

ASSESSMENT OF INNOVATION CAPABILITY IN THE CABLE AND WIRE MANUFACTURING INDUSTRY IN NIGERIA: A CASE STUDY APPROACH¹

A. A. Egbetokun^{*}, W. O. Siyanbola^{*}, A. A. Adeniyi[#]

Abstract

This paper assesses the innovation capability of firms in the Cable and Wire Manufacturing Industry in Nigeria, using a purposefully selected case firm. We explored the relationship between the innovative activities of the firm and explanatory variables established in the literature. Data for the study was collected through a structured questionnaire, relevant publications and focused discussions with key individuals. Our results show that the firm's performance is poor in terms of technological innovation. However, we found strong evidences of organisational and marketing innovation as well as significant benefits derived from the industry association. We therefore conclude, contrary to expectations, that it is very unlikely that the seemingly impressive performance of the firms in Nigeria's Cable and Wire manufacturing sub-sector can be adduced to technological innovation capability. Further studies are required to confirm this position.

Keywords: Innovation capability; Technological innovation; Technological capabilities; sub-sector; Cable and Wire manufacturing industry

1. Introduction

Innovation is a critical issue which determines how much benefit can be derived from national Science and Technology efforts. It forms the link between hardcore scientific and technological activities (including R&D, invention and new product development) and real economic growth. This inevitable link is inherently domiciled within the industrial sector of any economy and that partly explains why the leading economies of the world today are the ones with the strongest industrial bases. It is therefore important for any nation to establish the strengths and weaknesses of its industrial sector with a view to designing appropriate policies and structures to initiate and sustain growth.

More so, in today's globalised world, competing for the future is not necessarily based on products and services but on the underlying capabilities that make the products and services possible. This has a two-fold implication. At the firm level, there is an increased necessity for

¹ The study presented here is part of a larger on-going study to evaluate innovation capability in Nigeria's manufacturing sector. Data is still being collected for the study.

^{*} National Centre for Technology Management, Federal Ministry of Science and Technology, Obafemi Awolowo University, Ile-Ife, Nigeria. Tel: +234(0)803-431-2233; Fax: +234(0)36-231-245; E-mail: abiiodun.egbetokun@nacetem.org, wsybola@yahoo.com.

[#] Technology Planning and Development Unit, Obafemi Awolowo University, Ile-Ife, Nigeria. Tel: +234(0)803-4078737; E-mail: aadeniyi@oauife.edu.ng

firms to develop the capability to exploit the available and strategically source for the required technology as a means of gaining competitive edge. This capability (generally referred to in the literature as innovation capability) is embedded in the set of skills and competencies which the firm possesses and/or can exploit to manage change (Oyelaran-Oyeyinka *et al*, 1996). At the national level, it becomes more imperative for governments not only to have information about manufacturing firms, but to also create the appropriate policy ambience for enhanced innovativeness.

Within the developing country context, Mytelka (2000) has defined innovation as the process by which firms master and implement the design and production of goods and services that are new to them irrespective of whether they are new to their competitors, their customers or the world. This definition, which our study aligns with, is broadened to include a wide set of changes in products, processes, organisation and marketing. In this regard, the purchase of new machinery and equipment as well as licensing is considered as innovation (UNU-INTECH, 2004). The capability to initiate, manage and sustain these changes depends on a number of internal and external factors/inputs. 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. In addition to innovation activities, a number of other factors may affect the ability to absorb new knowledge and technology; and to innovate.

Unfortunately, the literature that throws light on R&D and innovation activities of SEs in developing countries is sparse (Bala-Subrahmanya, 2005). Notwithstanding, in India, Ramasastry and Krishnaswamy (1979), Desai and Taneja (1990) and Bala-Subrahmanya (2005) have carried out some assessment studies with interesting results. They found, among other things, that most of the firms developed technology on their own or imitated others; and that lack of availability of finance, high cost of R&D, and lack of good technology information infrastructure are the major barriers to small firm innovation. More specifically, Bala-Subrahmanya (2005) found an innovation intensity of 0.79% in terms of expenditure and 10% in terms of labour. On the dimensions and implications of innovation, he reported that while most of the enterprises have innovated, their efforts were predominantly informal and their motivation was mostly due to external factors such as competition, technology change and market needs with the major objectives of quality improvement, cost reduction and satisfaction of market needs. The study, *Technological Capabilities and Learning in African Enterprises*, carried out by Biggs *et al* (2005) is one of the first systematic attempts to assess technological capabilities and firm productivity in sub-Saharan Africa. The study utilised primary data from two surveys of manufacturing firms in three representative countries, Ghana, Kenya and Zimbabwe; and focused on a number of broad issues related to the patterns and determinants of manufacturing

productivity, the levels of endowment of technological capabilities, the specific nature of technological efforts being undertaken by manufacturing firms, and the constraints they face in enhancing such endeavours. One of the most interesting findings of the study is that an increase of 1% in the number of workers trained potentially increases the value added of firms by as much as 60%. Nonetheless, the study only considered technological capabilities and does not shed light on the specific issue of firms' capability to carry out innovations.

In Nigeria, several studies have assessed the level of interaction among the various elements of the National Innovation System (NIS) (e.g. Oyewale, 2005; Oyebisi *et al*, 1996; Ilori *et al*, 2000) and analysed the factors influencing the generation and successful adoption or non-adoption of industrial innovation by Nigerian firms (e.g. Adjebeng-Asem, 1995; Oyelaran-Oyeyinka *et al*, 1996). However, not much has been done in understanding the technological behaviour of manufacturing enterprises in Nigeria, especially in terms of their propensity to innovate, the sub-sectoral influences and differences in the capacity to generate and/or manage technical change; and their efforts in technological learning (Oyelaran-Oyeyinka, 1997). Specifically, there has not been a systematic evaluation of the innovation capability in the Nigerian manufacturing industry. The scarcity of this sort of policy-oriented information is, no doubt, a major hindrance to the government's efforts to stimulate and sustain industrial growth in Nigeria.

The purpose of this paper is to make a modest contribution towards filling this gap in the literature. The paper assesses the status of innovation capability in the Cable and Wire manufacturing industry - a key sub-sector of Nigeria's manufacturing industry - as a pointer to the situation within the entire manufacturing industry. The report presented here is on a case study of an important firm in the Cable and Wire manufacturing industry, as part of a larger ongoing study to evaluate innovation capability in Nigeria's manufacturing sector. A major aim of the work is to expatiate on the role of innovation (in particular, technological innovation) in the outstanding performance of the sub-sector. In Section 2, we discuss relevant literature that forms the conceptual basis for the study. The scope and methodology are considered in the paper are discussed in Section 3. The data and a discussion of the findings are in Section 4, followed by conclusions and policy implications in Section 5.

2. Conceptual Framework

Technological capabilities are required to enable a country and its enterprises perform some functions vital to international competitiveness and economic progress. International competitiveness and economic progress are, among other factors, driven by a process of continuous innovation. Thus, we may describe technological capabilities as the resources that

are organized to generate innovations, which may be incremental or radical. The primary assumption from which this paper sets out is a body of literature in which firm-level technological innovation is perceived as a learning process (Garvin, 1993; Malerba, 1992; Dodgson, 1991, 1993; Hitt et al., 2000; UNCTAD, 1996; Lall, 1992; Cohen and Levinthal, 1989). Learning results in technological capability - knowledge and skills needed for firms to choose, install, operate, maintain, adapt, improve and develop technologies. In the sort of competitive environment characterised by fast change (and hence, high level of uncertainty) in which small engineering firms generally operate, capability to innovate is likely to be a particularly crucial learning output because it is the key to gaining dynamic competitive advantage. 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).

Existing studies on the subject provide several directions about various factors that could possibly contribute to the build-up of innovation capability. While innovation is a complex concept, research identifies five key areas of influence on an organisation's ability to innovate. These influences relate to leadership; opportunistic behaviour; culture and change; learning; and networking and relationship building. Factors internal to the firm include first of all, the knowledge and skills brought into the firm by the entrepreneur(s) and workforce, which they obtained through earlier experience. Firms require an adequate stock of technically qualified manpower to absorb new technologies, modify them, create and transfer new technological information, particularly scientists and engineers (Hoffman et al., 1998; Wignaraja, 1998). 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).

Interaction with suppliers, customers, public assistance agencies, industry associations, foundations and the like, can provide missing external inputs into the learning process which the firm itself may not be able to provide. Interaction may occur for several reasons. Several 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; Rothwell and Dodgson, 1991; 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).

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

3. Scope and Methodology

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. In the light of the foregoing, what lessons can be learnt from the innovative behaviour of these firms? How much of their impressive performance can be attributed to their capability to innovate? What are the unique characteristics of the industry that are applicable for industrial policy purposes? These issues were examined using MicCom Cables and Wires Ltd. as a case study.

We selected MicCom as our case for a number of reasons. MicCom Cables & Wires Ltd is the first indigenous cable manufacturing company in Nigeria, with its main offices and factory in Lagos – a very industrially active city in Nigeria. The business journey of the company started in 1974 when it operated under the business name MicCom Engineering Works Ltd. Later in 1978, the company commenced the production of cables and wires for the local and international markets. Presently, the firm specialises in the production of overhead cables, insulated and sheathed cables as well as armoured cables. In the late 1990's the company name was changed to MicCom Cables & Wires Ltd. At present, MicCom Cables & Wires Ltd has carved a bold niche for herself in the manufacturing of international standard cables and has therefore captured a sizeable portion of the market in the entire West African sub-region. Apart from being Nigeria's first wholly indigenous Cable and Wire manufacturing firm, it is a market

leader in terms of key performance indicators such as product quality and sales (MicCom, 2005; SON, 2006).

This study focused on innovation capability, which is a specific component of overall firm-level technological capability³. For the reasons explained above, the context of the study is the Cable and Wire manufacturing industry 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 published sources (such as firm's annual reports, publications of the Manufacturers' Association of Nigeria (MAN) and the Central Bank of Nigeria (CBN)) as well as personal interviews.

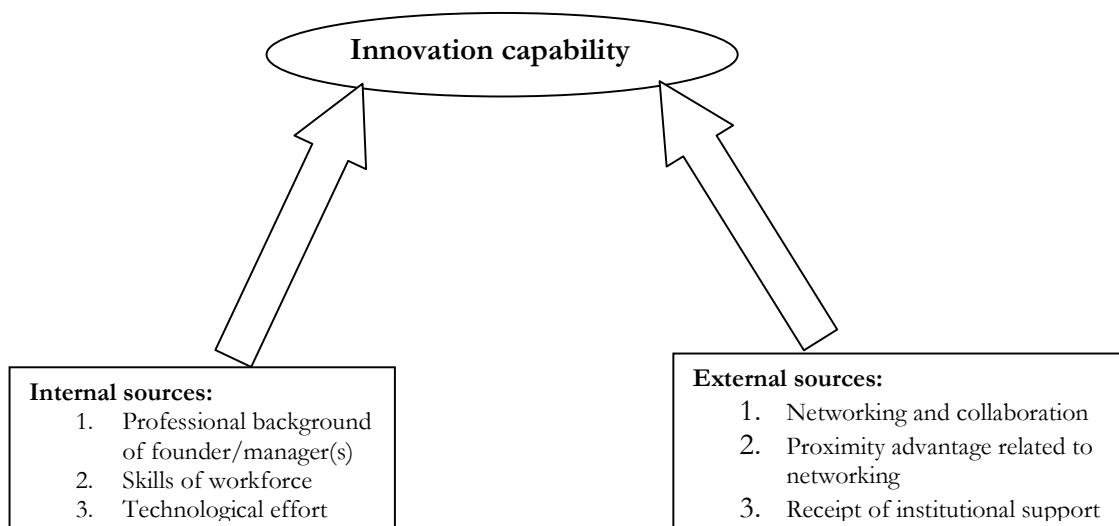


Figure 1: Conceptual Framework

Source: Adapted from Romijn and Albaladejo (2002)

The major analytical concept explored in the study (Figure 1) is based on established relationships in the literature on technological capabilities. This framework was first applied by Romijn and Albaladejo (2002) in their study of the determinants of innovation capability in small high-tech firms in the United Kingdom (UK). The oval at the top represents the innovation

³ For a detailed discussion of technological capabilities, see Lall (1992)

capability, which accumulates as a result of various internal and external inputs. The inputs, presented in the rectangles at the bottom of the model, comprise several specific variables which formed the basis for the operationalisation of the concept (Table 1). Although Romijn and Albaladejo's (2002) results showed that not all of the inputs in the model are significantly related to innovation capability, we have decided to include them in our assessment for two main reasons. First, Romijn and Albaladejo's (2002) study was carried out in a developed country where the characteristics are grossly different from our developing country context. For instance, infrastructural deficiencies, small-sized markets and weak innovation systems that typify the Nigerian environment are absent in the UK. Second, their study considered only one type of innovation, that is, product innovation within a high-tech sector and we consider here many types of innovation including organisational, marketing and diffusion-based innovations.

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 (Polcouch *et al*, 2005). 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). In our measurement of innovation capability, we considered 5 types of innovation. The first of these, product innovation, was measured via four proxy variables, of which two are similar to those used in some major previous studies (Romijn and Albaladejo, 2002; OECD, 1992; Pavitt, 1985; Patel and Pavitt, 1995; Archibugi and Pianta, 1996; Basberg, 1987 and Griliches, 1990). The first variable is the number of patents granted to the firm within the reference period. The next three variables are simple dichotomous variables that indicate whether or not the firm had achieved a radical or incremental product innovation during the reference period. 'Radical' in this sense 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 'incremental' refers to an existing product that has been improved or developed/modified by the firm (OECD, 2005).

Measurement of the second type of innovation, process innovation, was similar to the last three product innovation variables. In measuring organisational innovation, we used six simple binary variables: changes in management routine, quality controls, maintenance routines, plant layout and waste management procedures as well as introduction of new in-house training programmes. Marketing innovation was measured through two binary variables on the development of new local and foreign markets; and one binary variable indicating whether or not the firm introduced a new marketing technique. The fifth type of innovation that we considered, diffusion-based innovation, is unique in the sense that it is particularly important in

the developing country context⁴. We measured this innovation type through two simple binary variables: purchase of new equipment either locally or imported and acquisition of product or process licence.

The measurement of the sources of capability is more straightforward. The education of the entrepreneur/founder(s) is represented by multiple-choice measures 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. Human capital is measured by the numbers of technicians, scientists and engineers in the firm relative to total workforce. Internal technological efforts are captured by variables representing R&D investment, training expenditure and the number of R&D staff relative to total employment. 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 are scored separately. Geographical proximity advantages associated with the above network interactions 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. The importance of financial and knowledge transfers through institutional support was measured with a simple binary proxy and a set of Likert scale variables ranging from 4 (very important) to 1 (not important). The indicator 'institutional support received' measures whether or not firms had received support from government and the relative importance of each of these forms of support.

We also examined the firm's use of Information and Communication Technologies (ICT). 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). To further ensure relevance within the developing country context, we considered some additional variables as sources of innovation capability. The variables include firm profile as indicated by its location, ownership structure and size; exports (as a percentage of sales) and whether this is rising; and habits and practices of innovation as reflected in the objectives and sources of information for innovation.

⁴ 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.

4. Survey Results and Discussions

4.1. Firm Profile

A number of factors in the firm's profile confer some advantages on it. First, its emergence on the industrial scene as a first-mover indigenous firm had its associated advantages⁵. In addition, the management structure is such that there are only three levels under the top management level in the firm. This compact structure keeps the decision-making chain short and thus reduces the time required to take and communicate strategic decisions. Such a structure is also very likely to involve the employees more in innovation decision making rather than having them to simply act out the orders of some superior officers in a long chain of command.

Also, location within an industrially active environment offers significant advantages for the firm because, according to UNU-INTECH (2004), it presents the firm with access and proximity to sources of new knowledge and allows it to easily participate in knowledge flows. It is 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. However, apart from the benefits derived from its own industrial association and customer/competitor feedback, the firm seems not to have made good use of its proximity to knowledge centres. Contrary to speculations that superior technological and educational environment in a region within a developing country is likely to facilitate behaviour of enterprises similar to that of a developed country (Bala-Subrahmanya, 2005)⁶, there were no evidences of such in our case study. This is further confirmed by the firm's sources of information for innovation; the types of information obtained from the sources and the actors it collaborates with, as discussed later.

4.2. Innovation Capability

Given the limited scope of our data, we cannot explore in great detail the status of many of the determinants of innovation capability within the industry but we can comment on the likely situation. We begin by looking at human capital.

4.2.1. Human Resource and Internal Technological Efforts

According to Albaladejo (2003), human resource is a vital element for industrial competitiveness. With the pace of technical change, the spread of information and communication technologies and intensifying global competitiveness, the need for skill development has become even more

⁵ Sanni and Ilori (1997) identified early profits, reputation, channel selection and favourable facilities as some of the advantages associated with being a first mover. They also identified a number of disadvantages which include pioneering costs, demand uncertainty, low cost of imitation and technological discontinuities.

⁶ Bala-Subrahmanya (2005) actually found this to be so in Karnataka, India

commanding. More importantly, the patterns of skills needed for competing in the 'new economy' have changed as well as the institutional structures around them. Thus, while general industrial development in the past required simply improving general levels of education, the emerging competitive setting calls for greater emphasis on high-level specialised training, with the private sector extending the learning process in the company. Quite certainly, the intensity and effectiveness of technological activity performed by enterprises determine a country's competitive performance in manufacturing. It is in the context of the foregoing that we consider MicCom's internal technological efforts as inadequate.

Table 1 details the indicators of internal efforts assessed in this study. Only about 5% of staff underwent technology-related training in 2005 and the training expenditure per employee was approximately ₦ 6,000 (approximately 46 USD). The overall training expenditure was only 0.0075% of sales in 2005 even though the firm's annual sales increased every year from 2003 to over ₦ 400 million (approximately 3.1 million USD) in 2005. If we consider innovation intensity in terms of innovation expenditure (expressed in the firm's expenditure on training⁷) as a proportion of turnover, it follows that the strength of innovation in our case firm is 0.0075%, a far cry from the 0.79% reported by Bala-Subrahmanya (2005) in his study of Indian small enterprises. The paucity of MicCom's self-efforts is more evident when one considers the fact that the figures were reported to have increased each year since 2003, meaning that the indices were even worse for the years preceding 2005.

⁷ University of Cambridge (1992) considered innovation expenditure as one of the most commonly used indicators of innovation activity. Agreeing with this, Bala-Subrahmanya (2005) classified expenditure incurred for training and consultancy, equipment and testing, materials and labour as components of innovation expenditure. He goes further to explain that firms can relatively easily quantify their spending on training and consultancy as well as equipment and testing but the reverse is the case for materials and labour, owing largely to lack of systematic records.

**Table 1: Indicators of Internal Technological Efforts: MicCom Cables and Wires Ltd.,
2005**

<i>Total Turnover ('000 naira)</i>	<i>400 000</i>
<i>Total Employees</i>	<i>98</i>
R&D	
R&D Staff as % of total employees	-
R&D Funding	-
R&D Funding per employee	-
Training	
Training Expenditure ('000 naira)	30
Number of employees trained	5
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

Romijn and Albaladejo (2002), strictly considering product innovations, had earlier reported that the education profile of a firm's workforce can contribute to its innovative capabilities, particularly the presence of university-trained engineers. Table 2 shows the firm's full-time employees breakdown. Proportions of technicians and scientists/engineers are seen to be very low (about 5% and 8% of total workforce respectively) as against the proportions of administrative and factory workers (about 26% and 61% respectively). In fact, the majority of the firm's total workforce (about 75%) has either secondary school or vocational qualifications. The proportion of staff with university qualifications (about 8%) is considered low in technological terms because it includes the administrative staffs that make little or no technological contributions. Although the CEO has a science-related Master's degree with some previous work experience (considered to be very relevant to his current job functions) in a small business, the majority of the firm's workforce (more than 70%) has below 3 years work experience. Taken together, these indices suggest that the skills level of the firm's workforce, which is a key determinant of innovation capability, is rather low.

Table 2: Breakdown of Staff: MicCom Cables and Wires Ltd., 2005

Professional Specialties	No of Staff	% of total staff
Management	25	25.5
Technicians	5	5.1
Engineers/Scientists	8	8.2
Factory Workers	60	61.2
Total	98	100.0
Educational Background		
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
Years of Experience		
Under 1	43	43.9
1 – under 3	35	35.7
3 – under 5	4	4.1
5 - 10	6	6.1
Above 10	10	10.2
Total	98	100.0

Source: Authors' Survey, 2006

4.2.2. Networking and Collaboration

In spite of the firm's proximity to knowledge centres, we found no evidences of collaboration with research institutes and/or universities. Thus, there were no proximity advantages gained by the firm from the universities and research institutes. On the contrary, the firm collaborated with competitors, suppliers, consulting firms, financial institutions and industry associations to solve its problems. This pattern of collaboration where a gap exists between the research-knowledge system and industry is characteristic of the developing country context where the National Innovation System is highly fragmented (Oyewale, 2005; Polcuch, 2005, Egbetokun *et al*, 2007). Apart from internal sources, information for innovation was obtained from consulting firms, industry associations and trade publications. As shown in Figure 1 below, the most used sources of information are internal to the firm and from the customers. Product- and quality-related information was the main type of information obtained from these sources. However, with the paradigm shift currently taking place in the nation's NIS, whereby small and medium enterprises are being encouraged to set up moderate R&D departments or to leverage on

knowledge centres that are close to them, we expect to see more robust interactions between firms and universities/research institutes in the near future.

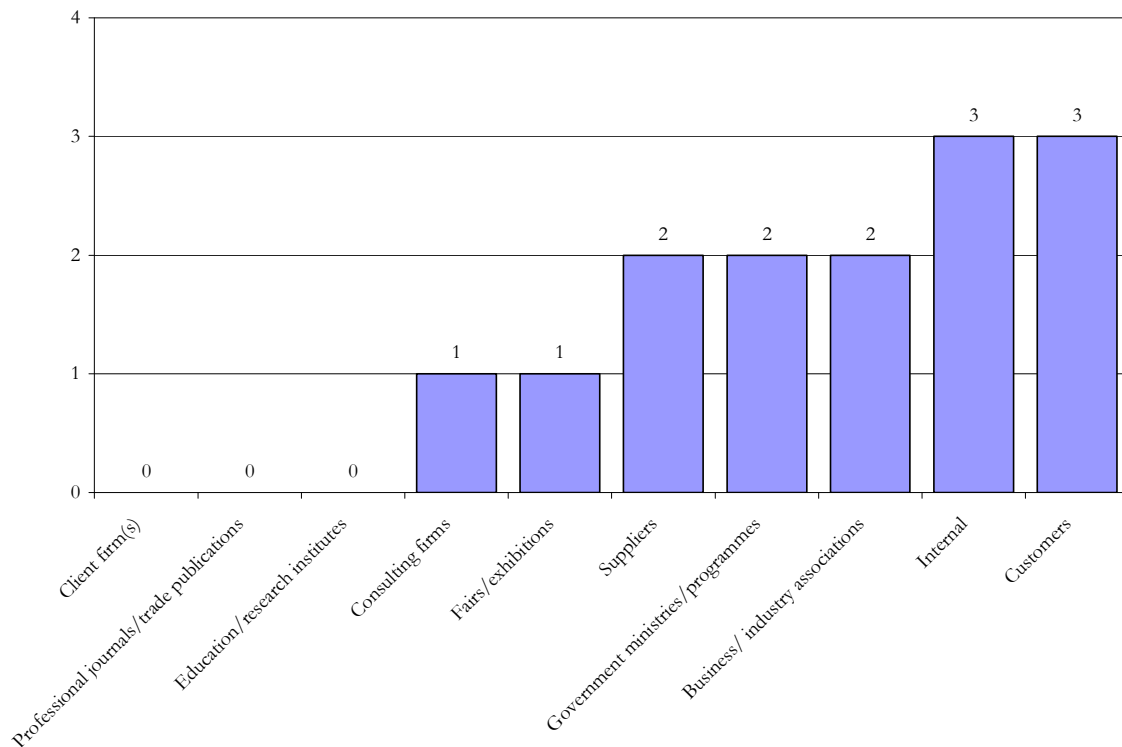


Figure 1: Use intensity of the different sources of information for innovation

Note: Use Intensity was measured by the different types of information obtained by the firm from each of the sources. The possible types of information are product-related, process-related, marketing-related and quality-related.

4.2.3. Access to Institutional Support

Our results showed that the firm did not make use of any form of government support during the reference period. However, support from its industrial association, the Cable Manufacturers Association of Nigeria (CAMAN) was important. Membership of CAMAN includes the 11 virile firms within Nigeria’s cable and wire manufacturing sub-sector. The association has established a CAMAN Technical Committee (CTC) which comprises technical staff from each member-firm. The main function of the committee is to ensure that member-firms comply with industrial standards. This singular 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 knowledge transfer.

The non-use of government support for innovation by MicCom holds important policy implications. First, while it may not be absolutely correct to say that the Nigerian government does not support innovation in firms, the level of government support, from the perspective of what industrial enterprises require, is relatively low. For instance, our survey revealed that government support in form of R&D funding; training (and other forms of) subsidies; technical support services and adequate infrastructure are considered by firms as highly important to their innovation efforts. On the contrary, government's approach to these issues has historically been skewed towards the provision of financial incentives, without paying adequate attention to the other macroeconomic issues. Second, access to government's support programmes may have attendant difficulties which firms would rather avoid than address. For instance, a recent assessment (Oyefuga *et al*, 2006) of the Small and Medium Enterprises Equity Investment Scheme (SMEEIS), which is a financial intervention scheme coordinated by the Central Bank of Nigeria, revealed that access to the funds is low due to the lack of certain requisite skills by entrepreneurs and problems of implementation on the side of the operators of the scheme.

4.2.4. Use of ICTs

Looking at internet penetration and usage in the United States, Ray Hurst (2006) observed that business people are more influenced by the web than by any other type of advertising medium. According to him, around 60 per cent of decision makers said that the Internet was the best way for advertisers to reach them, while fewer than 40 percent recommended using television or radio. Also, as much as 90 per cent of businesses offer online access to product or service information. Taken together, these imply that the internet has become very important to businesses.

Along these lines, we found that MicCom employs the internet for e-mail, marketing and information search purposes. In fact, the firm maintains a regularly updated website which contains historical, public relations and marketing information about it. Besides that, it was reported that internet is used in the firm for information exchange through e-mails and searches on the World Wide Web. Intensity of ICT usage within the firm is moderate (Table 3) with 10% of the workforce having access in their individual offices to the internet and a Local Area Network (LAN). A slightly higher proportion of the workforce (12%) was reported to have access to Personal Computers (PCs). These figures indicate a favourable organisational climate for the absorption of technologies.

Table 3: Intensity of ICT Usage: MicCom Cables and Wires Ltd., 2005

Facilities	% staff with access
Personal Computers	12
Internet	10
Local Area Network	10

Source: Authors' Survey, 2006

4.3. Innovative Behaviour

In the following sections, we outline our findings on the firm's innovative habits and practices as reflected in the kind of innovative activities it engaged in during the 2003 – 2005 reference period. It is informative to state that the innovative behaviour of the firm stems directly from a number of factors, notable among which are its innovation capability, as discussed in the preceding sections, and the sub-sectoral influences. Cable and Wire manufacturing is a relatively standardised business where little room exists for significant product innovations, except as it relates to expanding the firm's product range, adopting new materials, reverse engineering certain products and maintaining product quality, among others. Therefore, the absence of R&D, new products and other forms of radical product innovations may well be as a result of these factors.

4.3.1. Technological Innovation

Within the developing country context, many authors agree that minor or incremental changes can be the most frequent type of innovation activity, together with innovative applications of existing products or processes (see for instance OECD, 2005 and Polcuch *et al*, 2005). Consistent with this, we found that much of the product- and process-related innovation in MicCom was incremental in nature. During the reference period, the firm reported having improved at least an existing product or process. There was, however, no new product 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. More so, small and medium-sized firms are often regarded as being more

innovative than large ones because of their elasticity and readiness to adopt new approaches (Davis 1991). We note here that the firm under study is a medium-sized company with a total of 98 full-time employees⁸.

4.3.2. R&D and Patents

With close reference to the skills of the firm's workforce, as analysed above, it is not surprising that no R&D activities and patents were reported in the firm during the reference period. Notwithstanding, the absence of an R&D department and any R&D activities in the firm holds serious implications which are not peculiar to the Cable and Wire sub-sector. Most Nigerian firms have been observed by Ilori *et al* (2000) to be weak in terms of in-house R&D; and as a result do not have an efficient knowledge generation mechanism. In their 1999 study of 50 Nigerian food companies, for instance, they found that most of the firms were not active enough in R&D as is reflected in their low funding and inadequate staffing for research. About 40% of these firms devote less than 0.5% of their annual turnover to R&D while only 20% devote between 1.5% and 2.4% of their annual turnover to R&D. While it is not yet firmly established whether or not there is a connection between R&D and capacity utilisation and productivity, empirical evidence suggest that intensive and formalised industrial R&D could be key drivers of growth. In most developed and transition economies, private sector R&D is quite extensive. In Japan, for instance, about 50% of firms devote between 1.5 and 2.4% of their turnover to R&D; in Australia the figures are as high as 5% of turnover in about 30% of private firms (Liao and Greenfield, 1997a; 1997b). Evidences from South Korea indicate that 76% of all R&D were carried out by private firms in 2005, an increase of over 48% from 1960 (DST, 2005).

4.3.3. Organisational and Diffusion-based Innovation

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 MicCom Cables and Wires 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

⁸ In the Nigerian context, Ramachandran (2002) defined SMEs as those with fewer than 100 employees.

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 fairly good use of ICTs as discussed earlier in Section 4.2.4 is an indication of activeness in technology absorption.

4.3.4. Marketing Innovation

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.

4.3.5. Reasons, Barriers and Facilitators of Innovation

Why do firms in the Cable and Wire manufacturing sub-sector undertake innovations? An enterprise may innovate due to internal factors (such as the desire to lower costs of production, improve working conditions or improve product quality) or external factors (such as competition, customer feedback and technological changes within the operating environment). In MicCom Cables and Wire Ltd., we found that external factors were more responsible for the firm's innovation activities. Of the 12 reasons⁹ identified as very important for innovating within the firm during the reference period, 7 were external and include notably, to comply with local laws and standards and to satisfy customer's demands. It is not surprising that these factors were highly significant, given the factors that characterise the operating environment. The most significant patrons of cable and wire products are large firms and multinationals who have strong insistence on quality. Also, the activities of the Standards Organisation of Nigeria (SON), the government agency saddled with the responsibility of maintaining standards in industrial products is a main motivation for innovation. 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. MicCom has the Gold Award for its Single Core Cable and Aluminum Conductor which indicates that the

⁹ The reasons are lower production costs, extension of product range, improvement of product quality, improvement of working conditions, deliberate in-house efforts, dealing with local competition, compliance with standards and regulations, advantage of new technology, advantage of government support, challenge of new technology, environmental concerns and satisfaction of customers' demands. Of these, the first 5 are internal to the firms while the other 7 are external.

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.

Polcuch *et al* (2005) described the characteristics of innovation in developing countries, highlighting the specific characteristics of the economy and society that influence the innovation process. These authors believed that local markets in developing countries tend to be small - in some cases due to less developed infrastructure - reducing the scope of the firm's actions and relevance of actual innovations. It is therefore not surprising that one of the key obstacles to innovation identified in this study is weak customer demand. Besides the market size problem, the most significant barriers to innovation were high costs associated with production and marketing, poor domestic economic conditions and lack of skilled personnel. Interestingly, lack of technological information is considered as only a slightly significant obstacle to innovation. An implication of this is that the problems of the firm do not largely arise from paucity of technological information but in the internal capabilities of the firm to effectively deploy this information. These are consistent with the findings of previous studies in the developing country context (Bala-Subrahmanya, 2005; Desai & Taneja, 1990; Ramasastry & Krishnaswamy, 1979).

5. Conclusions and Policy Recommendations

From the preceding case analysis, it is clear that most of the innovations that occur within the Cable and Wire sub-sector in Nigeria are incremental in nature and most of the product-related innovation has to do with quality. Technological innovation performance is largely inadequate. There is however, significant marketing and organisational innovation. New product development is virtually absent, although the introduction of new process, new marketing technique and development of new local market were reported. Information for innovation is mostly obtained from internal sources; and there were no evidence of collaboration with research institutes and universities. The key reasons for innovating were found to be improvement of product quality, lower production costs, dealing with competition and customer satisfaction. Apart from internal sources, information for innovation was obtained from consulting firms, industry association and trade publications. Consistent with the findings of previous studies, product- and quality-related information were the main types of information obtained from these sources. The most significant barriers to innovation were high production and marketing costs, and poor domestic economic conditions. Innovation intensity is very low at 0.0075% and skill of workforce is just average with 8% of total staff as engineers/technicians, 5% as technicians and 8% as university graduates. Also, resource transfer and government

support appear to be low within a harsh industrial climate in the country, with poor infrastructure and weak policies.

We conclude from the foregoing that it is very unlikely that the impressive performance of the firms in Nigeria's Cable and Wire manufacturing sub-sector can be adduced to technological innovation capability. Other factors including strong organisational and marketing innovation capabilities as well as strict quality controls are suspected to be responsible. Further details on this are expected to be obtained in the larger on-going study. It is hoped that the larger study will overcome some of the limitations of this one, which include the short reference period and 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. We also expect that the larger study will throw more light on the technological innovation capability within the Cable and Wire manufacturing sub-sector, as a component of Nigeria's manufacturing industry.

In view of the issues raised in the case analysis, we suggest that the influx of cheap imports which make it difficult for the local industry to compete should be checked through appropriate government policies. Besides, tariffs on importation of production machinery should be reduced. This is considered necessary in the light of the importance of the acquisition of embodied technology to firm-level innovativeness within the developing country environment. In addition, there is great need for financial incentives such as low cost of capital and intervention schemes by government. The latter suggestion bears so much implication for policy considering the importance attached by industrial firms to lack of funds as an innovation obstacle. Furthermore, stronger industrial associations should be encouraged within industrial sub-sectors. This, as evidenced by the benefits derived by CAMAN members, has the potential to facilitate firm-level innovativeness.

Biggs *et al* (2005), in their study on technological capabilities cited earlier, made recommendations of four levels of policies that can enhance manufacturing productivity in sub-Saharan Africa, viz:

- i. policies that affect efficiency indirectly by altering the functioning of the national economy;
- ii. policies that directly affect the efficiency of an industry as a whole;
- iii. policies that influence the technical capability and efficiency of the individual enterprise; and
- iv. policies whose main impact is on the task-level efficiency of individual workers.

Egbetokun *et al* (2007) had also recommended that decided steps must be taken in the areas of institutional framework and support structure for the development of sound innovation capabilities in Nigeria. Not only do we agree with these recommendations, we also believe that

they are particularly crucial for Nigeria. Nationwide policies in the form of macroeconomic policies, financial system development, infrastructure, and national education attainment have important impacts on the efficiency of all firms. It is important to emphasise, therefore, the need for continued structural adjustment of the Nigerian economy in terms of macroeconomic reforms and elimination of gross distortions in prices and incentive structures.

References

- Adjebeng-Asem, Selina (1995) Translating Technical Innovations into Entrepreneurship in Nigeria: Social and Policy Implications in: Ogbu, O. M., Oyelaran-Oyeyinka, B and Mlawa, H. M. (eds). Technology Policy and Practice in Africa, International Development Research Centre, Ontario (available online at http://www.idrc.ca/en/ev-30793-201-1-DO_TOPIC.html; accessed March, 2006)
- Albaladejo, Manuel (2003). Industrial Realities in Nigeria: From Bad to Worse. *QEH Working Paper Series* –Working Paper Number 101. Queen Elizabeth House, Oxford University, Oxford (available at <http://www.qeh.ox.ac.uk/pdf/qchwp/qchwps101.pdf>, accessed November 17, 2006).
- Archibugi, D., Pianta, M. (1996). Measuring technological change through patents and innovation surveys. *Technovation* 16 (9), 451–468.
- Bala-Subrahmanya, M. H.: 2005, 'Technological Innovations in Indian small enterprises: dimensions, intensity and implications', *Int. J. Technology Management* Vol. 30 Nos 1/2, pp. 188 - 204.
- Basberg, B. (1987). Patents and the measurement of technological change: a survey of the literature. *Research Policy* 16, 131–141.
- Bell, M., 1984. Learning and the accumulation of industrial technological capability in developing countries. In: Fransman, M., King, K. (Eds.), *Technological Capability in the Third World*. Macmillan, London, pp. 187–209.
- Biggs, T, Shah, M, Strivastava, P. (1995) 'Technological Capabilities and Learning in Africa Enterprises' World Bank Technical Paper No.288 Washington, D.C.
- Brynjolfsson, E. and L.M. Hitt (2000), "Beyond Computation: Information Technology, Organizational Transformation and Business Performance", *Journal of Economic Perspectives* 14 (4), pp. 23-48
- Cohen, W.M., Levinthal, D.A., 1989. Innovation and learning: the two faces of R&D. *The Economic Journal* 99, 569–596.
- Cooke, P., Gomez Uranga, M., Extbarria, G., 1997. Regional innovation systems: institutional and organisations dimensions. *Research Policy* 26, 475–491.
- Davis, W.: 1991, 'The Innovators', in J. Henry & D. Walker (eds.), *Managing Innovation*, Sage Publications, London, 1991.
- Department of Science and Technology (DST) (2005). 'About the System' Science and Technology System in India.(available at <http://dst.gov.in/stsysindia/about-sys.htm>, accessed January 8, 2006)

- Desai, A. V. & Taneja, N.: 1990, 'The role of small and medium-scale industries in the industrial development of India', in *The Role of Small and Medium-Scale Manufacturing Industries in Industrial Development*, Asian Development Bank, Manila, 1990.
- Dodgson, M., 1991. Technology learning, technology strategy and competitive pressures. *British Journal of Management* 2/3, 132–149.
- Dodgson, M., 1993. Organisational learning: a review of some literatures. *Organisation Studies* 14 (3), 375–394.
- Edquist, C., 1997. *Systems of Innovation: Technologies, Institutions, and Organizations*. Pinter, London.
- Egbetokun, A. A., Adeniyi, A. A. and Siyanbola, W. O. (2007). *Indigenous Innovation Capability in Sub-Saharan Africa: A Review of the Nigerian Situation*. Paper presented at the 5th International Symposium on the Management of Technology (ISMOT '07), June 1-3, 2007. Hangzhou, China.
- Freeman, C. and Soete, L (1999) *The Economics of Industrial Innovation*, 3rd edition, London: Printers.
- Freeman, C., 1991. Networks of innovators: a synthesis of research issues. *Research Policy* 20, 499–514.
- Freeman, C., 1995. The National System of Innovation in historical perspective. *Cambridge Journal of Economics* 19 (1), 5–24.
- Garvin, D.A., 1993. Building a learning organization. *Harvard Business Review*, July–August, pp. 78–91.
- Griliches, Z. (1990). Patent statistics as economic indicators: a survey. *Journal of Economic Literature* 28, 1661–1707.
- Hadjimanolis, A. (2003) *The Barriers approach to Innovation*. In: L. V. Shavinina (Ed.), *The International Handbook on Innovation*. Elsevier Science, Oxford
- Håkansson, H., 1989. *Corporate Technological Behaviour: Co-operation and Networks*. Routledge, London.
- Hitt, M.A., Ireland, R.D., Lee, H., 2000. Technological learning, knowledge management, firm growth and performance: an introductory essay. *Journal of Engineering and Technology Management* 17 (3/4), 231–246.
- Hoffman, K., Parejo, M., Bessant, J., Perren, L., 1998. Small firms, R&D, technology and innovation in the UK: a literature review. *Technovation* 18 (1), 39–55.
- Hurst, Ray (2006). How big is it? Ray Hurst looks at internet penetration and usage. Microsoft Corporation (available online at <http://www.bcentral.co.uk/business->

- information/marketing/ebusiness/how-many-people-use-the-internet-what-do-they-use-it-for.msp, accessed May 10, 2007).
- Ilori, M. O., Oke, J. S. and Sanni, S. A. (2000). Management of new product development in selected food companies in Nigeria. *Technovation*, 20 (2000) (1996) pp. 333-342
- Ilori, M. O., Oke, J. S. and Sanni, S. A. (2000). Management of new product development in selected food companies in Nigeria. *Technovation*, 20 (2000) (1996) pp. 333-342
- Kim, L., Nelson, R. (Eds.), 2000. *Technology, Learning and Innovation: Experiences of Newly Industrializing Economies*. Cambridge University Press, Cambridge.
- Lall, S., (1992). Technological capabilities and industrialisation. *World Development* **20** (2), 165–186.
- Liao, Z. and Greenfield, P. F. (1997a). The impact of generic competitive strategies on corporate R&D: an empirical study in Japan. *International Journal of Technology Management* 13 (5/6), pp 542-555.
- Liao, Z. and Greenfield, P. F. (1997b). Major considerations in the corporate development of R&D strategies within Australian technology-based firms. *International Journal of Technology Management* 13 (5/6), pp 542-555.
- Lundvall, B.-Å., 1988. Innovation as an interactive process: from user–producer interaction to the national system of innovation. In: Dosi, G., Freeman, C., Nelson, R., Silverberg, G., Soete, L. (Eds.), *Technical Change and Economic Theory*. Pinter, London, pp. 349–369.
- Lundvall, B.-Å., 1992. User–producer relationships, national systems of innovation and internationalisation. In: Lundvall, B.-Å. (Ed.), *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. Pinter, London, pp. 45–67.
- Malerba, F., 1992. Learning by firms and incremental technical change. *The Economic Journal* 102, 845–859.
- MicCom Cables and Wires Limited (2005). How we started <http://www.miccomcables.com/index.htm> (accessed April 17, 2007).
- Mytelka, L. (2000)“Local Systems of Innovation in a Globalized World Economy” in *Industry and Innovation*, Vol. 7, No. 1, June, pp. 33-54.
- NAE (1995) *Risk & Innovation: The role and Importance of small high-Tech Companies in the U.S. Economy* Washington D.C.: National Academy of Engineering, National Academy Press
- Nanjundan, S. (1994) *Recent Developments in Small Scale Industry in Selected Countries and lessons for Indian*, New Delhi: National Council of Applied Economic Research – Friedrich-Naumann-Stiftung (NCAER_FNS)

- Organisation for Economic Cooperation and Development (OECD), (1992). Proposed Guidelines for Collecting and Interpreting Technological Innovation Data: Oslo Manual, 2nd ed. OECD. Paris.
- (2004), *The Economic Impact of ICT: Measurement, Evidence and Implications*, OECD, Paris.
- (2005). Proposed guidelines for collecting and interpreting technological innovation data: Oslo Manual, 3rd ed. OECD. Paris.
- Oyebisi, T.O.; M.O. Ilori, and M.L. Nassar, (1996) Industry-academic relations: an assessment of the linkages between a university and some enterprises in Nigeria, *Technovation*, 16 (4) (1996) pp. 203-209.
- Oyefuga, I., Siyanbola, W., Afolabi, O., Dada, A. and Egbetokun, A. (2006) SMEs funding: an assessment of an intervention scheme in Nigeria', *World Review of Entrepreneurship, Management and Sustainable Development*, forthcoming.
- Oyelaran-Oyeyinka, B (1997). NNEWI: An Emergent Industrial Cluster in Nigeria. Technopol Publishers. Ibadan.
- Oyelaran-Oyeyinka, B., Laditan, G. O. A. and Esubiyi, A. O. (1996). Industrial innovation in Sub-Saharan Africa: the manufacturing sector in Nigeria. *Research Policy* **25** (7), 1081-1096
- Oyewale, A. A. (2005). Addressing the research-industry linkage impasse in Nigeria: The critical issues and implementation strategies, Paper presented at Globelics-South Africa, 2005. www.globelics2005africa.org.za/papers/p0032/Globelics2005_Adesina%20Ayobami%20Oyewale.pdf (accessed December 2, 2006).
- Panda, H., Ramanathan, K., 1996. Technological capability assessment of a firm in the electricity sector. *Technovation* 16 (10), 561–588.
- Patel, P., Pavitt, K. (1995). Patterns of technological activity, their measurement and interpretation. In: Stoneman, P. (Ed.), *Handbook of the Economics of Innovation and Technological Change*. Blackwell, Oxford, pp. 14–51.
- Pavitt, K. (1985). Patent statistics as indicators of innovation activities. *Scientometrics* 7, 77–99.
- Polcuch, E. F., Lugones, G. and Peirano, F. (2005). Innovation in Developing Countries: Characteristics and Measurement Priorities In: Micheline Goedhuys (ed.). *Technology Policy Briefs*, Vol. 4 Issue 1, 2005. United Nations University, Netherlands.
- Ramachandran, Vijaya (2002). An Assessment of the Private Sector in Nigeria. Regional Program on Enterprise Development, Africa Private Sector Department, Small and Medium Enterprise Department, The World Bank Group. (available at www1.worldbank.org/documents/ICA005.pdf accessed May 5, 2006)

- Ramaswamy, A. S. & Krishnaswamy, K. N.: 1979, Transfer, Innovation and Development of Technology, Department of Industrial Science, Indian Institute of Science, Bangalore, 1979.
- Romijn, H. and Albaladejo, M. (2002). Determinants of innovation capability in small electronics and software firms in southeast England. *Research Policy* **31** (2002) 1053–1067.
- Rothwell, R., Dodgson, M., 1991. External linkages and innovation in small and medium-sized enterprises. *R&D Management* **21**, 125–137.
- Sanni, S. A. and M. O. Ilori (1997). Strategic Management of Technology. Readings in Technology Management, NACETEM Monograph Publication No. 1. S. A. Sanni, O. O. Mojola, M. O. Ilori and J. B. Akarakiri. Ile-Ife, National Centre for Technology Management (NACETEM), Obafemi Awolowo University: pp 43 - 56.
- Sethuraman, S.V (1987) 'Technology and small enterprise development', in P.A. Neck and R.E. Nelson (Eds) *Small Enterprise development: Policies and Programmes*, Geneva International Labour Office, pp 187-201
- Standards Organisation of Nigeria (SON) (2006). NIS Awards: Gold Awards http://www.sononline-ng.org/portal/alias_Sononline-ng.org/lang_en/tabID_87/DesktopDefault.aspx (accessed April 17, 2007)
- Storper, M., Harrison, B., 1991. Flexibility, hierarchy and regional development: the changing structure of industrial production systems and their forms of governance in the 1990s. *Research Policy* **20**, 407–422.
- United Nations University Institute for New Technologies (UNU-INTECH) (2004). Designing a Policy-Relevant Innovation Survey for NEPAD, A Study prepared by UNU-INTECH, Maastricht, The Netherlands.
- University of Cambridge (1992) *The State of British Enterprises: Growth, Innovation and Competitive Advantage in Small and medium-Sized firms*, Small Business Centre.
- Von Hippel, E., 1988. *The Sources of Innovation*. Oxford University Press, New York.
- Wignaraja, G., 1998. *Trade Policy, Technology and Exports: Sri Lanka's Liberalisation Experience*. Macmillan, London.