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Transplants and technological capability building in Africa: the case of IVM in Nigeria

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Abstract: *Africa has not being able to build the required technological capability to compete in the global market. Africa is known to be stocked in poor infrastructural development especially in the sub-Saharan Africa. China has stepped up from just being the greatest trade partner to growing Africa's local manufacturing beyond its provision of economic aid, investment in infrastructure and resource development. This study also took a case study approach to look at the case of Innoson vehicle manufacturing (IVM) and its learning mechanism of building technological capability. The study makes a critical analysis on claims; which paints IVM as a China automobile transplant in Nigeria. The paper concludes that China supportive efforts in Nigeria and some African countries will build up technological capabilities if only Africa can increase technological learning, efforts and R&D intensity*

Keywords: Technological capability, Africa, Nigeria, automobile, China, transplants
Codes of classification Jel : L22; L62,O39

Transplantations et renforcement des capacités technologiques en Afrique: le cas de l'IVM au Nigéria

Résumé : *L'Afrique n'a pas été en mesure de se doter de capacités technologiques nécessaires pour être compétitive sur le marché mondial. L'Afrique est connue pour son faible développement infrastructurel, en particulier en Afrique subsaharienne. La Chine est passée du statut de partenaire commercial le plus important à celui de fabricant locale le plus important de l'Afrique , ceci en plus la fourniture d'aide économique, d'investissements dans les infrastructures et de développement des ressources. Ce travail adopte l'approche d'étude de cas pour examiner le cas de la fabrication de véhicules Innoson (IVM) et son mécanisme d'apprentissage de renforcement des capacités technologiques. L'étude fait une analyse critique des réclamations; qui peint IVM comme une greffe de l'industrie de l'automobile Chinoise au Nigéria. Le document conclut que les efforts de soutien de la Chine au Nigéria et dans certains pays africains renforceront les capacités technologiques si seulement l'Afrique peut accroître l'apprentissage technologique ainsi que les efforts et l'intensité de la R&D.*

Mots clés: Capacité Technologique, Afrique, Nigéria, secteur automobile, Chine, transplantation
Codes de classification Jel : L22; L62,O39

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Introduction :

Technological capabilities (TC) are not known to be uniformly distributed across countries, regions and firms; and knowledge production seems to be largely concentrated in a few highly industrialized economies (Archibugi, and Alberto, 2003). Lack of technological capability and infrastructure are major contributions to abject poverty and underdevelopment in Africa, especially in sub-Saharan. Despite the acclaimed impacts of globalization, free trade, increased foreign direct investments, availability and free flow of information through ICT, public policies promoting international scientific cooperation and many other channels of technology transfer, technological catching-up by developing countries in Africa has remained a daunting task. According to Lundvall (2001), the very rapid rate of technological change gives a premium to those who are rapid learners. Technological development is path dependent and is also mirrored in infrastructural, institutional and organizational underpinnings of learning. Capability building in any nation depends on institutions, i.e. on the political, social and economic arrangements of the society. To build, sustain and improve capability processes, organizational and institutional changes are required to facilitate learning. The processes of generation of new scientific and technological knowledge as well as of technological imitation, adaptation and innovation involve a rich variety of complementary actors, often including business firms but, together with public training and research institutions, communities of practice, technical societies, and trade unions, among others (Cimoli *et al.*, 2006).

It is like a jinx. Africa has remained a passive learner. Successive governments have failed to build infrastructural that will support technological capability development. Africa especially the sub Saharan region is still stuck with the low level of industrialization. The African Union in 2014 (Ozawa, 2015) stated that Africa's industries still remain the world's least competitive and productive. The manufacturing value added (MVA) as a percentage of GDP, the measure of the contribution of the manufacturing sector to GDP, remains very low in Africa between 12-14%. As regards to the percentage of world manufacturing value added, Africa stands at 1.5% compared to East Asia, 17.2%; Latin America, 5.8%; North America, 22.4%; Europe, 24.5%...

Even though Africa can blame the new regime of international trade liberalization of World trade organization (WTO) of 2000, TRIPS, intellectual property rights and the negative impact of globalization making it difficult for African countries to enjoy the degree of freedom that the Asian countries (such as, Japan, Korea, India, China, e.t.c) had in using suitable trade policies to develop their economies. The question is this; had the development in these Asia countries stalled after the new global trade regime of 2000? Some of these emerging economies in Asia have developed technological capabilities and also have grown and home to notable multinational companies (MNCs); which are fast spreading globally and also acquiring other firms in the developed countries of Europe. China, Korea and India are good examples of countries that have bought over large firms in Europe and North America. Before now, Japan was able to build transplants in North America and increased her market share and global influence.

Robert Zoelick; a former World Bank president in 2008 showed concern by calling on China to invest in Africa's manufacturing base beyond her investments on infrastructure and resource-extractive projects. Today, we can see China transplants doted in most Africa countries; even in South Africa; which claims to be leading on technological efforts in Africa.

A focus on the automotive sector show a technological trajectory in Africa; where multinational companies (MNCs) and their first tier suppliers control the market. Even though African countries have not being able

to develop indigenous original equipment manufacturers (OEM) that assemble automobiles, they are yet to grow automobile competitive automobile component suppliers who can supply foreign owned automotive MNCs in Africa. In most cases the automobile component suppliers in African countries serve mostly as third tier suppliers in the automobile supply chain. These third tier suppliers find it hard to integrate into the global automobile value chain. The automobile component manufacturers in South Africa are known to supply leather seat clothing, exhaust pipes and other products at the low technology end of the automobile value chain. Their counterparts in Nigeria concentrate in the informal market and supply mainly the automobile repair market or the off the shelf product market. Despite the success achieved in the increase of number of vehicles produced and exported from South Africa with the introduction of the motor industry development plan (MIDP), the technological capabilities of the local automobile component suppliers are yet to compete globally to offset the net foreign exchange used in importation of automobile vehicles &components to maintain a favourable trade balance. The incentives offered by MIDP were not enough to develop local technological capabilities in the South African case and unfortunately, Nigeria has chosen to copy South Africa by introducing the automobile industry development plan that mimics the MIDP in South Africa which failed after about twenty years of its implementation.

1.1. Statement of problem

The Japan International Cooperation Agency; JICA (2015) carried out a survey after the Nigerian government requested from the Japanese government in July, 2014; to help develop automotive supplier parks in Nigeria. The results from the survey show that the some of the automotive companies consider it a tall order or high disincentive to invest in the automotive sector in Nigeria. Lack of infrastructural development also deter investors and is a common barrier to entry in Nigeria. The conditions of roads in Nigeria raise transportation costs and same as low power supplies which also hike production costs. Policy inconsistence and lack of clear vision of policy direction affects foreign direct investments in the sector. Most disturbing is the fact that there is no strategy to develop the local manufacturers that can meet the quality, cost, delivery and contribute to the complete knocked down (CKD) assembly whereas the deadline for CKD assembly was already set for next year; 2018. National Automotive Industry Development Plan (NAIDP) has fiscal measures that provide local assemblers with favoured levies on importation of fully built units (FBUs). However, the tariff difference is not sufficient to promote investment in local production and assembling because semi-knocked down (SKD) and CKD assembling requires more cost for design and logistics. It might need more than 40 percent difference between the assemblers and non-assemblers. In addition, the incentive to local assembling is applied only for 12 years. There is a possibility that foreign investors may regard the investment as not attractive and remain assembling at DKD or SKD levels. Poor control of importation of used vehicles, grey imports and smuggling discourage foreign manufacturers from investing in Nigeria because the price of grey-import cars/parts and illegally imported cars are very low compared to new cars sold in Nigeria. CKD assembly is already set for next year: 2018. NAIDP has fiscal measures that provide local assemblers with favoured levies on importation of FBUs. However, the tariff difference is not sufficient to promote investment in local production and assembling because SKD and CKD assembling requires more cost for design and logistics. It might need more than 40 percent difference between the assemblers and non-assemblers. In addition, the incentive to local assembling is applied only for 12 years.

The above stated issues raises doubt on how the objectives and targets of NAIDP could be achieve in subsequent years even as one is yet to see the real impacts of the policy since 2014; when it was launched. The much concern as it relates to this study is that the NAIDP will influence firm behaviour in the automotive sector. Most firms will not build the required technological capabilities without the right policy mix that have the right incentives. These external factors affect firm level capability and most automobile firms are winding down operations in Nigeria. The fact remains that firms who show organizational resilience in the automobile sector in Nigeria have to use unique strategies to survive. Automobile assembly has become a tall order in Nigeria and some big MNCs have entered and withdrawn from the Nigerian market. Volkswagen vowed not to come back to the market and had operated with its proxies while Damiler-Mercedes Benz had closed its subsidiary and yet to reopen its plant for years now. The grand strides displayed by IVM are taken as a flash in the pan and there has being insinuations that the firm is a type of Chinese transplant.

1.2. Research questions

What are the elements of technological capability (TC) seem in firms? What capabilities are found in IVM operating in the automobile sector in Nigeria? How do these capabilities emerge or developed? Can firms import capabilities from more advanced countries? If it is possible to import TC, then how do firms import TC?

1.3. Objective of the Study:

The objective of this study is to find out the level of TC developed in IVM; an indigenous automobile assembly plant in Nigeria. This study also will investigate the role of China in building TC in the manufacturing sector in Africa with a focus on IVM in Nigeria

2. 0. Literature review

Literature is replete of studies on TC (Lall, 1992; Bell and Pavitt, 1995; 1996; Panda and Ramanathan, 1996; Kim, 2000, Dutrénit, 2004, Archibugi et al, 2008, e.t.c) Archibugi *et al*, (2008) and a few others described TC at the national level while several others described firm level technology capability. The concept of TC was interchangeable used with technological effort or technological capacities till the use of TC dominated (Dutrenit, 2008). TC was referred in 1980s as 'the ability to make effective use of technological knowledge. This definition dwelt on the use of that knowledge and its use in production efficiency, investment and innovation rather than on the possession of knowledge (Westphal et al. 1985 as cited in Dutrenit, 2008). Caniels and Romijn (2003) stated that the term TC was first coined in the early 1980s by researchers probing intra firm technological dynamics in developing countries; where firms typically operate far from the technological frontiers. Lall's (1992) defined technological capability as complex array of skills, technological knowledge, and organizational structures required to operate a technology efficiently and accomplish any process of technological change. He also stated that firms do not operate on a common production function but at a point where their technical progress, building upon their own efforts, experience and skills, is localized around that point. He further stated that the asymmetry in firm-level technological efforts and mastery may vary by industry, size of firm or market, level of development or by trade/industrial strategies pursued. Technological knowledge is

neither shared equally among firms, nor is it easily imitated and evenly transferred across firms. Transfer necessarily requires learning because technologies have tacit forms. Mastery of new technologies requires skills, effort and investment by the recipients, and the extent of mastery achieved varies. Bell and Pavitt (1995) stated that industrial efficiency is not affected by external technology acquisition alone, but also refers to the ability to manage internal changes in technologies used in production. These capabilities are accumulated and embodied in skills, knowledge experience & exposure and organizational systems (Bell and Pavitt, 1993). Kim (1997) on his own account described TC as the ability to use technological knowledge efficiently to assimilate, use, adapt and change existent technologies. This also includes the ability to create new technologies, development of new products and processes. Kim (2002) further stated that TC is the ability to make effective use of technological knowledge in production, engineering and innovation. It also enables firms to create new technologies and develop new products and processes in response to changes in business environment. He also stated that technological learning is the process of building and accumulating TCs.

Caniels and Romijn (2003) gave a historical perspective of the development of the TC concept. They stated that the evolutionary theories of technological change (as developed by Nelson and winter, 1982; and Dosi, 1988) followed the failure of technology transfers. There were importation of new technologies from advanced countries to the developing world but there were neither improved productivity nor encouraged industrialization. This triggered the development of the TC concept. Accumulating TC requires technology efforts seen in the investment of time and other resources aimed at developing absorptive capability, (assimilation & adaptation), improving existing technologies and developing new ones. According to Caniels and Romijn (2003), the TC approach originated in the context of the developing countries; its focus seems to be on the assimilation of existing technologies created elsewhere. Capabilities initially needed in this context were skills to select, install and deploy new hardwares. It could be a long learning process; accommodating experimentation of shop floor routines with little room for formal R&D. However, Arnod (1997) at Technopolis gave two categories of characteristics to describe TC based on Howells (1994); and Dodgson & Bessant (1996) approaches. Howells' description was said to be more static than Dodgson and Bessant approach. The resources possessed by the firms are in the form of tangible and intangible assets which underpins firms' capabilities. Howells therefore made the distinction between these two kinds of assets central to his model and treats tacit knowledge as a particularly special category of intangible assets. Bessant and Dodgson (1996) define TC in terms of the following:

• Resources- All the assets in the firm which enable the firm to operate, including tangible and intangible assets, skills, knowledge, organisation, links with other firms

• Innovative capabilities- Features of firms and their management which enable them to define and develop competences required to create competitive advantage.

• Competences- That focused on combination of resources which enables firms to differentiate themselves from their competitors

Lall (1992) distinguished two levels of TC; which are: Firm level technological capabilities (FLTC) and national level technological capabilities (NLTC). Table 1 below states the components of FLTC and NLTC

Table (1): Two levels of TC

FLTC	NLTC
Production capability: this relates to the knowledge and skills used in plant operations. Activities included within this category are production management, production engineering, repair and maintenance of physical capital.	**Physical and social infrastructure**: These are the essential infrastructures that are generated by the nation. They include access roads, telephones, electricity and water supplies.
Investment capability: This refers to the knowledge and skills utilized in the identification, preparation, design, procurement, installing and commissioning of new industrial projects or the expansion and modernization of existing ones	**Human capital:** It includes the level of education of the workers and how their relevant education is improved over time**.**
Minor change capability: It is the firm's ability to improve and adapt continuously its products and processes in response to input and output markets.	**Science, engineering and technology:** It is concerned with research and development expenditure in relation to GDP, to total scientists, the number of relevant research institutions, the number of research and development personnel as a percentage of work force
	Institutional Infrastructure: It is concerned with the ability of industrial and training institutions to promote linkages, service support etc**.**
	Financial infrastructure: It concerns the number of financial institutions, depth of the financial market and availability of different classes of credit to promote technological development

Source : Adapted from Lall 1992 and Oruwari *et. al* (2002**)**

Lall's (1992) categorization however seems to be limited as described by Caniels and Romijn (2003). Arnod (1997) gave some key elements of TC; which can be applied to any firm in different geographical locations (beyond developing countries). This is seen in table 2.

Table (2): Key elements of TC

Strategic Capabilities	Internal Capabilities	External Capabilities (Networking
• Search for market opportunities • Understand and manage the fit between the firm's capabilities and market needs	**Manage tangible technology base** • Products • R&D facilities • Appropriate plant and equipment **Develop and manage appropriate intangible resources** • Codified intellectual capital • Qualification and skills profile adapted to the needs of the **firm** • Tacit knowledge **Create needed organisation** • Technology management capabilities • Change-management capabilities • Coordination among internal 'owners' of capabilities	**Access external knowledge** • Science • Technology, techniques • Artifacts, practices • Know-how, tacit knowledge • Information resources **Manage producer/user relations** **Access partners with needed complementary assets** • Complementary knowledge • Complementary production • Complementary supply-chain role

Source : Arnod (1997)

2.1. How do firms acquire TC?

The Technology learning process that allow firms to build TCs depend on two important functions. These functions are the existing knowledge base and intensity of technology efforts (Cohen and Levinthal, 1990). Both are related based on the fact that the technology base strengthens intensity efforts. Education, skills and competence determines the absorptive capacity of how employees perform their jobs and engage in problem solving. Perhaps the most significant concept in relation to this is that of absorptive capacity; which according to Cohen and Levinthal (1990, p. 128), is 'an ability to recognize the value of new, external knowledge, assimilate it, and apply it to commercial ends'. It is, therefore, to be found in the underlying knowledge and experience base of the firm that builds capabilities (technological or otherwise)

Molina (2009) studied the drivers of TC in developing countries of Southern America (Argentina, Brazil and Chile). She stated that TC is a crucial factor for enterprises' success- and that these capabilities need to be dynamic for properly adapting, innovating and changes while the business environment evolves. Dutrénit (2004) stated that there is no simple linear progression from the early stage of accumulation of the minimum levels of innovative capability to the management of knowledge as a strategic asset and the deployment of core capabilities. Rather the transition process is complex and firms make that transition, building deeper and broader stocks of knowledge and develop new types of knowledge.

Different learning mechanisms have being identified. They are learning by searching, training, using, doing and interacting (Cohen, 1995, Freeman, 1995 and Lundval, 1997). They significantly influence the accumulation of technological capability in any organization. Broadly, the factors that condition learning can be as internal or external to the firm.

2. 2. Measuring technological capability

It is not essay to measure TC in firms based on the different environments and national regulations that affect firms' behaviour and performance. However several attempts have being made and have given rise to different frameworks and audit tools. The Lall taxonomy of technological capabilities and its modifications have been used to assess levels of firm-level technological development in developing countries. Lall's taxonomy on TC divides indicators across the three functions, investment, production, and linkages. Table 3 depicts the evaluation of the final FTC score, which matches questions from the 2005 World Bank Enterprise Survey in India onto the FTC taxonomy developed by Lall. Please see the table on the appendix.

Basically, Molina (2009) captured the three levels of Lall's taxonomy as:
(a) Investment capabilities are the skills needed to identify, prepare, and obtain technology to design, construct, and equip an expansion or a new facility. They include capital costs of the project, the selected technology and equipment, and the understanding gained by the operating firm of the basic technology involved.
(b) Production capabilities start from the last step of the first typology: basic technology skills, like quality control, operation, and maintenance to more advanced ones like adaptation or improvement to research, design, and innovation. This implies in some way technology mastery and in others, minor or major innovation.
(c) Linkages capabilities are the skills needed to transmit information, skills, and technology to receive knowledge from component or raw material suppliers, consultants, service firms, and technology institutions. Consequently, they affect not only the firm but the whole industrial structure. They also include the access to external technical information and support (from foreign technology sources, local firms and consultants, and the technology

2.3. Importation of foreign national level technological capabilities (NLTC).

Japan has made foreign direct investments in several countries and also notably in the Northern America. These investments are in different sectors but most notable are the transplants in the automobile sector. The Japanese automobile firms responded to the voluntary restraint agreement limiting them from annual exports of about 1.68 million (fuel efficient) cars to the U.S as stipulated by U.S Government in the early 1980s (Takatoshi, 1992). The Japanese established assembly plants or "transplants" in the United States.
The issue of transmigrating low-end factories to Africa is relatively new, but there have been pioneering studies by experts on China's investment activities in sub-Saharan Africa (Ozawa, 2015). According to Ozawa (2015), the transmigration of labour-intensive industries (e.g., traditionally, textiles and sundries, and more recently, assembly of consumer electronics goods) has entailed a sequential pattern of growth spurts across East Asia. Since the end of WWII, Japan and then the new industrial emerging economies (NIEs) (Hong Kong, South Korea, Taiwan, and Singapore) and more recently, though to a lesser extent, the ASEAN-4 (Thailand, Malaysia, the Philippines, and Indonesia) have initiated rapid catch-up growth in by initial mobilization of its relatively abundant labour for export industries and eventual relocation to offshore those industries that had soon lost comparative advantages. Labour-intensive manufacturing is associated with the early stages of economic development in which labour supply from the rural sector is abundant and wages are low. Ironically, however, an expansion of such manufacturing could be suicidal once the rural labour is exhausted causing labour shortages and wage hikes. China has amassed a huge build-up of low-wage factories the world has ever known. Could China's advance into sub-Saharan Africa's manufacturing may be another repeat of the cross-border industrial transmigration experienced in East Asia? China carries the momentum of Asia's regional dynamics of structural upgrading that *pushes out* comparatively disadvantaged industries abroad. Ehizuelen and Omoruyi, (2016) stated that Growth in China and in other emerging market economies will create opportunities to other developing countries to jumpstart their industrialization. Due to low records of manufacturing in Africa; it remains an attractive destination for the relocation of light manufacturing from China and other emerging market economies. Lin (2011) (as cited in Ehizuelen and Omoruyi, 2016) argues that if China moves up the value chain, it will shed up to 85 million jobs in the manufacturing sector. The gap created would be filled by low income countries with abundant workforces, as long as the right policies are applied by governments in these countries to attract the investments. Some Chinese factories have already been set up in sub-Saharan Africa on a relatively small scale and across scattered areas. Currently, China's BAIC has agreed to build an 11 billion-rand ($759 million) auto plant in South Africa, the biggest investment in a vehicle production facility in the country in four decades (Bloomberg, 2016)

3.0. Research Design and Methodology:

Yin (1984) stated that the case study design makes room for an empirical inquiry that investigates a contemporary phenomenon within its real-life context; especially where the boundaries between phenomenon and context are not clearly evident. This necessitates the use of multiple sources of evidence. However, the continuous decline in manufacturing in the whole of Africa and winding down of firms in the automotive sector in Nigeria left the researcher no choice but to use a single case study as it relates to China transplant in automobile sector in Nigeria.

A case study approach was chosen to study the technological learning processes and mechanisms which underlie the technological capability in the firm chosen. The external and linkage capabilities were also

captured based on relationship with other institutions external to them and other actors such as suppliers, distributors, agents, customers and competitors. The case study approach allowed an in-depth longitudinal examination of this single case and also gave allowance for a rich description of facts and processes which would not have being be easily captured by a purely quantitative study. Data was obtained from multiple sources to ensure the triangulation of data and to adequately carry out retrospective investigation of the learning processes in the firm which have existed for about ten years (see Yin, 2009). Data was obtained from multiple sources which included: (i) semi-structured interviews (ii) internal company documents, (iii) online articles and (iv) literature.

Interviews were conducted using an interview guide that was constructed in the light of technological capability development and learning constructs and a total of ten persons were interviewed in this study. Three senior staffs of the National Automotive council of Nigeria were also interviewed to understand the policy issues that affect learning in the automobile sector in Nigeria. Each interview session lasted for about one hour to one and half. The number of persons interviewed enabled the researchers to obtain additional information and check for consistency of the data obtained. There were later discussions with some of the managers interviewed via the telephone calls and emails to verify data obtained for better clarity

3.1. Limitations of the study design: the drawback of a single-case design is its inability to provide generalising conclusions. However, every case study represents a portion of reality, so this influences the extent at which the analysis can be applied to other contexts. The chances of any relationship to other context is allowed where there are existing and established theories (Arbnor & Bjerke, 2009) already supporting the observations from the single case study. This case study follows the theoretical concepts of technological capability and learning. Moreover, the triangulation of data from multiple sources helped to generate robust data to study this phenomenon which is yet to be well replicated in the automotive sector in Nigeria.

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3. Results from the study (data presentation)

Innoson vehicle Manufacturing (IVM) plant is located in Nnewi, Anambra state. The Innoson group started as an automotive parts trading company in 1981 but it grew and established the IVM; which was commissioned in 2010. IVM is part of the Innoson Group of Companies. IVM product lines include heavy duty vehicles, middle and high level buses, special environment friendly vehicles.

3.1. Vision and Mission of the firm

The vision of IVM is to become Africa's most preferred automobile brand and its mission is to make durable and affordable brand new automobiles for African

4.2. Historical background and organizational capabilities

IVM is owned by Chief Innocent Ifediaso Chukwuma; a known Nigeria entrepreneur. His elder brother Gabriel Chukwuma, a business mogul in his own right, facilitated Innocent's entry into the Nnewi spare parts cluster through an apprenticeship with one Romanus Eze Onwuka. Romanus was Nnewi's largest importer of motorcycle spare parts in 1978, at the Nnewi automotive cluster's peak (Vanguard, 2014). Innocent completed his years of apprenticeship with Romanus, got financial assistance from his brother,

established Innoson Nigeria Ltd. in 1981 to import motorcycle and vehicle parts from Taiwan (Vanguard, 2014). At the time Nigerian firms only imported Japanese FBU motorcycles both new and used (Ufford, 2014). The Naira depreciated steeply in the late 1980s and 1990s which increased the cost of motorcycle imports, slowing demand for spares. Part of the cost issue was that each 40ft container of FBU motorcycles from Japan contained only 40 motorcycles (Vanguard, 2014). In an attempt to increase imports Innocent made connections with the low cost Chinese producers Jingcheng and Jiachi, who produced copies of popular Japanese brands, and got them to break down the motorcycles before shipping (Vanguard, 2014; Ufford, 2014). The motorcycles were then manually coupled in Nigeria, allowing 200 to be packed into each container (Ufford, 2014). The combined factors of low cost suppliers and lower transport costs meant that Innoson was able to sell new motorcycles at around 50% of the value of other new imports into Nigeria (Vanguard, 2014; Ufford, 2014). In the 1990s used Japanese motorcycles, known for their quality and relatively low price, truly dominated the Nigerian market and Innoson made some inroads into this market dominance with its lower cost Chinese knockoffs (Ufford, 2014). The firm was able to sell up to 40 000 motorcycles a month at its peak. Quickly competition appeared as others started assembly of completely knocked down motorcycles from lower cost producers instead of importing FBU motorcycles. Chief Innocent bought Eastern Plastics; a state owned plastics firm located in Enugu; which is about 110 km from Innoson's motorcycle plant in Nnewi. The plastic plant was christened the Innoson Technical and Industries Company Ltd and refitted with modern machinery to produce the plastics for motorcycles (Aziken, 2014). This divestment in 2002 assisted Innoson to import components for assembly of 250 motorcycles per container and sell them at below 66% of the cost of a used bike (Vanguard, 2014). This effectively wiped out the second hand motorcycle market (Vanguard, 2014; Abone, 2014; Ufford, 2014). The Innoson brand of motorcycles maintained the same quality as the foreign imported new ones, but sold for less, even cheaper than the foreign-used ones.

Unfortunately motorcycles were used by armed robbers to steal in some cities. The increased security measure by state governments restricted motorcycle numbers in cities and coupled with the influx of cheaper imports from India and China reduced demand for Innoson motorcycles. Innoson expanded production into rubber production and vehicle assembly (Vanguard, 2014). IVM, the Innoson group's automotive arm, was founded in 2007, also in Nnewi, and assembly started in 2010 when its factory was opened by then president Goodluck Jonathan (Emmanuel, 2014). It has quickly increased its product line from only assembling buses and pick-up trucks so that in 2014 IVM was assembling 13 brands. The Company metamorphosed from being a trading firm to a manufacturing company. This is typical of firms within the Nnewi automotive cluster... Based on the contributions of this IVM and its group, the Group Chief Executive office; Chief (Dr) Innocent Chukwuma is Member of the Federal Republic (MFR) of Nigeria; which is a national award. Elsewhere, he was bestowed with the Commonwealth Business Council award in London, and the recent Institute of Directors (IoD) award, among others.

3.3. Investment Capabilities

The organizational structure in IVM shows that it has a General Manager; who works under the CEO of the Innoson Group. IVM's production and marketing units are manned by Managers. The size of employees in IVM including the unit managers, the supervisors, and administrative officers was summed at six hundred (600) Nigerians and thirty (30) Non-Nigerians in Innoson motors manufacturing company Ltd

Nnewi. The table 5 below gives a demographic characteristic of the employees at IVM as of 2015 (Maduka, 2015)

Table (5): Demographic characteristic of the employees at IVM as of 2015

SN	Variables	Frequency	Percentage
1	Gender		
	Male	435	82.5
	Female	92	17.5
2	Age		
	Below 30 years	192	36.4
	31 - 40 yrs	201	38.1
	41 - 50 yrs	118	22.4
	Above 50 yrs	16	3.0
3	Education		
	O'Level	121	23.0
	NCE/OND	136	25.8
	HND/BSc	248	47.1
	Postgraduate Degree	22	4.2
4	Nationality		
	Nigerian	498	94.5
	Non-Nigeria	29	5.5
5	Job Cadre		
	Technical Staff	39	7.4
	Administrative Staff	92	17.5
	Support Staff	396	75.1
6	Employment Status		
	Contract Staff	29	5.5
	Full Time Staff	498	94.5

Source: (Maduka, 2015)

Local hiring of experienced technicians; who have worked previously in other plants were good sources of knowledge to IVM. The company is said to employ technicians and artisans from different states of Nigerian federation and other member states of West Africa. Most of the contract staffs are the expatriates from China; who install new machineries, train employees on operation and maintenance of the new hardwares. Training in IVM is surprisingly unique. IVM has a training centre which is used for training technicians on automobile assembly. It has started with the training of ex- militants from the Niger Delta region of Nigeria; who are participating in the amnesty programme of the Federal government of Nigeria. Most of who are given employment in the company. The company does not have other training programme outside its own training centre and on the job training for new employees.

IVM like most indigenous firms in the manufacturing sector does not have formalised research and development (R&D). Most of its new technologies and product innovation are outsourced and imported from China

Information sharing/ Knowledge Management profile of IVM is such that file system sharing is still used to store and retrieve information.

3.4. Production capabilities

Process innovation has being acquired in IVM as an automated system is used in the assembly production lines with technologies sourced from China. There is no claims of quality certification and management yet acquired by the company. It is stated that it working on obtaining quality management certification. On the learning processes and mechanisms, it is obvious that IVM uses more of learning by doing. It acquires foreign technology mainly from China and domesticates the knowledge in its plant. The main routine in the firm shows that IVM is engaged in production of completely knocked down parts. Some of the parts (mainly plastic components) are manufactured within the Innoson group of companies.

3.5. Linkage capabilities

Sources of knowledge/Information acquisition- The technical partners from China are main source of knowledge and technical. The Group Chairman is also said to be a good source of business information. IVM is having a good publicity both locally and internationally. It has linkages to Manufacturing Association of Nigeria (MAN), and Nigerian Association of Chambers of Commerce, Industry, Mines and Agriculture (NAICCMA) in Nnewi, IVM recently secured collaboration in 2016 with Nigeria Air force for the manufacture of Jet fighters spare parts in Nigeria. The collaboration is to first develop and manufacture jet braking system/assemble in Nigeria. The collaboration is expected to save cost of maintenance of Nigeria Air force Fleet in Nigeria.

IVM enjoys a working relationship with the National Automotive Council (NAC); now known National Automotive Design and Development Council (NADDC). IVM was also reported to have secured funds from Bank of Industry (BOI) in Nigeria.

IVM has also engaged in a marketing Innovation**;** whereby a car purchasing financing mechanism with Fidelity bank in Nigeria will help prospective and its existing customers to buy vehicles from it

4. Discussions

Lall's TC taxonomy and its subsequent modifications have helped to characterise capabilities in manufacturing in developing countries. Investment, production and linkages capabilities help to characterise firms even at their early stage of industrialization. TC is said to be an evolutional economics concept that is more adapted for firms in developing countries who lack TC in current global frontiers. These firms achieve TC through technological learning mechanisms. Technological learning may accommodate more experimentation on shop floor skills and techniques rather than formal R&D. Learning mechanisms such as learning by doing, using, searching and interacting are used to accumulate TC in most

firms in developing countries; who are constrained by lack of resource to obtain FLTC or have access to national technological capabilities.

IVM is one of the notable indigenous owned automobile assembly plants in Nigeria and it was chosen to assess its level of technological capability. It has strategically acquired Chinese technologies over time. It also adapted those technological capabilities in most of its manufacturing plants; where motorcycles and other plastic products are produced. It has replicated capabilities and product archetypes from China across its production and automobile assembly lines. Chinese are also employed as expatriates in the IVM plant. Most of the brands produced by IVM look as typical brands assembled by Chinese automobile firms. However, IVM tries to drive down its cost and maximise profit by producing some of its automobile components. Some of the automobile components include all plastic parts used in assemble of its Chinese brands. IVM also manufactures tubes for it motorcycles tyres. It is also integrating into the production of car tyres for its automobile assembly in Nigeria. These components produced by IVM within its Innoson group limits its classification as a Chinese transplant. It is obvious that the product archetypes of its vehicles do not look different from its Chinese technical partners because IVM currently does not own any design capability; which is lacking in most countries of Africa. Automobile designs are dire and are protected by intellectual property. Firms such as IVM can only licence and use such designs to produce automobile vehicles in different markets from China.

The limitations on the TC available in IVM makes it fit more on the Lall's model of TC. Moreover, IVM is located within the Innoson group and the other elements of its TC are not easily captured since the group is known to supply some of these elements. However, the move by IVM to produce component parts for the Nigeria air force is a display of giant strategic stride to increase its technological efforts and increase its TC.

Recommendations

Governments in Africa has to develop and actualise plans to build technological capabilities in firms in local manufacturing sector. Firms can start by using foreign license and coping of other technologies but there has to be a stage where these firms must move up the technological capability ladder. It is advised that government give license for certain periods and renew licences periodically. The conditions for renewal of license must be stated before operation commences. Incentives has to be tailored based on the peculiarities of the firms. Public procurement of goods from these local manufacturers is one of such good incentives. China transplants widely spread in Africa can turn Pan-African if government foster such plants to build technological capabilities that will help such plants adapt and assimilate new technologies that will help to meet local market needs. Policy interventions should also help establish strong linkages between local manufacturing firms, knowledge based organizations (universities, technology support offices, consulting firms) and research institutes.

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