Determinants of Innovation Capability in the Informal Settings

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Abstract

This study contributes to the growing literature on innovation capability in the informal sector in Nigeria. It explores the role of openness as a facilitator for measuring innovation capability, and proposes openness as a metric for the measurement of innovation capability in the informal sector. This new metric was tested using 200 informal information and communication technology (ICT) enterprises at the Otigba hardware cluster, which is located in the Nigerian commercial capital of Lagos and is regarded as a key ICT hub in West Africa. The main research instrument was a set of questionnaires designed to capture the core objective of the research. All 200 questionnaires were retrieved and found suitable for analysis. The questionnaires elicited information on the socio-demographic characteristics of the enterprises, the attributes of the Otigba cluster, the strength of the enterprises, the strength of the cluster, the extent of innovations within the cluster, and the proximity advantages drawn from clustering. Spearman's correlation and binary logistic regression were used to determine the direction and impact of the various independent variables (determinants of innovation capability) on the dependent variable (the extent of innovation as a proxy for innovation capability). It was found that openness plays a very significant role in access to: information, customers, new domestic markets, tools and technology, suppliers of raw materials, and inputs. However, openness was found to play only a limited role in finished products for the export market. It was also found that much more still needs to be done by the enterprises to build up their internal capabilities, so as to reduce their reliance on external sources of knowledge— notwithstanding the fact that exposure to external capabilities, through cooperation and openness, will remain necessary to complement enterprises' internal capabilities.

Keywords: microenterprises, clusters, informal sector, innovation capability, process innovation, openness, information and communication technology (ICT)

Introduction

Recent findings have shown that most innovations in the informal sector are not research and development (R&D)-based (De Beer et al., 2013; De Beer & Armstrong, 2015; Oyelaran-Oyeyinka & Lal, 2006). However, these innovations are nevertheless technical, since technical knowledge is used in achieving these innovations, even though most of the outputs are not technological in nature (Oyelaran-Oyeyinka, 2006; Oyelaran-Oyeyinka & Lal, 2006). These innovations are products of some kind of knowledge peculiar to informal microenterprises.

Despite the importance of the informal sector to employment and economic growth in developing countries, very little attention has been paid to informal enterprises, especially regarding innovation capability. The first, second and third edition of the Oslo Manual (OECD, 2005), as well as the Bogota Manual (RICYT et al., 2001) have conspicuously omitted microenterprises in conducting national innovation surveys. In view of this conceptual limitation, innovation studies have consistently and narrowly focused on enterprises in the formal sector, thereby blurring the theoretical lens of innovation measurement in Africa. Systematic research on innovation management in informal microenterprises may help re-orient the measurement of innovation in Africa. In practice, the goal of knowledge management is to improve organisational capabilities through better use of the organisation's individual and collective knowledge resources. These resources include skills, capabilities, experience, routines, and norms, as well as technologies. However, attention to knowledge management in the informal sector is very scant in the literature. Research has shown that larger enterprises have recognised that they compete in increasingly knowledge intensive markets. In order to thrive or survive, they are required to rethink the management of their organisational knowledge bases.

Studies carried out in the Otigba cluster so far have evaluated size and capacity (Abiola, 2008; Oyelaran-Oyeyinka, 2006), evolution of the cluster (Oyelaran-Oyeyinka & McCormick, 2007), mode of operation (Abiola, 2008), performance (Oyelaran-Oyeyinka, 2006; Oyelaran-Oyeyinka & McCormick, 2007), production capability (Awoleye, 2015), sustainability (Oyelaran-Oyeyinka, 2006; 2014; 2017), and constraints (OyelaranOyeyinka, 2006) for the industries located there. The literature defines a cluster in terms of geography and product specialisation. To this end, a cluster is defined as a sectoral and geographical concentration of enterprises (Schmitz, 1995). Previous studies (Cohen & Levinthal, 1989, 2000; Cassiman & Veugelers, 2006; Gallego, Rubalcaba, & Suárez, 2013) have identified that firms generally do not innovate in isolation because they rely heavily on knowledge sources external to the firm; which may be drawn from the proximity to one another within a cluster. Proximity fosters informal, face-to-face interaction as an effective means of information exchange among personnel from different enterprises and firm proprietors.

The importance of face-to-face interaction in clusters and industrial districts has been cited in the literature (Cooke, 2002; Keeble & Wilkinson, 2017; Oyelaran-Oyeyinka & McCormick, 2007, Oyelaran-Oyeyinka, 2014; 2017). Firms in dense geographic proximity tend to enjoy certain advantages of agglomeration relative to isolated enterprises (Oyelaran-Oyeyinka, 2006). This happens in at least two different ways. First, demand for their goods and services is enhanced as potential customers come to know about the existence of the cluster. This is especially true for micro- and small enterprises whose markets tend to be local and dependent on direct sales to traders and individual consumers. Second, a cluster's ability to innovate and supply high quality products also benefits from agglomeration. For these reasons, the main advantage of agglomeration derives from the properties of knowledge: that it is largely tacit, uncodified and informal. The growth of clusters is most times anchored on how much the enterprises improved in acquiring, disseminating, and adapting knowledge and technology (both domestic and foreign); building a relatively educated labour force; achieving collective efficiency through joint actions and cooperation, and gaining support from national and local governments, institutes, and, in some cases, international bodies (Zeng, 2008).

Previous studies (Abiola, 2008; Oyelaran-Oyeyinka & McCormick, 2007) on the Otigba market cluster investigated how the cluster was formed, how its enterprises evolved, which elements contributed to the enterprises' success, and how the cluster was sustained. These studies did not, however, explore how external (cluster-related) factors and internal (enterprise-related) factors influenced innovation capability. Hence, this research on which this Working Paper is based sought to fill this gap in the literature.

Innovation Capability

In the broad sense, innovation capability in enterprises can be described as the way in which production processes and technologies are organised and managed to manufacture the desired product/service for that enterprise (Bell & Figueiredo, 2012). It can also be seen as the ability of an enterprise to support the development of new products and services (Albaladejo & Romijn, 2000; Romijn & Albu, 2002). Hence, innovation capability has been defined in the literature from different perspectives. Adler and Shenbar (1990) explored innovation capability from five angles: the ability to develop new products that meet customer needs, the capacity to apply appropriate processes to produce these new products, the ability to adapt product and process technologies to meet future needs, the ability to respond to unexpected opportunities arising from technological change, and competitor activities. Capaldo, Iandoli, Raffa and Zollo (2003) view the innovation capability in six categories: skill of workforce (at the bottom), motivation, finance, human resources, advantages drawn from linkages and technological innovation capability (at the peak). Hence, drawing from existing literature, this study suggests that innovation capability can be drawn either from a source internal to the enterprise or from a source external to the enterprise which may or may not be limited to the cluster (Bell & Albu, 1999). The internal sources could include the firm's enterprise capital, the skill of the manager and that of the employees as well, and training of the workforce, while the external sources can be drawn from interaction with suppliers, customers, competitors, knowledge centres, trade associations, amongst others.

RESEARCH METHODOLOGY

A. Conceptual Framework

The conceptual framework used in this paper is based on concepts well-established in the literature. In the literature, chief among the conceptualisations of determinants of innovation capability are: research and development (R&D) expenditure/intensity; R&D expenditure and intensity (Bhattacharya & Bloch, 2004; Cabello-Medina et al., 2011; Jegede et al., 2015; Mytelka et al., 2004; Raymond & St-Pierre, 2010; Rogers, 2004; VegaJurado et al., 2008) the skill level of employees, firm capital, experience of the manager (Jegede et al., 2016; Kivimäki, 2013; Krause, 2004; Romijn & Albaladejo, 2002) and networks and collaboration (Bougrain & Haudeville, 2002; Freel, 2003; Hadjimanolis, 2000; Jegede et al., 2012a, 2012b; Oyelaran-Oyeyinka & Adebowale, 2012; Sarros et al., 2008). In order to apply, as this study did, an innovation-capability framework in an informal sector setting, the broad conceptual variables just outlined were simplified, in order to respond to the informal sector's peculiarities.

In Figure 1 below, the variable box at the top centre represents innovation capability, while the six other variable boxes connected to it represent six main determinants of innovation capability in informal, knowledge-based microenterprises. These six variables can be broadly categorised into two, namely: sources due to the strength of the enterprise, and sources due to the strength of the cluster/business environment to which they belong. The strength of the enterprise is premised on the background and characteristics of the enterprise, the skill of the employees in the enterprise, and the internal innovation efforts of the enterprise, while the strength of the cluster is premised on the breadth and depth of collaborating partners, proximity advantages drawn from collaborating partners, and the presence of an industry or trade association guiding the affairs of the enterprises in the cluster.

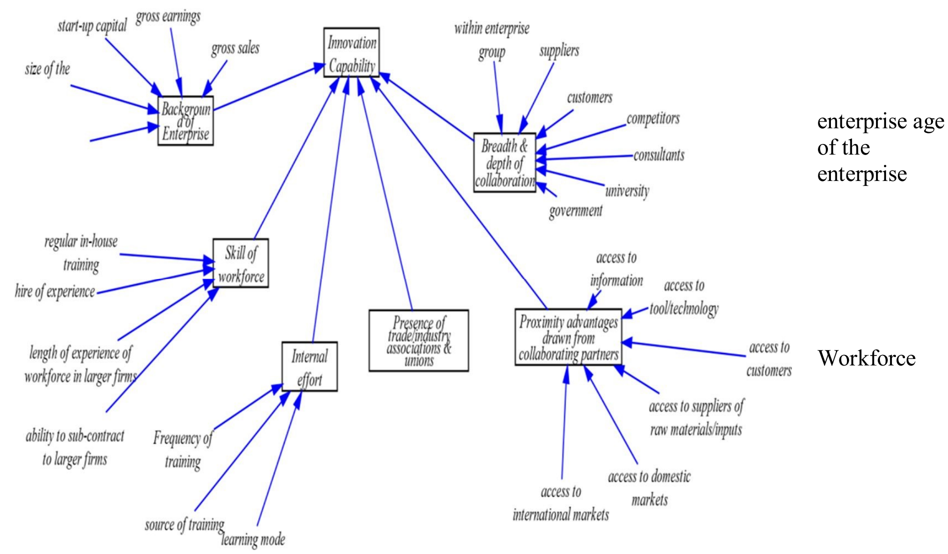

Figure 1: Determinants of Innovation Capability in Informal, Knowledge-Based Microenterprises. Developed by author through modifications of Hadjimanolis (2000), Romijn and Albaladejo (2002), and Capaldo et al. (2003).

B. Study Variables and their Measurement

i. Innovation Capability

Process innovation was found to be the most common innovation modality in the Otigba hardware cluster, and hence it was treated, in the data analysis, as a proxy for innovation capability in the cluster. Process innovations were measured in terms of implementation of a new or significantly improved method of production within the reference year, and were recorded on a binary scale of "Yes" (=1) or "No" (=0).

Determinants of innovation capability in the cluster were measured in two broad categories— internal (peculiar to enterprise) factors, and external (peculiar to cluster) factors—as advanced by Bell and Albu (1999), Romijn and Albaladejo (2002), and Jegede et al. (2012b). Internal factors were captured using three broad variables: demographic characteristics of the enterprise, skill of the workforce (Romijn & Albaladejo, 2002), and internal efforts of the enterprise (Romijn & Albaladejo, 2002). External factors were captured using three broad variables: breadth and depth of collaborating partners (Laursen & Salter, 2014), extent of proximity advantages drawn from clustering (Love et al., 2014), and support from trade/industry associations guiding knowledge sharing within the cluster (Jegede et al., 2012b).

ii. Internal (Enterprise-related) Factors

This was measured using three proxy variables: background (strength) of the enterprise, the skills of the enterprise's workforce, and the enterprise's internal training efforts. The measurement of these variables is outlined in Table 1 below.

Table 1: Measurement of Predictor Variables for Internal (Enterprise-related) Factors

Predictor Variable	**Measurement**
(i) Background (strength) of enterprise	
Initial start-up capital	Continuous variable
Age of enterprises	Continuous variable
Size of enterprises	Continuous variable
Financial capital (percentage increase in the enterprise's annual gross earnings in 2016 relative to 2015)	Continuous variable
Production capital (percentage increase in the enterprise's annual gross sales in 2016 relative to 2015)	Continuous variable
(ii) Skill of enterprise's workforce	
Exposure to regular internal training programmes	"Yes" (=1) or "No" (=0)
Employment of employees with extensive prior work experience with larger computer firms	"Yes" (=1) or "No" (=0)
Prior work experience in other larger firms	"1–2 years" (=1), "3–4 years" (=2), "5–6 years"(=3), "7–8 years" (=4)
Ability of enterprise to sub-contract for larger businesses	"Yes" (=1) or "No" (=0)
(iii) Enterprise's internal training effort	
Frequency of in-house training for the enterprises' workforces	"Once a year" (=1), "Quarterly" (=2)
	"Monthly" (=3), and "Weekly" (=4)
Source of training	"Sourced within the enterprise" (=1)
	"Sourced from other enterprises within the cluster" (=2)
	"Sourced from other enterprises outside the cluster" (=3)
	"Sourced from a knowledge institution" (=4)
	"Sourced from abroad" (=5)
Mode of learning among employees	"Learning under experienced personnel" (=1)
	"Assignment of simple task to the new employees" (=2)
	"Assignment of bigger task to the new employees with close supervision" (=3)

The direction of relationship between these internal factors—background (strength) of enterprise, skill of enterprise's workforce, and enterprise's internal training effort—and the extent of process innovation was analysed using Spearman's correlation. For the variables that showed significant positive correlations, binary logistic regression was used to determine the impact of each variable representing internal factors on extent of process innovation (innovation capability) as shown in the equation in Model 1 below:

Model 1 Specification log(odds) = log(y/1-y) $= \mathbf{a + b_1 x_1 + ... + b_n x_n + e}$ **……… (i)**

Where*: y = extent of process innovation a = intercept (constant) b = coefficient (constant) e = error term* x_1 to x_n = variables of internal factors

iii. External (Cluster-related) Factors

This was measured using three variables: breadth and depth of collaborating partners, extent of proximity advantages drawn from clustering, and support from trade/industry associations guiding knowledge-sharing within the cluster. The measurement of these variables is outlined in Table 2 below.

Table 2: Measurement of Predictor Variables for External (Cluster-related) Factors

(i) Breadth and depth of the collaborating partners	
other enterprises within your enterprise group	"Never" (=0), "Occasionally" (=1), "Always" (=2)
suppliers of equipment, materials, components or software	"Never" (=0), "Occasionally" (=1), "Always" (=2)
clients or customers	"Never" (=0), "Occasionally" (=1), "Always" (=2)
competitors or other enterprises in your cluster	"Never" (=0), "Occasionally" (=1), "Always" (=2)
consultants, commercial labs or private R&D institutes	"Never" (=0), "Occasionally" (=1), "Always" (=2)
universities or other higher education institutions	"Never" (=0), "Occasionally" (=1), "Always" (=2)
government research institutes	"Never" (=0), "Occasionally" (=1), "Always" (=2)
(ii) Support from trade/industry associations	"Yes" (=1) or "No" (=0)
(iii) Extent of the proximity advantages drawn from clustering	
access to information	"Not significant" (=0), "Slightly significant" (=1), "Very significant" (=2)
access to tools/technology	"Not significant" (=0), "Slightly significant" (=1), "Very significant" (=2)
access to customers	"Not significant" (=0), "Slightly significant" (=1), "Very significant" (=2)
access to suppliers of raw materials and input	"Not significant" (=0), "Slightly significant" (=1), "Very significant" (=2)
access to domestic market	"Not significant" (=0), "Slightly significant" (=1), "Very significant" (=2)
access to international market	"Not significant" (=0), "Slightly significant" (=1), "Very significant" (=2)

The direction of relationship between these external factors—breadth and depth of collaborating partners, support from trade/industry associations, extent of proximity advantages drawn from clustering—and the extent of process innovation was analysed using Spearman's correlation. For the variables that showed significant positive correlations, binary logistic regression was used to determine the impact of each variable representing external factors on the extent of process innovation (innovation capability) as shown in the equation in Model 2 below:

Model 2 Specification $\log(\text{odds}) = \log(y/1\text{-}y) = \mathbf{a + b_1 x_1 + ... + b_n x_n + e}$ ……… **(ii)**

Where: *y = extent of process innovation a = intercept (constant) b = coefficient (constant) e = error term* x_1 *to* x_n *= variables of internal factors*

C. Assumptions of the Models

Sample size: the study avoided small sample sizes within large numbers of predictors so as not to reduce its power. Also, categorical predictors with less than five cases in a category were a voided because this can lead to poor model fit.

Multi-collinearity: The study involved a bivariate correlation analysis to check for high intercorrelations between predictors. Any bi-variable correlation values greater than 0.70 indicated high collinearity and were not used in the regression analysis. In addition, collinearity diagnostic tests were also carried out: tolerance value of less than 0.10 indicated high collinearity while variance inflation factor (VIF)-values greater than 10 indicated high collinearity and were not used in the regression analysis.

Outliers: A scatter plot was used to identify any outlier variables in the model, using a standard deviation of 3.3.

D. Research Scope

The research was grounded on the collection of first-hand data, by developing a methodological framework/questionnaire useful for testing standard innovation indicator metrics for the informal sector and administering survey instruments on 200 ICT business units in the Otigba hardware cluster in Lagos, which consists of approximately 4,000 business units.

The sample frame used was the stratified sampling techniques to selected relatively equal number of respondent that were involved in different range of technical services. Those identified were: networking services, production of peripherals, installation of software, branding computer and other equipment, sales of hardware and software of computer, IT services, general IT maintenance and repairs, assemblage of computers and accessories, and sales of peripherals and repair of mobile phones and tablets. Twenty microenterprises were selected from each category to add up to the 200 selected microenterprises. The survey results were used for undertaking quantitative analyses responding to the study's objectives. The information gathered was supplemented with additional information from published sources.

E. Research Instruments and Subjects

The research instrument used was a set of questionnaires administered to the owners and employees of the microenterprises at Otigba hardware cluster. These microenterprises are comprised of businesses having employee size of less than 10, and that were not incorporated nor registered for taxation.

F. Data Analysis and Interpretation

Information from the questionnaire was fed into Statistical Package for Social Science (SPSS) 20.0, and was analysed using both descriptive and inferential statistics responding to the research's core objectives.

FINDINGS AND DISCUSSION

A. Socio-demographic Characteristics of the Enterprises in the Cluster

Figure 2 depicts the main business activities that the enterprises were found to be engaged in. The key activities were found to be hardware and software maintenance (46%), and sales and services (40%). Others were consultancy and trainings (6%), installations (4%), and web development (4%). All these activities represent involve technologies with plentiful and frequent incremental innovations.

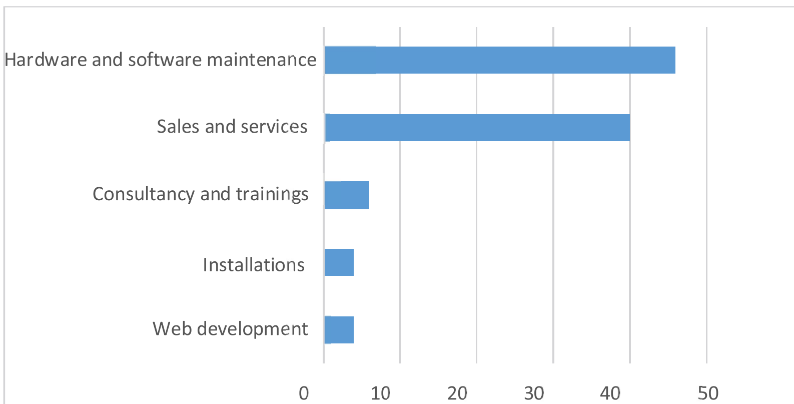

Figure 2: Business Activities in the Cluster

About half (52%) of the enterprises claimed that they had an initial start- up capital in the range of NGN200,000 – 400,000 (see Table 3 below), while about one quarter (22%) of the firms said they had started with NGN100,000 or less. The rest of the firms, about (24%), claimed to have had over NGN4 million as their start-up capital.

Table 3: Initial Start-up Capital for the Business

Amount of capital, in Nigerian Naira (NGN)	Frequency	%
No response	4	2
Less than NGN100,000	44	22
NGN100,000-1,999,999	103	51.5
NGN2,000,000 -3,999,999	8	4
NGN4,000,000 - 5,999,999	20	10
NGN6,000,000 - 7,999,999	5	2.5
NGN8,000,000 - 9,999,999	3	1.5
NGN10,000,000 - 11,999,999	3	1.5
NGN12,000,000 and above	10	5
Totals	200	100

Note: At the time of writing, USD1 is worth approximately NGN360

In the cluster, it was found that most operators preferred to separate family relationships from business as only 10.5% of the businesses studied were family enterprises (see Table 4 below).

Table 4: Percentage of Family Enterprises

	Frequency	**%**
Yes	21	10.5
No	177	88.5
Sub-totals	**198**	**99**
Missing	2	1
Totals	**200**	**100**

Hence majority of the enterprises have very few of their family members involved in the running of their businesses. Even though the business sampled were informal enterprises, a large majority (90%) of the respondents reported not having any family members in the day-to-day running of their business (Table 5 below). This further buttresses the point that informal businesses are hard to define, as some scholars interchangeably refer to informal businesses and household businesses.

Table 5: Family Members Working for the Firm in the Cluster

No.	**Frequency**	**%**
0	180	90
1	4	2
2	11	5.5
3	1	0.5
4	1	0.5
5	3	1.5
Totals	200	100

B. Characteristics of the Cluster

Table 6 below shows the nature of the openness at the Otigba market cluster. The majority of the enterprises in the cluster strongly agreed that while there was "competition within the computer village" (mean = 4.64) "cooperation within the cluster" was fully embraced at the same time. Since open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, the firms looked to advance their technology (De Beer et al., 2014; De Beer & Armstrong, 2015; De Beer, 2017).

Table 6: Nature of Open Innovation in the Cluster

	N.	**Min.**	**Max.**	**Mean**	**Std. dev.**
There is competition within the computer village	200	1	5	4.64	.576
There is cooperation within the computer village	200	1	5	4.10	.857
There is mutual trust within the computer village	200	1	5	3.43	.894
Valid N (listwise)	200				

Scale: Strongly agree (=5), Agree (=4), Undecided (=3), Disagree (=2), Strongly disagree (=1)

Table 7 below reveals more details regarding the nature of the cluster. All of the firms reported that they usually exchange information with other technicians, share experience with other technicians, engage technicians from other firms, and share tools and equipment with other technicians though none of them had a joint purchase of expensive equipment or importation of inputs. The reason for this disparity could be to avoid the conflict that may come with joint ventures. Also, the cluster placed more emphasis on sharing what they had than on combined effort.

Table 7: Modes of Open Innovation in the Cluster

	N.	Min.	Max.	Mean	Std. Dev.
Exchanging information with other technicians	200	0	4	3.45	0.855
Sharing experience with other technicians	200	0	4	3.20	1.130
Engaging technicians from other firms	199	0	4	3.17	1.172
Sharing tools with other technicians	200	0	4	3.07	1.354
Sharing equipment with other technicians	200	0	4	3.03	1.398
Joint purchase of expensive equipment	197	0	4	0.32	0.644
Joint importation of inputs	194	0	4	0.14	0.529
Valid N (listwise)	193				

Scale: always (=4), usually (=3), occasionally (=2, rarely (=1), not at all (=0)

C. Extent of Innovations by the Enterprises

The enterprises were mainly involved in process innovation (nearly 70% of the enterprises), followed by marketing innovation (nearly 30%), but their product innovation was low (Table 8 below). According to the Oslo Manual (OECD, 2005), process innovations include new or significantly improved methods for the creation and provision of services. This can also involve significant changes in the equipment and software used in service-oriented firms, or in the procedures or techniques that are employed to deliver services. For this research, process innovation was used to generalise for all innovation types, and was therefore used as the proxy for innovation capability.

Table 8: Types of Innovations Enterprises Involved in

	Frequency	%
Product innovation	7	3.5
Process innovation	134	67
Marketing innovation	55	27.5
Other kinds of innovation	1	0.5
Subtotals	**197**	**98.5**
Missing	3	1.5
Totals	**200**	**100**

D. Determinants of Innovation Capability in the Cluster

i. Internal (Enterprise-related) Factors

Of the 10 variables considered as internal determinants of innovation capability, seven were positively correlated with extent of innovation, while three were negatively correlated. Of the seven that were positively correlated, four were strongly positively correlated (Table 9 below). The incidence of in-house training had the highest positive correlation with ability of the enterprises to implement innovations ($r = 0.773$; $p < 0.01$), and similarly for frequency of the trainings ($r = 0.535$; $p < 0.01$). This was followed by percentage increase in annual turnover ($r = 0.468$; $p < 0.01$) and by percentage increase in annual sales ($r = 0.343$; $p < 0.01$).

Table 9: Spearman's Correlation between Enterprise Internal Factors and Process Innovation

	Correlation coefficient
Start-up capital	–0.49
Age of enterprise (year of establishment)	–0.007
Size of work force	0.067
Percentage annual increase in turnover	0.468**
Percentage annual increase in sales	0.343**
Sub-contracting to larger firms	–0.14
Presence of in-house trainings	0.773**
Frequency of trainings	0.535**
Source of the trainings	0.025
Mode of learning (transferring knowledge)	0.144
** Correlation is significant at the 0.01 level (2-tailed).	

The study went further to carry out a binary logistic regression of only the strongly positively correlated values, to determine the impact of each of these variables on innovation capability. Prevalence of process innovation was used to proxy innovation capability, which was the dependent variable. The independent variables included incidence of training, frequency of training, percentage annual increase in turnover and percentage annual increase in sales volume (Model 1, shown earlier). Because incidence of in-house training can be considered as perfectly predicting the outcome (innovation capability), due to its very high collinearity with the innovation capability proxy variable, it was dropped from the equation in Model 1. Hence, only three variables were used in the equation. The Nagelkerke R-square value from Table 10 below implies that the three variables in Model 1 explain 41.1% of the variates in the outcome being predicted or affected by the predictor variables in the model. This is quite acceptable for a binary logistics regression.

Table 10: Model 1 Summary

Step	–2 log likelihood	Cox & Snell Rsquare	Nagelkerke Rsquare
1	25.379[a]	.132	0.411

Note: Estimation terminated at iteration number 8.

Also, the classification table (Table 11 below) shows how accurate the variables were in predicting the outcome: of the outcome was correctly predicted about 94% of the time by Model 1, once again affirming that the model was strong.

Table 11: Classification Table [a] for Model 1

	Observed		Predicted		
			Process innovation		Percentage correct
			0	1	
Step 1	Process innovation	0	1	4	20
		1	2	96	98
	Overall percentage				94.2

Note: Cut value is .500.

Table 12 below gives the actual coefficients that we can use to create the equation in the regression model (Model 1). It also shows the odds ratio associated with each of the variables in the equation. The higher the ratio is above 1, the more likely it is that the enterprise will implement innovations. This implies that with a 1% increase in the annual turnover of an enterprise, the chances of its implementing innovations increases by 120%. Also, with a 1% increase in the sales of the enterprises, their chances of implementing innovation increases by 80%, while with a unit increase in the frequency of training of the employees in the workforce, the enterprises are about 7 times more likely to implement innovations. Hence, using the values shown in Table 12 below, Model 1 can be rewritten as:

$$\log(odds) = \log(y/1\text{-}y) = -4.804 + 0.179\times(PIAT) - 0.123\times(PIAS) + 1.917\times(FOT) + e$$

Where *y = implementation of process innovation, PIAT is percentage increase in annual turnover, PIAS is percentage increase in annual sales, FOT is frequency of training, and e = error term in the equation.*

Table 12: Binary Logistic Regression of Enterprise Internal Factors and Process Innovation

		B.	S.E.	Wald	Df.	Sig.	Exp(B)
Step 1[a]	Percentage increase in annual turnover	.179	.078	5.345	1	.021	1.197
	Percentage increase in annual sales	.123	.060	4.186	1	.041	.884
	Frequency of training	1.917	.670	8.191	1	.004	6.801
	Constant	–4.804	3.104	2.395	1	.122	.008

Regarding the internal determinants of innovation capability, the incidence of in-house training had the highest positive correlation with the ability of the enterprises to implement process innovations, and similarly for frequency of the trainings. This was followed by percentage increases in annual turnover and by percentage increases in annual sales – which is in line with previous studies carried out in other countries (Moodie, 2004; Van Adelsberg & Trolley, 1999).

Recent literature (Harmsen et al., 2000; Peretz et al., 2015) has also underlined the fact that the quantity of output of a firm determines to a great extent the amount of innovation within that firm. The studies found that the size of a firm, the mode of learning, and the source of training also had positive relationships with the implementation of innovation in the enterprises—which is again in accord with several studies that have been carried out, as described in earlier literature such as Adeyeye, Jegede, and Akinwale (2013), Adeyeye, Jegede, Oluwadare and Aremu (2016), Bhattacharya and Bloch (2004), Hadjimanolis (2000), Freel (2003), Jegede, Ilori, Olorunfemi and Oluwale (2016), and Rogers (2004). On the other hand, and in contrast to existing literature (see, for instance, Rogers, 2004), age of firm, start-up capital and being an auxiliary to a larger firm all have a negative correlation with the implementation of innovation as described in this study.

ii. External (Cluster-related) Factors

Of the eight variables considered as external determinants of innovation capability, five were positively correlated with four of these being strongly positively correlated— with the implementation of innovation (Table 13 below). Three variables were negatively correlated with implementation of innovation – with three being strongly negatively correlated. Collaborations within an enterprise or enterprise group ($r = 0.515$; $p < 0.01$), with customers ($r = 0.302$; $p < 0.01$), competitors ($r = 0.273$; $p < 0.01$), and trade associations or unions ($r = 0.240$; $p < 0.01$) were all strongly positively associated with implementation of innovation – once more corroborating several previous studies (Bramwell et al., 2008; Feldman, 1999; Jegede, 2017a; 2017b; Sandee & Rietveld, 2001) (see Table 13). On the other hand, collaborations with R&D laboratories and consultants, universities and knowledge centres, and with government agencies were all strongly negatively correlated with implementation of innovation (Table 13). This indicated that the institutional and government sources of collaboration were not used by the enterprises in implementing their innovations.

Table 13: Spearman's Correlation between Enterprise External Factors and Process Innovation

Type of collaboration	Correlation coefficient
Collaborations within group	0.515**
Collaborations with suppliers	0.143
Collaborations with customers	0.302**
Collaborations with competitor	0.273**
Collaborations with R&D consultants	–0.506**
Collaborations with universities	–0.342**
Collaborations with government	–.0508**
Collaborations with trade association	0.240**

** Correlation is significant at the 0.01 level (2-tailed).

In like manner, the author carried out yet another binary logistic regression of the strongly correlated values to assess the impact of each of the variables on the extent of innovation. Prevalence of process innovation was also used to proxy innovation capability as the dependent variable, while the independent variables included collaborations within an enterprise or enterprise group, collaborations with customers, collaborations with competitor, collaborations with R&D consultants, collaborations with universities, collaborations with government agencies and collaborations with trade associations or unions (Model 2). The Nagelkerke R-square value from Table 14 below implies that the seven variables in Model 2 explain 31.5% of the variates in the outcome being predicted or affected by the predictor variables in the model – again quite acceptable for a binary logistics regression. Also, the classification table on Table 15 below shows how good the variables were in predicting the outcome: about 81% of the outcome was rightly predicted by Model 2, once again affirming that the model was good (Table 15).

Table 14: Model 2 Summary

Step	–2 log likelihood	Cox & Snell R-Square	Nagelkerke RSquare
1	116.302[a]	0.188	0.315

Note: Estimation terminated at iteration number 20.

Table 15: Classification Table for Model 2

	Observed		Predicted		
			Process innovation		Percentage correct
			0	1	
Step 1	Process Innovation	0	5	23	17.9
		1	8	131	94.2
	Overall percentage				81.4

Note: Cut value is .500.

This implies that, for a unit increase in the depth of collaboration within an enterprise or enterprise group, the chances of the enterprise implementing innovations increases by a factor of 3. With a unit increase in the depth of collaboration with customers, the enterprises are about 116 million times more likely to implement innovations. Also, a unit increase in the depth of collaboration with competitors increases the enterprises' chance of implementing innovation by 110%. And as the enterprises join the trade association or union they are 3 times likely to implement innovations. Hence, Model 2 can be re-written as:

$$\mathbf{log(odds) = log(y/1\text{-}y) = -57.587 + 1.044 \times (CWEG) + 18.573 \times (CWCu) + 0.128 \times (CWCo) + 1.086 \times (CTAU) + e \ldots\ldots\ (ii)}$$

Where *y = implementation of process innovation, CWEG is collaborations within the enterprise group, CWCu is collaborations with customers, CWCo is collaborations with competitors, CTAU is collaborations with trade association or unions and e = error term in the equation.*

Table 16 below gives the actual coefficients that we can use to create the equation in the regression model (Model 2). It also shows the odds ratio associated with each of the variables in the equation. The higher the ratio is above 1, the more likely it is that the enterprise will implement innovations.

Table 16: Binary Logistic Regression of Enterprise External Factors and Process Innovation

Step 1[a]	B	S.E.	Wald	df	Sig.	Exp(B)
Within enterprise	1.044	.396	6.949	1	0.008	2.841
Customers	18.573	15282.763	.000	1	0.999	116465172.514
Competitor	.128	.433	.088	1	0.767	1.137
Association	1.086	.502	4.681	1	0.030	2.963
Constant	–57.587	45848.288	.000	1	0.999	.000

Note: Variable(s) entered on Step 1: within enterprise, customers, competitor, association

iii. Proximity Advantages from Openness in the Cluster

As seen earlier, in Table 7, it is evident that openness plays a very significant role in access to information, customers, new domestic markets, tools and technology, suppliers of raw materials and inputs. However, it plays only a limited role on finished products for the export market. This implies that the cluster still needs to expand its territory in terms of market range for its products. This may be achieved through continuous improvement on the products from the cluster. Regarding cluster determinants of innovation capability, several previous studies (Adebowale & Oyelaran-Oyeyinka, 2013; Dodgson, 2018; Jegede et al., 2012c; Jegede 2017a; 2017b; Kazadi et al., 2016; Lundvall et al., 2009; Romijn & Albaldejo, 2002) have highlighted the importance of the number of stakeholders within clusters that firms may network or collaborate with for innovation. Proofs exist in favour of customers, suppliers, trade associations, higher education and research institutions, among others, as helpful sources of information for the firms' innovation activities. Collaborations within enterprises or enterprise groups, with customer, competitors, and trade association or unions were all strongly positively associated with implementation of innovation. On the other hand, collaborations with R&D laboratories and consultants, universities and knowledge centres and with government agencies were all strongly negatively correlated with implementing innovation. This indicated that institutional and government sources of collaboration were not used by the enterprises in implementing their innovations. Suffice it to say that, although the enterprises did not take advantage of the knowledge output from institutional sources, they did leverage the information readily available from their market sources and, most importantly, from their industry and trade associations which more or less operate as private institutions.

CONCLUSION AND RECOMMENDATIONS

This survey showed that the microenterprises in the Otigba hardware cluster—which are primarily involved in engineering and repairs, sales, installation, and maintenance services—are very dynamic. They practice open innovation that allows them to supplement internal ideas with external ideas, as well as exploring both internal and external paths to market, as they aim to advance their technology and productivity. Hence, though there is visible competition within the cluster, while at same time strong cooperation within the cluster is fully embraced by the enterprises.

It was found that although product, market and organisational innovations were also present, process innovation was at the core of innovations in the cluster. Hence, the enterprises' innovation capability was mainly for the implementation of process innovations—which principally involve significant changes in the equipment and software used in offering their services, as well as significant changes in the procedures or techniques employed to deliver services.

The chief internal determinants of innovation capability in the enterprises were the incidence and frequency of training, and business growth (captured in the increment in annual gross earnings and sales). The principal external causes of innovation capability of enterprises in the cluster were the intensity of cooperation with an enterprise or the enterprise's network or group; receiving feedback from customers; spillovers from competitors; and joining trade/industry associations where up-to-date information was being shared.

It was evident that openness plays a very significant role in access to information, to customers, to new domestic markets, to tools and technology, and to suppliers of raw materials and inputs. However, it plays only a limited role on finished products for the export market as this is directly determined by enterprises internal capabilities, i.e., the skill of the workforce and how trained the workforce is. External sources of knowledge are important to complement internal capabilities. Internal capabilities will determine absorptive capacity, and will provide the foundation on which external knowledge can rest.

At the same time, it is apparent in the findings that a lot more is still required for the enterprises to build up their internal capabilities and reduce reliance on external sources of knowledge. (Most of the variables for internal factors did not have as much significant positive impact on innovation capability as the external factors.) The findings from the study showed that external capabilities through cooperation and openness are necessary to complement enterprises' internal capabilities (mainly internal training programmes). Finally, all of the respondent enterprises who benefitted from proximity in the cluster were involved in at least one form of innovation.

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