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Determinants of Sales of Foundry Products in Nigeria: a Discriminant Function Analysis

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Abstract

Major components of machine tools, power plants, industrial machinery and equipment, automobile, agricultural and textile industry and several others are products of the foundry industry. The development of foundry technology therefore, should be of strategic concern to planners of rapid industrialization of any nation. The study evaluates the determinants of sales of foundry products in Nigeria using Discriminant Analysis. The focus is to analyze the relationship between non-metric dependent variable; sales and metric or dichotomous independent variables; innovation, technology and government policy, using data collected from 68 foundries. The results revealed that innovation, with a calculated correlation value of -0.150 less than the significance benchmark of 0.300, is not a good predictor of sales of foundry products, while technology and government policy on the other hand with correlation values of 0.950 and 0.466 respectively, and greater than the significance level of 0.300 are both good predictors of sales. The study recommends among others, the need for foundries to urgently do more than pay lip service to technological changes and government policies. If they must compete favorably with foreign manufacturers and induce sales, state of the art machines and equipment for production must be acquired.

Keywords:
Foundry, Sales, Technology, Innovation, Government policy, Discriminant Analysis.

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Background to the Study

A Foundry is a factory that produces metal castings. Metals are cast into shapes by melting them into liquids, pouring the metal in a mold, and removing the mold material or casting after the metal has solidified as it cools. The most common metals processed are aluminum and cast iron. Foundry is the oldest engineering industry in Nigeria starting over 20 centuries ago. It was known to have been practiced in the middle belt region of Nigeria over 200 years ago by iron smelting termed the Nok-culture. Bronze casting was practiced on the Southern plains of Benin, Ife and Igbo-ukwu over 100 years ago. These ancient foundry practices provided the means by which our forefathers produced their domestic and agricultural tools/implements and preserved their artistic values (Inuwa, 1995).

The development of foundry technology therefore, should be of strategic concern to planners of rapid industrialization of any nation. Major components of machine tools, power plants, industrial machinery and equipment, automobile, agricultural and textile industry and several others are products of the foundry industry. Hardly can you think of any major machine or equipment which has no components that have been cast in a foundry. It is therefore, evident that the existence of foundries and associated machine tool shops are very important for the deepening and widening of the industrial base of any economy. Thus without foundries, there would be no engineering subsystem, and consequently no realistic industrial base, no end to excessive importation dependence and hence no national industrial and economic self-reliance (Majekodunmi, 1997).

Foundry activity is a highly energy and labor intensive operation (Su and Chou, 2008). Waste generation and lack of quality is however, a serious issue militating against efficient performance in foundry operation. Since profit making remains a major objective of every business, value addition through sales of products has to be given due attention in order to save money and increase revenue. West and Farr (1990) opine that for organizations to improve their sales revenue, it is important for them to be innovative which implies both change and creativity though not all change and creativity are innovative. Therefore, the harnessing of creativity of the workforce in order to promote innovation remains problematic in most companies, the foundry subsector inclusive. Thus, many organizations have the perception that customers often do not know what they want until they see new developments in the market place, the foundry sector inclusive. Agbu (2003) also posits that technology and policies of government are crucial factors that can possibly influence revenue and performance in organizations. In this regard, the study set out to evaluate sales of foundry products against predictor variables: innovation, technology and government policy.

Problem Statement

In Nigeria, little attention has been paid to the development of the foundry for too long. This explains the country's over dependence on imported spare parts and machine components for such vital sector of the economy. The Foundry industry in Nigeria is confronted with the challenge of lack of patronage from consumers of foundry castings and thus the urgent need for local content policy. The situation is synonymous with the situation where many industries in Nigeria today are living in the 1960s and in the era of non-performance which has invariably crippled their marketing operations and therefore affected customer satisfaction. The objective today is to adopt marketing strategies that will make Nigerian industries

productive, dependable, efficient and forward looking towards the process of continuous customer satisfaction and sales.
In the view of the CEO of Nigeria Foundries Limited, Vassily Berberopoulous, Nigerian foundries lack OEMs (Original Equipment Manufacturers) like Caterpillar, and so foundry production in the country is based on backward re-engineering of castings, and that to remain competitive, everything is based on specifications, inspection test procedures, and plans. This implies that the foundries ought to be technology complaint, innovative and creative. If they have problem with patronage then it implies that they are not operating efficiently, locally, internationally and globally.

Objectives of the Study
Based on the identified problem, the following objectives were proposed for the study.
(i) To find out if innovation is a determinant of sales of foundry products in Nigeria.
(ii) To examine the influence of technology on the sales of foundry products in Nigeria.
(iii) To examine the role of government in the sales of foundry products in Nigeria.

Hypotheses
HO1 Innovation is not a determinant of the sales of foundry products.
HO2 Technology is not a determinant of the sales of Foundry products.
HO3 Government policy is not a good predictor of sales of foundry products.

Literature Review
Sales of Foundry Products in Nigeria
It is an open secret that the few public foundries which are in existence such as Ajaokuta Steel Company, Aladja Steel Company, Nigeria Machine Tools and Nigeria Railway Corporation (NRC) foundries are operating below optimal level because of lack of adequate working capital, trained manpower, stable power supply and infrastructural facilities (Aladewolu, 1998). The author further argued that, it is not too different for the privately owned foundries, which, though are better managed and productive, but yet are few and majority are only jobbing foundries. This is understandable as many private investors cannot afford the investment required to set up large scale foundries.

Despite the above mentioned problems, one fact stands out clearly, that, there can be no meaningful industrialization without developing and patronizing the foundry sector in Nigeria. This fact was succinctly presented by Ezekwe (1995), when he described the foundry industry as "the mother of all industries". Similarly, many experts believe that the Nigerian foundries have come a long way and they readily point to some of the giant strides made by the subsector currently in the servicing of the cement industry, construction industry, automobile industry, mining and quarry industry to mention just but few.

A survey commissioned by the National Agency for Science and Engineering Infrastructure, NASENI in 1995, shows that Nigeria has about 160 foundries, of this only 60 are registered commercial and they produce at an average capacity of 55%, accounting for less than 30% of the nation's required castings. Inuwa (1995) asserted that over 70% of our casting needs is still

imported, 40 years after our independence. This to say the least is preposterous. It shows the low level of commitment of this nation to start a determined journey to the destination of the developed nations.

Innovation

Innovation is the implementation of a new or significantly improved product (good or service) or process, a new marketing method, or a new organizational method in business practices, workplace organizations or external relations (Jassawalla & Sashittal, 2002) What is apparent from the innovation process is that companies need to recognize industry differences and to have a system in place which is capable of both generating and screening ideas (Kale & Little, 2007). Both require the development of an innovation culture within the organization. The firm's readiness and flexibility to innovate will be influenced by marketing factors relating to both strategic direction and management controls. The Foundry industry is no doubt an innovation driven subsector that owes its growth and existence to technological awareness and innovative changes.

However, Barnett and Hansen (1996) argued that an important consideration for organizations is that their innovative effort that are initially effective may result in worse relative performance in the long run as competitors are provoked into coming up with different and better innovations to compete. In sum, it takes predictive capability, through awareness and motivation, along with implementation capability to realize successful innovation outcomes.

Technology

In its original conceptualization, technology meant the systematic knowledge of the industrial arts, which was then implemented by means of techniques. However, in the modern times, technology is often taken to comprise both the knowledge and the means of its utilization (Ina & Derek, 1977). Therefore, in a wider sense, technology is the elaboration of techniques and methodologies for the solution of defined problems of a given society in a given environment. It is usually fundamentally assisted by basic scientific research, which provides the basis for sustainable transformation of research findings into use-value. However, it is important to note that technology is not necessarily applied science all the time. Whereas, science is a codified and systematized knowledge that has the power to explaining certain phenomena, it is not necessarily technology per se, and technology is not always a product of science.

Technically, the concept of technology has two basic parts. The first consist of all kinds of tools, machines, vehicles and buildings. The second comprise all kinds of knowledge required for the use, maintenance, repair, production, change and innovation of the first. The two parts could be termed as 'equipment' and 'technological knowledge'. Equipment is often denoted by the term (hardware) and technological knowledge by the term (software). Technological knowledge is often divided into two- the knowledge of how to do things (know-how) and the knowledge of why certain things have to be done in certain ways (know-why). Given a certain configuration of equipment and knowledge, knowledge embodied in human beings is the more decisive factor in technological growth and has both quantitative and qualitative components. Though, technology is embodied in most human activities, its

direction and shape is largely determined by the systems of mode of production in which it is located, produced, distributed and regulated (Agbu, 2003). Today, this mode could be seen embodied in the capitalist market economy, which has become so globalized that countries have little option but to maneuver within it. For this study, our interest is in all knowledge and hardware that have to do with the development of the iron and foundry industry and its use in the social and economic transformation of Nigeria, and whether the crave and use of technology by the foundries has led to increase sales.

Government Policy

The national policies on Foundry development are very laudable. They include:

(a) The promotion of growth and spread of foundries and allied metal forming industries in the country.
(b) The promotion of metal forging and spare parts manufacturing industries.
(c) The development and promotion of machine tools industries.
(d) The development of indigenous engineering capabilities for the design and manufacture of plants and machinery (Ezekwe, 1995).

Realizing, the important role of the engineering subsector, the Federal Government established the National Agency for Science and Engineering Infrastructure (NASENI) in 1992, to remedy the nation's previous mistakes and map out strategies to develop the level of Nigeria's capability in the production of delivery systems and components. NASENI organized the existing Foundries companies to form the Foundry Association of Nigeria (FAN), a forum for favorable government foundry policy.

NASENI has assisted FAN enormously to channel the views and aspirations of the foundry men to government. Through their joint efforts and that of the Nigeria Society of Engineers, NSE, it was possible to win the mandate of government to ban the exportation of metal scraps, one of the major raw materials for foundries. In the words of the pioneer chairman of the NASENI, Late Prof. Ezekwe, government main objective is to "promote a program for the growth and expansion of a robust foundry practice in Nigeria".

The most unfortunate problem about schemes introduced by government to promote expansion of industries is that their conditions of lending are very difficult to be satisfied by most foundries as the foundry industry is treated by these schemes as a service sub-sector having high risks of lack of expected customer patronage. Regrettably, NSE's move in the 1990s to set up an Engineering and Technological Bank, specifically planned to address this issue was killed mid-way (Inuwa 1995).

Theoretical Review

In this study, we align with an empirical test of the consumer behavior assumptions and firm-level pricing decisions embodied in Salop and Stiglitz's (1982) theory of sales. They examined equilibrium in a competitive market in which the mythical auctioneer is absurd and information is costly to gather. As a result, individuals may not be perfectly informed about prices or qualities of what is being sold. The model developed by the authors is of interest not only for the insight that it provides into the nature of price dispersion in the economy but also because it provides at least a partial explanation of some aspects of retailing which otherwise would be difficult to explain.

The foundry subsector is no exception to the foregoing as the foundries boost sales with a strategic combination of manufacturing quality products, greater emphasis on pricing considerations such as: the chemistry of the metals, composition of the metals, metallurgical analysis and the client as a factor amongst others. Not much emphasis is placed on promotional activities in this respect, and because lots of the foundries are jobbing, they do not mass produce and hence little or no need for warehouses or middlemen.

Empirical Review

A plethora of studies in economics, finance and management have focused on the determinants of sales in organizations. Mohd, Yusoff & Ahmad(2014) examined the moderating effect of government policy on entrepreneurship and growth performance of small and medium enterprises (SMEs) in Cambodia. In their study, the researchers use entrepreneurial value, firm financing, management, market practices, and Government policy as the factors that influenced the growth performance of SMEs. The finding of the study indicates a positive relationship between entrepreneurial value, firm financing, management, market practice and growth performance of SMEs. The result also confirms that government policy has an essential role as a full moderator in such relationships.

Alegre, Lapiedra & Chiva (2006) found that both product innovation dimensions (efficacy and efficiency) were strongly and positively related to firm sales. The introduction of novel product is positively associated with firm performance was also confirmed by Varis and Littunen (2010). Findings of Eggert & Serdarolgu (2014) also revealed that technology has a direct effect on sales performance when used as a customer relationship tool and a perfectly mediated effect when used for internal coordination. The departure from existing literature lies in our focus on a sector specific research (Nigerian foundry industry) which is distinguished from other organizations based on their high emphasis on product quality as well as realistic price mechanism so as to induce sales. This sector has been neglected by policy makers and researchers (Edosa, 2015).

Methodology

The population of the study is the entire foundry companies in Nigeria. The Foundry Association of Nigeria (FAN) has a list of 70 members (see Appendix). Out of this number, Ajaokuta steel foundry and Delta steel foundry are not operational. Therefore, the study used the 68 operational foundry organizations. Questionnaires were administered to the owners of these foundries. Reliability test was used to test for the internal consistency of each of the questions (variables) in the questionnaire. The most convenient method for testing for the internal consistency is the Cronbach's Alpha. The reliability measure shows that Cronbach's Alpha value is .0.77. This indicated that the questionnaire is valid and reliable. Based on the result, the questionnaire was considered for further analysis.

Discriminant analysis was used to analyze relationships between a non-metric dependent variable (sales) and metric or dichotomous independent variables (innovation, technology and government policy). Discriminate analysis attempts to use the independent variables to distinguish among the groups or categories of the dependent variable. The usefulness of a discriminate model is based upon its accuracy rate, or ability to predict the known group memberships in the categories of the dependent variable (Timm, 2002). The discriminate model for this study is stated thus:

$D_j = \theta_o + \theta_i X_i + \theta_2 X_j + \theta_3 X_k$

Where:

D = discriminate function for increased and decreased foundry sales

X_i = Innovation

X_j = Technology

X_k = Government policy

θ_o =the intercept

θ_1 θ_2 and θ_3 = the weight for the independent variables

Results

Table 1: Reliability Statistics

Cronbach's Alpha	N of Items
.77	24

Source: SPSS 21.0Output

Table 2: Analysis Case Processing Summary

Unweighted Cases		N	Percent
Valid		68	100.0
	Missing or out -of-range group codes	0	.0
	At least one missing discriminating variable	0	.0
Excluded	Both missi ng or out -of-range group codes and at least one missing discriminating variable	0	.0
	Total	0	.0
Total		68	100.0

The table 2 shows the summary of data used for testing the minimum requirement of the model for the discriminant function. The ratio for this study is 23:1 which is higher than the minimum and maximum requirements of 15:1 and 20:1 respectively. This is calculated by dividing 68 by 3.

The 68 is the sample size used for the analysis while 3 represents the number of independent variables. Therefore, the model and data is valid for further analysis.

Table 3: Group Statistics

Sales		Mean	Std. Deviation	Valid N (listwise)	
				Unweighted	Weighted
Decreased sales	Innovation	1.5714	.53452	7	7.000
	Technology	1.5714	.53452	7	7.000
	Government	4.5714	.53452	7	7.000
Increased sales	Innovation	2.1148	1.00164	61	61.000
	Technology	1.0000	.00000	61	61.000
	Government	1.8852	1.00164	61	61.000
Total	Innovation	2.0588	.97556	68	68.000
	Technology	1.0588	.23704	68	68.000
	Government	2.1618	1.26503	68	68.000

The table 3 shows the descriptive statistics for all the independent variables. Under the total mean, government policy is more prevalent with a mean value of 2.16. This is followed by innovation and technology with mean value of 2.05 and 1.05 respectively. It therefore shows that among the three variables, government policy influences foundry sales (either decrease or increase) more than innovation and technology.

Table 4 Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	Df	Sig.
1	.430	54.862	2	.000

Table 3 shows the overall multivariate relationship (MANOVA) was statistically significant at the .05 (chi square = 54.862; Wilk's L= 0.430; p = .0000) indicating that the two sales groups (increased sales and decreased sales) were significantly different. Thus, the vafriables used were able to classify the subjects into the two sales level groups.

Table 5: Classification Results

		Sales	Predicted Group Membership		Total
			Decreased sales	Increased sales	
Original	Count	Decreased sales	4	3	7
		Increased sales	0	61	61
	%	Decreased sales	57.1	42.9	100.0
		Increased sales	.0	100.0	100.0
Cross-validated[b]	Count	Decreased sales	4	3	7
		Increased sales	0	61	61
	%	Decreased sales	57.1	42.9	100.0
		Increased sales	.0	100.0	100.0

a. **95.6% of original grouped cases correctly classified**.
b. Cross validation is done only for those cases in the analysis. In cross validation, each case is classified by the functions derived from all cases other than that case.
c. 95.6% of cross-validated grouped cases correctly classified.

The Classification table shows that the classification of the dependent variable is not correctly classified. Classification is classifying subjects into the one of several groups on the basis of a set of measurements. The results in the footnote indicated a 95.6% cross-validated accuracy rate computed by SPSS was 95.6% which is higher than the proportional by chance accuracy criteria of 62.5% (1.25 x 0.5% = 62.5%). The criterion for classification accuracy is not satisfied. This may be due to the problem of outliers and small sample size.

Table 6: Structure Matrix

	Function
	1
Technology	.950
Government	.466
Innovation	-.150

The structure matrix in table 5 shows the predictive power of each variable with the discriminant function. Usually, a factor value of 0.30 is seen as the cut-off between significant and insignificant variables. The hypotheses for this study was to test the predictive power of the independent variables; technology, government, and innovation on the sales of foundry product. Only innovation could not be used to predict sales however, technology and government policy were statistically significant.

Discussion

The result from the table 5 shows that the correlation value for innovation is -0.150. This is less than the 0.300 significance benchmark. This implies that innovation is not a good predictor of the sales of foundry products. This supports the assertion of Barnett and Hansen (1996) that innovation alone cannot translate to increased sales in an organization. It takes predictive capability, through awareness and motivation, along with implementation capability to realize successful innovation outcomes.

Furthermore, the results show that the correlation value for technology, which iso.950, is more than the 0.300 significance benchmark. In this regard, we conclude that technology is a good predictor of the sales of foundry products. This also supports the claim made by Eggert & Serdarolgu (2014) that technology has a direct effect on sales performance especially when used as a customer relationship tool. The importance of technology in our daily lives is undeniable. This is due to the fact that in today's dynamic world, life without technology is meaningless, hence its influence on sales.

Lastly, findings revealed a correlation value of 0.466 for government policy, which is more than the 0.300 significance benchmark. Therefore, we conclude that government policy is a good predictor of the sales of foundry products. This is in alignment with the study of Mohd, Yusoff & Ahmad (2014) which found government policy to have a significant impact on the firm's value and performance.

Conclusion and Recommendations

The study highlighted the strategic importance of the foundry subsector in the nation strive for industrialization. In Nigeria, little attention has been paid to the development of the foundry for too long. This explains the country's over dependence on imported spare parts and machine components for such vital sector of the economy. Therefore, any study that focuses on this important subsector is invaluable. The study has revealed that technology and government policy are critical success factors for increased sales of foundry products in Nigeria. As a result, the following are recommended.

i. The foundries need to urgently do more than pay lip service to technological changes. If they must compete favorably with foreign manufacturers and induce sales, the state of the art machines and equipment for production must be acquired.
ii. The urgent need to put in place growth driven policy that will lead to sustainable development of the foundries cannot be overemphasized. Government can support patronage by encouraging its agencies and other private sector end-users to look inward and source their castings locally. This can only be achieved by the enactment of the local content policy for foundry products.
iii. For Nigeria foundries to compete favorably, government should also initiate special credit schemes for foundries in Nigeria. This will boost their ability to respond to technological changes, thereby improving the quality of their products.

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Appendix
List of Private and Public Foundries in Nigeria

S/N	Names	Location	Category
1.	Nigerian Foundries Ltd.	Lagos	MPF
2.	Michael Kunle Foundry Nig. Ltd.	Lagos	SPF
3.	Jimex Industries Nig. Ltd.	Nnewi	MPF
4.	Associated Tech. & Eng. Ltd. (ATEL)	Lagos	SPF
5.	Central Workshop, Fed. Min. of Works	Lagos	SGF
6.	Continental Foundry Ltd.	Lagos	SPF
7.	Muhayak Eng. Coy	Owo	SPF
8.	Addis Eng. Ltd.	Lagos	SPF
9.	Olympic Tech. Ltd.	Abagana	MPF
10.	P. O. Idokoji (Abco) Foundry	Warri	SPF
11.	Systemax Foundries Ltd.	Sango-Ota	SPF
12.	Aranla Industries Nig. Ltd.	Warri	SPF
13.	Grand foundry& Eng. Ltd.	Lagos	MPF
14.	Leos Eng. Ltd.	Lagos	SPF
15	Basic Tech. Industries Ltd.	Kano	SPF
16.	Bisbol Eng. Ltd.	Sango-Ota	SPF
17.	Indus Mechanique Nig. Ltd.	Lagos	SPF
18.	Dormanlong Eng. Ltd.	Lagos	MPF
19.	Foundry and Metallur. Serv. Nig. Ltd	Lagos	LPF
20.	S. SOA (Nig.) Foundry Ltd.	Warri	SPF
21.	Dozik Foundry Ltd	Kano	SPF
22.	Alagura Foundries and Ventures Ltd.	Ota	SPF
23.	Auto Components	Sango-Ota	SPF
24.	Premier Foundries Ltd	Warri	MPF
25.	F. A. Foundries Ltd	Lagos	SPF
26.	MARTH Foundry Ltd	Kano	SPF
27.	Isaho Industries Ltd	Nnewi	SPF
28.	Ebunso Nig. Ltd	Nnewi	MPF
29.	Castek Ltd	Lagos	MPF
30.	ACKO International Ltd	Lagos	SPF
31.	Ajaokuta Steel Foundry	Ajaokuta	MGF
32.	Scientific Equip. Dev. Inst. (SEDI)	Minna	SGF
33.	Federal SC. Equip. Centre	Enugu	SGF
34.	Nigerian Machine Tools	Osogbo	MGF
35.	CADD	Zaria	SGF
36.	FIIRO	Lagos	SGF
37.	Delta Steel Foundry	Warri	MGF
38.	Hydraulic Equipment Dev. Centre	Kano	SGF
39.	National Metallurgical Dev. Centre	Jos	SGF
40.	Cast Product Ltd	Lagos	SPF
41.	Abayomi Foundries Ltd	Ibadan	SPF
42.	S. T. Foundries Ltd	Sango-Ota	SPF
43.	Makstech Industries & Eng. Ltd	Ilesa	SPF

S/N	Names	Location	Category
44.	Gabmunis Foundries	Otta	SPF
45.	Genesis Foundry	Otta	SPF
46	Sunday Foundry Moil	Lagos	SPF
47	Bemidele Foundry	Ota	SPF
48	God First Foundry	Lagos	SPF
49	Adekunle Foundry	Lagos	SPF
50	Shegun Makinde Foundry	Otta	SPF
51	Alagura Foundry	Lagos	SPF
52	Unique Foundry	Enugu	SGF
53	Kolmak Foundry and Engineering Works	Ota	APF
54	EEMAC Foundry Tech	Lagos	SPF
55	Foundry and Metallurgical Services Ltd	Lagos	MPF
56	Kunle Foundry	Otta	SPF
57	God Foundry	Otta	SPF
58	Ayos Engineering Foundries	Lagos	SGF
59	PRODA	Enugu	SGF
60	Abbey Foundry Ltd	Lagos	MPF
61	Foundries and Engineering Works Ltd	Ondo	SPF
62	Bindele Foundry Ltd	Ota	SPF
63	Foundry Workd Ltd	Lagos	MPF
64	Segun Makinwe Foundry	Lagos	SGF
65	Adegold Foundry Ltd	Ota	SPF
66	Foundry Tech Ltd	Ota	MPF
67	Foundries Limited	Ondo	SPF
68	Foundry Services Ltd	Lagos	SPF
69	Ayos Foundry and Engineering Work Ltd	Lagos	SGF
70	Alagura Foundries and Ventures Ltd	Ota	SPF

Source: Foundry Association of Nigeria, Lagos, Foundry Chronicle Vol. 1 No 7 & 8

KEY:
SPF: Small Private Foundry
LPF: Large Private Foundry
MGF: Medium Government Foundry
MPF: Medium Private Foundry
SGF: Small Government Foundry