Learning to Innovate in Nigeria's cable and wire manufacturing sub-sector: inferences from a firm-level case study

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LEARNING TO INNOVATE IN NIGERIA'S CABLE AND WIRE MANUFACTURING SUB-SECTOR: INFERENCES FROM A FIRM-LEVEL CASE STUDY

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Abstract

Firm performance is known to be connected to firm-level innovation capability. Innovation capability, in turn, is an output of technological learning. This paper evaluates technological learning among firms in the Cable and Wire manufacturing sub-sector in Nigeria, using a purposively selected case firm. We developed a model of the relationship between the innovative activities of the firm - as evidence of its capability – and its knowledge acquisition methodology. These are discussed within the context of the firm's stock of human capital. We found low technological innovation capability and high capability for organisational and marketing innovation. Preparedness for technological learning is relatively poor with staff training intensity of 5% and innovation intensity of 0.0075%. We therefore propose stronger interconnectedness of the National Innovation System and creation of industry specific structures that could enhance learning.

Keywords: Technological learning, sub-sector; Cable and Wire manufacturing industry

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1. Introduction

The subjects of innovation and learning are receiving increased interest from both the academic community and from companies because of the influence of innovation and learning on the achievement of a sustained competitive advantage for the firm in today's knowledge-based economy. Literature on innovation and learning suggest that competitive advantage flow from the creation, ownership, protection and use of certain knowledge-based organisational resources. Better organisational performance depends mainly on the firm's ability to be good at innovation, learning, protecting, using and amplifying these strategic intangible resources (Abramovitz, 1986; Lall, 1992; Romijn and Albaladejo, 2003; Albu, 1997; Romijn, 1996).

At the national level, effective policies to stimulate and sustain technological development requires a good understanding of the dynamics of technological change. UNCTAD (2007) argues that for poor developing countries, like Nigeria, technological change occurs primarily through learning – that is, the acquisition, diffusion and upgrading of technologies that already exist in more technologically advanced countries – and not by pushing (or even attempting to push) the global knowledge frontier further. In other words, the key to technological progress in developing countries is technological catch-up through learning rather than undertaking R&D to invent products and processes which are totally new to the world. Within this context, the commercial introduction of products and processes that are new to a country or an individual enterprise, whether or not they are new to the world, properly depicts creative technological innovation. In this sense, 'radical innovation' refers to a product that is new to the firm irrespective of whether it is new to the industry, the country or the world (Mytelka, 2000); and an existing product that has been improved or developed/modified by the firm would amount to 'incremental innovation' (OECD, 2005).

With this broader view, innovation will be perceived as a critical aspect of technological catch-up even though it does not depend on inventions which are new to the world. Innovation also occurs when a firm introduces a product or process to a country for the first time. It also occurs when other firms imitate this pioneering firm. Likewise, it occurs when the initial or follower firms make minor improvements and adaptations to improve a product or production process, leading to productivity improvements. In short, innovation occurs through "creative imitation", as well as in the more conventional sense of the commercialisation of inventions (UNCTAD, 2007), with the enterprise as the locus of innovation and technological learning. In these regards, there is a major technological gap between the developed and the developing world, and this gap has grown over the years. The gap arises, first and foremost, from the poor performance of the manufacturing sector in developing countries. In Nigeria, for instance, evidence shows that industry is inexorably falling behind and becoming increasingly marginalized in the international and regional industrial scene. Total manufacturing value added and manufactured exports have significantly declined and there has been a technological downgrading of Nigeria's traditional manufacturing sectors (Albaladejo, 2003).

This paper explores how well posited developing country firms are to acquire and apply knowledge. To start with, do they possess the requisite human resources that will facilitate effective acquisition, diffusion and improvement of foreign technologies? What stimulates or drives the learning process? What external resources/inputs support the learning process? Considering the centrality of the domestic knowledge systems to enabling or constraining) the creation, accumulation, use and sharing of knowledge UNCTAD, 2006), how well-connected are they to the domestic firms? These issues were investigated within the context of Nigeria's Cable and Wire manufacturing industry, using a case study approach. It is not always possible to survey all firms and thus the ability to profile the potentially innovative firms, as targets for policy and support programmes is very useful. The impressive performance of Nigeria's Cable and Wire manufacturing sub-sector makes it worth studying. In spite of the difficult economic conditions in Nigeria, firms in the Cable and Wire industry are reputed to produce world-class products. Despite the prevalent capacity under-utilisation in the industrial sector of the country as a whole, the Cable and Wire manufacturing firms have survived. This study focused on innovation capability, which is a specific component of overall firm-level technological capability. In Section 2, we discuss relevant literature that forms the conceptual basis for the study. The scope and methodology are discussed in Section 3. Section 4 contains a discussion of the findings, followed by conclusions and policy implications in Section 5.

2. Conceptual Framework

2.1 Innovation: The Development Rationale

Development is not just about increasing the resources available to society, but perhaps more importantly; it is about expanding people's capabilities to do valued activities with those resources. Doing valued activities frequently involves using technology in some form, and therefore the mastery of technologies forms an important subset of the human capabilities vital to development (Romijn 1996). In a broad sense, technology is "the science and art of getting things done through the application of skills and knowledge" (Smillie 1991:65). Most researchers who study technological matters admit that technology is vested in people as much as in the machines they use. Machines and tools are only the physical expressions of technology; the knowledge, skills and routines involved in its deployment are much more important. In other words, the concept of technology implies a subtle mix of know-how, techniques and tools.

Indeed, mere access to the physical elements of a technology – even if accompanied by usage instructions, and time to build up experience in using them – does not automatically lead to "mastery" of that technology. This is because mastering technology is not just developing the capability to use a given technology efficiently but also entails the technological capability to use knowledge about physical processes underlying that technology in order to assimilate, adapt and/or create novel elements, in response to changing needs (Dahlman & Westphal 1982:106). It is then obvious that the effective use of technology borders more on innovation and learning than on sourcing and acquisition. Without accepting the foregoing paradigm, it becomes easy to erroneously associate "technology" only with production activities, for example product design, manufacturing processes and the organisation of production; in which case the importance of capabilities in other areas of supporting activity: in investment activities; in the procurement of capital goods; in raw materials supply, and in distribution of products would be undesirably ignored (Lall 1992:167; Bell 1995:84).

Why does the mastery of technology matter for economic development? In a market-orientated economy, economic development is based on firms' success at achieving and maintaining competitiveness. One general way to do this is by consistently performing specific activities better or differently than competitors do. In many sectors, the new competition is based not just on price, but on innovation and continuous improvement in products and services (Schlie 1996; Best 1990). The need to perform activities differently and better means firms continuously need to choose, use and master technology which is novel new to the user, if not the world. Technological capabilities: the capabilities to generate and manage technical change are therefore a key issue for firms (Barnett 1995:15).

2.2 Technological Learning and innovation: Imperative for the Firm

More recently, the role of innovation in superior organisational performance, and the centrality of organisational learning in firm-level innovation efforts have become much clearer. To begin with, it is now known that the successful adoption of technology is not a plug-and-play exercise. It involves more than merely the purchase of machinery and the learning of operating procedures (Dahlman & Westphal, 1982). This is due, in part, to the generally tacit nature of technological knowledge, making it difficult or very costly to effectively communicate the full range of skills and knowledge required for executing complex tasks. As such firms must make conscious efforts to improve their productivity (Lall 1992), and invest time before being able to operate any particular technique at optimal efficiency. What this implies for firms in the developing world is that, while technology "transfers" may be necessary, they are not sufficient. The effective adoption and mastery of a technology requires the acquisition of knowledge about a set of procedures, understanding of why the procedures work and skill in putting them to use. It also involves, according to Bell & Pavitt (1993), the adaptation of a technology to meet specific situational needs and continuous incremental modifications to improve the technology.

To generate innovations, whether incremental or radical, technological capabilities are required. In a wide range of literature, firm-level technological innovation is taken as a learning process (Garvin, 1993; Malerba, 1992; Dodgson, 1991, 1993; Hitt *et al.*, 2000; UNCTAD, 1996; Lall, 1992; Cohen and Levinthal, 1989). Knowledge acquired through learning is applied in the build-up of technological capability. Indeed, technological capabilities refer to the knowledge and proficiency needed for firms to choose, install, operate, maintain, adapt, improve and develop technologies (Lall, 1992). In the competitive environment characterised by fast change and high level of uncertainty in which small and medium firms usually operate, capability to innovate is likely to be a particularly crucial learning output because it is the key to gaining dynamic competitive advantage.

The foregoing has a two-fold implication. First, innovation is best understood as an integral process internal to the firm and not as an isolated forerunner of technical improvement in production. This suggests that innovation should be understood not as a distinct precursor to technical change in production, but rather as part of an integral process which takes place within the environment of the innovating firm. It is, among other things, the process which involves matching technological possibilities to market opportunities (Freeman 1982: 112). Second, as observed by Bienaymé (1986), the incremental innovations that occur within the firm are just about as economically important as externally originated major changes.

2.3 Drivers of Technological Learning at the firm-level

Improvements in industrial performance as mentioned above are often perceived to arise from an automatic learning-by-doing process (Arrow 1962). However, more recent literature (e.g. Bell *et al.* 1982; Albu, 2003) prove that learning is not spontaneous, and that performance can easily stagnate or decline over the long-run despite repeated production activity. With close reference to the developing world, firms which successfully master technology and initiate a process of incremental innovation, do so as a result of learning which is neither automatic nor effortless (Albu, 2003). Even minor innovation requires a spectrum of skills, knowledge and capacities for searching, selecting, assimilating and adapting technologies and techniques. Developing and maintaining these capabilities require both a conscious effort by firms and the investment of significant resources. However, while the pursuit of innovation is not effortless, its outcomes are intrinsically uncertain and unpredictable. This is particularly true for firms in the developing world which face an especially uncertain environment, and often have only limited access to, or capability to absorb, the latest research knowledge.

Two things follow from this uncertainty. First, because of the cost and effort involved, firms must feel obliged to effect changes – either by competitive pressures, or because of technical problems (bottlenecks) within the firm. Second, because of the uncertainty, firms are more likely to concentrate their efforts in areas that are already familiar and thus less risky to them. Nevertheless, organisations which monitor their own performance, analyse their strengths and weaknesses, plan strategically etc. are more likely to learn and improve than ones which are constantly in fire-fighting mode, reacting mainly to external events.

The stimuli or causes of technological learning in the sense intended here are those external and internal pressures or ambitions that motivate a firm to increase its capabilities (Albu, 2003). These distinctive stimuli which induce a firm to seek long-run improvements in its capacity to generate and manage technical change may stem from management strategies, awareness of long-run trends or even government policies, with the possibility of internal knowledge feedback. Systematic feedback from the process of engaging in production and distribution contributes to the process of technical change – for example: interaction with customers can provide information about desired modifications to products – which leads to improvements in production capacity. Feedback from the process of technical change - for example: from the experience of purchasing and installing new machinery – can contribute to a firm's capability to manage future investments. The external resources or inputs which firms use to build capabilities include a variety of skills, knowledge, technical and financial services available from the labour market, from interactions with other firms and from supporting institutions. For instance, knowledge derived from close and systematic links with research institutions or from links with other more innovative firms or consultants are considered to be very important (Albu, 2003; Romijn & Albaldejo, 2003).

2.4 Technological Learning, Innovation and the SMEs in the South: a conceptual model

Although there has been a general neglect of SMEs in the literature on technological capabilities, innovation and learning[1] (Albu, 1997), empirical proof of the relevance of knowledge acquisition to SMEs in the south exist. Evidences for three general mechanisms by which small firms learn technologically were found by Romijn (1996) in 26 studies in the small enterprise development and informal sector literature, as follows:

a. Internal technological activity: Romiijn refers by this to the trial and error efforts of firms to learn from the repair, maintenance and reconditioning of equipment (ibid.:102). This mechanism can be related to the concept of knowledge feedback derived from the internal efforts and experience of the firm. The more effort a firm makes to systematically learn from observation, reverse engineering and practical experimentation the greater the knowledge fed back into building its capabilities.

[1] For instance, Romijn (1996:27) reviewed 29 major capabilities studies carried out in the South during the 1980s, and found that "the great majority of firms studied have been large, very large, even gigantic, especially by local standards…".She concluded that although many authors see technological learning in small firms as desirable, they seem not to believe that it actually occurs, because they assume small firms in the South lack the incentives or the potential for building capabilities (ibid.:35).

b. Information search or communication: This refers to the acquisition of new information from outside the firm. This mechanism can be compared with the concept of external inputs to the knowledge acquisition system. Acquisition may occur passively via general interaction with the outside world, or actively as a result of systematic search efforts (ibid.:104). The latter is correlated with successful capability building in some studies (e.g. Girvan & Marcelle 1990).
c. Direct human capital formation: Here Romiijn refers to formal and informal training and education, which widens the channels through which information can be obtained and makes internal efforts more efficient (Romijn 1996:106). This mechanism could be considered as the direct augmentation of capabilities. Alternatively it may be useful to distinguish between training which involves imparting existing knowledge that already lies within the firm's ambit (a form of knowledge feedback), and training that involves instilling knowledge or skills that are new to the firm an external input).

From this body of literature, the author also extracted common indicators of increasing capabilities, viz:

a. Increasing range and complexity of output over time
b. Development of internal design skills
c. Introduction of new, more advanced machinery

The foregoing indicators are put together in a model as shown below. In summary, the model suggests that firms build capabilities, which is expressed in their innovation activities, when they learn through their internal activities (learning-by-doing), information search and high-quality staff.

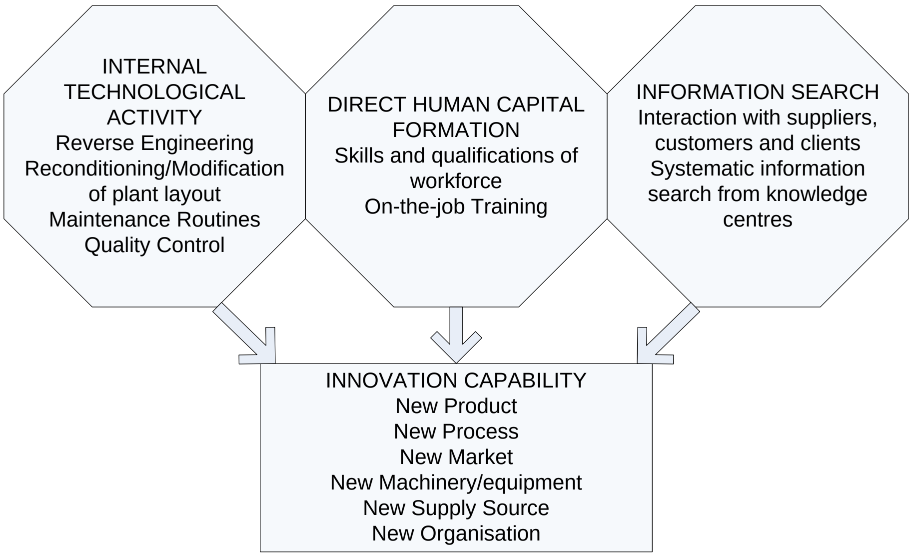

Figure 1: A Model of Firm-level Technological Learning

3. Research methodology

The context of the study is the Cable and Wire manufacturing sub-sector in Nigeria. At the moment, there are only 11 virile manufacturing firms in the industry from which we have purposively selected the leading wholly indigenous firm. The 3-year period between 2003 and 2005 was taken as reference in consonance with most previous innovation surveys worldwide (UNU-INTECH, 2004). The main instrument was a structured questionnaire supplemented with additional information from the internet as well as personal interviews.

Human capital is measured by the numbers of technicians, scientists and engineers in the firm relative to total workforce; and the firm's expenditure on training as a proportion of its sales as well as the proportion of its staff trained during the reference period. The education of the entrepreneur/founders is represented by a multiple-choice measure of management, science and engineering and other academic degrees obtained. 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. Internal technological activities were captured by variables indicating whether or not the firm engaged in reverse engineering, plant modifications/reconditioning, new/modified maintenance routines and new/modified quality control methods. Information search 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. The importance of knowledge transfers through each of the above relationships was measured with a simple binary proxy and a set of Likert scale variables ranging from 4 (very important) to 1 (not important).

The measurement of innovation capabilities is not so straightforward since it implies measuring tacit knowledge. However, tacit knowledge 'stored' in individuals' minds or organisational routines is expressed in the firm's innovation activities, which then constitute useful proxy variables. We considered 5 types of innovation activities that the firm might have engaged in during the reference period, using Schumpeter's (1934) classification.[1] These were measured via 5 simple dichotomous variables indicating whether or not the firm introduced a new product, process, method of organisation; or opened a new market or source of supply. To Schumpeter's typology we added a sixth variable indicating whether or not the firm introduced new machinery or acquired product/process licenses during the reference period. We term this diffusion-based innovation.[2]

4. Results and discussions

4.1 Firm Background

This section details the key findings from the case study. Before going further with the discussion, an examination of the firm's background is in order. The firm was founded in 1978 (as reported on its website) as Nigeria's first Cable and Wire manufacturing firm fully owned and controlled by Nigerians. Although it met a few key players in the industry, the firm still enjoyed some first-mover advantages, notably reputation and channel selection, by virtue of its being the first of its kind. In addition, the firm gains significant advantages from its compact management structure which has only three levels under the top management level. First, the decision-making chain is short and thus reduces the time required to take and communicate strategic decisions. Second, more employees are likely to be involved in innovation decision making rather than having to simply act out orders. It is also to be noted that Lagos where the firm's main offices are located has two frontline universities, numerous research institutes and a myriad of small, medium and large firms as well as industrial associations. Together, these present huge access and proximity to new knowledge for the firm. Finally, we note here that the firm under study is a medium-sized company with a total of 98 full-time employees[3].

4.2 Human Capital

Figure 2 shows the distribution of staff by professional specialties. The overall proportion of scientists and engineers (8%) as well as that of technicians (5%) is rather low relative to the proportion of factory workers and management staff. Comparatively, there are about eight factory workers for every engineer within the firm; and about 12 factory workers for every technician. As regards staff qualifications, the analysis in Table 1 reveals that only about one in four staff has tertiary education with just about a third of these having University degrees (about 8% of total staff).

Considering staff exposure through their experience on the job, Figure 3 shows that most of the staff (about 80%) has less than 3 years work experience. Taken together, the figures suggest that staff supervision, especially relating to technological activities, may be difficult. Also, effective sourcing and assimilation of new information is not likely to be optimal. This becomes more obvious considering the fact that the firm's spending on technology-related training for the staff is low and that staff training intensity is somewhat insignificant. From Table 2 we see that only 0.0075% of the firm's turnover in 2005 was spent in training a mere 5% of total staff. In fact, if all the staff that underwent technology-related training in 2005 were engineers/scientists, technicians or factory workers, staff training intensity would

[1] Joseph Scumpeter (1934, p. 66) defines innovation as the executing "new combinations". He resolves these new combinations into 5 types, viz, the introduction of a new good; the introduction of a new method of production; the opening of a new market; the opening of a new source of supply; and the carrying out of a new organisation of any industry.

[2] This innovation type is unique in the sense that it is particularly important within the developing country context. According to Polcuch et al (2005), 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.

[3] In the Nigerian context, Ramachandran (2002) defined Medium Enterprises as those with more than 50 but fewer than 100 employees.

amount to just 6.8%. In the sort of competitive environment where manufacturing firms operate, these efforts largely do not suffice for the learning firm.

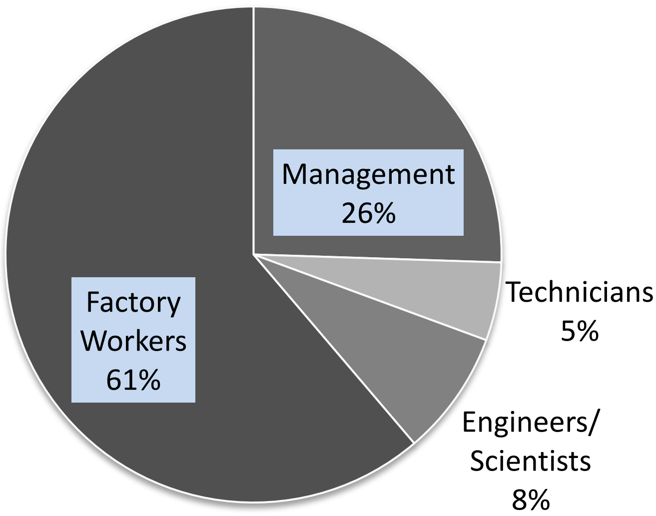

Figure 2: Breakdown of Firm's Workforce by professional specialities

Table 1: Breakdown of Staff by Educational Background

Educational Background	No of Staff	% of total staff
Doctoral Degree	-	-
Master's Degree	1	1.0
Bachelor's Degree	7	7.1
HND	5	5.1
OND	10	10.2
Secondary	45	45.9
Vocational/Trade Tests	30	30.6
Total	**98**	**100.0**

Source: Authors' Survey, 2006

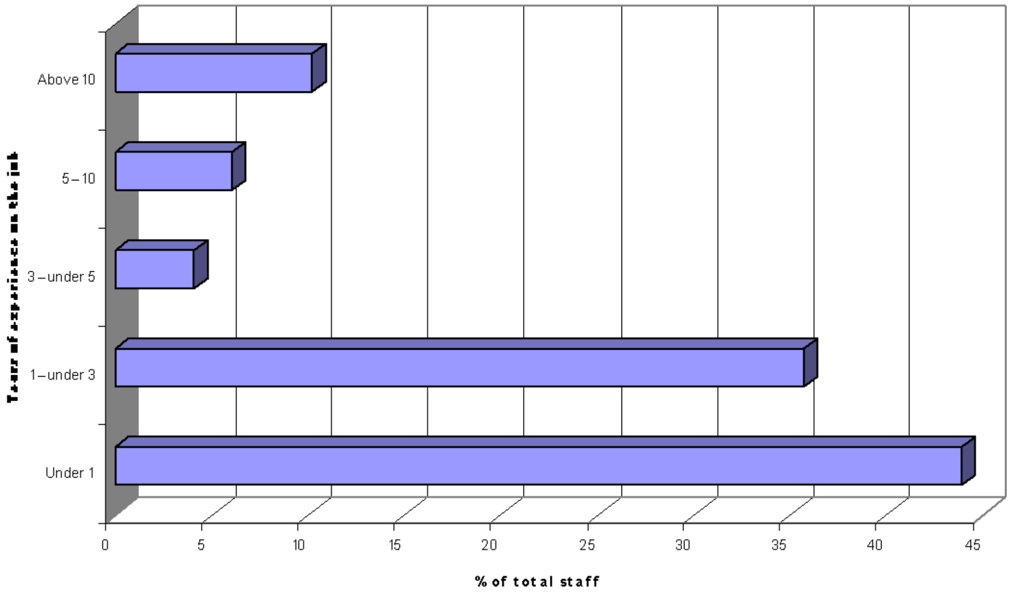

Figure 3: Breakdown of Staff by Work experience

Table 2: Indicators of Training Activities

Total Turnover '000 naira)	*400 000*
Total Employees	*98*
Training	
Training Expenditure '000 naira)	30
Number of employees trained	5
Staff Training Intensity (Number of employees trained as % of total employees)	5%
Training Expenditure per employee ('000 naira)	6
Innovation Intensity (training expenditure as % of total turnover)	0.0075%

Source: Authors' Survey, 2006

4.3 Information Search

With close reference to Figure 4, we note an interesting trend in the firm's external knowledge sources. The bubble chart illustrates the various external sources of information for innovation listed by the firm. Types of information obtainable from each source are product-, process-, marketing- and quality-related information. The size of the bubble indicates the importance attached to each source of information. It is in no way surprising that the firm attaches maximal importance to Universities and Research Institutes as sources of knowledge flows. It is however surprising that no type of information was reported to have been obtained from these sources, during the reference period. within that context, one is not surprised that customers are the most used sources of information for the firm, as interaction with these actors usually occur as a normal part of business and then as a routine. Altogether, the foregoing suggests that the firm learns, not significantly from knowledge centre, but from less formal sources including its customers. However, it is worth mentioning that the firm reported learning a lot from its industry association. Support from this industry association, Cable Manufacturers Association of Nigeria (CAMAN), was rated as very important. This association - which includes the 11 virile firms within Nigeria's cable and wire manufacturing sub-sector – ensures, among other things, strict compliance of its member-firms with industrial standards. Another notable source of knowledge transfer is the Standards Organisation of Nigeria (SON), the government agency saddled with the responsibility of maintaining standards in industrial products. Apart from being a major motivation for innovation, especially quality-related, SON assists the firms with knowledge that helps them to improve and/or maintain product quality. One important aspect of the quality control activity of the organisation is the annual certification exercise of products from companies for quality award known as the NIS Award. This mark is given to manufacturers as a symbol of quality and could be displayed on their products for the year it was won. Our case firm has the Gold Award for its Single Core Cable and Aluminum Conductor which indicates that the product conforms to relevant specified standards parameters established by SON, valid for 10 – 24 years. In 2001, the company's products were further certified by the International Standards Organization when the company was awarded the ISO 9002 certification. Later in 2002, the body revalidated the company's products with the ISO 9001: 2000 certification.

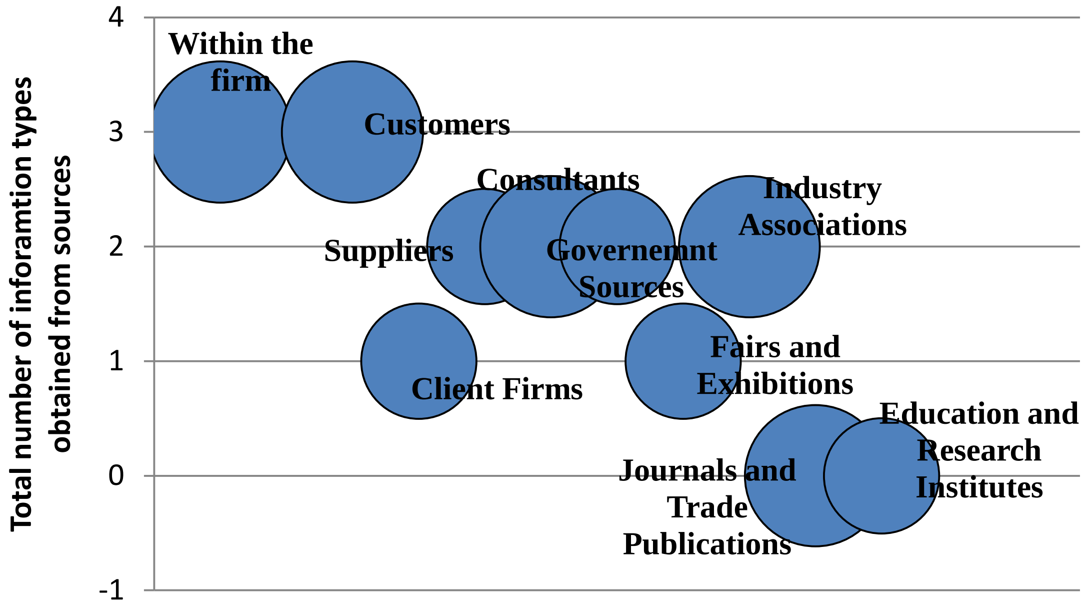

Figure 4: Relative importance of the firm's sources of innovation information

4.4 Internal Technological Activity

Although no reverse engineering activity took place within the firm between 2003 and 2005, it was found that the firm carried out significant quality control, maintenance routine activities and plant layout modification. On their own, these activities potentially provide the firm with an abundant knowledge and capability acquisition source through learning-by-doing. The knowledge so acquired fill up a certain amount of the gap created by deficiencies in the firm's human capital.

4.5 Evidences of Innovation Capability

After learning in the manner described above, what for and how do the firms in Nigeria's Cable and Wire Manufacturing sub-sector apply the knowledge they acquire? More specifically, how do these firms demonstrate their capabilities to innovate? In the following sections, we attempt to provide answers to these questions, discussing the illustrative reasons for innovation and the types of innovation that occurred within our case firm during the 2003-2005 reference period.

To begin with, the innovative behaviour of the firm stems directly from a number of factors, notable among which are its learning capability, as discussed in the preceding sections, and the sub-sectoral influences. Cable and Wire manufacturing is a mature industry where virtually all products are more or less standardised; therefore not much radical product innovations could occur, except as it relates to expanding the firm's product range, adopting new materials, reverse engineering certain products and maintaining product quality, among others. More so, Romijn (1996), cited in Albu (2003), pointed out that a problem for the small firm (particularly in the South) is that it does not make sense to build up specialised capabilities across a broad range of tasks. Instead, it is more efficient to concentrate on "acquiring choice capability, simple repair and maintenance capability and product-design capability, and to rely on specialised suppliers and repairers of machinery and equipment to supply the major installation and breakdown services and substantial process adaptations." Therefore, the absence of R&D, new products and other forms of radical product innovations in our case firm during the reference period may well be as a result of these factors.

Notwithstanding, an appreciable level of incremental product and process innovation occurred in the firm. During the reference period, the firm reported having improved at least an existing product or process. However, no new product was developed or reverse engineered, although the introduction of new process was reported. There are two main implications of this finding. First, since technological innovation deals with products and processes (Hadjimanolis, 2003), it is evidenced that the firm's performance is rather poor in product innovation. The absence of any patents during the period under review further attests to this fact. Second, the firm appears to be comparatively stronger in process innovation as evidenced by the introduction of at least one new process during the reference period, apart from the incremental process modifications. This is to be expected since processes are less rigid and more responsive to the individual capabilities of staff and organisational change, than products.

Organisational change is recognised to be particularly significant in the innovation process in developing economies. In addition to its direct impact on firm performance, it contributes to the firm's preparedness to absorb new technologies incorporated in machinery and other equipments. It is instructive to note that the introduction of in-house training programmes, quality controls, changes in management routines, waste management procedures, maintenance routines in our case firm during the reference period all indicate significant organisational innovation capability. Despite this impressive performance in organisational innovation, the firm was apparently inactive in terms of absorption of new technologies. No product licenses were acquired during the study period; neither was any new equipment purchased. However, it might be misleading to firmly conclude on this basis that the firm is perpetually inactive in diffusion-based innovation considering the short period that this study covered. Any of the activities that amount to technology diffusion could have occurred outside our reference period. Besides, the firm's relatively good use of ICTs is an indication of activeness in technology absorption. The firm has a customised website through which it markets itself and its products; and additionally employs the internet for e-mail and information search purposes. Also, 10% of the workforce has access in their individual offices to the internet and a Local Area Network (LAN); and about 1 in 8 staff was reported to have access to Personal Computers (PCs).

New marketing technique and development of new local market were reported, these being indicative of substantial marketing innovation capability in an environment characterised by small, unstructured and highly unpredictable markets. The value of exports was however not indicated and thus we cannot assess its proportion of the firm's sales. This does not in any way mean that the firm had no exports during the reference period. As mentioned earlier, the firm's products are exported into a large portion of West Africa.

Of the several stimuli identified for innovation within the firm, competition arising from international markets and obsolescence of products were the least important. This is not surprising for two main reasons. First, as discussed earlier, the industry is a mature one where products seldom need to be changed to the extent that a new generation of products will emerge. Second, firms in Nigeria's Cable and Wire sub-sector have successfully established locally a reputation for high-quality products that outperform the imported ones; and because of their size and scope of activities, they do not feature prominently in export markets. As regards the important stimuli, we found that there was a fair balance in the sources of our case firm's motivation to innovate. Of the 11 reasons cited as important innovation stimuli for the firm during the reference period, about 46% are internal while the remaining 54% are from the firm's external environment. A summary of the important factors is presented in Table 3, in no particular order.

Table 3: Important Stimuli for Innovation

Internal Stimuli	External Stimuli
Lowering production costs	Dealing with new competitors at home
Extending product range	Complying with local laws and standards
Improving product quality	Taking advantage of government support
Improve working conditions	Taking advantage of new technology
Developing more environmental-friendly products/processes	Dealing with the challenge of new technology
Deliberate in-house efforts	Satisfying customers' demands

5. Conclusions

Given the specific strengths and weaknesses observed in the sub-sector, we come to the conclusion that technological innovation capability in Nigeria's Cable and Wire manufacturing sub-sector is low while the capability for organisational and marketing innovation is substantial. A key reason for this, apart form the institutional influence mentioned earlier, might be the fact that cable manufacturing is a relatively standardised industry where products are not so flexible. Thus, it may well be sufficient for the firm to maintain product quality and market share for it to remain competitive. Moreover, the knowledge acquisition methodology is somewhat tilted towards the less demanding sources of customers and suppliers, away from the more organised universities and research institutes.

It is therefore recommend, in the light of the foregoing, that more attention be paid to the formation of stronger industry associations because they appear to be more important than we might have believed, especially in the developing country context. It is also desirable to have explicit policies tailored to suit sectoral peculiarities; for instance, rather than encourage ground-breaking R&D and/or new product development – which may be quite useful in other sectors – government could focus on facilitating incremental and diffusion-based innovation by forging 'useful' partnerships between local and foreign firms, and between local firms and the knowledge centres. By 'useful' partnerships we mean such interactions that have high learning intensity attached to them. It must not be assumed that learning automatically occurs with increasing foreign direct investment or even licensing. Within the context of technological catch-up, improving physical infrastructure, human capital and financial systems is fundamental because without an improvement in these foundations for development, it is difficult to see how technological transformations will occur.

This study had certain limitations which must be considered in interpreting the results. In the first place, a single firm from the entire C&W manufacturing sub-sector had been studied. Innovation behaviour and capabilities in other firms may be different. A robust sample of firms in the sub-sector will be more representative. In addition, the 3-year reference period considered in this study is rather short. A longer period of say 5 years might yield more interesting results. The limited information obtained from a single firm for a short reference period gave rise to our inability to quantify certain important indices such as the impact of ICTs in the firm and the impact of innovation on the firm's performance.

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