Linking Information Sources, Innovation Outputs and Financial Performance in Nigeria's Mining Sector

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Abstract

The paper contributes to the on-going discussion on innovation sources and innovation systems in literature. Primary data was collected from mining companies in six states in Nigeria. One hundred and fifty mining companies in the six states-being all companies with mineral title were purposively selected for the study administering a questionnaire per company. However, only one hundred and six questionnaire were completed with accuracy and found useful for analysis. Three models were used to address the study's objectives: For models one and two, binary logistic regression (maximum likelihood method) was used to determine the impact of information sources on innovation outputs (technological and non-technological innovations) while in model three, multi-linear regression (ordinary least square method) was used to determine the impact of innovation output on financial performance in the mining companies.

Keywords: Information Sources, Technological Innovation, Non-Technological Innovation, Financial Performance.

JEL Codes: O31, O34, O55

Introduction

The mineral industry has played vital roles in the emerging world civilization ranging from the Iron Age to the Bronze Age, the industrial revolution and the recent micro-electronics and information ages. Thus, mankind's progress and civilization drive could be linked to solid minerals. With the evolution of civilization, democratization and the massive drive for development of industrial economy the world over, alongside the increase in

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technology, construction and building activities, there has been a corresponding increase in the need and demand for solid minerals. To sustain our technology-based society, demands for raw materials are increasing, hence exploration for these natural resources is on the increase as well. Africa as a continent is endowed with abundant mineral deposits and high in potential for precious and base metals. It is also a major producer of several strategic minerals and metals while it hosts about 30% of the planet's mineral reserves; 80% of the global platinum, chromium and tantalum; more than 40% of gold, diamond, cobalt, manganese and phosphate (USGS, 2010).

Several literatures (Pavitt, 1984; Freeman, 1988; Freeman, 1995; Lundvall, 1992a; 1992b; 2003; 2007; Edquit, 2005; Jensen et al., 2007; Lundvall *et al.,* 2009; Isaksen and Karlsen, 2010; 2012; Aslesen et al., 2011; Chen et al., 2011; Parrilli and Elola, 2012; Fitjar and Rodriguez-Pose, 2013; Nunes et al., 2013) have stressed the relationship between innovation modes and innovation output. For instance, Jensen *et. al.* (2007) tested the relevance of both the science, technology and innovation (STI) mode and learning by Doing, Using and Interacting (DUI) mode on 4000 Danish firms concluding that the most productive innovation mode is the combination of the two innovation modes. Other studies (Aslesen et al., 2011 on Norway, and Chen et al., 2011, on China) corroborated the same result. Yet other studies offer more nuanced results, i.e. international DUI vis-a-vis local DUI. Dahl-Fitjar and Rodríguez-Pose, 2013, and, Parrilli and Elola (2011) found that such combination may not be the most efficient in all contexts. In the STI learning mode, learning and innovation is based on science and technology drivers such as R&D expenditure, human capital in science and technology (S&T) disciplines, investment in infrastructures while in the DUI learning mode, learning and innovation is based on interactions such as learning-by-doing, by-using and by-interacting, thus based on interactive experience and practice. DUI innovation is based on experiential knowledge, the "know-how and "know-who", often called learn-by-doing (Jensen *et al.,* 2008). DUI bring with it a commanding response loop that helps organizations build the right thing, often quicker, and be open to solutions that it may not currently see this links to organizational learning (Lundvall, 2003).

Recent models of innovation stress that innovation is an interactive process in which firms interact both with firm and non-firm agents (Lundvall, 1985; 1988; 1992). Despite the extensive reception of this literature, there remains a bias among scholars and policy makers to consider innovation process largely as aspects connected to formal processes of R&D, especially in the science-based industries" (Freeman, 1982; Freeman, 1987). This paper situates itself in literature by advancing research on the DUI mode of innovation by exploring the different sources firms engage for information/collaboration for their innovation activities. This was done by using a very viable yet neglected industry in Nigeria which is the mineral mining industry. The study therefore explored the effect of information sources on the different innovation types and the effect of the different innovation types on financial performance in the mining industry in Nigeria with a view to understanding the nexus between information sources, innovation output and financial performance of firms in the mining industry in Nigeria.

The rest of the document is organized into three broad sections: methodology, results (with discussion) and conclusion. The methodology section is further broken down into sub-sections as: conceptual framework, study variables and their measurement, study sample and sampling technique, research instrument, model specification and statistical analysis and presentation.

Methodology

Conceptual Framework

The conceptual framework (Fig.1) explored in this study was drawn from established concepts in literature but mainly by exploring OECD/Eurostat (2005). This was achieved by establishing the various indicators of information sources for innovation and linking them to innovation output indicators and finally linking innovation outputs to financial performance drawing upon the third edition of the Oslo Manual.

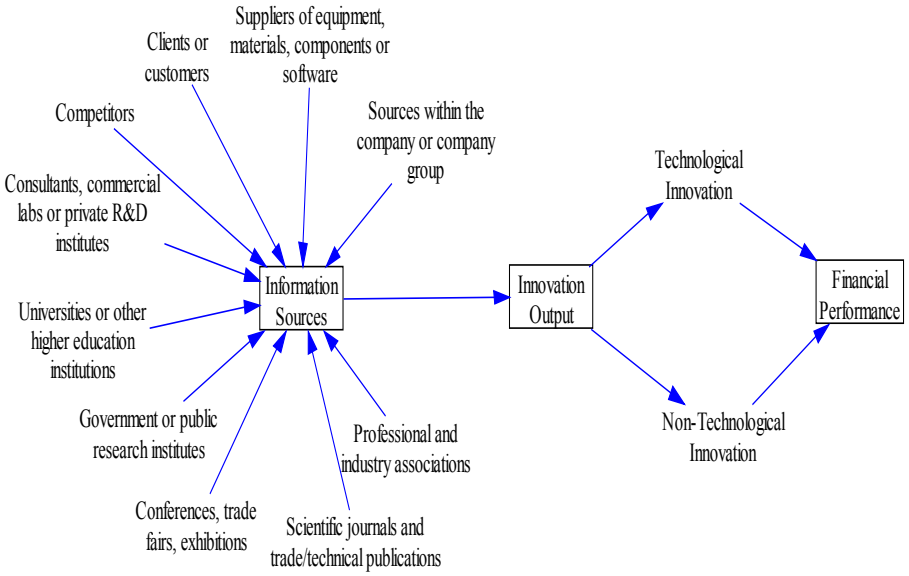

Figure 1: Conceptual framework showing nexus between information sources, innovation outputs and financial performance (source: Authors)

Study Variables and Measurement

Some of the variables measured in this study could not directly captured, in such cases, proxies and surrogate variables were used. Structured questionnaire was administered in each firm. The questionnaire used in this study was drafted using the Community Innovation Survey CIS 4 (Eurostat/ OECD 2005 - Oslo manual) which has been widely used for innovation survey. This was supplemented with field observations. Secondary data were sourced from firms' records and from different published sources.

The prevalence of the innovations was measured under two broad categories:

Technological innovation was measured via three proxy variables drawn from OECD (2005) indicating whether the firm introduced:

new or significantly improved methods of mining raw materials or prospecting for natural resources,

new or significantly improved logistics, delivery or distribution methods for inputs, goods or service, and

new or significantly improved supporting activities for your processes, such as maintenance systems or operations for purchasing, accounting, or computing.

The prevalence of technological innovation was measured on a two-item code; yes or no.

Non-technological innovation was measured with three variables drawn from OECD (2005) indicating whether the firms introduced:

new business practices for organizing procedures (i.e. supply chain management, business re-engineering, knowledge management, lean production and quality management) was measured by a yes or no

new methods of organising work responsibilities and decision making (i.e. first use of a new system of employee responsibilities, team work, decentralisation, integrating/de-integrating different departments or activities, education/training systems) was measured by "yes or no"

new methods of organising external relations with other firms or public institutions (i.e. first use of alliances, partnerships, outsourcing or subcontracting, etc) was measured by "yes or no".

The information sources for innovation was measured by. sources of information for innovation was measured by sources: sources within the company or company group, suppliers of equipment, materials, components or software, clients or customers, competitors, consultants, commercial labs or private R&D institutes, universities or other higher education institutions, government or public research institutes, conferences, trade fairs, exhibitions, scientific journals or trade/technical publications, and professional/industry associations was measured on a four-point Likert scale of not used = 0, hardly used = 1, averagely used = 2, frequently used = 3.

The degree of association of sources of information for innovation on innovation was analysed using regression analysis, the co-efficient of the variables and their probability value was used to determine the strength and direction of the association.

Model Specification

log (odds) = log (y1/(1-y1)) = a + b1X1 + b2X2 **+...**+ b10X10 + e- - - - (Eqn I)

log (odds) = log (y2/(1-y2)) = a + b1X1 + b2X2 **+...**+ b10X10 + e- - - - (Eqn II)

Where;

Y1 = Innovation prevalence (Technological)

Y2 = Innovation prevalence (Non-technological)

a = Intercept (constant variable),

b = Co-efficient (constant variable),

e = Error,

X1 = Sources within the company or company group

X2 = Suppliers of equipment, materials, components or software

X3 = Clients or customers

X4 = Competitors

X5 = Consultants, commercial labs or private R&D institutes

X6 = Universities or other higher education institutions

X7 = Government or public research institutes

X8 = Conferences, trade fairs, exhibitions

X9 = Scientific journals and trade/technical publications

X10 = Professional and industry associations

d) The impact of the innovation output (technological and non-technological) on financial performance was measured using linear regression model using technological and non-technological as independent variables and log of turnover as the dependent; turnover was logged to reduce

stochastic error in the equation. The responses for the independent variables are dichotomous.

Model Specification

Y = a + b1X1+ b2X2 + e- -- - - - (Eqn 3)

Where;

Y = Log of Turnover

a = Intercept (constant variable),

b = Co-efficient (constant variable),

e = Error,

X1 = Technological Innovation (measured by "yes or no")

X2= Non-Technological Innovation (measured by "yes or no")

Study Sample and Sampling Technique

The study used primary and secondary data sources. One hundred and fifty purposively selected (exploration, small scale mining and quarrying) companies with mineral titles not later than Dec 2010 in 6 States (Lagos, Ogun, Oyo, Osun, Ondo, Ekiti) were selected as respondents for the study. The reason for this was to select all companies that were functional and that fall within the formal sector of the economy within Southwestern Nigeria by 2010; the reference period for the study is 2011 to 2013.

Research Instrument

The questionnaire used in this study was drafted using the Community Innovation

Survey IV (Oslo manual - Eurostat/OECD 2005). Secondary data were sourced from firms' records and from different published works. The questionnaire was designed to obtain information such as the sources of collaboration, innovation activity, and prevalence of innovation, amongst others.

Validation of Research Instruments

Measures were put in place to ensure the content validity of the research instrument. The questionnaire was framed to be easily understood by the respondents and to exactly convey their sense and purpose to the respondents. The adaptation of the CIS (IV) questionnaire which has been proven to be appropriate in previous similar studies elsewhere also enhanced the appropriateness of the questionnaire used in this study.

Statistical Analysis and Presentation

Descriptive and inferential analyses were used for data analysis. The data were presented in figures and tables. The inferential Statistics involved multivariate statistical analysis. For the purpose of the study, the binary logistic regression was adopted in the first three models. The regression model was adopted in order to find out whether changes in independent variables had significant impact on the dependent variable and also to examine the direction of the relationship between the dependent and independent variables.

Binary logistic regression was used in Models I & II because the dependent variables are dichotomous e.g. either the companies implement innovation or not. It was expressed in probabilities. If the probability of a company implementing innovation is P, automatically, the probability of the company not implementing innovations becomes 1-P.

Mathematically it can be expressed as follows:

If the probability of implementing innovations = P and

The probability of not implement innovations = 1-P

Then, the odds ratio of the companies implementing innovations becomes…

$$Odds\ Ratio = \frac{P}{1-P} \quad \text{.....(Eqn 5)}$$

The probability of companies implementing innovations is expressed as:

$$P = \frac{e^{\beta_o + \beta_1 X}}{1 + e^{\beta_o + \beta_1 X}} \quad \text{.....(Eqn 6)}$$

The probability of companies not implementing innovations is stated as:

$$1 - p = \frac{1}{1+e^{\beta_o+\beta_1 X}} \quad \text{.....(Eqn 7)}$$

Hence, the odds ratio (likelihood of implementing innovations) is:

$$\frac{P}{1-P} = e^{\beta_o+\beta_1 X} \quad \text{.....(Eqn 8)}$$

To get rid of the exponential term „e", the log of both sides is taken, hence the equation becomes:

$$\ln\frac{P}{1-P} = \beta_0 + \beta_1 X \quad \text{.....(Eqn 9)}$$

The coefficient of the independent variables in models 1 to 3 is expressed as □1… □□ in the models. This represents the logarithm of the odd ratio (log odds). The implication of this is that the independent variables do not have a linear relationship with the dependent variable unlike it is observed in the ordinary least square method in model 4 where a unit change in the independent variable will change the dependent variable by the amount attached to the coefficient of the independent variable.

Results and Discussion

Prevalence of Innovation Output in the Industry

Table 1 shows the frequency of the different innovation types identified in this study. On the whole, technological innovation was implemented by 64.2% of the companies while 68.9% of the companies implemented non-technological innovation during the reference period. These values are close to what was recorded in an innovation survey conducted in Nigerian manufacturing sectors published in 2011 (NACETEM, 2011). The Nigerian Innovation Survey showed that about 82% of the sampled firms was innovative; having implemented at least an innovation type within the reference period (2005–2007). Technological and Non-technological innovations were implemented by 63.3% and 62.8% of the firms (NACETEM, 2011). Nigeria ranks highest in the continent in terms of implementation of innovations. For instance, in the recent business innovation survey carried out in South African firms, it was found that about 65% of the firms were innovative (ie started and completed an innovation process). The reasons for highest innovativeness of firms in Nigeria may be connected to the large consumer

market available for the products or services coupled with high concentration of firms competing for market positions. It has also been found out in previous studies that firms innovate due to constraints and bottlenecks they encounter in production. These facts may not be unconnected with the relatively high levels of innovation recorded for the mining industry in Nigeria.

More specifically, Table 1 shows that product innovation was expressed as introduction of new or significantly improved mineral/raw materials likes Granite, Bauxite, Galena, Zinc Blende, amongst others (14.2%) and introduction of new or significantly improved exploration techniques/services like magnetic surveys, electromagnetic surveys, radiometric surveys, amongst others (27.4%). Technological innovation was expressed as introduction of new or significantly improved methods of mining such as pitting and trenching, auger drilling, diamond drilling and rotary drilling (33%). Also, as new or significantly improved logistics, delivery or distribution methods for inputs such as just in time, total quality management, amongst others (46.2%). And new or significantly improved supporting activities for company's production processes like computer-aid mining, technology/work stations upgrade (34%). The mining industry is also a technology based industry, it is capital intensive and knowledge intensive as well. It may not be surprising to find a high prevalence of technological innovation in the industry. However, since, a lot of capital is involved, it becomes important to manage cost (either fixed cost of variable). Since the goal of every mining company in Nigeria is to make profit or at least break-even, they have to devise means to reduce production cost and maximise profit, in trying to achieve this, they tend to implement technological and non-technological innovations. This in the opinion of the author may be responsible for the high prevalence of non-technological innovations in a technology-based industry as the mining industry in Nigeria. Non-technological innovation was expressed as introduction of new business practices for organising procedures (35.8%). This included supply chain management, business re-engineering, lean production and quality management. Non-technological innovation was also expressed as new methods of organising work responsibilities and decision making (34.9%). These activities include first use of team work, decentralisation, integrating/de-integrating different departments or activities and lastly, organizational innovation was expressed as new methods of organising external relations with other firms or public institutions (50.9%) such as first use of alliances, partnerships, outsourcing or sub-contracting.

Table 1: Prevalence of Innovation output in the Mining Industry in Nigeria

	Innovation Types	Prealence (%)
(i)	New or Significantly improved method of mining from ore or gange	33
(ii)	New or Significantly improved mining logistic and delivery methods	46.2
(iii)	New or Significantly improved support activities for inputs and processing	34
(i), (ii) and (iii)]	Technological Innovation	64.2
(iv)	Introduction of new business practices for organising procedures	35.8
(v)	New methods of organising work responsibilities and decision making	34.9
(vi)	New methods of organising external relations with other firms	50.9
(iv), (v) and (vi)]	Non-technological Innovation	68.9

Sources of Information for Innovation

Recent literatures have criticized the overly aggregative view that research and development (R&D) is the principal driver of innovativeness in firms and organisations (Hirsch-Kreinsen et al., 2005a; 2005b; 2006; Hirsch-Kreinsen, 2008; von Tunzelmann and Acha, 2005). The censure hinges on equating high R&D intensity with high innovativeness, since R&D is just one of the numerous innovation activities known. This supports the position advanced by Lundvall that innovation is often in practice a non-linear, rather complex, collaborative and multi-level process which is embedded in innovation systems (Lundvall, 1992a). Indeed, innovation could require more of collaboration of actors rather than formal R&D processes. Nowadays, arguments existing in favour of non-technological forms of innovation to be increasingly recognized as distinct innovation paths which can potentially contribute to organisation's economic success and industrialisation in developing countries (OECD, 2005).

In line with modern trends in literature, this paper explores sources of information as a potential driver of innovativeness. The evaluation of the sources of collaboration for innovation within mining industry in Southwestern Nigeria

was carried out by considering the sources that are: internal to the firm, market sources (suppliers, competitors, customers, consultants), information sources (universities, government) and other sources (conferences, technical journals, industry association, etc). From Table 2, the most important sources were market: competitors (Mean 2.27±1.175), clients/customers (Mean 2.24±1.167) and suppliers of machinery and/or input (Mean 2.31±1.133). The reason for this might be because most of the innovations in the mining industry are usually not patented. Hence, there may have been fast diffusion of new techniques and technologies in the industry through rapid knowledge spill over. Consequently, competitors ranked as the most important source of collaboration for innovation in the industry. Furthermore, the important of open innovation is also fast gaining attention in literature and also among business enterprises. The role played by trade associations, unions and self-help organisation have made information exchange a lot easier. Business enterprises are encouraged to share technical information for all to benefit even while still in competition. Most of the negotiation with government and suppliers are done through the associations and unions, in doing this individual business entities would consciously or unconsciously volunteer some useful information in the process. Rothwell (1994) claimed that customers or users influence the development or improvement of products or processes by providing complementary knowledge, including access to tacit knowledge, establishing a precise set of user requirements, providing a source of solicited information on new/evolving needs and enhancing the likeliness that the innovation will be adopted by other companies within the same user community. Suppliers have been identified in literature as one of the most important sources of collaboration (Lundvall 1992). The advantages provided by customers and users as sources of information to develop innovation suggest that customers and users are likely to be used more frequently by firms when the innovations are expected to carry a higher degree of novelty, such as innovations which are world first introductions, rather than innovations offering minor incremental changes which are first introductions for the firms. The next most important sources of collaboration after market sources (competitors, client and suppliers) industry association (Mean 1.87±1.204), sources within the companies or within the companies group (Mean 1.85±1.372), private R&D institutions (Mean 1.53±1.366). Being part of a large conglomerate helps in accessing information. Naturally knowledge and scientific information will flow downwards from the parent companies. These parent companies are most times located in a developed country.

Then followed closely by information sources: universities (Mean 1.26±1.229). The least important sources of collaboration for innovation are the information sources - government/public research institutes (Mean 0.39±0.753) and other sources - conferences/trade fairs/exhibitions (Mean 0.57±0.884) and scientific journals/technical publications (Mean 0.75±0.967). This trend corroborates previous studies conducted in Nigeria by NACETEM (2011) and Jegede *et al.* (2012) which showed that market sources were the most frequently used innovation sources while information sources was had least frequency. Generally, most companies in Nigeria (not restricted to the mining companies alone) find it very hard to source information from knowledge institutions or government. They find it hard to source for knowledge from knowledge institutions probably because the researches from the knowledge institutions don't address the fundamental needs of the industry. In cases where they collaborate, its it usually through consultancy. Also, the industry firms in Nigeria also find it difficult to access basic infrastructural support from government. Hence, they would rather not collaborate with government or even source for information from government.

Table 2: Mean of the different Sources of Collaboration

Sources of information	Mean	Std. Dev.
Sources within company or group	1.85	1.372
Suppliers	2.31	1.133
Clients or customers	2.24	1.167
Competitors	2.27	1.175
Consultants, commercial labs or private R&D institutes	1.53	1.366
Universities or other higher education institutions	1.26	1.229
Government or public research institutes	0.39	0.753
Conferences, trade fairs, exhibitions	0.57	0.884
Scientific journals and trade/technical publications	0.75	0.967
Professional and Industry associations	1.87	1.204

Not Used = 0
Slightly Used = 1
Averagely Used = 2
Frequently Used = 3

Table 3 shows the impact of sources of information for innovation on technological innovation. At 5% significance level, three of the independent variables (competitors, universities and industry association) had direct impact on technological innovation. Indicating that as the companies collaborated more frequently with their competitors, they lean towards implementing technological innovation by a log (odds) of 0.824626 ($p < 0.05$). As the companies as the companies collaborated more frequently with universities, they are less likely to implement technological innovation by a log (odds) of -0.519502 ($p < 0.05$). As the companies as the companies collaborated more frequently with their industry association, they are less likely to implement technological innovation by a log (odds) of -0.672309 ($p < 0.05$). However, the p-value of the Prob (LR Statistics) of 0.000022 shows that all the sources of collaboration for innovation jointly and significantly impact technological innovation.

Table 3: Impact of Information Sources on Technological Innovation

Variable	Coefficient	Std. Error	z-Statistics	Prob.
Parent Company	0.374390	0.262080	1.428533	0.1531
Clients or Customer	0.824626	0.321041	2.568604	0.0102
Competitors	-0.586021	0.412006	-1.422361	0.1549
Suppliers	0.532084	0.409070	1.300717	0.1934
Universities	0.519502	0.261909	1.983521	0.0473
Private R&D Institution	0.324618	0.244435	1.328032	0.1842
Government	-0.322863	0.376290	-0.858017	0.3909
Conference/Trade fair	0.091049	0.393515	0.231374	0.8170
Journals	-0.072837	0.361313	-0.201589	0.8402
Trade Association	-0.672309	0.286075	-2.350113	0.0188
Parent Company	-1.428876	0.624618	-2.287599	0.0222
McFadden R -squared	0.288009	Mean depen dent var		0.63461 5
LR statistics	39.32542	Avg. log likelihood		-0.467389
Prob(LR Statistics)	0.000022			
Obs with Dep=0	38	Total obs		104
Obs with Dep=1	66			

Dependent Variable: Technological Innovation
Method: ML - Binary Logit (Quadratic hill climbing)
Sample: 1 106
Included observations: 104
Convergence achieved after 4 iterations
Covariance matrix computed using second derivatives

Table 4 shows the impact of sources of collaboration for innovation on non-technological innovation. At 5% level of significance, only the variable private R&D Institutions had significant impact on non-technological innovation. Indicating that as the companies as the companies collaborated more frequently with private R&D institutions, they become inclined to implementing non-technological innovation by a log (odds) of 0.683287; $p < 0.05$. However, with the model having the p-value of the Prob (LR Statistics) of 0.000040 shows that all the sources of information jointly significantly impact Non-technological innovation.

Table 4: Impact of Information Sources on Non-Technological Innovation

Variable	Coefficient	Std. Error	z-Statistics	Prob.
Government	-0.292450	0.359525	-0.813436	0.4160
Client or Customer	0.151054	0.393719	0.383659	0.7012
Suppliers of Equipment	0.570108	0.388237	1.468456	0.1420
Universities	-0.293367	0.277033	-1.058958	0.2896
Private R&D Institutions	0.683287	0.247629	2.759319	0.0058
Parent Company	0.211864	0.249268	0.849948	0.3954
Journals	0.209990	0.395305	0.531210	0.5953
Competitors	-0.014547	0.314417	-0.046267	0.9631
Conference	0.089244	0.448852	0.198828	0.8424
Trade Association	-0.065823	0.260669	-0.252514	0.8006
C	-1.61826	0.669622	-2.416688	0.0157
McFadden R-squared	0.291283	Mean dependent var		0.682692
LR statistics	37.85609	Avg. log likelihood		-0.442823
Prob(LR Statistics)	0.000040			
Obs with Dep=0	33	Total obs		104
Obs with Dep=1	71			

Dependent Variable: Non-technological Innovation
Method: ML - Binary Logit (Quadratic hill climbing)
Sample: 1 106
Included observations: 104
Convergence achieved after 4 iterations
Covariance matrix computed using second derivatives

Effect of Innovation Output on Financial Performance

Table 5 shows the impact of the two innovation types on the turnover in the companies. At 1% level of significance, both technological and non-technological innovations had direct and significant impact on turner. Indicating that as the companies implement technological innovation, the log of turnover of the companies increases by a factor of 1.342736 ($p < 0.01$) and if the companies implement non-technological innovation, the log of their turnover increases by a factor of 1.315869 ($p < 0.01$). A F-statistics value of 34.98281 ($P = 0.000000$) indicates that both variables jointly have direct and significant impact on log of turnover in the companies.

Table 5: Impact of Innovation Output on Financial Performance

Variable	Coefficient	Std. Error	t-Statistics	Prob.
TECH INN	1.342736	0.304805	4.405231	0.0000
NON-TECH INN	1.315869	0.315682	4.168339	0.0001
C	17.68166	0.248407	71.18025	0.0000
R-squared	0.40	Mean dependent var		19.44925
Adjusted R-squared	0.39	S.D. dependent var		1.700178
S.E. of regression	1.32	Akaike info criterion		3.428104
Sum squared resid	180.74	Schwarz criterion		3.503485
Log likelihood	-178.68	Hannan-Quinn criter.		3.458656
F-statistics	34.98	Durbin-Watson stat		2.092418
Prob(F-Statistics)	0.00			

Dependent Variable: LTurnover
Method: Least Squares
Sample: 1 106
Included observations: 106

Conclusion

The study gathered that on a general note, all the indicators for information sources of innovation collectively were jointly significant in explaining the outcomes of both technological innovations and non-technological innovations. This is to say that that sourcing of scientific information from mar-

ket sources, sources within enterprise group, institutional sources and other relatively non-formal sources are important for enterprise's innovativeness. Overall, the companies were seen to have sourced for information more from their market sources. It can be deduced that probably market sources provided more useful technical/scientific information needed by the mining companies to thrive than the intuitional sources. Also, technological and non-technological innovations jointly explained the financial performance in the companies. Against conventional backdrop, it was found from this study that non-technological innovations may probably be more important for financial performance of the mining firms than the technological innovations. However, more specifically, information sources for innovation had higher effect on technological innovation than non-technological innovation owing to the higher number of significant variables (Three to One) in the regression equation. On the other hand, technological innovation had approximately same effect on turnover as non-technological innovation owing to the closeness in the coefficient of the two independent variables (technological innovation/non-technological innovation = 1.315869/1.342736). The study contrasts with conventional wisdom, this is to highlight that the trend in developing countries may be very different from the trend in developed countries. In addition, this study studied just one sub-sector within the manufacturing sector in a just one developing country. Hence, it may not be right to generalize the result of the study for all developing countries or even for all sectors of the economy. However, the study can be a good reference point for researchers and also be a good input for policy making while enriching the existing theories and literature on innovation modes and innovation outputs.

Appendix - Questionnaire

PART 1: General information about the enterprise, business, company or firm

1.0.	**Name of Enterprise:** **Address:** **Main Activity:**
1.1	**Short Description of your Main Business Activity:**

PART 2: Technological (Process) Innovation

Process innovation is the use or implementation of new or significantly improved process or method for the production or distribution of goods or services or supporting activity. The innovation (new or improved) must be new to your enterprise, but it does not need to be new to your industry sector or market.

2.1	**During the three years 2011 to 2013, did your enterprise introduce any:**	**1Yes**	**0No**	**If yes, specify the methods/ activities**
	→ New or significantly improved methods of mining or processing minerals from ore?			
	→ New or significantly improved logistics, delivery or distribution methods for your inputs (such as explosives, etc) minerals or output (such as minerals or raw material)?			
	→ New or significantly improved supporting activities for your processes, such as cmaintenance and software packages for evaluating reserves or grade of ore?			
				If no to **all** questions, please go to section **4**.

2.2	**Who developed these process innovations?**	Please select the single most appropriate option only
	→ Mainly your enterprise by itself	
	→ Your enterprise together with other enterprises* or institutions**	
	(*) independent enterprises plus other part of your enterprise group (such as subsidiaries, sister enterprises, head office, etc.	
	(**) universities, research institutes, non-profit, etc	

	→ Your enterprise by adapting or modifying goods or services originally developed by other enterprises or institutions	
	→ Mainly other enterprises or institutions	
2.2.1	**Were any of your process innovations introduced during the three years 2011 to 2013 new to your market?**	
	Yes No Do not know	
2.2.2	**Did these innovations originate during the three years 2011 to 2013 mainly in Nigeria or abroad?**	
	Yes No Do not know	

PART 3: Non-technological (Organisational) Innovation

An organisational innovation refers to the *implementation of a new organisational method in the firm's business practices, workplace organisation or external relations in firm structure or management methods that are intended to improve your firm's use of knowledge, the quality of your goods and services, or the efficiency of work flows.*

3.1	**During the three years 2011 to 2013, did your enterprise introduce:**			
	Organisational innovations	1Yes	0No	
	→ **Business practices:** New business practices for organising procedures (i.e. supply chain management, business re engineering, , lean production, quality management, etc)			
	→ **Work responsibilities and decision making:** New methods of organising work responsibilities and decision making (i.e. first use of team work, decentralisation, integrating/de- integrating different departments or activities)			
	→ **External relations:** New methods of organising external relations with other firms or public institutions (i.e. first use of alliances, partnerships, outsourcing or sub-contracting, etc)			

3.2	**If your enterprise introduced an organisational innovation during the three years 2011 to 2013, please tick how important were each of the following results or effects?**				
	Results	**Degree of importance**			
		0No results	**1Low**	**2Medium**	**3High**
	→ Increased or maintained market share				
	→ Reduced time to respond to customer or supplier needs				
	→ Improved quality of your goods or services				
	→ Reduced costs per unit output				
	→ Improved employee satisfaction and/or reduced rates of employee turnover				

PART 4: Sources of information and co-operation for innovation activities

4.1	**During the three years 2011 to 2013, how important to your enterprise's innovation activities were each of the following information sources?** **Please identify information sources that provided information for innovation activities/projects or contributed to the completion of existing innovation activities/projects.**					
	Information sources		**Degree of importance** **Tick 'not used' if no information was obtained from a source.**			
			0Not used	**1Low**	**2Medium**	**3High**
	Internal sources	Sources within your enterprise or enterprise group				
	Market resources	Suppliers of equipment, materials, components or software				
		Clients or customers				
		Competitors or other enterprises in your sector				
		Consultants, commercial labs or private R&D institutes				
	Institutional sources	Universities or other higher education institutions				
		Government or public research institutes				
	Other sources	Conferences, trade fairs, exhibitions				
		Scientific journals and trade/ technical publications				
		Professional and industry associations				

THANK YOU FOR YOUR PARTICIPATION. IT IS SINCERELY APPRECIATED

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