firm had carried out any of the activities representing each type of innovation and 0 otherwise. The implication of this is that a firm would be classified as innovative with respect to a particular type of innovation as long as it carries out any activity that amount to that type of innovation. In our analyses, we made no distinction between radical and incremental innovation.

A total of 27 independent variables were included in the correlation analyses. These are appropriately detailed in Table 1 and would therefore not be individually discussed here.

It is worth menitioninig, however, that the term actors is used to refer collectively to competitors, customers, suppliers, associated companies within a firm's corporate group, consulting and marketing firms, private research institutes, public research institutes, universities or other higher education institutions, government ministry, financial institutions, training institutions and industry associations. Also, we constructed variables to particularly capture the interactions within the NIS as predictors of firm-level innovativeness. These interaction indicators include Incidence of Collaboration, Breadth of Collaboration, Breadth of Knowledge sources, Depth of Knowledge sources and Breadth of proximity advantage from actors.

Table 1: Description of Variables

S/N	Variable Name	Definition/Measure	Mean	SD
DEPENDENT				
1	Product innovation	Introduction of new product or modification/improvement of an existing one. 1 if the firm had carried out any of the activities representing this type of innovation and 0 otherwise	0.85	0.36
2	Process innovation	Introduction of new process or modification/improvement of an existing one. 1 if the firm had carried out any of the activities representing this type of innovation and 0 otherwise	0.78	0.42
INDEPENDENT				
1	Firm Size	Measured as the logarithm of the firm's employees in 2006	2.82	1.11
2	Firm Age	Evaluated as the logarithm of the difference between the year of the survey (2007) and the firm's year of establishment	2.87	0.92
3	Organisational structure	Logarithm of the number of levels in firm's organizational structure	1.51	0.41
4	Ownership	The types of stakeholders that own the firm. Possibilities include Nigerian or foreign individuals, firms or government and partnerships among these	2.29	1.78
5	Training of CEO	Measured via 3 binary variables indicating whether or not the CEO possesses foreign degree, training programmes or working experience	2.84; 3.00; 3.29	1.55; 1.78; 2.01
6	Experience of CEO	3 quantitative variables indicating in years the working experience, if any, that the CEO had in either of a small enterprise (including family business), large/multinational firm or a university or related institutions	16.38; 11.60; 6.14	13.42; 6.72; 2.67
7	Staff training	The incidence of training programmes for staff. 1 if there is and 0 otherwise	0.73	0.45
8	R & D	A measure of the overall R&D activities of the firm. Captured via 2 binary variables indicating whether or not the firm has R&D activities and a separate R&D department	0.52; 0.22	0.5; 0.42
9	Patenting	Count of patents applied for between 2003 and 2006	3.20	2.28
10	Use of Internet	An indicator of whether or not the firm uses the internet in any of its activities. Measured via a binary variable taking value 1 if firm uses the internet and 0 otherwise) and a quantitative variable giving the percentage of staff with access to internet facilities in their offices	0.87; 20.56	0.34; 23.37
11	Government support	A binary variable indicating whether or not the firm used any form of government support in its innovation activities	0.24	0.43
12	Innovation budget	A binary variable indicating whether or not the firm has a separate budget for innovation	0.60	0.49
13	Reasons for Innovation	Constructed as the sum of scores on the reasons that were rated by the firm as very important for its innovation activities	18.07	7.59
14	Obstacles to Innovation	Constructed as the sum of scores on the obstacles that were rated by the firm as important in its innovation activities	2.89	2.61
15	Clustering	Whether or not the firm is located within an industrial cluster. Captured through the firm's location	19.27	7.26
16	Incidence of Collaboration	Constructed measure of whether or not the firm engages in joint activity with any of several actors. 1 if this is so and 0 otherwise	0.79	0.41
17	Breadth of Collaboration	Constructed as the sum of actors a firm collaborates with	4.47	3.92
18	Breadth of Knowledge sources	Constructed as the sum of knowledge sources that a firm draws on	12.21	6.21
19	Depth of Knowledge sources	Constructed as the sum of scores on the knowledge sources that have been rated by the firm as very important in its innovation activities	7.70	6.83
20	Incidence of proximity advantage from actors	Constructed measure of whether or not the firm gains any proximity advantages from being located close to any of several actors. 1 if this is so and 0 otherwise	0.75	0.43
21	Breadth of proximity advantage from actors	Constructed as the sum of actors a firm gains proximity advantages from	4.35	3.76

Note: Where there are more thatn one variable, the figures are given in the same order in which the variables are described

5. Results and Discussion

a. Descriptive Statistics

Of the 105 firms in our sample, there are 89 firms (84.8% of sample) and 82 firms (78.1% of sample) which had carried out product and process innovations respectively, during the 2003 – 2006 period. Only 1 firm reported having started but later abandoned product innovation activities. 9 product innovators did not innovate in their processes and 2 process innovators did not did not have any product innovations. The innovation activities of these firms can be resolved, as shown in Figure 1, into only either of product or process innovations or a combination of both. A total of 80 firms (76.2% of sample, 89.9% of product innovators, 97.6% of process innovators) carried out both product and product innovations during the reference period. A total of 14 firms did not innovate at all.

Process Innovation	Product Innovation: No	Product Innovation: Yes	
Yes	2 *1.9%*	80 *76.2%*	**82** ***78.1%***
No	14 *13.3%*	9 *8.6%*	**23** ***21.9%***
	16 ***15.2%***	**89** ***84.8%***	**105** ***100%***

* Figures in italics are proportions of total sample; totals are in bold print

Figure 1: Demonstrative pattern of firm-level innovation in Nigeria

The average age of the firms was found to be about 24 years and average firm size was about 35. Approximately half of all the firms in the sample have been in existence for 20 years or less and about 93% have less than 100 employees. About 51% of our entire sample are fully owned by Nigerian individuals and 21% are joint venture enterprises. The rest are owned by either of the Nigerian government, a foreign individual or corporation. These figures present fair evidence in support of the fact that Nigerian firms are mostly citizen-owned SMEs since the size and ownership of the firms were not considered in the selection of the sample.

42% of the entire sample reported having done some R&D in the last 4 years, only 17% indicated having a separate R&D department and 47% claim to have a separate budget for innovation. The two latter variables are more likely when a firm is active in R&D. Among the firms that have done some R&D, 41% claim to have a separate department for that and 59% claimed to have a separate innovation budget. Altogether, a total of 16 patent applications were filed between 2003 and 2006 by just 6 firms, representing a mere 4.8% of the sample. Taken together, these figures lead us to believe that R&D activities in the industrial sector may not be too low but what these activities are meant to achieve and whether or not they achieve it are still uncertain. Without doubt, patents seem not to be coming from industrial R&D as might be expected.

b. Innovation Collaboration, Objectives and Obstacles

In Table 2 we present the various actors that the firms have collaborated with and from whom they gain certain advantages by virtue of being closely located. The table was constructed using the average of the scores attached to each actor by the firms. Clearly, in terms of collaboration and proximity advanatages, the sampled firms have been more

involved with their customers and suppliers than any other actor. The occurrence of industry associations among the first 5 of 12 actors that firms collaborated with seems to be a pointer to the fact that these associations are rather important in the innovation efforts of firms. As a source of knowledge for innovation, they ranked fourth, ahead of education and research institutions and government ministries/agencies. The most important sources of information for innovation were found to be customers, internal sources and suppliers (especially of equipment). The knowledge centres – that is, research institutes and higher education institutions – turned out to be the least used by the firms in their innovation efforts.

Table 2: Ranking of actors by the firms in terms of collaboration and proximity advantages gained by being located close to them

Actor	Cooperation or Joint activity	Proximity Advantages
Customers	0.94	0.99
Suppliers	0.92	0.93
Associated companies	0.75	0.75
Financial Institutions	0.72	0.75
Industry Associations	0.67	0.66
Training Institutions	0.61	0.53
Marketing firms	0.61	0.65
Competitor	0.61	0.69
Government Ministry	0.50	0.52
Public Research Institute	0.49	0.42
Private Research Institute	0.47	0.47
Higher Education Institutions	0.44	0.48

The foregoing results point in two significant directions. First, as a recent study (Jaruzelski and Dehoff, 2007) showed, customers probably matter more than any stakeholder in innovation. They, alongside suppliers of equipment and raw materials exert considerable influence on the success of a firm's innovation. Customers' influence comes from the fact that they ultimately dictate the direction and detrmine the success of any

innovation efforts. This point is intensified by our finding that the most important reason why firms innovate is to satisfy customer demands (see Table 3). This is, indeed, to be expected consiering the huge market that exists in Nigeria. Suppliers' influence arise from their being key actors on which the firm must depend to deliver to the market on time and according to demands.

Secondly, the poor rating of government and educational/research institutions seems to suggest that they offer sub-optimal support to firms in the latter's innovation efforts. It is not impossible that the firms have low absorptive capacities which make it difficult for them to assimilate the knowledge available from these actors. It is also likely that the activities of these actors are not demand-driven and hence do not address the specific needs of the domestic industrial sector. Whatever the reasons for their observed sub-optimal support to firm-level innovation hitherto, there is a dire need to drive, through appropriate policies, research-industry connection within the country.

Table 3: Ranking of the reasons why firms innovate

Reasons for Innovation	Mean
Satisfy customer's demand	1.89
Improve product quality	1.83
Lower production costs	1.79
Extend product range	1.70
Take advantage of New technology	1.69
Improve working conditions	1.67
Comply with Nigerian laws & standards	1.59
Develop more environmental -friendly product/process	1.58
Deal with the challenge of new technology	1.51
Deal with new competitors at home	1.51
Avail of Government support	1.39
Deliberate in-house efforts	1.38
Replace old product generations	1.34
Deal with new competitors in export markets	1.32
Other reasons	1.00

It comes out also from Table 3 that the most important reasons why firms innovate, besides customer satisfaction, have to do with their products. Specifically, improvement of product quality, reduction in production costs and extension of product range, in that order, rank next to customer satisfaction among the firms' innovation objectives. The importance attached by the firms to these objectives could be explained by the fact that the profitability of businesses are significantly dependent on these. For instance, when manufacturers produce higher quality products at lower costs relative to their competitors, they are said to be competitive and are likely to gain more profits. Findings from other developing economies have shown similar trends. In India, for instance, Bala-Subrahmanya (2005) found quality improvement, cost reduction and customer satisfaction, in that order, as the leading reasons why firms innovate.

Table 4: Ranking of the obstacles to firms' innovation efforts

Obstacles to Innovation	Mean
High cost of innovation	1.76
Domestic economic conditions (e.g. economic recession, inflation etc)	1.68
Lack of financing	1.55
Legal restrictions	1.28
Lack of information on technology	1.16
Weak customer demands	1.11
Lack of skilled personnel	1.00
Long approval process within firm	0.94

Table 4 contains the main obstacles identifed by firms in their innovation efforts. As the figures indicate, financial issues as reflected in high cost of innovation, unfavourable economic conditions and lack of financing constituting the most important obstacles to innovation. The identification of weak customer demands (albeit at a very low level) as an obstacle again shows the importance of customers in innovation.

c. The Drivers of Innovation

The correlation results are containned in Table 5. As demonstrated in Figure 1, product and process innovations are not mutually exclusive to the firm. Any firm could actually engage in both types of innovation during the same period. Indeed, since most products go through processes, we argue, based on our results, that most product innovations would be accompanied by changes in processes and vice versa. This is further supported by the fact that we found a significant positive statistical relationship between these two type of innovation ($\chi^2 = 47.48$ at 1 df, $r = 0.672$; $p<0.01$) .

One of the first things that come out from the table is that our special variables have done better than all the other variables in explaining firm-level innovativeness. We deduce from this that interactions matter more than most other factors in firms' innovation efforts. It would, however, be desirable to carry out cross-country comparative studies to further verify this. Secondly, more variables are significantly associated with product innovation than with process innovation. A total of 9 variables are correlated with product innovation, 6 of these at 1% confidence level. In contrast, 7 variables are correlated with process innovation, albeit 6 of them at 1% confidence level.

Table 5: Significant drivers of innovation

S/N	Variables		Correlation Coefficient	
			Product Innovation Indicator	**Process Innovation Indicator**
DEPENDENT				
1	Product Innovation Indicator		1	**0.672****
2	Process Innovation Indicator		**0.672****	1
INDEPENDENT				
1	Firm Size		-0.118	0.033
2	Firm Age		-0.02	-0.008
3	Organisational structure		0.087	-0.1
4	Ownership		0.135	0.077
5	Training of CEO	Overseas Degree	0.264	0.251
		Overseas training programme	0.117	0.12
		Overseas work experience	0.169	0.025
6	Experience of CEO	Small enterprise (including family business)	-0.335	-0.064
		Large domestic firm	0.16	0.336
		University or related institution	**-0.764***	**-0.764***
7	Staff training		**0.242***	0.159
8	R & D	Firm's R&D activities	-0.013	0.144
		Separate R&D department	-0.059	0.07
9	Patenting		.	-0.181
10	Use of Internet	Firm's use of internet	0.035	0.022
		% staff with access to internet in their offices	-0.016	**-0.370****
11	Government support		-0.171	0.028
12	Innovation budget		**0.240***	0.07
13	Reasons for Innovation		**0.322****	0.164
14	Obstacles to Innovation		**0.363****	**0.261****
15	Clustering		0.104	-0.007
16	Incidence of Collaboration		**0.368****	**0.350****
17	Breadth of Collaboration		**0.344****	**0.299****
18	Breadth of Knowledge sources		0.192	0.151
19	Depth of Knowledge sources		**0.463****	**0.396****
20	Incidence of proximity advantage from actors		**0.309****	**0.336****
21	Breadth of proximity advantage from actors		**0.352****	**0.368****

* indicates significance at 5% level and ** 1% level of confidence

The dissimilarities in the variables that are associated with each of product and process innovation suggest that they depend on different factors. For instance, while product innovativeness might increase with staff training and the number of important reasons that a firm has for its innovation efforts, process innovation does not appear to be

responsive to these factors. Also, the creation of a separate budget for innovation is not associated with process innovation whereas it is significantly positively correlated with product innovation. It then follow that firms that presently have innovation budgets spend more of that on implementing changes in products than on process changes and that when a firm has a special innovation budget its product innovativeness could be enhanced. The non-significant relationship between the existence of an innovation budget and process innovation may not be unusual because changes in processes are less rigid, more responsive to 'shop-floor' serendipitous discoveries and may not generally require financial investments as much as product innovations.

On the other hand, the intensity of ICT usage within a firm, expressed in the proportion of staff that have internet access in their offices, is significantly correlated with process innovation whereas it did not with product innovation. Use of the internet within a firm, therefore, might give rise to changes in processes more often than in products, the negative correlation suggesting that this occurs when fewer staff use the internet. This is particularly interesting in that it suggests that firms would tend to benefit more from ICT use if only a limited proportion of staff have extensive access to it.

The engagement of of a firm in formal cooperation or joint activity with its customers, suppliers and other actors is important to both product ($r=0.368$; $p<0.01$) and process ($r=0.350$; $p<0.01$) innovation, albeit, seemingly more important to product innovation. Similarly, the number of actors a firm collaborates with, its important sources of knowledge and incidence of innovation obstacles are associated more with product innovation than process innovation. These results point out that firms would more often engage in collaborations and seek for more knowledge from a greater number of actors

for the sake of product innovations than process innovations. Also, a firm is more likely to encounter barriers in its prodcut innovation than process innovation.

When firms are closely related to certain actors, they gain some advantages from this proximity. Among other benefits, lead time for knowledge transfer would be reduced and collaborative efforts should be easier to implement. The occurrence of these advantages was found to be significantly associated with firms' product ($r=0.309$; $p<0.01$) and process innovation ($r=0.336$; $p<0.01$). The number of actors from which such advantages are gained are also important. Contrary to the situation with collaboration, process innovation is more strongly associated with proximity advantages than product innovation.

Of all the variables on leadership that we considered, only the possession of previous work experience in a knowledge centre by the CEO came out important. This variable was equally negatively correlated with both product and process innovation. We presume, based on this, that the presence of leaders with this kind of experience in a firm reflects in the firm's innovative performance. The negative correlation seems to indicate – counter-intuitively, though - that this factor might actually inhibit innovation. Whether or not this would be the case begs for further detailed studies specifically designed for that purpose.

Size, age, structure and ownership of the firm do not appear to be important predictors of firm-level innovativeness. The same goes for patenting, R&D activities and the use of government support in innovation. These indicate that firms that are active in R&D and patenting are not necessarily innovative.

6. Implications

This chapter explored the important determinants of firm-level product and process innovativeness in Nigeria. In view of the small sample, the findings can only serve as indications of possibly broader directions. Notwithstanding, the emergence of some very clear patterns from the data may suggest that they do have wider validity in the entire African continent in which the research took place. In view of this, a number of useful inferences can be drawn for policy and practice.

a. Implications for Policy

The poor rating of government and educational/research institutions as sources of knowledge and collaborative activities with industrial firms indicates that they offer sub-optimal support to firms' innovation efforts. It is therefore particularly important for African nations to drive interactions among these actors and industrial firms with appropriate policies. The perceived importance of business and industry associations also suggest that the formation of stronger ones, possibly with government intervention, would be highly beneficial.

Although clustering of industrial firms was not signifcantly correlated with either of the innovation types that we assessed, this does not in any way suggest that clustering is not desirable. In fact, the apparent consequence of proximity of firms to several actors, particularly suppliers, imply that more of them should be attracted into closer locations to the firms.

As demonstrated by our results, the obstacles that a firm encounter in its innovation efforts require some attention. Without doubt, creating an enabling economic

environment and ensuring adequate funding will enhance firm-level innovativeness in Nigeria, and indeed Africa.

b. Implications for Practice

The dissimilarities in the variables that are assocaited with each of product and process innovation suggest that they depend on different factors. This leads us to suggest that firms need to be strategic in their approach to innovation. The type of innovation that a firm should commit its resources to should be such as it is optimally positioned to successfully pursue and that aligns with its strategy.

That interactions seem to matter more than most other factors in firms' innovation efforts should lead firms in the direction of forming more of these. In doing that, attention should be paid to interacting with the most beneficial actors. As our results suggest, customers and suppliers of equipment and raw materials probably matter more than any stakeholder in innovation. From a market perspective, our results support the neo-classical economic paradigm that the location of firms to sources of supply and demand is beneficial. Relationship with industry associations also matters.

On firm-level leadership, our findings imply that the possession of previous work experience in a knowledge centre, say a university or research institute, by the CEO of a firm may constitute an added advantage to firm-level innovativeness. In using ICT, especially the internet, firms should give extensive access only to a strategically selected proportion of staff who need it directly for their job functions. Other categories of staff might actually be distracted in their jobs if granted extensive internet access.

7. Conclusions

Nigerian firms are active in product and process innovations but R&D and patenting activities are still very low. The data analysis suggested that the key drivers of firm-level product and process innovation are dissimilar to some degree. Common drivers include collaboration and proximity to several actors, the search for and several sources of a firm's innovation-related knowledge as well as the previous work experience of the top decision maker in the firm and the obstacles encountered by the frim in tis innovation activities. Factors specific to product innovation include staff training, innovation budget and a firm's reasons for innovation. The only process innovation-specific factor was the proportion of staff with personal access to the internet.

Taken together, our results lead us to conclude that, ultimately, the key to innovation success has nothing to do with how much money a firm spends. It is directly related to the effort expended to align innovation with strategy and customers, and to manage the entire process with discipline and transparency.

It would, however, be desirable to carry out cross-country comparative studies to further verify the results that we have obtained. Further research is needed also before firm policy conclusions could be drawn regarding the patterns observed above. The validity of the outcomes from this research would have to be tested with a larger sample, drawn from a larger number of industries and countries. Further work is also necessary to improve the measurement of firm-level innovation drivers by means of reasonably simple and yet reliable and discerning indicators. The composite interaction indicators introduced in this work only represent some early steps in that direction.

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