Journal of Technology Management & Innovation

Received November 14, 2008 / Accepted April 30, 2009 J. Technol. Manag. Innov. 2009, Volume 4, Issue 2

Technological Innovation Sources and Institutional Supports for Manufacturing Small and Medium Enterprises in Nigeria

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Abstract

The study examined the technological innovation sources, the relevance of these sources as well as institutional supports and their significance to the innovativeness of small and medium manufacturing enterprises (SMEs) in Southwestern Nigeria. The data for the study were collected through questionnaire and interview schedule from a sample of 100 manufacturing SMEs. The results reveal that the key information sources for innovation among these companies are customers; suppliers of equipment and machinery; seminars, training and conferences; market research and business associations. None of the external inputs that the companies needed for internal learning and innovation come from government agencies. The results suggest the urgent need for enterprise-oriented technology transfer from public funded R&D institutions to link the science and technology system with small and medium enterprises production units. Similarly, the SMEs associations should be strengthened to provide opportunities for their members to continuously learn about new technology developments and opportunities to enhance the competitiveness of enterprises in the sector.

Keywords: technological innovation; manufacturing SMEs; innovation sources; institutional supports.

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ISSN: 0718-2724. (http://www.jotmi.org)

Introduction

The manufacturing small and medium enterprises (SMEs) in the present globalised economy are facing stiff competition and increasing demands for high quality products and services which is characterised by fast response time, reliable deliveries and new product functions. In such a dynamic environment, innovation is regarded as a prime strategic factor for these manufacturing SMEs' competitiveness. But technological innovation has been shown to take many paths that reflect the multiple sources of knowledge upon which it is based (Belotti & Tunälv, 1999). That is, one of the key insights of modern innovation theory is that firms rarely innovate on the basis of internal resources only, but they draw on knowledge, skills, technical solutions, methods and equipments from outside the firm itself (Sandven, 1996). Most innovating firms have complex webs of relationships with customers, suppliers, research institutes, industry associations and so on, which are used to solve the many technical, organisational and financial problems presented by attempts to innovate. These processes of interdependence have led to a wide set of models of innovation based on 'interactive learning' between firms and their wider environment (Sandven, 1996).

Consequently, the innovation process, as noted by Dosi (1988), is a complex one that requires the mobilisation of many kinds of scientific and technological knowledge as well as their contextual adaptation to the specific situation of the company's activity and business. This demands the development of technical, research and development (R&D), organisational, and strategic competences and learning capability (Carlsson & Eliasson, 1991). Due to the above factors, the innovation process may not be easy for majority of the manufacturing SMEs due to scarce financial and personnel resources at their disposal. It can then be presumed that external knowledge acquisition is especially important for innovation in these small and medium firms.

In Nigeria, since manufacturing SMEs do not necessarily innovate in formally recognised ways (Oyelaran-Oyeyinka, 2002); it is likely that they make much more extensive use of external linkages. Therefore, the questions considered in this study are with whom are these linkages formed, and of what type and with what purpose? Therefore, the focus of this paper is to identify the technological innovation sources within the National Innovation System (NIS) available to, and being used by the manufacturing SMEs in Southwestern Nigeria, particularly with regard to identification and selection of exploitable innovations.

Technological innovation sources for SMEs

No firm operates in isolation, for all firms are embedded in social and institutional settings, which influences their strategies and structures (Klaus, *et. al*., 1995). At the country level these social and institutional settings comprise of three key elements: local institutions and culture, industrial structure, and firm organisation. Local institutions include public and private organisations, such as universities, training and research institutes, business support agencies, local governments, professional societies and other forums, which facilitate social interactions. These institutions are shaped, among other things, by the country's culture, which affects everything from labour market behaviour to attitudes towards risk-taking (Klaus, *et. al*., 1995).

Industrial structure refers to the division of labour within a country. Critical issues include the extent to which a sector is vertically integrated and the nature of linkages between the supply chain and the relationships between customers, suppliers and competitors within the country (Klaus, *et. al*., 1995). Firm organisation is concerned with the internal organisation of firms within the country. Critical questions are the degree of vertical or horizontal co-ordination, centralisation and decentralisation of decision-making, and the allocation of responsibilities and specialisation of tasks within the firm (Klaus, *et. al*., 1995). Hence, since a firm is embedded within the fabric of its industrial systems, the availability and efficiency of the infrastructure in the vicinity is crucial to its business activities. Therefore, the ability of any firm to produce successful innovations lies in its capability to make new combinations of knowledge and expertise from the various sources of technological innovations available within the national innovation system.

Several studies have focused on the role of business networks for innovation in companies. Thus the knowledge exchange and the learning processes that are taking place within the frame of the customer-supplier relationships, and their importance for technological

ISSN: 0718-2724. (http://www.jotmi.org)

innovation in companies have been well highlighted in the literature (Easton & Araujo, 1992). Some studies among SMEs confirm that it is firstly in the frame of their business network that small companies receive important technological impulses and innovation support (Belotti & Tunalv, 1999). The declared dominating influence of the small company's business network, for their innovative activity, reflect that in many small companies nearly all innovation is a matter of product and process upgrading to satisfy their customers. In other words, innovation in small companies is rarely strategically aimed to anticipate market demands on the basis of precompetitive knowledge that may be acquired from research and advanced technology producers. In fact most quantitative surveys that concern small companies' technological exchanges with their environment show low frequencies of technological exchange by means of horizontal relationships with other companies or with universities, research institutes and diverse technology transfer organizations (Allen, Hyman, and Pinckney, 1983; Leonard-Barton, 1982; SBRC, 1992).

On the other hand, some studies underline the importance of horizontal exchanges for the development of innovation capability in small companies especially when they are taking shape in the frame of more structured "knowledge networks of small firms" or of "collaborative research networks" (Belotti & Tunalv, 1999). Reed and Walsh (2000) reports the findings of various studies carried out by a number of institutions in United Kingdom (UK), which showed that small and medium firms regard their own internal resources as the most important in the innovation process. Customers and suppliers are also identified as extremely significant, with customers been most important for product ideas, and equipment suppliers for process ideas. The information and informal networking opportunities provided by conferences and exhibitions, and by trade associations, were also identified as contributors to the innovation process. Other sources, like business link, higher institutions and commercial research organisations were also found to provide a reasonably high input. However, the customers have an extremely important role in influencing new technology within small companies in the U.K. The reason for this is that the focus is very much on immediate requirements, rather than on future technology needs (Reed and Walsh, 2000).

The study carried out by Taiwo, Oladepo, Ilori and Akanbi (2002) on small scale food companies Nigeria reports that one major source of technological change is personnel (operators and craftsmen). The reasons adduced for this were simplicity of the innovation processes to the work force; accurate and adequate information about the system of production; and the involvement of the workforce in the initiation and implementation of any technological change. Another research showed that the key information source for manufacturing small and medium firms' production and innovation are machinery suppliers, exhibition and trade fairs, client firms, publications, repair workshops (foundries, heat treatment shops and others), staff of other firms, and social and professional associations, and consultancy firms within and outside the clusters (Oyeyinka-Oyelaran, 2001).

In summary, the above findings indicate that interaction with suppliers, customers, public institutions and industry associations will provide missing inputs into the learning process, which the firm itself cannot easily provide. The interaction may take place for the purpose of gathering information about technologies and markets, and also for obtaining various other inputs to complement the internal learning process, such as external staff training, parts and components, consulting services, and the like.

Methodology

Participants

The sample, which was purposively selected from the database and directories of the SMEs associations, consisted of 100 small and medium companies in manufacturing activities with less than 300 employees. The companies are those in Food, Beverages & Tobacco (FBT) sector, Pulp, Paper and Paper Products (PPP) sector, and Plastic & Rubber Products (PRP) sector in Southwestern Nigeria. The data collected were analysed using frequencies, means, percentages and correlation analysis. The main instrument used in collecting data was questionnaire, which was self-administered by the owners/managers of the companies. Moreover, guided interviews were later conducted with the owners/managers of those companies that are discovered to be innovative from the completed questionnaires.

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Design

The questionnaire, which was closed ended, was used to collect information about the innovation activities of the companies. That is, the types, sources and the assessment of the originality and technological complexity of such innovation. Also, the range of networking relationships with private enterprises, and public and public research/training institutions are also requested for in the questionnaire. Moreover, interview was used to further probe on the nature of the innovation of the companies and the source(s). The responses from the interview are used to supplement the data supplied in the questionnaire so as to determine the innovative index of each company.

Procedure

To understand the level of technological innovation in these companies, we determined the innovative index score (ι) of the companies, using the model developed by Romijn and Albaladejo (2004) and adapted by Abereijo (2006). This differentiated the companies into five groups according to the degree of novelty in the innovations and the extent to which the innovations required specialised technological expertise. Those in group I achieved no innovation ($\iota=0$), group II ($0<\iota\leq1$) are those with incremental innovation based on casual observation, group III ($1<\iota\leq2$) achieved high level of innovation with scientific contents, those in group IV ($2<\iota\leq3$) achieved higher innovation that are new, while group V ($\iota=3$) are those with high level of innovation with originality and scientific complexity.

Among those that showed some level of originality, their innovative index scores were then correlated with the technological innovations sources, like industry associations networking, customer-supplier relationships, interaction with universities, research institutes and other technological transfer organisations, and collaborative research networks. Also the degree of relevance of each of the above sources of technological innovation was identified. Furthermore, the extent of knowledge transfers through institutional support was examined through the types of assistance these companies had received (mainly non-financial) from governmental agencies, which are established to reduce barriers or obstacles faced in the technological development by SMEs. This support covers areas such as access to capital markets, business advisory services and help with accreditation and business registration.

Results

Out of the 100 questionnaires administered 89% was found usable, which include 12.4% from Pulp, Paper and Paper products industry, 24.7% from Plastics and Rubber product industry, and 62.9% from Food, Beverage and Tobacco industry.

Indicators of Innovation

Table 1 shows that 18% of the total sampled companies reported having achieved innovation in product, process and organisation, however most of the innovations were neither scientifically complex nor highly original. This was because none of the companies obtained innovative index score (ι) of 3, while only 1% obtained ι of between 2 and 3 (Table 1). However, 29% obtained an average ι of between 0 and 1, and about 14% had ι of between 1 and 2.

Sources of Technological Innovation

Table 2 shows various sources of external inputs to the technological innovation in the companies. The significant ones are through customers (43.8%), suppliers of equipment and machinery (38.2%), seminars, training and conferences (31.5%), market research conducted within the company (27.0%), and through business associations (20.2%). Also, majority of the respondents rated these external sources as been relevant to their innovation capability (Table 2). The least reported external source was 'the right to use the innovations of others (that is, being licensed to use the innovation of others)' and 'the use of consultancy services and information or special services from other firms'. The above results suggest that majority of their product and process innovations are of minor kinds to meet immediate requirements of the customers.

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	Frequency	Percent (%)
A. Indication of Innovation in:		
1. Product, Process and Organisation (N = 89, 100%)	16	18.0
2. Product (N = 88, 98.9%)	36	40.9
3. Production process (N = 62, 69.7%)	47	52.8
4. Organisation restructuring (N = 89, 100%)	19	21.3
B. Contribution of Innovation to the Growth of the Business (N = 47, 52.8%)		
1. Product Innovation	33	70.2
2. Process Innovation	14	29.8
3. Organisational Innovation	-	-
Innovative Capacity Scores	**No. of firms**	**Percent (%)**
Innovative Index Score (ι)		
$\iota = 0$	50	56.2
$0 < \iota < 1$	26	29.2
$1 < \iota < 2$	12	13.5
$2 < \iota < 3$	1	1.1
$\iota > 3$	0	0.0

Source: Field Survey, 2006

Table 1: Indicators of Innovation by the Sample Companies/Innovation Capacity Scores

Sources of Technological Innovation	Percent of Total sample (%)	Responses to the Relevance of Sources of Innovation (%)		
		Not Relevant	Relevant	Highly Relevant
Through the seminars, training and conferences.	31.5	-	85.7	14.3
Through the customers, based on the markets needs.	43.8	-	74.4	25.6
Through the suppliers of equipment and machinery.	38.2	2.9	64.7	32.4
Through research and development findings from the universities, research institutes, etc.	7.9	-	85.7	14.3
Through business associations (e.g. NASSI, MASME, etc)	20.2	5.6	88.8	5.6
Through market research conducted by our company.	27.0	-	58.3	41.7
The right to use the innovations of others (that is, we are licensed to use the innovation).	1.1	-	100	-
The use of consultancy services and information or special services from other firms.	1.1	-	-	100
Hiring of qualified personnel.	6.7	-	66.7	33.3

Source: Field Survey, 2006

Table 2: External Interaction and Relevance of Interaction in the Acquisition of Innovation

In terms of the association between each of the external interaction and the innovative index score, there was only significant relationship ($r=0.528$, $p<.01$) between the innovative index (ι) and interaction with R&D findings from universities and research institutes by few (7.9%) that interacted (Table 3). This seems to suggest that much of the interactions with other external sources are not innovation-related in the sampled companies.

Table 4 presents the institutional supports and types of assistance received. The Table shows that the only institution that majority (40.4%) of the respondents had benefited from was Federal Institute of Industrial Research, Oshodi (FIIRO). The response indicate that

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72.2% and 25.0% of the companies benefitted from 'business advisory services' and 'training of their staff' respectively from this institution. However, 9.0% and 1.1% of the companies had benefited from services provided by Industrial Development Centres (IDCc) and the Standard Organisation of Nigeria (SON) respectively. The assistances received from IDCs were also 'business advisory services' and 'training of staff'; while the only support received from SON was 'assistance with accreditation'. Moreover, there was no association between the assistance from any of the agencies and the companies' innovative index (Table 5). This could simply be explained by the fact that majority of sampled companies did not patronize these government agencies. When they patronize any of them at all, it was only for business advisory services and training.

Technological Innovation Sources	**r values**
Seminars, training and conferences attendance	0.226 (.72)
Customer, based on the market needs	0.104 (.640)
Suppliers of equipment and machinery	0.107 (.222)
Research and development findings from universities, research institutes	**0.528**** (.03)
Business associations	0.068 (.560)
Right to use the innovations of others	0.265 (.680)
Use of consultancy services and information or special services from other firms	0.296 (.734)

Source: Survey, 2007

** Significance at the 0.01 level (2-tailed) p-values in bracket.

Table 3: Correlation Coefficient (r) between Innovative Index and Technological Innovation Sources

Sources of Assistance	% of Companies that received assistance	Response to the types of Assistance Received (%)			
		Business advisory services	Assistance with accreditation	Innovation award/fund to carry out R&D	Training of staff
Industrial Development Centres (IDC)	9.0	50.0	-	-	50.0
Product Development Agency (PRODA)	-	-	-	-	-
National Agency for Science & Engineering Infrastructure (NASENI)	-	-	-	-	-
Standard Organisation of Nigeria (SON)	1.1	-	100	-	-
Federal Institute of Industrial Research, Osohodi (FIIRO)	40.4	72.2	2.8	-	25.0

Source: Field Survey, 2007

Table 4: Sources of Assistance and Types of Assistance Received

Discussion

The study assessed the various technological innovation sources available to manufacturing SMEs in the south-western Nigeria and the relevance of each of the sources to their innovativeness. The result revealed that the key information sources for innovation among these companies are customers; suppliers of equipment and machinery; seminars, training and conferences; market research conducted within the company; and business

ISSN: 0718-2724. (http://www.jotmi.org)

associations. However, interaction with research and development (R&D) outputs from the universities and research institutes by few (7.9%) of these firms, had significant relationship with their innovativeness. However, none of the external inputs that the companies needed for internal learning and innovation came from assistance from government agencies.

Since innovation is seen to be instrumental in increasing the country's competitiveness and SMEs are at the core of this. But these small and medium firms rarely engage in R&D, and the product and process improvements are of minor kinds. Therefore, the results show that there are some policy implications from this study.

First, there is urgent need for enterprise-oriented technology transfer units to link the science and technology system with the production system. This then calls for constant re-tooling and re-engineering of the country's SMEs' development agencies to be able to design and implement an effective mechanism to strengthen information flow relationships from the national innovation system of the country to the SMEs.

Secondly, the SMEs associations should be strengthened to provide opportunities for their members to continuously learn about new technology developments and opportunities from external sources. Therefore, greater collaboration between these associations and the state need to be encouraged. This is especially important in the provision of timely technical information sources and creation of opportunities for information development, exchange, and dissemination.

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ISSN: 0718-2724. (http://www.jotmi.org)

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ISSN: 0718-2724. (http://www.jotmi.org)