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Parametric Analysis on Information Technology Adoption and Organizational Efficiency in Northern Nigeria

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***Abstract*—**The adoption and diffusion of Information Technology (IT) is one of the fastest growing trends in organizations operating within Nigeria's economy. Public and private organizations make huge capital investments in an attempt acquire and adopt the state-of-the-art IT for improving operational efficiency. In this study the level of IT adoption is considered the primary driver of efficiency witnessed by organizations. The research gathered data on the intensity of IT usage, and resultant efficiency increase in the organizations' operations. The data was analyzed using multiple regression analysis and reveals that high level of IT usage has enhance efficiency of private and public organizations in Northern part of Nigeria with organizations having strategic intent on IT adoption indicating higher efficiency gains.

***Keywords*—**IT Adoption, Nigeria, Organizational efficiency.

I. Introduction

SUBSTANTIAL number of empirical research on the significance of information technologies systems on businesses and organizations focuses on the effect of IT adoption as measures of firm performance such as productivity or market value [1], [2]. The work of [3] on the relationship between IT and organization describes the complementary relationship between IT and organizational processes, and practices.

Moreover, research conclusions are increasingly calling for the uncovering of the effect of IT usage on intangible measures of firm performance, such as greater responsiveness to clients and operational efficiency, [1], [2]. Alongside this development, experts are also worried that despite evidence of huge investment in acquisition and development of IT capabilities by organizations in Nigeria, research results are quite scanty and vary across measures on the evidences of efficiency gains. In an attempt to add to the existing knowledge, this research was conducted to provide understanding on the effect of IT systems on organizational performance by answering three basic researches questions: (1) What is the effect of IT adoption on organizations' efficiency?, (2) Does the strategic intent of organizations influence the level of efficiency gains? (3) Is there any difference in the level of efficiency gained between private and public organizations? In doing so, three predictive variables (hardware, software and infrastructure/network technologies) were isolated while organizational efficiency has been chosen as the criterion variable. Through performance self-reporting rating, primary data were collected from the sampled organizations for the analyses.

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II. Conceptual Foundations & Hypotheses

The generic expression on IT as provided in the work of [4] covers the harnessing of electronic technology for the information needs of businesses at all levels. As noted by [5] the existing literature IT suffers from indistinctness in the definition and conceptualization of IT resources. Majority of the current conceptualizations of IT adoption link it to investment allocations across organizations by measuring total IT adoption intensity [6], [7]. Some studies empirically isolate resources from capabilities by not measuring both investments and organizational factors simultaneously. Others theoretically make a distinction of IT infrastructure from human capital but do not differentiate them empirically.

By and large capabilities of organizations moderate the relationship between IT adoption and different measures of their performance [8], [9]. It must however, be noted that aggregate measures of IT adoption signified investment and vague definitions of IT resources produce varied results. This can be seen in the works of [10] that identify four metrics that assess the e-commerce capability of firms and demonstrate that firms with greater capabilities perform better on some dimensions of performance while performing poorly along other dimensions. Their results provide convincing evidence of complementarities between a measure of IT adoption intensity and organizational capabilities. In this study IT adoption are combinations of acquired technologies and a dynamic synergistic system of competencies and practices that together represent organizational IT capabilities as represented in Fig. 1. The model presented in Fig. 1 is built on theoretical concepts drawn from reviews of the IT and organizational performance literatures theories, depicts IT adoption as combinations of investment in acquired technologies and a mutually reinforcing system of capabilities and practices that together represent organizations' IT.

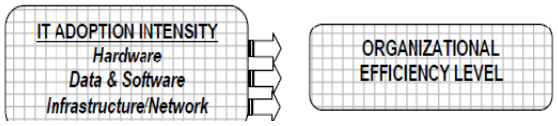

Fig. 1 Relationship between IT Adoption & Efficiency

This dimension ultimately influences level efficiency, hence providing the base for hinging the empirical analysis of this research. Based on the above model the following hypotheses were developed and tested:

H1. IT adoption positively affects efficiency of organizations in Nigeria

H2. Organizations' strategic intent affects the level of their efficiency gains.

H3. Level of efficiency differs based on the type organization

III. Methodology

A. Sample

Public and private organizations were selected to form the sample of the study. This is intended to provide opportunity for combined analysis of the two sectors within the economic zone. As such, selection of organizations was guided by the geo-political zoning of the country in which organizations were clustered in to 3 zones with each zone represented by 40 organizations randomly selected and stratified into public and private with each strata comprising of 20 organizations. In all, a total of 120 organizations provided information for the study on the intensity of IT adoption and the consequent efficiency increase in their respective organizations. In doing so, effort was made to ensure that elements within a cluster were ideally heterogeneous as possible, and there was homogeneity between cluster means and that the clusters were mutually exclusive. Hence as shown in Table I the data collection process involved a proportionate distribution of a total of 60(50%) of the public organizations and 60 (50%) private organizations; making a total of 120 organizations evident by the apportionment of 40 (33.3%) organizations in each of the six geopolitical zones.

TABLE I
Distribution of Clustered Sample by Zone and Type

Zones (Clusters)	Type		All organizations (Sample)
	Public	Private	
North-Central	20(50%)	20(50%)	40 (33.3%)
North-East	20(50%)	20(50%)	40 (33.3%)
North-West	20(50%)	20(50%)	40 (33.3%)
All Zones (3)	60(50%)	60(50%)	120 (100%)

The rule of thumb to isolate only the northern part of the country was necessitated by the limited fund for the study, as such the findings of this study is by no means conclusive on the topic. Further studies are needed to provide adequate insight on this important topic.

As shown in Table II, out of the 120 questionnaires distributed 118 (98%) were retrieved and 2(1.7%) were not retrieved. A total of 34 (28.8%) were found to be invalid leaving 84 (71.2%) valid for use in the analysis.

TABLE II
Distribution and Retrieval of Questionnaires

Description	Response rate	
Total questionnaires distributed	120	100%
Total questionnaires returned	118	98%
Total questionnaires not returned	2	0.2%
Total questionnaires not valid	34	28.8%
Total Valid questionnaires	84	71.2%

B. Measurement Scale

Sampled organizations provided responses on a five-point intensity-estimation scale with values ranging from a minimum of 1 and a maximum of 5 indicating intensity levels of IT usage and operational efficiency from very low to very high levels.. The design of the questionnaire followed the guiding principles of questionnaire design explicated by [11], [12]. As demonstrated in Fig. 1, the variables in the questionnaire have been segmented in to two parts representing the three constructs measuring IT adoption and one construct measuring efficiency of organizations. The responses on the intensity levels were scaled in the following pattern: - 1 signifying very low; 2, low; 3, moderate; 4, high; 5, very high level of IT adoption intensity. While for organizational efficiency, 1 signifies very low; 2, low; 3, moderate; 4, high; 5, very high level of efficiency.

C. Reliability of Constructs & Normality of Data

In view of the fact that the main analysis was parametric in nature, reliability and normality were tested by using SPSS. The reliability test on the measurement scale was conducted by calculating the alpha coefficients guided by the positions of [13]. The three constructs exhibited Cronbach's alpha value based on standardized Items ranging from 0.792 to 0.920. These coefficients signify internal consistency and therefore high reliability of data generated by research instrument as shown in Table III.

TABLE III
Cronbach's Alpha Coefficient Based On Standardized Items

SN	Constructs	coefficients
1	(OE) Organizational Efficiency	0.905
2	(HTA) Hardware technology adoption	0.792
3	(DSTA) Data & Software technology adoption	0.917
4	(INTA) Infrastructure & network technologies adoption	0.920

Organizational efficiency measured by the level of increase in output, workers' efficiency, effectiveness, product/service quality, cost reduction, product & process innovation. *Hardware technology adoption* measured by the extend of usage acquisition and usage of desktop computers, laptops, palmtops, iPods, GSM handheld devices, screens and display devices, telex, telephone, fax, televisions, radio, satellite, DVD devices and other components. *Data & software technology adoption* which comprises of extend of acquisition, development and usage of data and knowledge bases, systems and applications software, operating instructions, manuals,

operations and decision support systems, system security software. *Infrastructure & network technology adoption* acquisition of IT buildings and centres, broadband width, internet, communication satellite and systems, communication coaxial and fibre-optic cables, microwave systems, communication processors, modems, and inter-network processors.

Normality of data was tested based on the evaluation of collinearity statistics on the levels of variation inflation factor (VIF), tolerance (TL) and Durbin Watson (d) to check for autocorrelation. The test output shows that the data meets the normality requirement for parametric analysis; for instance, all of the constructs have VIF of between 2.332 and 4.043 which are below the threshold of not more than 10 with tolerance of less than 0.429 as shown in Table IV. Diagnosis of the Durbin Watson indicates d = 1.565 which is above 1.0 indicative of the absence of autocorrelation as also shown in Table IV.

TABLE IV
NORMALITY STATISTICS

	Collinearity Statistics		Durbin-Watson
	Tolerance	VIF	
			1.565
HTA	0.429	2.332	
DSTA	0.231	4.326	
INTA	0.247	4.043	

IV. RESULTS AND HYPOTHESES TESTING

The proceeding analyses of the descriptive statistics shows the behaviour of the data as determined by the variables. The mean statistics in Table V show a distribution ranging from a minimum of 2.9390 on HTA and a maximum of 3.4211 on OE implying an average of moderate intensity of technology adoption on one hand and organizational efficiency on the other, all falling within the range of the measurement scale.

TABLE V
DESCRIPTIVE STATISTICS

	Mean	Std. Deviation	N
OE	3.4211	0.67154	84
HTA	2.9390	0.64836	84
DSTA	3.2158	0.83939	84
INTA	3.1439	0.91248	84

Similarly, the standard deviation shows minimum and maximum levels of 0.64836 and 0.91248 respectively, not far from the mean.

A. Hypothesis One – H_1: IT Adoption Positively Affects Efficiency of Organizations in Nigeria

Multiple regression analysis was conducted in a composite manner to validate the existence and establish the strength of relationship among the variables as outlined in the hypothesis. Hence, the predictive variables were combined and employed to test their effect on the criterion variable - $Y = a + b1X1 + b2X2 + b3X3 + \ldots + error = OE = a + b1\ HTA1 + b2\ DSTA2 + b3\ INTA3 + error.$

The parametric analysis, as shown in Table VI, demonstrates that the coefficient of determination i.e. the adjusted R^2 is 0.395; which indicates that about 39.5% of the variation in the data on the ability of the organizations to experience operational efficiency is explained by variation in the data on their level of intensity of adoption of information technology.

TABLE VI
MODEL SUMMARY

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.645[a]	0.417	0.395	0.52245

The ANOVA statistics in Table VII further demonstrates that the linear combination of the three independent factors being significantly related to changes in dependent factor, F (3, 80) = 19.044, P = 0.000 < 0.05 alpha, thus the hypothesis is accepted that there is a significant positive relationship between intensity of IT adoption and organizational efficiency. Hence, the regression equation emerges to be very useful for making predictions since the value of adjusted R^2 is closer to 1. Hence at (0.05) 5% significance and 95% confidence levels, the data provide sufficient evidence to conclude that the slope of the population regression line is not 0 and, hence, IT adoption is useful as a predictor of efficiency gained by organizations.

Further evaluation of individual contribution of the variables in explaining the variation in the model was done based on the standardized coefficient results in Table VIII for instance INTA and DSTA made significant contributions i.e. with Beta = 0.387, p= 0.000 at 0.05 α, and 0.380, p= 0.035 at 0.05 α respectively.

TABLE VII
ANOVA STATISTICS

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	15.594	3	5.198	19.044	0.000[a]
Residual	21.836	80	0.273		
Total	37.431	83			

However, HTA made slight but insignificant contribution to the model with Beta = - 0.132, p= 0.313 at 0.05 α. Thus INTA appears as the main driver of OE. The implication of this is that preponderance of the organizations has generally adopted moderate level of IT adoption strategy as a result of which they have also experienced moderate level of efficiency in their operations.

B. Hypothesis Two – H_2: Organizations' Strategic Intent Affects the Level of Their Efficiency Gains

In testing this hypothesis, an independent sample t-test was employed in conducting analysis, as explained in [14], [13] to further determine if there is a variation between the means of the organizations that consider IT adoption as strategic to their survival and those that do not vis-à-vis the demonstration of efficiency gains. Based on the result displayed in Table IX, standard deviations for the two groups show some form of dissimilarity with those who consider IT adoption as strategic

(0.68106) and those that do not (0.55570), alongside a *P*-value of 0.0859 for Levene's test in Table X.

TABLE VIII
MULTIPLE REGRESSION COEFFICIENTS

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.951	0.270		7.230	0.000
	HTA	-0.137	0.135	-0.132	-1.016	0.313
	DSTA	0.304	0.142	0.380	2.140	0.035
	INTA	0.285	0.126	0.387	2.254	0.027

Because the two groups show difference in means of 3.4623 and standard error means of 0.07971 for organizations with strategic intent and means of 3.1477and standard error means of 0.16755 for organizations without strategic intent, it implies that organizations with strategic intent and thus having higher mean values are more likely to generate operational efficiency gains than those without the intent. However, it must be noted that the variances are not significantly large (t = 1.458, p = 0.149).

TABLE IX
GROUP STATISTICS

		N	Mean	Std. Deviation	Std. Error Mean
Strategic intent on IT adoption					
OE	Strategic	73	3.4623	0.68106	0.07971
	Not Strategic	11	3.1477	0.55570	0.16755
Type of organization					
OE	Public	29	3.4310	0.67529	0.12540
	Private	55	3.4159	0.67574	0.09112

C. Hypothesis Three – H_3: Level of Efficiency Differs Based On the Type Organization

However, in testing for differences using the independent sample t-test based on the organizational type, the results Table IX show that the two groups have similarity in their mean distributions with the public organizations having a mean of 3.4310 while the private organizations have 3.4159. Similarly, standard deviations for the two groups show some form of facade with public organizations (0.67529) and private organizations (0.67574), alongside a *P*-value of 0.0859 for Levene's test in Table X. By implication, the results in Tables IX and X indicate that there is a statistically no significant difference between the mean score of the two groups (t = 0.098, p = 0.923).

TABLE X
INDEPENDENT SAMPLE T-TESTS STATISTICS

	Levene's test for equality of variances		t-test for equality of means				
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Strategic intent on IT adoption							
Equal variances assumed	0.032	0.859	1.458	82	0.149	0.31460	0.21574
Equal variances not assumed			1.696	14.933	0.111	0.31460	0.18555
Type of organization							
Equal variances assumed	0.005	0.944	0.098	82	0.923	0.01513	0.15504
Equal variances not assumed			0.098	57.117	0.923	0.01513	0.15501

V. DISCUSSIONS

The descriptive part of the analysis produces results in Table V indicating generally organizations adopt moderate level of IT adoption which in turn enable them to record corresponding level of efficiency gains. Three hypotheses were tested with primary objective of establishing relationship between intensity of IT adoption, organizational strategic intent, and organizational type with operational efficiency.

Analysis of the multiple regression ANOVA statistics and the standardized beta coefficients shows that significant positive relationship exists between the variables and two of the factors are statistically important in explaining the significant relationship between IT adoption and organizational efficiency. Specifically infrastructure and network technology adoption (INTA=0.387, p=0.027) emerges as the main driver of the explained relationship, followed by data and software technology adoption (DSTA=0.0380, p=0.035). While hardware technology adoption, appears not to make any contribution to the relationship of variables in the model.

Analysis of the effect of strategic intent of organizations on IT adoption shows that organizations that consider the adoption of IT as strategic to their survival seem to be more likely to generate efficiency gains than those that do not; however, the different is not significant. The type of organization does not seem to be an important factor in the level of efficiency gained by the organizations based on the intensity of IT adoption.

VI. CONCLUSION

Even though research on IT adoption is a well-beaten road, this study adds to the existing literature fresh research evidence on the influence of IT adoption related organizational efficiency. The study has successfully established a link between the variables, and also demonstrates

the effects of strategic intent of organizations on the level of efficiency gains. Therefore expenditures on acquisition of IT may be increased by all organizations so that high and sustainable level efficiency can be achieved. Organizations should also attached significant importance to IT adoption in their corporate strategic decisions, this will certainly lead to high efficiency and productivity performance in the local economy.

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