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Abstract

This study explored the factors that explain innovation capability in SMEs in developing countries. This is important given the increasing global pressures that these SMEs have to face. The data employed came from a survey of Cable and Wire manufacturing firms in Nigeria. The important factors that accounted for innovation performance were firm-level leadership and use of new technologies – particularly ICTs. Important external factors included interactions with customers and suppliers of equipment/raw materials. Particularly, the industry association was about the most significant driver of innovativeness. We therefore conclude that it is beneficial for industries in developing countries to be well-organised as a means to achieving improved innovation capability.

Keywords*: innovation; innovation capability; innovation pattern; SMEs; internal and external factors, Nigeria*

1. Introduction

The objective of this paper is to explore the specific factors that influence the capability of small and medium-sized enterprises (SMEs) in developing countries to innovate. The literature in the area of sustainable competitive advantage leads to the conclusions 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 (Hamel and Prahalad, 1994; Prusak, 1996); and that the cause of the competitive gap between nations and organisations is knowledge (Prusak, 1997). Hence, with or without technology transfer, late industrialisers – like Nigeria - do not automatically benefit from the increasing global pool of technologies (Timmer, 1999). This is because the effective use of technology borders more on innovation and learning than on sourcing and acquisition (Egbetokun et al, 2009). It is often argued that SMEs are better positioned for innovation than larger firms but empirical evidence regarding this is mixed (Davis, 1991; Hallberg, 2000). For instance, empirical research has shown that the share of SMEs in total innovations was very high in the early stages of major new technologies (particularly in the decades between the 1970s and 1980s) but their share declined as and when technologies matured. The decline was accompanied by a process of concentration of R&D and innovations in a few large firms. However, due to the influence of networking and collaborative research in the last quarter of 20th century, SME innovations have genuinely increased (Freeman and Soete, 1999; Bala-Subrahmanya, 2005a). While the provision of further empirical evidence would require comparative studies that

include both small and large firms, enlarging the body of evidence relating to SME innovation capability (on which studies about large firms is relatively extensive) is particularly useful in the meantime.

We adopt a broad definition of innovation as proposed by Mytelka (2000). Within the context of developing economies, innovation describes the 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. 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. In this respect, a wider set of changes in products, processes, organisation and marketing; including the purchase of new machinery and equipment as well as recent licensing-in of technology, are accepted as innovation (UNU-INTECH, 2004).

To implement these changes, firms need to acquire or develop technological capabilities which, according to Lall *et al* (1993), refer to the information and skills (technical, managerial and institutional) that allow productive enterprises to utilise equipment and technology efficiently. Several kinds of technological capabilities are distinguished in the literature (see for instance Lall, 1992; Romijn and Albaldejo, 2002) but we focus narrowly on innovation capability. We argue, given our broad conceptualization of innovation, that innovation is driven more by learning than by 'formal R&D' and that the build-up of innovation capability could occur at several stages of the firm's development and not necessarily at the 'later' stages as is generally argued[1]. Thus, we adopt a more subtle perception of innovation capabilities as 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). Thus, the capability of a firm to innovate would be influenced by both its internal and external environments.

Authors like Bell (1984), Katz (1987) and Lall (1987; 1991) have persistently stressed the fact that "innovation" in the developing country context tends to revolve predominantly around assimilation and local adaptation of technologies imported from advanced countries, while full-fledged innovation capabilities driven by formal R&D tend to develop at a relatively late stage. While that is largely true, especially when new product development (NPD) is the focus, our broad conceptualization of innovation presupposes that it does not have to derive from R&D. As Erust (2007) noted, innovative capabilities rather refer to the skills, knowledge and management techniques needed to create, change, improve and successfully commercialize products, services, equipment, processes and business models. Thus, although there is a substantial body of literature on technological capabilities and innovation generally, in-depth understanding of the innovation capability of small and medium-sized manufacturing enterprises in the developing country context is still largely limited.

In recent years a lot of research has been done to find out which factors influence SME innovation. The resulting body of literature attempts to build a more thorough theoretical understanding of what works and what does not, and to validate practical interventions (see Keizer et al, 2002 and Aralica et al, 2005 for systematic reviews). These studies revealed that activities directed towards innovation show a relationship with a considerable number of variables, the most common of which are firm size (Cohen, 2005); ownership (Račić et al., 2005); age (Jung et al, 2003); geography (Hoffman et al, 1998); R&D (Birchall et al., 1996), staff characteristics (Romijn and Albaladejo, 2002); and collaboration with several actors like customers (Le Blanc et al., 1997), suppliers (Lipparini

[1] see, for instance, Katz (1987); Bell (1984); Lall (1987)

and Sobrero, 1994) and knowledge centres (Hoffman et al., 1998; Oerlemans et al., 1998). The factors that influence innovation, as identified in the literature, can be clearly delineated as internal or external. An important observation about this extensive body of literature is that so far, little has been focused on in-depth understanding of the specific determinants of innovativeness in developing countries, especially in Africa. The literature is still very much skewed towards the developed country context.

This paper, therefore, seeks to shed some light on how and under what conditions do SMEs in developing countries accumulate innovation capability. This issue was examined within the context of the Cable and Wire manufacturing sub-sector. The sub-sector is one of the most economically significant components of the Nigerian manufacturing industry and is the only one in Nigeria whose products are preferred to imported ones (Egbetokun, 2009). From the theoretical and managerial perspectives, it is relevant to know the inputs into the build-up of SME innovation capability at the firm level in developing countries. It is also important given the reputation of SMEs as boosters of employment as well as economic growth and dynamics (Keizer et al, 2002). The next section discusses the method adopted in the research. In Section 3, we discuss our empirical findings followed by before concluding the paper in Section 4.

2. Methodology

2.1 Data Collection

The data used in this study were collected between September 2007 and January 2008 from the Cable and Wire manufacturing sub-sector in Nigeria. A structured questionnaire based on UNU-INTECH's (2004) proposed template for innovation surveys in Africa was administered on the four departments identified as relevant to this study (Administration/Human Resource; Production, Engineering/Maintenance and Marketing Departments). For this study, the 4-year period between 2003 and 2006 was taken as reference. Although up to 26 firms were reported by MAN (2007), only the firms that belonged to the Cable Manufacturers Association of Nigeria (CAMAN) were included in the study. CAMAN is the industry association comprising the 11 major firms that manufacture electrical and telecommunications cables in Nigeria presently. All of these firms were either small or medium-sized. At the time of collecting data, one of these firms was temporarily closed and was excluded from the study. Three respondents were selected per firm and the responses were later normalized to yield single firm-level responses which were finally used as the basis of analysis. Altogether, 73% useful completed questionnaire, which included at least 2 returns from every firm, was obtained. We complemented these with a number of Key Informant Approach (KIA) interviews and secondary data.

2.2 Variables and measures

2.2.1 Innovation Capability

The dependent variable is the innovative activities (which indicates the presence of some capabilities) undertaken by the firm during the reference period. There are many difficulties in measuring innovation capabilities, since it implies measuring knowledge that is not codified, but 'stored' in individual's minds or organizational routines (Polcuch *et al.,* 2005). At first, the number of patents could be accepted as a good measure. But its incapacity to measure the total knowledge and technological production has been recognized (Zucker *et al.,* 1998). This is because many innovations are not patented; and patenting neither reflects all representative aspects of the innovative capacity nor does it say anything about the economic value of an innovation (Quintana-García and Benavides-Velasco, 2004; Patel and

Pavitt, 2005). The best measures of innovation capability relate to the outputs that result from the utilisation of a firm's capabilities (Hyvärinen, 1990; Abereijo
, 2006). Therefore, we resorted to the use of proxy variables of the firm's innovative performance as reflected in whether it has innovated and the type(s) of innovation it has undertaken (UNU-INTECH, 2004). We considered 5 types of innovation as outlined below.

$$Var_x = \alpha \quad \text{..... 1}$$

where x = i, j, k, l as shown in Equations 3 - 6
α = 0 (No), 1 (Started but later abandoned), 2 (Yes)

$$Var_m = \beta \quad \text{..... 2}$$

where m = 1, 2 as shown in Equation 7
β = 0 (No), 1 (Yes)

Equations 1 and 2 represent the proxies used to approximate the innovations. The variable PRODINN was the sum of the scores obtained on three proxy variables which indicated whether or not the firm developed a new product, introduced a new product to the market or modified an existing one during the reference period (Equation 3).

$$\mathrm{Pr}odInn = \sum_{i=1}^{3} Var_i \quad \text{..... 3}$$

where i refers to each of the variables

PROCINN (Equation 4) was the sum of the scores on two variables indicating whether or not the firm introduced a new process in its production activities or modified an existing one (UNU-INTECH, 2004; Romijn and Albaladejo, 2002).

$$\mathrm{Pr}ocInn = \sum_{j=1}^{2} Var_j \quad \text{..... 4}$$

where j refers to each of the variables

Organisational innovation was captured with six variables drawn from UNU-INTECH (2004): changes in management routine; quality controls; maintenance routines; plant layout and waste management procedures; and the introduction of new in-house training programmes. The variable ORGINN was the sum of the scores on these variables (Equation 5). The highest score obtainable was 12.

$$OrgInn = \sum_{k=1}^{6} Var_k \quad \text{..... 5}$$

where k refers to each of the variables

The variable MARKINN (Equation 6) was a measure of whether or not the firm developed a new local or foreign market; and one variable indicating whether or not the firm introduced a new marketing technique (UNU-INTECH, 2004).

$$MarkInn = \sum_{l=1}^{3} Var_l \quad \text{..... 6}$$

where l refers to each of the variables

As Polcuch *et al.* (2005) noted, in developing countries, technology transfer from multinational corporations and from abroad is a fundamental source of innovation; and

acquisition of embodied technology (equipment) for both product and process innovation is a major component of innovation. The variable DIFFINN was created to capture diffusion-based innovation. It was the sum of three simple binary variables: purchase of new equipment (either locally or imported) and the acquisition of product licence or process licence (Equation 7).

$$DiffInn = \sum_{m=1}^{2} Var_m \quad \text{..... 7}$$

where m refers to each of the variables

Each of the foregoing variables served as indicators of whether or not a firm was innovation-active or not. It is important to note that an innovation-active firm is considered as one that has had innovation activities during the period under review, including those with ongoing and abandoned activities (OECD, 2005). Thus, a firm was classified in this study as innovative irrespective of whether its innovation activities had become successful or not.

2.2.2 Determinants of Innovation Capability

The measurement of the determinants of innovation capability was relatively straightforward. The internal determinants were measured through three main variables and the external determinants were also measured through three main variables as follows:

a. Internal determinants of innovation capability:

i. **The professional background of the founder/manager** was captured through three variables. The **educational qualification** was represented by multiple-choice measures of management, science and engineering and other academic degrees obtained. **Prior work experience** was represented as the number of years that the chief executive worked in any of small enterprises, large corporations, and university or related institutions. **Relevance of prior work experience** in small enterprises, large corporations, and university or related institutions to current work was measured on a Likert scale ranging from 5 (very relevant) to 1 (very irrelevant), according to the opinion of the respondent.

ii. **Human Resources** of the firms was measured by variables representing the numbers of technicians, scientists and engineers in the firm relative to total workforce and the working experience of the firm's staff, in years. The proportion of R&D staff in total workforce is also considered as useful here (Romijn and Albaladejo, 2002) but it was excluded because none of the firms indicated having R&D employees.

iii. **Internal technological effort** was captured by variables representing innovation investment and training expenditure as percentage of firm revenue, and whether or not the firm uses information and communications technologies (ICT), specifically the internet, personal computers and a local area network (LAN). R&D investment as a proportion of sales is also considered to be useful (Bell, 1984; Katz, 1987) but we did not consider it here because, although firms responded to the question on whether or not they performed R&D, none of them supplied information on the cost of their R&D efforts. Use of internet was measured via a simple binary variable indicating whether or not the firm uses the internet and a multiple-choice variable indicating the purpose(s) of internet usage. Intensity of ICT usage was represented by the proportion of staff with access to Personal Computers (PCs), internet and a Local Area Network (LAN). A similar operationalisation had been used by Olamade (2007).

b. External Sources of Innovation Capability:

i. **Networking and collaboration** was captured by the incidence of contacts with external agents. Relationships with customers, suppliers, enterprises in related lines of business, financial institutions, training institutions, universities, research institutions, service providers and industry associations were scored separately via a multi-item rating matrix.
ii. **Proximity advantages from networks** measured the geographical proximity advantages associated with the above network interactions and these were measured as simple binary variables, by asking the respondents to indicate, whether or not a proximity advantage was attached to each of the interactions.
iii. **Institutional support** was measured with a simple binary proxy which measured whether or not firms had received financial support from government or other forms of support from other institutions such as industry associations.

3. Results

3.1 Frequency of innovations

To establish the extent of innovations that occurred in the industry, a frequency analysis was carried out. The proxies were first analysed separately and then aggregated. The aggregation was done by re-coding the non-zero sums captured in the composite variables (PRODINN, PROCINN, ORGINN, MARKINN and DIFFINN) as 1 and then running the frequencies. The results are shown in Table 1. The aggregate proportion of firms that innovated during the reference period reveals considerable innovativeness in the Nigerian Cable and Wire manufacturing industry. As would be expected, most of the technological innovations are incremental in nature; mainly because it is cheaper and easier to improve products and processes than develop new ones. Specifically, new product development (NPD) is rather less frequent than other types of product innovation activities. In this type of industry and geographical context, this finding is reasonable. The process of creating new cable products – which essentially involves insulator material substitution – is rather long and capital intensive but developing country firms are known to be faced with resource constraints that hinder NPD. In Nigeria, low NPD expenditure and staffing had been earlier reported in the literature (Ilori et al, 2002). The higher incidence of introducing new products to the market than NPD tells us that not all the products regarded as new by the firms were developed by them. The existence of some diffusion-based innovations (mainly through licensing) then makes sense. The development of new processes is also less frequent (Table 1), for the same reasons mentioned above.

Commitment to market expansion is evidenced in the presence of local and foreign market expansion activities, albeit not completely successful (Table 1). Within the Nigerian context, the development of a new foreign market – which is an indication of significant exporting – is of particular importance. It presents the Cable and Wire manufacturing sub-sector as really economically significant, being a source of products that are of export quality. Crude oil presently represents a very high proportion of Nigeria's export, contributing about 20% of GDP, 95% of foreign exchange earnings, and about 65% of budgetary revenues in 2005 (Oyewale, 2005; Albaladejo, 2003). The Cable and Wire manufacturing sub-sector, therefore, shows noteworthy potentials for driving economic diversification in Nigeria. Although most of the exports from the sub-sector presently go to neighbouring African countries, the market reach of the firms can be expanded if the domestic economic environment is made more supportive. The removal of infrastructural barriers such as erratic power supply, weak transportation systems and poor telecommunication facilities will begin to have immediate impact.

Despite an apparently high level of organisational innovativeness (which is understandable within this context[2]), there is an accompanying prevalence of abandoned activities especially relating to training, waste management and plant layouts. Reasons that explain this are not be far-fetched. Training is costly; moving machinery around takes time and money, and sometimes has far-reaching implications on production processes; and the introduction of new procedures take time before they yield expected results. Many of these might not be readily obvious to firms until they start to implement the changes.

Table 1: Results of the frequency analyses on innovation types

Type of Innovation	Percentage of Firms	
	Innovated	Started but later abandoned
PRODINN		
Developed new product	40	-
Introduced new product	60	
Improved existing product	60	-
Aggregate	**60**	
PRODINN		
Introduced new process	60	-
Improved existing process	70	-
Aggregate	**80**	
MARKINN		
Introduced new marketing techniques	60	-
Developed new local market	30	10
Developed new foreign market	10	20
Aggregate	**70**	
ORGINN		
Changed management routine	50	10
Introduced Quality Control	10	7
Introduced new maintenance routine	80	-
Changed plant layout	40	50
Introduced new waste management procedures	10	50
Implemented in-house training	10	70
Aggregate	**90**	
DIFFINN		
Obtained product licence	30	-
Obtained process licence	30	-
Aggregate	**30**	

Regarding diffusion-based innovation, less than a third of the firms were active. Perhaps this is explained by the general economic paradigm that firms require a certain level of absorptive capacities (usually approximated by firms' proportion of R&D staff, engineers or scientists) – which many developing country firms do not possess - to be able to assimilate scientific

[2] UNU-INTECH (2004) posited that changes in management and maintenance routines, quality control, plant layout, waste management procedures and in-house knowledge levels collectively bring costs down and increase efficiency among firms in developing countries.

knowledge and to optimize technologies from elsewhere (Fontana et al., 2006; Rosa and Mohnen, 2008).

3.2 Factors Influencing Innovation Capability in the Cable and Wire Manufacturing Sub-sector in Nigeria

In this section, the results on the specific influencers of innovation capability that were assessed in this study are discussed. The pattern of innovativeness found among the firms, as discussed in the foregoing section, are explained by these influencers. Our approach to the discussion is to present our findings on the influencing factors and then relate them to innovation capability in the sub-sector. Detailed econometric analyses were not possible because of data limitations. The internal influencers or sources of innovation capability are evaluated first, followed by the external influencers.

3.2.1 The internal influencers of innovation capability

The main internal sources of innovation capability evaluated in this study are the background of the Chief Executive Officer (CEO) or top decision-maker in the firm, the human resources of the firm and the internal technological efforts of the firm (evaluated in terms of Information and Communication Technologies, staff training and innovation expenditure). Information on the staff profiles in most of the firms was not obtained as the firms were unwilling to supply such data. It was therefore difficult to carry out a thorough evaluation of the firms' human resources as it influences their innovation capabilities.

The fact that firms require an adequate stock of skilled manpower and the role played by firm-level training investments in training in enhancing this has been established in the innovation literature (Romijn and Albaladejo, 2002; Amara *et al.,* 2008). More recent research has indeed proven that firms that continually invest in staff training tend to be more capable to innovate. For instance, Amara *et al.* (2008) found that Canadian manufacturing SMEs that carried out staff training activities were 1.92 times more likely to innovate than their counterparts who did not. The results in Table 2 show that the Cable and Wire manufacturing firms in Nigeria were very active in this regard as all of the firms reported having implemented one or more staff training programmes within the period covered by this study. Thus, they all appear to be well posited for innovation. However, their preparedness is undermined by the low intensity of the traiing investments and activities. The staff training intensity, in terms of the number of employees trained as a proportion of total employees, was about 5% and per capita training investment was 2446 naira (just about 20 USD). It is therefore, not surprising that innovation types – such as certain organizational innovation activities and NPD - which require considerable investments and absorptive capacities as well as strategic decision making were relatively less prevalent is, therefore, not surprising. Another main factor that explains this is the leadership of the firms. While it is known that the possession of a degree by the CEO facilitates problem-solving and enables top-quality leadership (UNU-INTECH, 2004), especially when the degree is in science or engineering (Romijn and Albaladejo, 2002), the qualifications of the Chief Executives of the firms that we studied, comprised 58% non-degree holders and almost an equal proportion of PhDs and secondary school leavers. Encouragingly, 60% of the degree-holding CEOs, studied science or engineering disciplines and the rest hold their degrees in management or finance-related disciplines (Figure 2).

Considering the importance of the educational attainment of the firm's top decision-maker, the firms headed by secondary school leavers might be deficient in problem-solving and effective strategic planning. Nonetheless, this deficiency has been overcome to a large extent by the extensive support system available through the industry association. The association facilities open innovation through inter-firm learning. For instance, all the CEOs

have the obligation to attend a regular monthly meeting even though there is no rule in CAMAN that stipulates that. The reason for this is that firms that are not represented at any of the meetings perceive over time that certain useful information might have eluded them. At the monthly meeting, every CEO is free to share their unique problems and solutions to the problems of others. As well, the economic and technological welfare of each firm is a regular issue for discussion at the meetings.

Regarding this, sixty percent of the CEOs of the firms that were studied had previously worked in a small or medium enterprise, 10% indicated having worked before in a large multinational for twenty-five years and 20% had worked overseas. Average relevant work experience for these CEOs was about 15 years, the possession of previous work experience is considered to be particularly beneficial for firm-level innovation because it helps the CEO lead the firm effectively (UNU-INTECH, 2004; Raward, 2004; Goedhuys, 2007). It is not surprising, therefore, that all respondents indicated that the previous experience of the CEO was very relevant to present job functions (Table 3).

This rich mix of exposure processed by the CEOs is definitely a major determinant of the manner in which the industry is organized, as evidenced by the functionality CAMAN
On the use of Information and Communication Technologies (ICTs), especially the internet, the firms can be said to have done relatively well. Table 4 shows that nearly all the firms use one or more of a local area network (LAN), personal computers and the internet. About a quarter of the staff in these firms have access to and make use of these facilities in their individual offices. This intensity of ICT use is an indication of considerable capability for innovation among the firms as it indicates readiness for adoption of new technologies. The use of ICT facilitates intra-firm, firm-firm (B2B) and firm-customer (B2C) interactions. It also enhances organisational learning and increases a firm's visibility (UNIDO, 2002).
As Oyelaran-Oyeyinka and Lal (2006) have established, adoption of ICT in an SME is significantly associated with high skill intensity, among other factors such as qualification of CEO and domestic competition. These authors also presented findings to show that e-business fosters organisational innovation that enables firms to enter new and changing markets. It is in this context that the 90% level of adoption in the Cable and Wire sub-sector is considered a reflection of significant firm-level capabilities. In fact, 30 % of the firms have a website through which they advertise their products and publicise their activities, among other things, and 60% of them have official company e-mails for external communications. These figures are consistent with Olamade's (2007) findings, based on a study of firms in 6 industrial sectors (including Automobile and Tyres; Food, Beverages and Tobacco; Pharmaceuticals, Chemicals and Paints; Breweries; Building materials, Industrial and Domestic Products, and Textiles) that the greatest use of the internet among firms in Nigeria was for e-mail and company news, among other uses. It is therefore not surprising that organisational and process innovations are predominantly prevalent among these firms.

Table 2: Staff Training Intensity in the Cable and Wire Manufacturing Industry in Nigeria (2003 - 2006)

Variable	Value
Total Training Expenditure (million naira)	1.805
Total Employees	738
Proportion of firms that trained staff	100.0
Total number of staff trained	37
Training Expenditure per employee ('000 naira)	2.446

Staff Trained as proportion of total employees	5.01

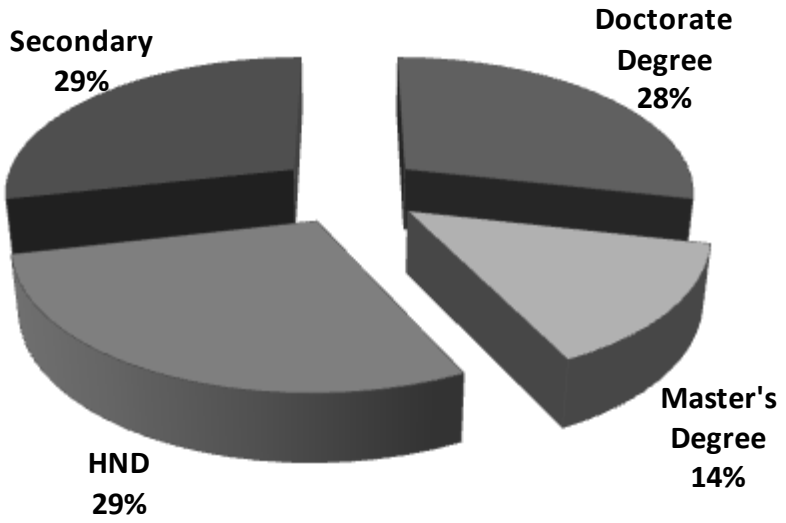

Figure 1: Distribution of the Chief Executive Officers by Qualification

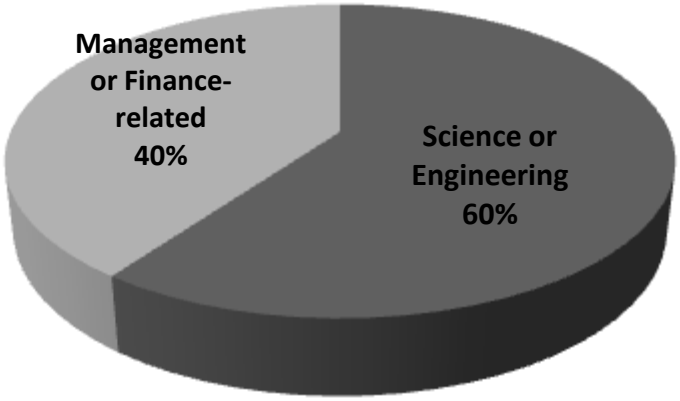

Figure 2: Distribution of Degree-holding Chief Executive Officers by Discipline

Table 3: Information on the Experience of the Chief Executive Officers in the sampled firms

Work Experience of CEO	**% of firms**
Overseas	20
SME	60
Large Enterprise	10
Knowledge Centre	-
Years of Experience of CEO	
Below 20	16.7

20 – 25	50.0
Above 25	33.3
Relevance of Previous Work Experience	
Very relevant	28.6
Moderately relevant	71.4
Not relevant	-

Table 4: Use of ICT among the Cable and Wire manufacturing firms

Prevalence of ICT use	**Percentage**
Users of ICT	90.0
Non-users of ICT	10.0
Average personal office access to ICTs	
Personal Computers	22.75
Local Area Network	29.33
Internet	24.88
Overall Average	**25.65**
Firms' use of the internet	
Company websites	30.0
Company e-mails	60.0

3.2.2 The external influencers of innovation capability

We considered networking and collaboration as well as the advantages that firms might derive from these when they are located close to the actors involved in these networks. Several previous studies (Meeus *et al.,* 1999a, 1999b; Romijn and Albaldejo, 2002) have highlighted the importance of a number of stakeholders within an innovation system that firms may network or collaborate with. Evidences exist in favour of customers, suppliers, industry associations, higher education and research institutions, among others as helpful sources of information for the firms' innovation activities.

Table 5 shows that the firms interacted more with customers than with most other actors. This finding is consistent with the result of an earlier study where Egbetokun *et al.* (2009) found that the most highly rated source of information for innovation were customers. Jaruzelski and Dehoff (2007) also showed that customers probably matter more than any stakeholder in innovation. Interaction with suppliers and industry associations were also relatively intense as 70% of the sampled firms collaborated with each of these stakeholders during the period covered by this study. Customer satisfaction usually forms a major reason why firms innovate (OECD, 2005); and market acceptance almost always determines the economic gains of a firm from its innovation efforts. Thus, firms are required to create close ties with their customers. The Nigerian cable and wire manufacturing firms have done this, as was gathered in the interviews carried out, by creating several distribution outlets that bring their products closer to the customers. Selecting locations for such outlets is usually done in consultation with customers. Suppliers are also critical components of the firm's value chain, and they provide key inputs in terms of machinery and raw materials, making them indispensable.

For the Nigerian cable and wire manufacturing firms, machineries and raw materials are mostly imported. It has therefore become important for these firms to consistently interact closely with the suppliers of these inputs in order to guarantee satisfactory quality and timeliness, especially when the distances are considered. Table 5 further shows that the

sampled firms have fairly extensively collaborated with higher education institutions. Firms mainly engaged educational institutions through capacity building programmes, sample testing and equipment fabrication. Also, students from educational institutions are usually employed temporarily by industrial enterprises as interns under the Industrial Training Fund programme.

Table 5: Firms' Collaboration for innovation with key actors

Actors	Prevalence of collaboration (%)	Incidence of Proximity Advantages (% of firms)
Industrial Associations	100	90
Customers	80	80
Suppliers	70	70
Marketing Firms	60	60
Higher Education Institutions	60	50
Financial Institutions	60	50
Associated Companies	60	40
Training Institutions	50	40
Public Research	50	30
Private Research Institutions	50	30
Government Ministry	40	10

All the cable and wire manufacturing firms belong to the Manufacturers Association of Nigeria (MAN) which is the umbrella body for all industrial enterprises and industry associations in Nigeria. However, the Cable Manufacturers Association of Nigeria (CAMAN) is the industry association in the cable and wire manufacturing sub-sector to which all of the sampled firms belong. By extension, membership of CAMAN meant that the firms also belonged to MAN. As an industrial institution, MAN provides support for its member firms mainly by facilitating information flow through a members' database and regular meetings. The association also acts as a pressure group to protect members' interests. However, given the large and diverse membership of MAN, it is not always possible for it to provide micro-level or specialised support to individual firms. In this context, CAMAN instituted an extensive support structure to assist its members. The association has evolved since its formation about two decades ago into a sort of oligopolistic organisation. Presently, only about two firms produce cables in the country that do not yet fully belong to CAMAN but are already being encouraged to join the association. The association has a CAMAN Technical Committee (CTC) which comprises technical staff from each member firm. The CTC members are usually the managers in charge of production, the factory floor and quality control; and they meet once a month. The main function of the committee is to ensure that member firms comply with industrial standards. This particular institutional arrangement has gone a long way to influence positively the quality of the products emerging from the sub-sector, and it constitutes a significant path of learning, sharing and knowledge transfer. The CTC ensures that thorough tests are carried out on raw materials and final products. Every company in CAMAN is compelled to have a product testing laboratory for carrying out all the required tests. Each firm finally takes the tested product to the CTC meeting where the products are exchanged and tested in other companies' laboratories to confirm the quality. These routine tests are carried out on a yearly basis. Furthermore, the Chief Executive Officers of all the firms also meet twice a month for administrative knowledge sharing.

Considering these, it would not be surprising that there was a 100% prevalence of firms' collaboration with industry associations (Table 5).

In contrast with the general trend in the literature (Autant-Bernard and Massard 2001; Keller, 2002; UNU-INTECH, 2004; Audretsch *et al.,* 2005; Rosa and Mohnen, 2008), the occurrence of proximity advantages from knowledge centres among the firms was very low (Table 5). This is in spite of the fact that 60% of the firms are located in the same city with at least a university (Table 6). Perhaps this is explained by the general economic paradigm that firms require a certain level of absorptive capacities (usually approximated by firms' proportion of R&D staff, engineers or scientists) to be able to assimilate scientific knowledge and to benefit optimally from partnerships with knowledge centres, especially universities (Cohen and Levinthal, 1990; Fontana *et al.,* 2006; Rosa and Mohnen, 2008). Although it was difficult to empirically evaluate the firms' absorptive capacity because data gathered on staff profiles were largely partial and unreliable, the information gathered from the interviews conducted pointed out that the absorptive capacities of the firms in the cable and wire sub-sector was quite low. For instance, in two of the firms, apart from the CEO and his team of about 4 managers, every other staff had less than a university degree. Within the production department in those firms, nearly every worker was employed with secondary or vocational qualifications and then trained on the shop floor. In one particular firm, we found about 75% of employees having either secondary school or vocational qualifications. Proportion of engineers and scientists in firm's total workforce was 8% while the proportion of technicians was 5%.

Table 6: Distribution of the cable and wire manufacturing firms by location relative to a university

Firm Location	Proportion of sample
Not within a university city	40.0
Within a university city	60.0
Total	100.0

On the other hand, majority of the firms admitted that close location to suppliers (60%), financial institutions (70%), customers (80%) and particularly industry associations (90%) had been very beneficial to them (Table 5). This seems to suggest that it could have been easier for the firms to pursue and seize the advantages from being close to these actors since no considerable level of absorptive capacity is required. An implication that could be drawn from the foregoing discussion is that in facilitating industry-academic relations, both proximity and firm-level absorptive capacities are critical and require attention from all stakeholders. Previous studies have shown that major government S&T policies and programmes may have more impact on innovation than the activities and strategies of private enterprises (OECD, 2005). Thus, the role of government as an institution is critical for firm-level innovation. Such roles typically include the design and implementation of innovation-friendly policies, effective monitoring of these policies, procuring innovative products from domestic firms and creating a stable political and economic ambience, among others. With regard to the receipt of institutional support by the firms in their innovation efforts, the role of CAMAN and its CTC in facilitating the firms' innovation capabilities had been considerable (Tables 5). Perhaps even more striking is the fact that the firms have apparently not collaborated extensively with or gained serious proximity advantages from government organs (public research institutes and government ministries). Only 40% of the firms have

collaborated with government ministries and an equal percentage indicated gaining proximity advantages from these. While the latter is understandable as the firms are not so closely located to the ministries, the dearth of collaborative activities with them seems to suggest that these institutions have not been adequately supportive.

Unlike the experiences in the EU (Romijn and Albaladejo, 2002), few competitive motivational initiatives, if any, can be identified in Nigeria. As shown in Table 7, only 30% of the firms indicated having received support from government in their innovation efforts. The interviews further showed that the government does not consciously encourage innovation among the firms through procurement. Ultimately, support from government for firm-level innovation is perceived to be low as far as the cable and wire manufacturing sub-sector is concerned. Among the sub-sector focused in this study, macro-economic and institutional support for business in Nigeria is perceived to be generally low. Many business concerns cited infrastructural deficiencies such as poor power supply and delayed business registration as key constraints to innovation and growth. The constraint of power supply is particularly serious in its implications for the cable and wire sub-sector where manufacturing is through a continuously running process. Given the irregularity of public power supply, most of the firms run their machines permanently on power generating sets. Ultimately, production costs have become higher than they should ordinarily be and capacity utilisation is low in global competitive terms.

To further examine how all the foregoing external sources have influenced innovation capability among the firms, a cross-tabulation was carried out. In doing this, the level of collaboration with and proximity advantages from the actors was calculated. This was done in three stages. First, for each firm, the sum of the scores on the variables representing collaboration with and proximity advantages from each actor was evaluated to obtain an index. The mean ($\overline{X}$) and standard deviation (σ) of these indices were then calculated over the sample. Finally, the indices for each firm was categorised as high (values above $\overline{X} + \sigma$), medium (values between $\overline{X} - \sigma$ and $\overline{X} + \sigma$) and low (values below $\overline{X} - \sigma$). The same procedure was followed to convert the innovation indices into a single overall innovation index which could either be high, medium or low for each firm in the sample. The results of the analysis are shown in Table 8.

The information implies that higher levels of collaboration, proximity advantages from actors and availability of government support are associated with higher firm-level innovation. These results point out the need for conscious innovation support from government, the attraction of key innovation actors into close location with firms and the facilitation of stronger and prevalent collaboration among these actors and the firms. Albeit, the predominance of medium innovation performance here is a further reflection of the average innovative capabilities earlier discussed.

Table 7: Frequency of Support from Government to firms

Use of Government Support by Firms	Proportion of Sample
Used Government Support	30
Did not use Government Support	70
Total	**100**

Table 8: **Cross-tabulation of external influencers of innovation capability and level of innovation**

		Level of Innovation		
		High	Medium	Low
Level of Collaboration	High	33.3	33.3	33.3
(% of firms)	Medium	40.0	60.0	-
	Low	-	50.0	50.0
Level of Proximity	High	33.3	66.7	-
Advantages	Medium	40	40	20
(% of firms)	Low	-	50	50
Use of Govt Support	Used Gov't Support	66.7	33.3	-
(% of firms)	Did not use Gov't Support	14.3	57.1	28.6

4. Conclusions, recommendations and directions for future studies

In the first instance, the results showed that these firms, which are all SMEs, demonstrated appreciable innovation capabilities, albeit in an uneven manner. Although some product, process and marketing innovation with traces of diffusion-based innovation were found, organisational innovations were at the heart of the innovation activities of the firms. Given the generally deficient state of the innovation influencers, it is not surprising that the firms were more capable to implement changes in organisation and processes than what they would do with their products and embodied knowledge from elsewhere.

The importance of firm-level leadership and investment in organisational learning is underscored by the results. These are clearly or precursors to the build-up of absorptive capacity and strategy within the firm. Adopting the use of ICTs is also conclusively influential as far as firm-level innovation capability is concerned. When this happens within a network of strong institutions and a favourable economic ambience, a firm will definitely be much more capable for innovation. This is to say that while the firms make efforts to build capabilities, the success of their efforts depend directly on the supportiveness of the environmental context within which they operate.

As we have explained in detail, belonging to industry associations could play in facilitating firm-level innovation capability. Empirical evidence available on the specific roles that these associations are capable of playing is still very sparse. Our results have, however, showed that these associations could play very key roles in ensuring that an industry is well organized; and that these activities could cover resource deficiencies for member firms. Firms were seen to have benefitted from CAMAN through knowledge exchange, the creation of a strong sub-sectoral innovation system and protection from foreign competition through the maintenance of a high quality standard. Much is to be gained by developing countries if all industrial associations are encouraged and assisted in fulfilling these roles.

The need for a strong innovation system is also indicated by the findings of this study. Firms were seen not to have received much support from knowledge and centres and even from government. Specifically, diffusion-based innovation was very low. The few firms that succeeded in implementing this innovation type were those that on their own had significant external resource endowments by virtue of belonging to a global group or creating international ties. Most of the firms were largely unable to muster enough resources on their own to engage in activities that would give rise to that kind of innovation. Thus, stronger

government-finance-research-industry linkages that would ease resource deficiencies are critical to firm-level innovativeness. Several implications arise directly from the findings of this study.

4.1 National-level policy measures to enhance innovation capability

At the national level, it is particularly important to:

i. strengthen business and industry associations and
ii. stimulate the clustering of firms with key actors within the NIS.
iii. drive interactions among educational/ research institutions and industrial firms with appropriate policies;
iv. create new institutions where they are absent and strengthen existing ones. The Cable and Wire sub-sector calls for specific urgent action as there was no known knowledge centre that worked extensively with any of the firms in providing knowledge-driven solutions;

4.2 Firm-level recommendations to enhance innovation capability

For the firms, the following specific suggestions are useful for the build-up of innovation capability:

i. interactions matter so much as far as firm-level innovation is concerned. Firms should therefore make efforts to form 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 the other stakeholders.
ii. membership of a vibrant industry association is helpful
iii. On firm-level leadership, our findings imply that the possession of a university degree and previous work experience in an SME by the CEO of an SME is very useful. Firms would therefore benefit greatly if their top executives possess these characteristics.

4.3 Suggestions for Further Studies

This study had used a sub-sectoral approach to the study of firm-level innovation capability. Although the findings are useful, they can only serve as indications of possibly broader directions because of the limitations in the sample size and the data. Studies that use more robust samples would, therefore, be very beneficial. In addition, it remains to be seen whether or not there is a link between the internal and external influencers of innovation capability. This study treated these categories of influencers independent of each other but they might be related. We therefore recommend further studies along that line. Our exposition of industry associations as being important also begs for more empirical explanation. Finally, more detailed sub-sectoral studies like this one would facilitate comparison of results.

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