

ICT INFRASTRUCTURE MANAGEMENT: A CRITICAL SUCCESS FACTOR FOR ELECTRICITY
DISTRIBUTION COMPANIES IN THE INFORMATION REVOLUTION ERA

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Article Info	Abstract
Keywords: Information Communication Technology, Management, Effectiveness, ICT integration, ICT management policy, Electricity distribution companies.	This study examines the impact of Information Communication Technology Management (ICTM) on the organizational effectiveness of Electricity Distribution Companies (EDCs) in Nigeria. The survey research design was used, and data were collected from 280 staff members from major EDCs in Nigeria. The study found a significant relationship between ICTM's constructs of facility availability, integration, policies, and the organizational effectiveness of EDCs. The article highlights the importance of effective management of ICT infrastructures for the operational and strategic efficiency of EDCs. The study contributes to the existing literature on ICT and its management through the integration of key ICTM practices into the operational and strategic needs of EDCs. The article emphasizes the need for proper management of ICT infrastructures to enhance their capacity to deliver and keep pace with the emerging information revolution. The study calls for more attention to be given to ICTM in organizations for efficient service delivery, information flow, and improved performance.

Introduction

The use of Information Communication Technology (ICT) has significantly impacted organizations and has become a crucial factor in organizational effectiveness. In the Nigerian Electricity Distribution Companies (EDCs), there is a preponderance of literature on the effects of ICT on functionality and usage, leaving a gap in strategic alignment and management of ICT systems and processes. This study aims to investigate the impact of Information Communication Technology Management (ICTM) on the organizational effectiveness of EDCs. The study uses a survey research design and data collected from 280 staff members from major EDCs in Nigeria. The study formulated hypotheses to guide the study, which relied on the survey research design. The findings affirmed a significant relationship between ICTM's constructs of facility availability, integration, policies, and effectiveness of Nigerian EDCs. The study contributes to the existing literature on ICT and its management through the integration of key ICTM practices vis-à-vis effectiveness of EDCs in Nigeria and Diasporas. The study highlights the need for proper management of ICT infrastructures to enhance their capacity to deliver and keep pace with the emerging information revolution. The study calls for more attention to be given to ICTM in organizations for efficient service delivery, information flow, and improved performance.

2. Literature Review

2.1. Conceptualization of ICT Management

A corporate organization is supposedly established for profitability while maintaining uninterrupted service delivery in the environment it situates. It calls to reason that the obviously growing trend of activities surrounding the use of ICT calls for its effective management in all facets of the organization (Birchall & Giambona, 2008; Chirani & Tigar, 2013). However, some organization could outsource ICT services rather than integrating and installing any (Hanafizadeh & Zararavasan, 2020). The advent of ICT has given rise to installations of Automatic Teller Machines (ATM), Point of Sales (POS) and Prepaid Meter Machines (PMM) mostly used by Electricity Power Distribution Company in Nigeria (Hashem, 2015; Patru & Petrache, 2011). Battistella and De Toni (2011). Despite their potential strategic relevance, oftentimes satisfactions or dissatisfactions could result from how the ICT facilities are used of calling for the efficient management of the process (Cuevas-Vargas et al., 2016; Tezci,

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2009). In the absence of effective management platform, decision making becomes problematic as records are not always readily available and any strategic misstep can be fatal and can abruptly obliterate an organization that has taken years to build (Hashem, 2015). Consequently, vital issues such as customer's needs and demand, suppliers and stakeholders' information may turn out to be elusive. Leavitt (2004) saw information communication technology as output consisting of organizational image, product and services to be distributed to the frontend users. Most organizations are starved of information that can improve and enhance their performance, thus justifying case for ICT Management to improve their operations (Aristovnik, 2012); thus aligning with the observation by scholars that no meaningful improvement can be made if ICT facilities are not adequately and appropriately managed (Brown, 2016). Qosasi et al. (2019) revealed that ICTs have been used by organization in a wide range of business applications with significant strategic undertones. ICTs' relevance can also be inferred from the fact they provide opportunities and help in dramatic reductions in the cost of obtaining, processing, and transmitting information which are increasingly changing the business landscape in the contemporary society (Heath, Maghrabi, & Carr, 2015). The vast changes in ICTs make technology undisputedly the backbone of commerce (Brynjolfsson, Rock, & Syverson, 2019). Technology underpins the operations of individual companies, ties together far-flung supply chains, and increasingly links businesses to customers they serve (Nakata, Zhu, & Kraimer, 2008). With information communication technologies underpinning the way businesses operate, it is not surprising that business spending on these ICTs continues to grow with its attendant returns. The US Department of Commerce's Bureau of Economic Analysis recorded 1965 figures of American companies' expenditure on information technology at less than 5%. By the end of the 1990s, this figure rose to near 50% of expenditure. In the heat of spiral down-turn in expenditure on information technology in the early 2000s, businesses around the world continue to spend well over \$2 trillion" per annum on ICT's (Heath et al., 2015). Prastacos, Söderquist, Spanos, and Van Wassenhove (2002) also see that technology changes are occurring at increasing rates. The change, coupled with the wide application of these technological developments, has recorded a breakthrough among management scholars and ICT practitioners. In many industries nowadays, the existence and effectiveness of any organizations depend largely on the exhaustive application of information communication technology (ICT) and the way it is managed (Ermelinda et al., 2011). Organizations are intensely seeking to apply information communication technology to support existing business, and to create competitive advantages. Over the years, ICT has been thought of significantly changing corporate behavior and organization structure, which should increase productivity (Brynjolfsson et al., 2019). The internet resource is extending to other platforms such as commerce, entertainment, communication, and industry. Over the globe, monthly internet traffic in 2010 is two-third higher than one year ago (Naqshbandi & Kamel, 2017). Information on cost is supplied by accounting section and the capacities and technology to be available in the future depend greatly on financial investments, both planned and recently undertaken. Demands hinge not only on the marketing strategy of the firm, but on the competition and the economic climate (McClain & Thomas, 2003).

2.2. Hypotheses Development

Research works on ICT while presumably sound and strategically compelling, may have ignored the managerial impacts of ICT deployment and usage for competitive enhancement of an enterprise. Nigel, Kraemer, and Gurbaxani (2004) undertook a study on "Information technology and Organizational Performance: An Integrative Model of IT Business Value". The study involved exploratory review of literature on the association between information technology and organizational performance. Study found that IT was valuable, but the extent and dimensions are dependent upon internal and external factors including complementary organizational resources of the firm and its trading partners as well as the competitive and macro environment. Fernandez and Borias (2008) investigated the impact of ICT on organizational performance in a Brewing in Dublin, Ireland, using a sample of 300 respondents from five departments of the Brewing namely Brewing, Engineering, Marketing, Distribution and Safety Departments. The study employed research survey design and found that ICT had a positive and significant impact on organizational performance in the Brewing he studied. In a related study by Jalagat and Al-Habsi (2017) the study found significant positive relationship between IT's use of variables of internet applications, mobile and devices, data management system and college performance in the measures of financial performance, accountability, quality service and operational efficiency. Studies have also buttressed strong correlation between ICT utilization and improving performance of employees in Local Government Administrations in South Africa. In another study, Day, Paquet, Scott, and Hambley (2012) deployed Exploratory Structural Equation Modeling to assess the moderating effect of organisational ICT support in the interface of perceived information and communication technology demands on employees and outcomes with the results showing partial moderating effects. A study was conducted by Sagir (2013) on impact of organizations as Information Communication Processors on the Effectiveness of a Brewery industry in Lagos using a sample of 260 respondents, interviewed through structured and undisguised questionnaire Study affirmed positive relations

between ICT and effectiveness of organizations. Although the study made appreciative impacts on ICT usage, it made limited impacts on management of ICT in the organizations. In their empirical study to investigate the ICTbased innovations on organisational performance, Yunis, El-Kassar, and Tarhini (2017) found corporate entrepreneurship mediating the relationships. Study was however limited by research scope in use of instrument and sampling procedure. The corollary of this study was effort by Nyarko & Kozari to assess the use of ICTs among agricultural extension workers and implications on service delivery extension. With a sample of 153 field extension workers, structured questionnaire was adapted to glean information from sample respondents. Statistical packages including IBM and SPSS version-22 were instrumental bases for analysis. Finding had it that agricultural extension officers use ICT for personal communication beyond extension activities. Aligning with the above, the hypotheses to be tested are:

- H1. There is no relationship between ICT integration and organizational effectiveness.
- H2. There is no relationship between ICT availability and effectiveness of organization.
- H3. There is no relationship between ICT management polices organizational effectiveness.

The model that explains the above relationships is shown in the Figure 1:
The below model illustrates how ICTM’s constructs of integration, infrastructures and management policies relate to measures of organisational effectiveness of productivity, commitment, competitiveness, cost reduction, profitability and organisational image. of Electricity Distribution Company of Nigeria (EDCN).

3. Methodology

This research work adopted a descriptive survey design in exploring the opinions of the respondents on relationship between ICTM and organizational effectiveness of EDC. The population of 937 from which a sample size of 280 was randomly selected, consisted of all employees of the EDC in South-South Nigeria namely: The Port-Harcourt Electric Power Distribution Company (EPDC) Plc in Rivers state; and the Benin Electricity Power Distribution Company (EPDC) plc in Edo state. The Port-Harcourt and Benin Grids have subsidiaries in Balyesa and Delta states respectively. Electronics e-mail survey through structured questionnaire was used to elicit responses from sampled employees. The mailed Questionnaire was organized in two sections - A and B, in which A dealt with demography of the respondents and B for obtaining information pertaining to the subject focus of the research. A five-point Likert scale was designed to elicit responses ranging from strongly agree (SA - 5), agree (A - 4), neutral (N - 1), disagree (D - 3), and strongly agree (SD - 2).

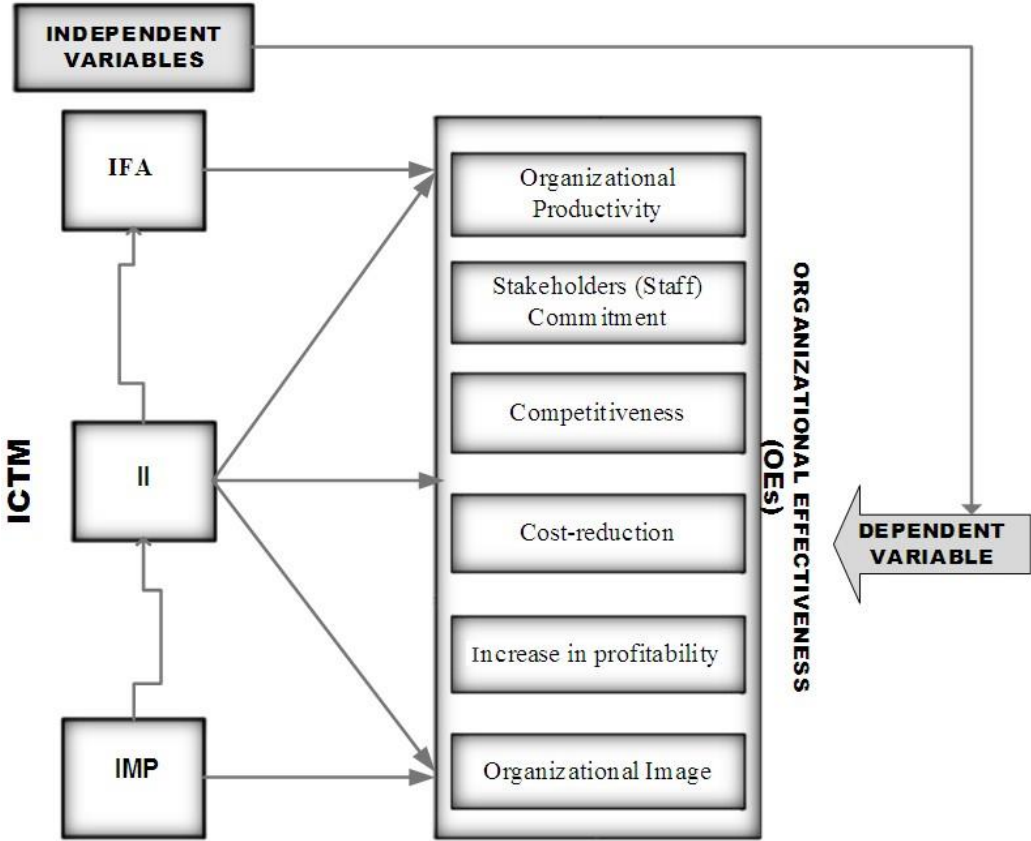


Figure 1. Authors’ model showing relationship between ICTM and organizational effectiveness (2021). Instrument reliability Appendix B was confirmed at Cronbach’s alpha ($\alpha = 0.93$) and content validity (Straub, Boudreau, & Gefen, 2004) was deployed to measure the appropriateness of the research instruments. Confirmatory Factor analysis was used to test for the good-fit of the variable for the analysis Appendix C. The CFA carried out, complements the investigation result and erodes every doubt about the validity of the questionnaire used for the analysis. Descriptive statistics of the Mean, and standard deviation were used for the analysis whereas Pearson Product Moment Correlations (PPMC) alongside multiple regression engaged to test the hypotheses by means of the Statistical Packages for Social Sciences, version 26.1, at $p < 0.05$ level of

significance. Also Microsoft Visio 2016 for Management Model Development software was used for the Conceptual framework.

Model specifications are:

$$OEs = \delta_0 + \delta_1, IFA + E_1 \tag{1}$$

$$OEs = \square_0 + \square_1, II + E_2 \tag{2}$$

$$OEs = \square_0 + \square_1, IMP + E_3 \tag{3}$$

Where $\delta_0, \square_0, \square_0$, are the constant terms while $\delta_1, \square_1, \square_1$, are the coefficients Whereas $E_1...E_6$ are the Error terms.

OEs = Organizational Effectiveness.

IFA = ICT Facility Availability.

II = ICT Integration.

IMP = ICT Management Policy.

4. Results

4.1. Descriptive Analysis of ICTM Constructs

Table 1 depicts the descriptive analysis of the mean value of ICT facilities availability among the electricity distribution company in the south-south Nigeria. All the mean shown in the table are above the bench mark of 2.5 except, IFA_2 (2.0564±0.867), this is because the electricity distribution company has not fully embraced the optimal use of POS and PMM machines for operations, therefore the responses were below acceptable limit. The highest mean value IFA_3 (3.664±0.679) above 2.5 acceptable limits was obtained as a result of the high use of internet connectivity and websites for online services such as e-mail addresses.

Table 1. Descriptive analysis of the mean value of ICT facility availability.

Variable	ICT Facility Availability	Mean	Std. Deviation	Remark
IFA_1	We have multimedia such as projector for management board meetings	3.179	0.659	Agree
IFA_2	My organization has introduced the use of P.O.S Machine, Prepay Meter Machine (PMM) and customers use them	2.036	0.867	Disagree
IFA_3	Our organization has internet connectivity and websites for our online services such as e-mail addresses	3.664	0.679	Agree
IFA_4	We have ICT Department fully equipped for functional ICT and telecommunication services (telephone calls)	3.236	0.458	Agree
IFA_5	We have Wi-Fi and Mi-fi and intercom facilities	2.625	0.976	Agree

A grasp at Table 2 reveals the mean statistics of value of ICT integration. The mean responses are all above bench mark of 2.5 level of acceptance. The highest mean obtainable was identified with II_5 (3.671±0.580) with the affirmation that memo and information letters are communicated to stakeholders easily through the use of ICT. The lowest mean value of all the items was identified with II_4 (2.939±1.094).

Table 2. Descriptive analysis of the mean value of ICT integration.

Variable	ICT Integration	Mean	Std. Deviation	Remark
II_1	Our staff has been trained on the use of ICT facilities and thus enhance workflow	3.750	0.517	Agree
II_2	Our organization has migrated from manual and traditional to automated payment mechanism	3.754	0.568	Agree
II_3	We use collaborative work through staff engagement in use of ICT	3.157	0.840	Agree
II_4	Our organization share information and communication resource easily between staff	2.939	1.094	Agree
II_5	Memo, and information letters are communicated stakeholders easily through the use of ICT	3.671	0.580	Agree

The descriptive statistics in Table 3 shows the mean value of ICT Management Policy, with each dimension assuming the value above the bench mark of 2.5. This means that the electricity distribution company has good knowledge of ICT policy and it is being implemented satisfactorily for the benefit of the stakeholders. However,

item IMP 4 (3.154±0.843) show that effort need to be made to periodically review and modified ICT polices to reflect challenges in ICT business environment.

Table 3. Descriptive analysis of the mean value of ICT management policy.

Variable	ICT Management Policy	Mean	Std. Deviation	Remark
IMP_1	Our organization has an ICT guide to decision making or action	3.668	0.472	Agree
IMP_2	We have a laid-down course of action with the organization	3.593	0.492	Agree
IMP_3	Our organization laid-down the limits within which ICT decisions are made and operated	3.104	0.877	Agree
IMP_4	We periodically reviewed and modified ICT policies to reflect challenges in ICT business environment	3.154	0.843	Agree
IMP_5	Our ICT policies is to an extent is to adopt ICT to reduce managerial cost	3.443	0.546	Agree

The descriptive analysis of the mean value for organizational effectiveness is reflected in Table 4. On the measures of organisational effectiveness, agreement was reached among the respondents that ICT installation has increased productivity and profitability margin; and stakeholders’ commitment to the organization, and has benefited the organization better than traditional and manual operation. The mean value for the items being above 2.5 bench mark limit is within the acceptance range.

Table 4. Descriptive analysis of the mean value of organisational effectiveness.

Variable	Organisational Effectiveness	Mean	Std. Deviation	Remark
OEs_1	ICT installation has increased our productivity and profit margin	3.755	0.432	Agree
OEs_2	ICT Management has increased stakeholders’ commitment to the organization	3.429	0.674	Agree
OEs_3	ICT management has benefited our organization better than traditional and manual operating	3.825	0.381	Agree
OEs_4	ICT management in our organization has helped to keep sales information intact	3.557	0.539	Agree
OEs_5	We get information easily from our stakeholders	3.904	0.371	Agree

Table 5a. Summary of correlation matrix and Logistics regression of the hypotheses formulated.

Variable	OEs	1	2	3					
OEs	1.000								
IFA	-0.023	1.000							
II	0.258	-0.271	1.000						
IMP	0.218	-0.605*	0.290	1.000					
R	R Square	Adjusted R Square	Std. Error of the Estimate						
0.348 ^a	0.121	0.105	0.357						
ANOVA^a									
Model	Sum of Squares	Df	Mean Square	F	Sig.				
Regression	4.822	5	0.964	7.561	0.000 ^b				
Residual	34.949	274	0.128						
Total	39.771	279							
Coefficients^a									
Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF

(Constant)	1.230	0.494		2.488	0.013	0.257	2.202		
IFA	0.152	0.085	0.149	1.788	0.075	-0.015	0.320	0.460	2.174
II	0.242	0.064	0.228	3.808	0.000	0.117	0.368	0.891	1.122
IMP	0.263	0.102	0.235	2.587	0.010	0.063	0.463	0.389	2.569

Note: Dependent Variable = OEs (Organizational Effectiveness).
Independent Variable = IFA (ICT Facility Availability), II (ICT Integration) and IMP (ICT Management Policy).
Source: Researcher Computation, using SPSS Version 26).

4.2. Hypotheses testing

Table 5a displays the result of multiple logistic regressions (LR) performed in determining the level of prediction of IFA, II and IMP to OEs, IFA ($\beta = 1.788$, $P = 0.075$); II ($\beta = 3.808$, $P = 0.000$); and IMP ($\beta = 2.587$, $P = 0.010$). Results strengthen the evidence that ICT integration and ICT management policy contributed significantly to organizational effectiveness (OEs). The ‘*’ in the correlation matrix shows high correlation ($r = 0.605$) which suggests further analysis of LR. The logistic regression column, ‘a’ depicts the R-value of the predictors (independent variables, IFA, II and IMP) showing 0.348 contribution to the dependent variable OEs. The ‘b’ reflects the F-ratio ($r = 7.561$) which is significant at $p = 0.000 < 0.05$, thus affirming strength of relationship. The column, IFA ($t = 1.788$, $p = 0.075$), II ($t = 3.808$, $p = 0.000$) and IMP ($t = 2.587$, $p = 0.010$) support the standardized coefficient, IFA (0.149), II (0.228) and IMP (0.235). In the confidential interval, IMP shows high lower and upper bound (0.063 - 0.463) evident that II and IMP contributed more significantly than IFA (ICT in predicting Organizational Effectiveness (OEs) at $p < 0.05$ level of significance. Furthermore, with the Variance Inflation Factor (VIF = 2.174, 1.122 and 2.569) being below the level of diagnosing which is 10, it implies low tolerance of co linearity in the regression analysis. The model plot with factor correlation categorically explained the above table clearly.

Model 1

H1. There is relationship between ICT Availability and organizational effectiveness.

The covariance estimated standard (0.575) and calculated ($p = 0.001 < 0.05$) makes the hypothesis statistically significant leading to the rejection of the null hypothesis. The ICT Availability and organizational effectiveness have relationship (see Appendix C).

Model 2

H2 There is relationship between ICT Integration and effectiveness of organization.

This the covariance estimated standard (0.413) and calculated p- value (0.001) less than 0.05 level of significance imply that the hypothesis is statistically significant. Consequent upon the above result, the ICT Integration and organizational effectiveness have relationship (see Appendix C).

Model 3

H3 There is relationship between ICT Management Polices organizational effectiveness.

With covariance output of estimated standard (0.908) calculated p- value (0.001) less than 0.05 level of significances strengthens the evidence that the hypothesis is statistically significant and implies rejection of the null hypothesis (see appendix). The ICT Management Policy and organizational effectiveness have relationship. Off the three factors predicted organizational effectiveness, ICTM Policy has higher value of correlation than the other two factors.

4.3. Factor Correlation Analysis of ICTM Variables

The factor analysis and model pilot showing how ICTM constructs correlate with measures of organisational effectiveness is aptly depicted in Table 5b & Figure 2:

Table 5b. Factors correlation.

	Estimate	Std. Error	z-value	p	95% Confidence Interval	
					Lower	Upper
IFA↔II	0.575a	0.063	9.070	< 0.001	0.451	0.699
IFA↔IMP	0.413 b	0.052	7.955	< 0.001	0.515	0.311
II↔IMP	0.908 c	0.046	19.688	< 0.001	0.998	0.817

Model plot

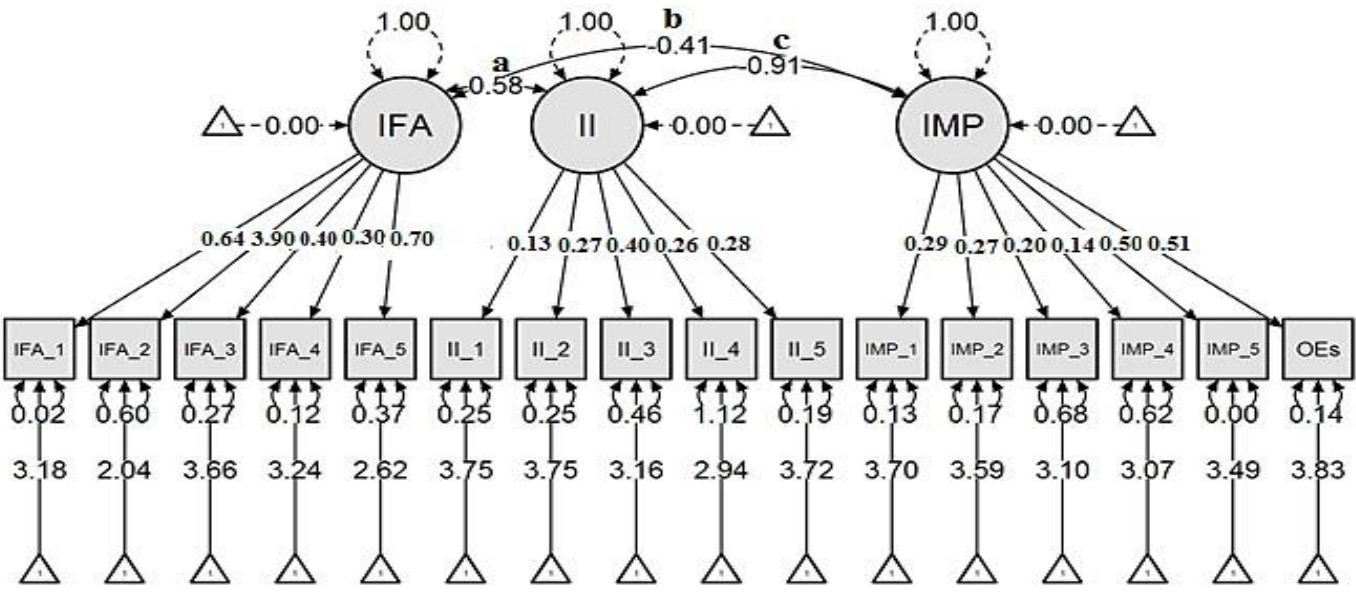


Figure 2. Factor analysis of the correlation of information communication management variables as it impacts on organizational effectiveness of electricity distribution companies in the South-South Nigeria.

The above model plot is an output of the Confirmatory Factor Analysis (see appendix) designed to examine the nature of the relationships between the observed measures or the predictors, where IFA and IMP predicting OEs = 0.58’ II and IMP predicting OEs = 0.91; and IFA and IMP predicting OEs = 0.41. The posited measurement model for the 20-items with five Likert scale is as presented in the model plot (see Figure 2). The conventional model plot notations are depicted by circles and indicators by rectangles or squares. Factor loadings can be found on the large unidirectional arrows, and are clearly outlined in the tables of factor covariance (see Appendix C) where all are positive and significant. Consequently, in the model plot (Figure 2), all the factor loadings are significant at (0.001< 0.05) level of significance. All the variances and residuals have positive values which shows that the predictor (IFA, II and IMP) are positive and significantly determines the dependent variable (OEs) thus IMP which is ICT Management Policy has higher relationship value (0.91) than the other two, IFA (0.58) and II (0.41).

5. Discussion

From the model 1, finding has shown evidence of significant relationship between ICT Facility Availability (IFA) and organizational effectiveness (OEs) of electricity distribution companies in Nigeria. Evidently organisational effectiveness will to a large extent be affected by integration and deployment of ICT facilities. It is no doubt that a number of organizations are craving for new technology to remain at the competitive edge. In addition, the model specification has revealed effective usage of ICT resources at management board meeting and the introduction of innovative ICT devices have helped to facilitate the distribution of electricity companies; notwithstanding, the finding has revealed that the use of these machines are in low key. The second finding has shown that ICT integration significantly impact on organizational effectiveness in south-south Nigeria. This was exhibited in table 4.9 under summary of multiple regression analysis for hypothesis 2. Results align with the findings of Ssewanyana and Busler (2007) that investigated the extent of incorporating and usage of ICT on one hundred and ten firms with respect to their contributions. The above evidence correlates with the current study in such areas as ICT integration and utilization. Heeks (2002) also advocated that ICT integration is far-reaching than firms sourcing ICT contract from external firms. This, study has confirmed would not give organizations an upper grip on the ICT system. Findings from the second hypothesis conform to the work of Hyunjin et al. (2020). The finding from the analysis of third hypothesis affirms that ICT management polices significantly influence organizational effectiveness of Electricity Distribution Companies in Nigeria. The result accords with (Calder, 2011). The effect of size of the ICT Management on the Organizational effectiveness is even more visible with the variables of the ICT Management Policy as could be seen in Table 5(b). This is aspect is the central focus of this research.

6. Implications for Theory, Research Value, and Future Research

The piece of research work revolves around existing theories on ICTM through construction and validation of model relating typologies of ICTM to effectiveness of Electricity distribution companies in Nigeria. While it could be averred that research endeavors in this area have addressed the use, benefits, impacts and trends of ICT, literature on the management of the ICT is still scanty. It becomes imperative that strategies and processes for managing ICT infrastructures be developed in order to optimize ICT effectiveness. It is within this context that this research found its originality as it is the first of its kind in the pool of extant literature that underscored the place of management processes in the use of ICT resources. Implicated in the above is the need to review ICT

management policy periodically to meet the increasing dynamics in the ICT environment. It is also instructive to assert that proper management of ICT device availability and integration will bear positively on the organizational effectiveness. Moreover, the study will form a vital platform for other researchers and pointed grey areas to research into related areas such as customers' opinion and satisfaction with ICT's device and its consumption in the south-south, Nigeria. Future research may also conduct a comparative analysis of ICTM deployment, use and integration across countries.

7. Conclusion

Electricity Distribution Companies in the South-South Nigeria are majorly two: the Benin Electric Distribution Company controlling the Edo and Delta region, and the Port-Harcourt Electricity Distribution Company controlling Rivers, Bayelsa, Akwa-Ibom and Cross-Rivers states. The study stressed the need for the regional power grids to adopt the Information Communication Technology in their effort to ensure swift and stable distribution of electricity in the region. To be fully integrated and for effectiveness, the distributing companies must brace-up actions to imbibe rudiments of sound management practices. Even as at now, quite a handful of companies have deployed prepay meter machine (PMM) and Point of Sales (POS) machine to assist the stakeholders and investors in designated areas. The ICT Facilities Availability is yet to cover all the South-South Nigeria. Consequently, the study has foreclosed the strategic bearing of ICTM constructs of ICT availability, ICT integration and ICT management policy on the organizational effectiveness of the Electricity Distribution Companies.

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