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Technology Transfer and Technology Transfer Performance: The Role of Technology Network of Manufacturing Entrepreneurships

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ABSTRACT

The Nigerian manufacturing sector has been performing abysmally in spite of the strategies employed by the government to improve the sectors performance. However, the commonplaceness of technology networks and manufacturing entrepreneurships in Nnewi town sets the tune for this study. This study therefore seeks to examine the relationship between technology network and technology transfer and technology transfer performance among indigenous family-owned manufacturing entrepreneurships in the town. Survey design and simple random sampling technique were adopted. Questionnaire was employed to generate the study data. The chi-square analysis of the data shows that technology transfer and technology transfer performance significantly depends on technology network. The study concludes that through cooperation within a technology network, actors can acquire, apply and put a transferred technology to commercial ends based on their absorptive capabilities. In addition to increased investment in education and other infrastructures, the study recommends taking advantage of the Nigerian market power to create various technology networks of owners and users of similar technologies. Further research themes are provided.

Keywords: *Technology Transfer, Technology Transfer Performance, Tacit Knowledge, R&D,Technological Innovation, Non-technological Innovation, Nnewi Town*

INTRODUCTION

The concept "technology transfer" was first used by Vannevar Bush in his report to President Roosevelt of the United States (US). Bush suggested that the US can achieve post war economic recovery and success through public investment in Research and Development (R&D) and commercialization of technology (Bush, 1945). Technology transfer entails R&D, technological innovation, non-technological innovation (Berkhout et al., 2006) and tacit knowledge transfer through cooperation between the source and receiver. Such cooperation among the actors who are embedded in benefit-rich technology network contributes to the performance of the transferred technology (Komninos, 2008). The companies, developed and developing countries in the network that have the ability to absorb the transferred technology achieve some advancement in their economies (Waroonkun, 2007) and experience higher performance. This is because technology transfer has been suggested as the process that will bridge the wide gap between developed and developing countries (Vutsova, 2013).

When China developed her investment and industrial policies, their focus was technology transfer through collaboration in production, research and training (US Bureau of Industry and Security, 1999). China jettisoned these policies on realizing that by relying on internal hard work alone, it will take about 50 years for the Chinese to acquire the technological innovations that will match that of the US. Consequently, China resorted to forced technology transfer, joint venture, exchange and intellectual property theft practices with the multinational companies the country enters into contract with (Atkinson, 2012). China uses her large market size to force multinational companies to form joint ventures with China's State-owned enterprises, locate their most sophisticated R&D projects and facilities in China and transfer the latest technology in exchange for business opportunities (Ezell & Atkinson, 2011; Atkinson, 2012).

China is still largely a technologically developing nation (Atkinson, 2012). However, the Chinese have used the aforementioned strategies to acquire the core technologies in high-speed rail transportation from Japan's Kawasaki. Today, China has one of the most advanced technologies in high-speed rail transportation. It is based on this record that the Chinese worn and executed high-speed rail ways for Saudi Arabia, Turkey, Venezuela, Australia, New Zealand and the State of California in the US. China has employed the same method to transfer Ford's automobile R&D laboratory and technology to Chinese automobile producer, Chang'an Motors. It has acquired the core technologies in electric car from General Motors, Nissan and Volkswagen. China is using the same process to pressurize Boeing and Airbus to transfer advanced aeronautics and aviation technology to Commercial Aircraft Corporation of China (COMAC) (Atkinson, 2012). Today, India, Indonesia and Brazil are using the same strategies to acquire sophisticated technology in medical drug production (Ezell & Atkinson, 2011; Atkinson, 2012). India is also employing the same strategies to acquire advanced technology in telecommunication (United States Trade Representative's Office, 2012).

Africa as a continent is characterized by low productivity and weak competitiveness relative to the rest of the world. One of the suggested interventions to reversing this trend is innovation and technology transfer (Economic Commission for Africa, 2014). In Nigeria, recent researches in the manufacturing sector have identified absence of technology transfer as one of the bane of the sector's abysmal performance. Conversely, among low income countries, Nigeria is the second largest recipient of FDI; which is a huge source of technology transfer (Economic Commission for Africa, 2014). This is owing to the country's large market size and openness to trade (Okoli & Agu, 2015). Nigeria has a number of under-staffed, under-funded and under-utilized research institutes. The country has many Higher Institutions that graduate engineers, technologists, scientists, technicians and artisans on a yearly basis. There are also many Nigerians studying in various Higher Institutions in the world, some own firms outside Nigeria, while others work in some of the best firms in different parts of the world.

Fundamentally, the government of Nigeria has employed strategies such as the Structural Adjustment Programme (SAP), local content initiative, import restriction and export promotion to improve the performance of the manufacturing sector. However, these strategies have all failed to give the desired result. Based on the foregoing, it is evident that the continued applications of these strategies alone are no longer meaningful ingredients for the technological development of the nation. Corroborating this view, Andersson (2009) notes that creating opportunities to enable economies to catch up with technology, based broadly on trade is no longer accepted universally. Besides, multinational companies are now preventing the transfer of technologies that would be most valuable to the receiving country. They have resorted to maintaining control over valuable technologies and preventing their transmission to local actors who possess the capability to become future competitors.

Aside the several success stories of technology transfer especially at University level, researchers and practitioners alike have for almost two decades critiqued technology transfer specifically for its inability to generate positive economic and commercial returns (Davenport, 2013). In spite of the critiques, research has shown that technology transfer contributes significantly to competitive advantage (Al-Abed et al., 2014). This study therefore seeks to examine the relationship between technology network and technology transfer and technology transfer performance.

Literature Review

Technology Transfer

Technology has been defined as a transformer, a tool, as knowledge (Ramanathan, 1995) and as a specialized knowledge. Technologies can drive significant structural changes and economic development (Vutsova, 2013). Technology transfer has been variously defined according to the purpose of the research and the academic background of the researcher. However, most of the published researches in technology transfer have been conducted by management researchers (Bozeman, 2000). Technology transfer involves the transfer of knowledge, best practice, know-how, implication process and expert (Kim & Hong, 2016). Technology transfer is the movement of technology from one site to another, namely from a University to an organization, from one organization to another, and from one country to another (Bolatana et al., 2016). Technology transfer is the process of deliberate and systematic acquisition, provision, sharing, li-

censing of equipment and machinery, technology, skills, knowledge, intellectual property rights, business and organizational processes, designs and facilities, for the manufacture of a product, for the application of a process or for the rendering of a service. This definition delineates technology transfer as the transfer of a system that includes hardware, software, procedures and skills, among other things, as a package; unlike a "product transfer" such as the sale of a tractor (Economic Commission for Africa, 2014).

For the purpose of this study, technology transfer is defined as a planned and systematic cooperation and exchange between owners and users (who have purchasing and/or market powers) of tacit knowledge, technological/non-technological innovations and R&D who wish to achieve long-term adoption, and improved knowledge, work practices, productivity, service delivery and competitive advantage. This definition depicts that technology transfer is a deliberate cooperation that is embedded in a technology network where the actors exchange tacit knowledge, technological innovations, non-technological innovations and R&D based on their purchasing power or market size.

Technology can be transferred through trade, licensing and FDI. Technology transfer through trade occur when domestic firms import capital goods; business professionals and technological services; and other forms of machinery and systems (such as software) that embody technologies; or when they purchase intellectual property rights (Economic Commission for Africa, 2014). Licensing can take the form of licensing-in or licensing-out. Licensing-in is the acquiring of rights to other company's intellectual property. Licensing-out is a way of selling a company's unused technology to other companies (from industrialized to developing country) (Park & Lee, 2011). However, the company in a developing country must have sufficient absorptive capacity. Absorptive capacity is a firm's ability to recognize the value of new information, assimilate it, and apply it to commercial ends. A firm's absorptive capacity develops cumulatively from the absorptive capacities of its employees and the organization's ability to exploit information through transfers of knowledge across and within subunits (Cohen & Levinthal, 1990). Technology transfer through FDI may take any of the forms enumerated under trade. It may also take forms such as the import of machinery, marketing and distribution management systems, which are required in order to successfully implement the investment projects. However, increase in FDI flow does not necessarily result to increase in technology transfer (Vutsova, 2013).

Tacit knowledge exchange

Knowledge is information that changes somebody, either by becoming grounds for action or by making an individual or an institution capable of different or more effective action (Drucker, 1989). This "knowledge is always embodied in a person; carried by a person; created, augmented, or improved by a person; applied by a person; taught and passed on by a person; used or misused by a person. The shift to the knowledge society therefore puts the person in the center" (Drucker, 2001:287). The embodied knowledge is tacit knowledge. It is difficult to duplicate by competitors because it is embedded in the person (Chen & Huang, 2009). When this technology and knowledge are transferred to new contexts, they are adapted to apply in the new contexts (Argote & Ingram, 2000). Recently, knowledge exchange is being preferred to knowledge transfer because the former more accurately depicts innovation as a process that is non-linear and interactive (Davenport, 2013). In spite of this preference, Polkinghome (2011) notes that technology transfer, knowledge transfer and knowledge exchange are still used interchangeably.

Technological/non-technological innovations

Innovation as a process is related to entrepreneurial activity that is explained by W. R. Maclaurin's traditional linear model. This model comprises basic research, applied research, technology development, product/process development, production and market (Davenport, 2013). Damanpour and Gopalakrishnan (2001) note that innovation as a process is associated with both the creation and adoption of something new. However, today, innovation is now viewed as a system. As a system, innovation has been redefined because of the emergence of new and more complex economies and the need to produce goods/services for both local and international markets (Berkhout et al., 2006). Berkhout et al. explains the change in the definition of innovation using three different generation models.

The first generation

Is explained by the traditional linear model of innovation that starts from basic research and

ends with the market. It does focus on technology push and science as sources of innovative ideas.

The second generation

The traditional linear model in the first generation is reversed here to start with the market. It does focus on market pull; emphasizing the role of innovation as a driver of performance and improvement. But neglects long-term research that aims at radical innovations.

The third generation

Technology push and market pull are balanced here so as to increase the technical capabilities of organizations. However, the third generation neglects the role of non-technological innovation. In the third generation, innovation is no longer based on an "open" process with organizations' R&D collaboration efforts.

The fourth generation

Emerged as a result of the critique of Berkhout's et al. three generation models. In the fourth generation, innovation is embedded in a system of partnerships or "open innovation". The fourth generation relates science and industry. It brought to the fore the need to combine knowledge on technologies and markets, adapt organizational capabilities to the requirements of the network, and the role of entrepreneurship as a fundamental driver. The generations of innovation models are useful as each generation complements the preceding generation model. Innovation as a system is defined by Gu and Lundvall (2006) as a set of institutions, which jointly and individually, contribute to the generation, diffusion and use of knowledge for the development, diffusion and application of new technologies. These institutions constitutes the framework through which governments formulates and implements public policies as instruments of change. These governments also shape the innovation system into an "interactive learning" network where actors involved exchange knowledge and technology. The "open innovation" model refers to the use of external sources and actors to achieve innovation (Chesbrough, 2003). A company that has openness tendency will acquire more innovations from outside sources. This company outsources its own-R&D that is not a core technology of the company (Park & Lee, 2011). This is why the Connect and Develop (C&D) strategy of exploiting external ideas and actors used by Proctor and Gamble is more effective than the R&D strategy used by most organizations (Sakkab, 2002).

Innovation is associated with technological and non-technological innovation. Technological innovation is described by product and process innovation. Product innovation implies new or improved consumer products or services in the market, while process innovation is the use of new procedure in production or service delivery (Laursen & Salter, 2006). Non-technological innovation is the combination of organizational and marketing innovation. Organizational innovation is the introduction of new methods, procedures and practices in the business and relationships maintained by a firm. On the other hand, marketing innovation is the introduction of new placement, promotion and pricing methods in a firm's products and services. Technological and non-technological innovations are complementary. Product innovation is enhanced by new marketing methods, while organizational changes contribute to improved productivity. Cooper (1998) opine that technological innovation is the most significant form of innovation because of its capability to value, solve problems, improve performance and enhance competitive advantage. Furthermore, technological innovations are of minimal value if the society fails to adopt and make use of them (Lybecker, 2014).

Cooperation in research and development (R&D)

R&D is a creative work undertaken on a systematic basis in order to increase the stock of knowledge and the use of this stock of knowledge to devise new applications (OECD, 2008). R&D is a laboratory or workshop that has the capacity of providing product ideas. R&D capability is a firm's ability to reframe the present knowledge and produce new knowledge (Fleming, 2001). R&D enables firms to create new technologies from existing or transferred technology (Zhouying, 2005). A company or country can obtain technology from its own-R&D (or imitation) or through technology transfer. Park and Lee (2011) notes that using own-R&D strategy is time consuming, expensive and risky as it is impossible to take back the efforts in case of failure. Technology is obtained through technology transfer when there is need for target technology. Technology transfer is an easier way to enter a specific market compared to own-R&D. Moreover, technology transfer reduces R&D periods and ensures the use of pa-

tents with no risk. However, whether technology is obtained from own-R&D or through technology transfer, the two ways create substitute and complementary relationships. The substitute relationship implies that when a firm is dependent on transferred technology, there is the likelihood that it makes little or no effort to develop its technological ability. The complementary relationship suggests that technology transfer can stimulate R&D activities (Park & Lee, 2011). Internally focused R&D is no longer fashionable. This is evident in the declining expenditure on own-R&D. Firms who do this are successfully achieving both technological/non-technological innovations by basically drawing from global knowledge and expertise. These firms further commercialize external ideas by deploying outside pathways to the market (Chesbrough, 2003).

Technology Transfer Performance

Technology transfer performance is the outcome attained by local companies for implementing technology transfer projects with foreign companies (Waroonkun, 2007). The outcome could be productivity growth (Wu, 2009; Han, Kwon & Lee, 2016), effectiveness (Jafari, Akhavan & Rafiei, 2014) or success (Yoo & Yang, 2015) in production or service delivery.

Technology Network

In the process of technology transfer, partnerships and networks of various stakeholders are often created (SPI, 2015). The actors in this network form connections, reciprocity relationships and linkages to co-purchase, co-manufacture, co-own or exchange related and complementary knowledge and technology (Gulati & Singh, 1998; Stuart, 2000; Tang, 2017). Technology network employ an innovative system of interactions involving owners and users of knowledge, technological/non-technological innovation and R&D to achieve improved innovative and technological capability (Chesbrough, 2003). These actors work together based on trust that is embedded in the network (Scott & Brown, 1999; Brown & Duguid, 2000; Tang, 2017). The strength of the interconnection among actors in a network explains why some types of knowledge are difficult to transfer. Thus, there is need to ensure compatibility among the actors. Such compatibility is essential for the transfer to be successful (Argote & Ingram, 2000).

New knowledge is acquired through interaction with other people, institutions and entities based on established ties (Gulati, 1998; Vanhaverbeke et al., 2002) in the network. R&D can be accelerated through a network involving companies from both developed and developing countries and who share complementary knowledge (Sorrentino & Garraffo, 2012). Networking activities give rise to unprecedented opportunities, facilitates internalization and the dissemination of advanced knowledge, technology and experience (Indradewa et al., 2016). Technology network facilitates the effectiveness of technology transfer. Vutsova (2013) note that the effectiveness of technology transfer is measured by access to adequate knowledge on the transferred technology, access to the relevant technology, availability of relevant capacity to absorb and adapt the technology, the profitability of the technology to the user, the effect of the transferred technology on the environment in terms of pollution or cleanliness, and the results of the monitoring, evaluation and feedback mechanism of the transferred technology. For the purpose of this study, technology network is define as the connections, relationships, ties and linkages among individuals, institutions, firms and governments, who co-create, co-own, co-share or exchange related tacit knowledge, technological/non-technological innovations and R&D for the purpose of enhancing their technological capability.

Previous Empirical Studies

Roxas, Piroli and Sorrentino (2011) found that a technology "pull" approach that involves long-lasting relationship among SMEs improves performance. Yoo and Yang (2015) empirically established that strong ties of firms in a network are positively associated with successful technology transfer. The study conducted by Chan, Oerlemans and Pretorius (2008) reveal that inter-organizational networks (i.e., degree of centrality, tie characteristics and diversity of actors) contribute positively and negatively to the innovative performance of firms. Tang (2017) empirically illustrated that the performance of cross-region technology transfer improves as the regions' reciprocity relationship in the transfer network increases. Park and Lee (2011) found that human technology and fixed assets are positively related to financial performance. It can be inferred from the surveyed empirical studies that there is a dearth of empirical works on the influence of technology network on technology transfer and technology transfer performance.

Methodology

Nnewi is the second largest town in Anambra State. The industrialization of the town which started in 1970 was pioneered by traders from Nkwo Nnewi market through the various networks they formed. Today, through this network, Nnewi is dotted with large and small scale manufacturing companies. Recently, artisans, engineers and industrialists from Nnewi have started moving or sending family members to China to work and/or invest in manufacturing companies of their choice with the intent of transferring such technologies back home. The aforementioned issues therefore make Nnewi a suitable study area for this research.

The study adopted survey design. The indigenous family-owned manufacturing entrepreneurships were selected from the 2016 Anambra State Ministry of Commerce and Industry list of manufacturing firms. The selected 28 entrepreneurships in Nnewi have 287 industrialists, managers, engineers and technicians. Yamane's (1967) formula was used to compute the sample size of 167. Simple random sampling technique was employed to select the respondents. The employed technique for data collection was questionnaire. Technology transfer was measured based on the adapted proxies from the works of Gu and Lundvall (2006), Damanpour and Gapalakrishnan (2001), and Chesbrough (2003). Technology transfer performance measures were adapted from the works of Bozeman (2000) and the 12 item statements used by Al-Abed et al. (2014).

The proxies for measuring technology network were adopted from the works of Gulati and Singh (1998), Stuart (2000), and Argote and Ingram (2000). All the item statements in the questionnaire were measured on a 4 point Likert scale that ranged from strongly agree (4) to strongly disagree (1). The validity of the questionnaire was confirmed by experts in innovation and entrepreneurship. The reliability of the questionnaire was confirmed by the Cronbach's alpha value of 0.84. The 154 useable questionnaire from the number retrieved gave a response rate of 92.0%. Data on the characteristics of the respondents were analyzed using simple percentage, while the hypotheses were analyzed using chi-square statistical method at 5% level of significance. The analyses were conducted with the aid of SPSS (Version 21.0 for Windows). The decision rule is to reject H_0 if $P < 0.05$. Otherwise do not reject.

RESULTS

H_{01}: Technology transfer is significantly independent of technology network

H_{a1}: Technology transfer is significantly dependent on technology network

Table1.*Summary of Coded Responses and Result of Chi-Square Test for Hypothesis 1*

Technology Network	Technology Transfer				Mean	df	χ^2	P-value
	SA	A	D	SD				
Knowledge workers share and exchange their tacit knowledge in a rewarding and cordial atmosphere of collaboration.	26 (31.5)	68 (55.0)	43 (52.0)	17 (15.5)	2.7	3	11.6	<0.05
The relationship among institutions, firms' stakeholders and relevant government agencies facilitate the adoption of new product and process innovation.	37 (31.5)	42 (55.0)	61 (52.0)	14 (15.5)	2.7			
Knowledge workers are influenced by the interactions among actors in their technology network to apply new marketing and organization innovations.	30 (35.5)	64 (70.5)	44 (38.0)	16 (20.0)	2.6	3	18.3	<0.05
The interconnection among technology network actors encourages cooperation in R&D.	41 (35.5)	77 (70.5)	32 (38.0)	4 (20.0)	3.0			

Source: *Field Survey, 2018*

The summary of the coded responses on the item statements for hypothesis one in Table 1 show that the respondents affirm that technology transfer depends on technology network.

This is evident from the mean values (i.e., 2.7, 2.7, 2.6 and 3.0) that are higher than the response threshold mean of 2.5, that is, (4+3+2+1)/4. Table 1 further depict the result of the test of hypothesis one. The result reveals that at 3 degree of freedom (df) and 5% level of significance, the chi-square values are significant [$\chi^2_{cal.}$ Values (11.6, 18.3) > $\chi^2_{tab.}$ = 7.815]. Hence, H_{01} is rejected. This implies that technology transfer is significantly dependent on technology network.

H_{02}: Technology transfer performance is significantly independent of technology network

H_{a2}: Technology transfer performance is significantly dependent on technology network

Table 2: *Summary of Coded Responses and Result of Chi-Square Test for Hypothesis 2*

Technology Network	T T Performance				Mean	df	χ^2	P-value
	SA	A	D	SD				
Participation in technology network improves the knowledge in the use of the new tools for a manufacturing process.	72 (57.0)	67 (70.0)	10 (14.0)	5 (13.0)	3.3	3	20.0	<0.05
Involvement in technology network improves marketing and organization knowledge.	42 (57.0)	73 (70.0)	18 (14.0)	21 (13.0)	2.9			
A learning tie with technology network actors improves the knowledge for implementing the transferred knowledge and firm's profit.	67 (65.0)	69 (70.5)	15 (11.0)	3 (7.5)	3.3	3	8.6	<0.05
Knowledge gathered from technology network contributes to the effectiveness and efficiency of the allocation, use and maintenance of resources.	63 (65.0)	72 (70.5)	7 (11.0)	12 (7.5)	3.2			
Network cooperation in R&D facilitates the integration of existing and absorbed knowledge and the creation of new knowledge.	52 (59.5)	58 (62.0)	21 (18.0)	23 (14.5)	2.9	3	14.7	<0.05
A working relationship with actors in the network leads to the successful adoption of advanced product, process, marketing and organization innovations, and knowledge in manufacturing.	67 (56.0)	66 (62.0)	15 (18.0)	6 (14.5)	3.3			

Note: *TT = technology transfer*

Source: *Field Survey, 2018*

Table 2 reveals that the mean values (i.e., 3.3, 2.9, 3.3, 3.2, 2.9 and 3.3) of the responses are higher than the mean threshold of 2.5 [i.e., 4+3+2+1)/4]. This implies that technology transfer performance is dependent on technology network. Table 2 further shows that the chi-square values are significant [$\chi^2_{cal.}$ Values (20.0, 8.6, 14.7) > $\chi^2_{tab.}$ = 7.815] at 3 degree of freedom (df) and 5% level of significance. Hence, H_{02} is rejected. This implies that technology transfer performance is significantly dependent on technology network.

DISCUSSION

The result of this study shows that technology transfer depends on technology network. This result confirm the findings of Ferraro and Iovanella (2017) that inter-organizational network of relationships contribute to technology transfer. The knowledge embedded in an organization's tools, technology and tasks are transferred through interactions in a network (Argote & Ingram, 2000). Most developing countries are relying more on technology transfer from developed countries in different industries, since developed countries are technologically developed (Al-Abed et al., 2014). Developing countries do this because it is cheaper to transfer technology than to reproduce it (Bolatana et al., 2016). Technology transfer requires the establishment of a network that will involve

all the actors concerned. The participating actors create and maintain a reciprocity relationship among them to enhance the transfer. Reciprocity relationship implies the existence of mutual confidence and learning that encourages technology transfer and by extension the sharing and exchanging of knowledge and innovation since technology is the carrier of knowledge and innovation (Tang, 2017). The ability of family business owner/mangers to actively participate in diverse network, identify opportunities and acquire competitive resources enables the firm to acquire tacit knowledge, secure R&D collaboration and learn new innovation (Wang & Quan, 2017). In addition, such R&D collaboration exposes firms to advanced technologies (Wu, 2012).

The analysis of the data for the current study reveals that technology transfer performance depends on technology network. This result is somewhat consistent with previous findings (Chan et al., 2008; Roxas et al., 2011; Yoo & Yang, 2015). By being actively involved in technology network, a family business owner/manager can access from other actors tacit knowledge with which to develop his own technology. Also, maintaining the closeness with the collaborating actors enhances successful technology transfer, technology adoption and performance of the new technologies (Chan et al., 2008). The collaboration with Universities and Research Institutes across regions is important as it can offer the Institutions information that will guide them to develop technologies that are environmentally friendly and cost effective both in usage and maintenance to the local manufacturing firms. Consequently, technology innovation and industry development can keep inspiring each other (Tang, 2017).

The implications of this study are first, family business owner/managers should no longer see technology network as a business development strategy that is open only to large firms but to all firms irrespective of size. Second, owner/mangers may not necessarily build all facilities it needs as technology network encourages facility sharing/exchanges and contract manufacturing. Third, since the complexities in today's business environment has necessitated a paradigm shift in innovation from a process to a system that encourages the participation of all knowledge workers, owner/managers should allow all the knowledge workers in their firms to actively participate in technology network. Fourth, the findings have further confirmed tacit knowledge, technological/non-technological innovations and R&D as the dimensions of technology transfer. Fifth, as an early study in Nigeria, technology transfer should be embraced as a strategy that requires the development of absorptive capacity. This implies that technology can be acquired by interacting with other people, institutions and firms in a technology network. The adoption and exploitation of the transferred technology is dependent on the degree of a firm's absorptive capacity. Moreover, new knowledge creation, improved innovation capabilities and R&D cooperation through technology network strengthens absorptive capacity and improves the performance of the transferred technology.

CONCLUSION

This study has shown that technology network facilitates technology transfer and enhances technology transfer performance. Thus, family businesses will experience improved performance based on the transferred technologies, when their owner/managers and knowledge workers are actively involved in a technology network. However, the technology network must encourage mutual exchange and/or sharing of tacit knowledge, technological/non-technological innovation and R&D facilities among the actors. The reciprocity relationship among the actors will further promote technology transfer, creation of new knowledge and increase in the adoption of new technologies by the actors in their respective firms.

This study is not without limitations. First, the study was conducted with special focus on the manufacturing industry. Thus, further studies can examine other sectors. Second, the study only surveyed manufacturing firms in Nnewi town. This relatively connotes a narrow geographical scope which can be widened in further researches. Third, the study data were generated through questionnaire. A mixed methodology is suggested for further studies. In spite of these limitations, the findings of the current study present some recommendations. In addition to increased investment in education and other infrastructures, Nigeria can take advantage of her market power to create various technology net-

works of owners and users of similar technologies. Actors in the networks should include but not limited to foreign and local industrialists, engineers, technicians, multinational companies, Universities and research institutes. This is to enable the Nigerian companies employ their absorptive capacities to ensure knowledge and innovations transfer or exchange, R&D cooperation or technology commercialization. The Nigerian actors can acquire the technologies from the multinationals through joint ventures, agreement to expose Nigerians to the core technology and to employ a certain percentage of Nigerians in return for a business contract.

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