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COMPUTER MODEL ANALYSIS OF THE PERFORMANCE OF ICT IN THE NIGERIAN UNIVERSITIES

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Abstract— **This paper proposes twenty-four performance indices contained in the questionnaire that was used for the evaluation of the contributions of some factors to the current performance of Information and Communication Technology (ICT) in Nigerian universities. The researchers surveyed forty five out of sixty three public universities that cut across the six geo-political zones of Nigeria by administering copies of the questionnaire at meetings with staff and students. The indices, through the responses, were subjected to factor analysis by principal components using Statistical Package for Social Scientists (SPSS). From this analysis, four factors; namely communication and feedback, study aid, processing and administration and management and relationship were extracted and the percentage contribution of each factor to the current performance of ICT in the university system in Nigeria was estimated. It was discovered that the total sum of the percentage contributions was less than 100. This showed that the performance indices of some extraneous factors which contribute in no small measure to the current performance of ICT in Nigerian universities were not given consideration in the research instrument. Such extraneous factors include but not limited to staff training, security of lives and properties, discipline among staff and student, curriculum and government policy on ICT. Moreover, a factor scores coefficient matrix was generated and used to estimate and rank the contribution of each respondent to the performance figure.**

Keywords— Nigerian Universities, Information, Communication, Technology, Model, Factor Analysis, Performance

I. INTRODUCTION

Nigeria as a developing country is currently experiencing rapid transformation in the various sectors of her economy. Rapid growth is being experienced with the participation of both public and private organizations in the Information and Communication Technology (ICT) sector. This has continued to pave way for ICT as a tool for finding, exploring, analyzing, exchanging and presenting information responsibly and without discrimination. It is reported in [1] that ICT is presently a veritable tool for quick access to ideas and experiences from a wide range of people, communities and cultures and also offers solid support for improved and enhanced service delivery. Selected parameters for measuring the overall contributions of ICT to the university educational system in Nigeria are taken based on their support for quick access to information, improved response time, increased usefulness, greater reliability, availability and so on [2]-[5]. Such support could be in areas such as lecture delivery, private studies, information disseminations, program (conferences and seminars) planning and execution, communication at different levels, crises prevention and management. With this array of interest areas, ICT has become a versatile tool for running a smooth and efficient university system. Positive attitudes towards financing good ICT projects for the universities by major stakeholders such as government, parents and the private sectors is inevitably of paramount importance [6].

In [7], factor analysis was used for measuring the effectiveness and usefulness of ICT in managements and investments. A special base model for the systematic study of the features, factors and delivered benefits was used for the analysis. Survey was employed as an instrument to operationalize the model. The results revealed that system quality, service quality, use, user satisfaction and net benefits are the underlying constructs that guide decision making and planning process for successful ICT implementations. In [8], an evaluation of ICT projects performance in the public sector of the Nigerian economy was carried out. A questionnaire comprising of fifty three (53) performance indices of ICT projects was used for data collection and evaluation.

Completed questionnaires were received from forty five (45) Federal Ministries, Departments and Agencies; thirty six (36) States and Federal Capital Territory (FCT); one model local government from each State; thirty seven (37) Universities; forty two (42) Polytechnics and forty three (43) Colleges of Education. The data collected were subjected to factor analysis by principal components using SPSS. The results obtained placed high premium on the involvement of users in the effective planning and implementation as well as efficient management of ICT projects. It was also reported that the approach to ICT projects' planning, implementation and management should be evolutionary and allow for the active participation of the community of users.

The current study takes a holistic view of the practical issues of the conceptualization of the impact of ICT and provides data that serve the basis for the determination of the contribution of some factors to its current level of performance in Nigerian universities. It also provides data that is relevant for drawing conclusion based on comparison between results from the current study and some related works.

II. MODEL AND ANALYSIS OF ICT'S PERFORMANCE INDICES

The Indices or variables used for evaluating the performance of ICT in Nigerian universities are numerous and are related to one another for the i^{th} respondent in a general form as follows:

$$Y_e = \sum_{1}^{n} a_{e,f} X_f \; ; \; f = 1,2,\dots,n \qquad (1)$$

where Y_e represents the e^{th} respondent, $a_{e,f}$ represents the assessment of the f^{th} index by e^{th} respondent, X_f represents the f^{th} index and n is the number of indices.

In this research, the main reason behind the use of factor analysis by principal components was to generate some clusters of performance indices. Each cluster is a factor with its percentage contribution to the overall performance of ICT. The following statistics were derived and used to achieve this objective.

a. Descriptive Statistics.
b. Correlation Matrix.
c. Bartlett's and Kaiser-Mayer Olkin (KMO) tests.
d. Communalities.
e. Initial Factor loadings.
f. Rotated factor loadings.
g. Factor Score coefficient matrix.
h. Eigenvalue.

The descriptive statistics defined the mean and standard deviation of the scores of each decision variable given by the respondents. The correlation matrix showed the degree of pair-wise relationships of the performance indices. A positive value in the correlation showed a positive relationship while a negative value dictates a negative relationship. Zero value means there is no relationship between indices. The Bartlett's test of sphericity is used to test the adequacy of the sample from the population. Another measure of sample adequacy is Kaiser-Mayer Olkin (KMO) test. In factor analysis, there is a set of factors which are generally referred to as "common factors", each of which loads on some variables. There is another set of factors, which are extraneous to each of the variables. The proportion of the variance of a variable explained by the common factor is called the "communality" of the variable [9]-[10]. The factor loading associated with a specific performance variable is the correlations between the factor and the variable's standard scores. Each factor represents an area of generalization that is qualitatively distinct from that represented by another factor. The degree of generalization found between each variable and each factor is referred to as "factor loading". The farther a loading is from zero in the positive direction, the more we can conclude the contribution of a variable to a factor. In SPSS, the component matrix can be rotated orthogonally by varimax, equamax, quartimax or promax for the purpose of establishing a high correlation between variables and factors. While the component score matrix of the factors is generated to evaluate the contributions of each of the variables to the performance of the university system, the eigenvalue and percentage variance of the extracted factors are generated for evaluating the contribution of each factor [11].

III. DATA SURVEY AND COLLECTION

The researchers formulated some performance indices of ICT which were used to design the questionnaire shown in Appendix 1. Each of the formulated performance indices was offered loose linguistic representation and range of values as shown in Table 1.

TABLE 1: MATRIX OF THE WEIGHT ATTACHED TO LINGUISTIC VALUE

Linguistic Repre-sentation	Exce-llent	Very Good	Good	Average	Poor
Range of Values	4.01-5.0	3.01-4.0	2.01-3.0	1.01-2.0	0.0-1.0

The questionnaire served as the research instrument and its first part provides vital information about each respondent while the second part provides five columns where a respondent can rank each of the twenty four indices as 'Excellent', 'Very Good', "Good', 'Average' or 'Poor'. The questionnaire was administered to forty five out of sixty three [12] public (government) universities selected across the six geo-political zones of Nigeria. A total of fifty (50) staff and one hundred and fifty (150) students were surveyed in each university. The summary of the number of questionnaires that were duly completed and returned is presented in Table 2.

TABLE 2: SUMMARY OF THE SURVEY ACROSS THE GEO-POLITICAL ZONES

Zone	University	Total Questionnaire Retuned by staff	Total Questionnaire Returned by students	Total Returned	Total not returned
North Central	University of Ilorin, Ilorin	47	121	168	32
	Kogi State University, Ayigba	46	109	155	45
	Benue State University, Makurdi	34	134	168	32
	University of Jos, Jos	50	132	182	18
	University of Abuja, Abuja	43	110	153	47
	University of Agriculture, Makurdi	23	108	131	69
	Federal University of Technology, Minna	37	99	136	64
	Nasarawa State University, Keffi	22	134	156	44
North East	University of Maiduguri	49	127	176	24
	Federal University of Technology, Yola	50	145	195	5
	Abubakar Tafawa Balewa University, Bauchi	29	129	158	42
	Adamawa State University, Mubi	39	149	188	12
	Bukar Abba Ibrahim University, Damaturu	49	141	190	10
	Gombe State University, Gombe	50	121	171	29
North West	Nigerian Defence Academy, Kaduna	44	128	172	28
	Ahmadu Bello University, Zaria	45	147	192	8
	Usman Dan Fodio University, Sokoto	45	134	179	21
	Kebbi State University, Benni-Kebbi	48	142	190	10
	Bayero University, Kano	42	135	177	23
	Ibrahim Babangida University, Lapai	43	136	179	21
	Kaduna State University, Kaduna	29	128	157	43
	Kano University of Science and Technology, Wudil	46	121	167	33
South East	Abia State University, Uturu	50	145	195	5
	University of Nigeria, Nsukka	50	127	177	23
	Michael Okpara Federal University of Agriculture, Umudike	34	135	169	31
	Nnamdi Azikiwe University, Awka	45	143	188	12
	Enugu State University of Science and Technology, Enugu	43	142	185	15
	Ebonyi State University, Abakaliki	49	150	199	1
	Imo State University, Owerri	47	129	176	24
South South	University of Benin, Benin	50	132	182	18
	University of Port-Harcourt, Pout-Harcourt	50	150	200	0
	Federal University of Petroleum Resources, Effurun	32	136	168	32
	University of Calabar	41	142	183	17
	University of Uyo, Uyo	39	135	174	26
	Niger Delta University, Yenegoa	38	125	163	37
	Ambrose Alli University, Ekpoma	41	134	175	25
South West	Obafemi Awolowo University, Ile-Ife	50	150	200	0
	University of Lagos, Lagos	38	123	161	39
	Federal University of Technology, Akure	50	150	200	0
	Ladoke Akintola University of Technology, Ogbomoso	49	145	194	6
	Adekunle Ajasin University, Akungba-Akoko	50	150	200	0
	University of Ado-Ekiti, Ado-Ekiti	50	150	200	0
	University of Agriculture, Abeokuta	36	142	178	22
	Lagos State University, Ojoo	39	132	171	29
	University of Ibadan, Ibadan	47	127	174	26
	Total	1928	6024	7952	1048

A total of nine thousand (9000) copies of the questionnaire were administered through direct and online contacts. In the direct contact, the researchers were physically present in twenty of the surveyed universities including The Federal University of Technology, Akure (FUTA). FUTA is the host University of the Researchers and is located in the South-West geo-political zone of Nigeria.

With a view to cut the cost associated with transportation over long distances, copies of the questionnaire where administered through third parties in the remaining twenty five universities. The third parties received copies of the

questionnaire through online (internet) service. Duly completed and returned questionnaires were sent back to the researchers through postal service.

In all, seven thousand nine hundred and fifty two (7952) respondents (which include both staff and students) returned duly completed questionnaires from the forty five surveyed universities. The responses were verified and validated through follow-up meetings and personal interviews with the respondents in each university.

IV. RESULTS AND INTERPRETATION

All the 7952 responses were subjected to factor analysis by principal components using SPSS. The descriptive statistics shown in Table 3 presents the means and standard deviation of the rating of the performance of ICT in the universities on each of the indices.

TABLE 3: DESCRIPTIVE STATISTICS OF RAW SCORES

Variable	N	Mean	Std. Deviation
CRSREG	7952	3.72	.776
PROADM	7952	3.68	.786
DELLEC	7952	2.68	.786
STUASS	7952	3.12	.864
STURES	7952	3.28	.826
STUSEM	7634	3.04	.676
STUGRW	7634	3.08	.954
STUIDW	7952	3.48	.985
CONSEM	7952	3.20	.894
STUSTU	7952	4.00	1.095
STUSTA	7952	3.68	1.085
STUPAR	7952	3.88	1.211
STUMAN	7634	2.79	.956
STAPAR	7952	2.68	.926
STAMAN	7952	4.16	.833
PARMAN	7952	2.44	.898
RESPRO	7952	3.20	.894
RESCHE	7952	3.00	.980
FINPAY	7952	3.36	.975
CRIPRE	7952	2.68	.786
CRIRES	7952	2.56	.804
EXTLIN	7952	3.24	1.069
SOCACT	7952	2.56	.804
GENMAN	7952	3.32	.968

Appendix 1 provides index to the variable names (abbreviations). For example, the mean and standard deviation of the rating on 'support for students course registration (CRSREG)' are 3.72 (74.40%) and 0.776 respectively while the mean and standard deviation of the rating on 'support for processing students admission requests (PROADM)' are 3.68 (73.60%) and 0.786 respectively.

These mean values reveal that on the average, the respondents agreed that ICT provides 'very good' support for students' course registration and processing of students admission request. This interpretation is based on the matrix of the weight attached to the linguistic values presented in Table 1. Similarly, standard deviation of 0.776 and 0.786 represent the statistical measure of dispersion from the mean for the response values for 'support for students course registration' and 'support for processing students admission request' respectively.

The communalities of the performance indices are presented in Table 4. The Table shows that the communalities of 'support for course registration (CRSREG)' and 'support for admission request (PROADM)' are 0.668 and 0.699 respectively. These imply that 66.8% of the variance in 'support for course registration' can be explained by the extracted factors while the remaining 33.2% is attributed to extraneous factors. Similarly, 69.9% of the variance in 'support for processing students admission request' can be explained by the extracted factors, while the remaining 30.1% is attributed to extraneous factors.

TABLE 4: COMMUNALITIES OF VARIABLES

Variable	Initial	Extraction
CRSREG	1.000	.668
PROADM	1.000	.699
DELLEC	1.000	.554
STUASS	1.000	.608
STURES	1.000	.806
STUSEM	1.000	.792
STUGRW	1.000	.785
STUIDW	1.000	.873
CONSEM	1.000	.693
STUSTU	1.000	.886
STUSTA	1.000	.871
STUPAR	1.000	.851
STUMAN	1.000	.645
STAPAR	1.000	.744
STAMAN	1.000	.437
PARMAN	1.000	.521
RESPRO	1.000	.870
RESCHE	1.000	.648
FINPAY	1.000	.861
CRIPRE	1.000	.637
CRIRES	1.000	.691
EXTLIN	1.000	.764
SOCACT	1.000	.496
GENMAN	1.000	.602

The analysis of the correlation matrix presented in Appendix II shows the highest correlation of 0.965 exists between 'Impact on students-students communication (STUSTU)' and 'Impact on students-parents communication (STUPAR)'. The next highest correlation of 0.873 exists between 'Impact on students-staff communication (STUSTA)' and 'Impact on students-students communication (STUSTU)'. The implication of the former is that 'Impact on students-students communication' is very likely to share same factor with 'Impact on students-parents communication'. Similarly, in the latter, 'Impact on students-staff communication

(STUSTA)' is very likely to share same factor with 'Impact on students-students communication'. The least correlation of -0.323 exists between 'Impact on social activities (SOCACT)' and 'Impact on students-staff communication (STUSTA)'. This means that 'impact on social activities' and 'Impact on students-staff communication' are not likely to share same factor.

In factor analysis by principal components, the Bartlett's test of sphericity is used to confirm the adequacy of the sample population by testing the null hypothesis that the variables in the population correlation matrix are uncorrelated and inadequate. The observed significance level of .0000 is used to reject this hypothesis. For this analysis, the Bartlett's test of sphericity produces a χ^2 of 298959.754 with a significance level of 0.0000, which indicates that the sample population is adequate. Another adequacy test is the Kaiser-Meyer-Olkin test. It is used to confirm if the sampling adequacy value is greater than 0.5 for a satisfactory factor analysis to proceeds. The Kaiser-Mayer Olkin (KMO) test produces a measure of 0.814 for this analysis, which further confirms the adequacy of the sample population. These adequacy results are good indicators of the suitability of the application of factor analysis as well.

TABLE 5: EXTRACTED FACTOR LOADINGS

Variable	Component			
	1	2	3	4
STUSEM	.835			
CONSEM	.808			
STUIDW	.798		-.444	
STUSTA	.747	-.480		
STUSTU	.728	-.501		
STUGRW	.721			
STUPAR	.709	-.523		
PROADM	.662			
GENMAN	.606			.434
STAMAN	.605			
STURES	.593		-.455	
STAPAR	.571		.536	
DELLEC	.557		-.476	
CRSREG	.459			
PARMAN	.450	-.450		
FINPAY		.643	.580	
RESPRO	.518	.604	.421	
RESCHE	.511	.553		
STUMAN	.498	-.508		
STUASS	.413	.462	-.458	
EXTLIN				.717
CRIRES				.681
CRIPRE			.412	.591
SOCACT				.515

The initial factor extractions are often achieved in factor analysis by principal components using two different approaches. In the first approach, specific number of factors is specified for extraction while in the second approach, the numbers of factors to be extracted are specified on the basis of a Social Science rule which states that only the variables with loadings equal to or greater than 0.4 should be considered meaningful and extracted for factor analysis. Applying the latter rule on the initial component matrix generated, the extracted factor loadings obtained is presented in Table 5.
From Table 5, it is revealed that:

a. Four factors were extracted,
b. Nineteen variables load on factor 1
c. Nine variables load on factor 2
d. Eight variables load on factor 3
e. Five variables load on factor 4

In order to obtain a meaningful representation of variables and factor mapping along principal axis, the resulted principal component is rotated using orthogonal transformation by varimax, promax, equamax and quartimax. However, the result obtained from the rotation by promax, which is presented in Table 6, appears to be most realistic and meaningful for interpretation among all others. Hence, it is used for the purpose of the analysis. Table 6 reveals four factors with their corresponding loadings as follows:

TABLE 6: FACTOR ROTATION BY PROMAX

Variable	Component			
	1	2	3	4
STUSTA	.846			
STAPAR	.822			
STUMAN	.790			
STUPAR	.774			
STUSTU	.750			
PARMAN	.746			
STAMAN	.532			
SOCACT	.528			
CONSEM	.440			
STURES		.860		
STUIDW		.826		
STUASS		.783		
DELLEC		.734		
STUSEM		.644		
STUGRW		.615		
RESPRO			.911	
FINPAY			.898	
PROADM			.678	
CRSREG			.659	
RESCHE			.627	
EXTLIN				.819
CRIPRE				.718
CRIRES				.699
GENMAN				.592

Factor 1- Communication and feedback, loads on
a. Impact on students-staff communication (STUSTA)
b. Impact on staff-parent communication (STAPAR)
c. Impact on students-management communication (STUMAN)
d. Impact on students-parents communication (STUPAR)
e. Impact on students-students communication (STUSTU)
f. Impact on parent-management communication (PARMAN)
g. Impact on staff-management communication (STAMAN)
h. Support for social activities (SOCACT)
i. Support for conferences and seminars (CONSEM)

Factor 2 – Study aid, loads on
a. Support for students' research/projects (STURES)
b. Support for students' individual work (STUIDW)
c. Support for students' assignments (STUASS)
d. Impact on delivering of lectures (DELLEC)
e. Support for students' seminar (STUSEM)
f. Support for students' group work (STUGRW)

Factor 3 – Processing and Administration, loads on
a. Impact on results processing (RESPRO)
b. Impact on financial payment (FINPAY)
c. support for processing students' admission request (PROADM)
d. Support for students' course registration (CRSREG)
e. Impact on results checking (RESCHE)

Factor 4 – Management and Relationship, loads on
a. Impact on external linkages (EXTLIN)
b. Impact on crises prevention (CRIPRE)
c. Impact on crises resolution (CRIRES)
d. Impact on general management (GENMAN)

The results placed high emphasis on the use of ICT as veritable tool for communication and feedback, study, processing, administration, management and relationship. The use of ICT for communication and feedback on important matters is paramount for sustaining stable and smooth academic calendars in the universities. A free-flow communication and feedback aided by ICT in the universities contributes immensely to high quality study, course registration, results processing as well as aversion and resolution of crises. It is also important for effective management and good relationship towards meeting the needs of the different participating parties in the campuses. This corroborated the view presented in [7] that ICT is a standard tool for running a system, providing quality services and meeting users' satisfaction. The use of ICT as study, processing, administrative, management and relationship tool also corroborated the position held in [8] that ICT provides a medium for active participation of community of users.

A factor can also be estimated as a linear combination of the original variables. Factor score generated by SPSS for the research variables produced a coefficient matrix shown in Table 7. The coefficient matrix is used for the estimation of the performance of ICT from the view of each respondent to each of the extracted factors. This is done by forming a linear equation of the weighted standard scores of each respondent on the variables as follows:

$$M_{b,c} = \sum_{m=1}^{24} d_{a,c} W_{b,a} \quad b = 1,2,\ldots,x;\ m = 1,2 \quad (2)$$

where $M_{b,c}$ represents the contribution of b^{th} Respondent to c^{th} factor, $d_{a,c}$ represents the factor score coefficient of a^{th} performance index for c^{th} factor, $W_{b,a}$ represents the standard score of b^{th} Respondent for a^{th} performance index and x represents the population of the sampled Respondents. $W_{b,a}$ is estimated from:

$$W_{b,a} = A + (p_b - q_b)/e_b \quad (3)$$

where A represents the allowable minimum raw score for the performance index; in this instance, it is 1; p_b represents the raw score of b^{th} performance index; q_b represents the mean of the raw scores of b^{th} performance index by the sampled Respondents; e_b represents the standard deviation of the raw scores of b^{th} performance index by the sampled Respondents.

Given that the standard scores by the b^{th} respondent in the twenty four variables under consideration are $W_{b,1}$, $W_{\mathbf{b},2}$, $W_{\mathbf{b},3}$ . . . , $W_{\mathbf{b},24,}$ then the performance of ICT based on the view of each respondent, in the areas of communication and feedback, study aid, processing and administration and management and relationship are denoted by M_1 $M_{2,}$ M_3 and M_4 and are defined as follows:

$$M_1 = 0.057W_{b,1} + 0.083W_{b,2} + \ldots + 0.076W_{b,24} \quad (4)$$
$$M_2 = -0.101W_{b,1} + 0.088W_{b,2} + \ldots + -0.003W_{b,24} \quad (5)$$
$$M_3 = 0.141W_{b,1} + 0.117W_{b,2} + \ldots + 0.080W_{b,24} \quad (6)$$
$$M_4 = -0.042W_{b,1} + -0.087W_{b,2} + \ldots + 0.173W_{b,24} \quad (7)$$

Based on the matrix presented in Table 1, the standard scores by ten randomly selected respondents for each of the twenty four variables under consideration are presented in Table 8. Table 9 shows the calculated percentage contributions of each of the ten sampled respondents to each of the four factors. It is revealed that sampled respondent described with identity Res6 has highest contribution of 7.100 (13.10%) to factor 1 while sampled respondent Res3 has the highest contribution of 3.581 (32.00%) to factor 2. Similarly, sampled respondent described with identity Res6 has highest contribution of 2.090 (19.32%) to factor 3 and sampled respondent Res3 has the highest contribution of 1.459 (18.43%) to factor 4.

TABLE 7: FACTOR SCORES COEFFICIENT MATRIX

Variable	Component			
	1	2	3	4
CRSREG	.057	.101	.141	-.042
PROADM	.083	.088	.117	-.087
DELLEC	.070	.028	-.174	.045
STUASS	.052	.131	-.167	.037
STURES	.074	.113	-.166	-.125
STUSEM	.104	.021	-.084	.051
STUGRW	.090	.064	-.076	.157
STUIDW	.100	.020	-.162	-.069
CONSEM	.101	.007	.037	-.011
STUSTU	.091	-.143	-.098	-.082
STUSTA	.093	-.137	-.018	-.111
STUPAR	.088	-.149	-.078	-.078
STUMAN	.062	-.145	.140	.018
STAPAR	.071	-.093	.196	-.083
STAMAN	.076	-.076	.013	.007
PARMAN	.056	-.128	.131	-.026
RESPRO	.065	.172	.154	-.100
RESCHE	.064	.157	.016	-.107
FINPAY	.040	.183	.212	.019
CRIPRE	.031	-.065	.151	.236
CRIRES	.032	-.103	-.074	.272
EXTLIN	.049	.053	.059	.286
SOCACT	.010	.111	-.084	.206
GENMAN	.076	-.003	.080	.173

TABLE 8: STANDARD SCORES BY TEN SAMPLE RESPONDENTS

Respo-ndent	COUREG	ADMREG	DELLEC	STUASS	RESPRO	STUSEM	GROWRK	STUINW	CONSEM	STUSTU	STUSTA	STUPAR	STUMAN	STAPAR	STAMAN	PARMAN	RESPRO	RESCHE	FINPAY	CRIPRE	CRIRES	EXTLIN	SOCACT	GENMAN
Res1	4	4	2	1	4	3	2	4	3	4	4	4	2	4	4	2	4	3	3	2	2	1	1	3
Res2	4	3	2	4	4	2	2	3	2	5	4	5	2	2	4	2	3	2	2	2	1	2	1	2
Res3	4	4	2	5	5	3	4	4	3	2	2	2	2	2	2	2	5	5	5	2	2	4	4	3
Res4	3	5	1	3	3	3	3	3	4	3	3	3		3	4	3	4	3	5	3	2	2	2	3
Res5	4	4	4	4	4	3	2	4	3	4	5	3	2	2	4	2	3	4	4	1	1	2	2	3
Res6	5	5	3	3	4	4	4	4	5	5	5	5	5	5	5	4	5	4	4	3	2	4	3	4
Res7	4	4	3	3	3	3	3	4	4	4	4	4	3	3	5	3	4	5	4	2	2	3	3	3
Res8	2	3	4	3	4	3	3	5	4	5	4	5	3	2	4	2	2	3	1	1	4	2	4	1
Res9	2	3	2	3	2	3	2	3	3	4	4	4	4	3	3	5	2	2	2	3	3	3	2	3
Res10	4	4	2	2	3	3	3	4	3	5	5	5	4	4	4	4	2	2	2	3	3	3	2	3

TABLE 9: AGGREGATE FACTOR SCORES WITH PERCENTAGE CONTRIBUTIONS FOR A SUBSET OF RESPONDENTS

	Factor 1		Factor 2		Factor 3		Factor 4	
Respon-dent	Score	% Contribution	Score	% Contribution	Score	% Contribution	Score	% Contribution
Res1	5.140	9.50	0.276	2.46	1.183	10.94	0.772	9.75
Res2	4.717	8.71	0.074	0.66	0.123	1.14	0.510	6.44
Res3	5.214	9.62	3.581	32.00	0.702	6.49	1.459	18.43
Res4	4.976	9.18	1.584	14.16	1.687	15.58	0.610	7.72
Res5	5.334	9.84	1.423	12.71	0.026	0.24	0.442	5.58

Res6	7.100	13.10	0.454	4.06	2.090	19.32	0.707	8.93
Res7	5.840	10.78	1.093	9.77	1.084	10.02	0.489	6.18
Res8	5.327	9.83	0.315	2.82	1.911	17.67	0.692	8.74
Res9	4.881	9.01	1.138	10.17	0.983	9.09	1.400	17.69
Res10	5.653	10.43	1.252	11.19	1.029	9.51	0.834	10.54
Total	54.18	100	11.19	100	10.82	100	7.92	100

In a bid to evaluate the percentage contributions of each factor to the current performance of ICT in the universities, the eigenvalues and percentage variance of each factor shown in Table 10 is generated.

The percentage contribution of each factor is denoted by CF and is formulated as follows:

$$CF = \frac{EF}{N} * 100 \quad (8)$$

$$EF = \sum_{p=1}^{24} M_{s,t}^2; \; s = 1,2,\dots,24; \; t = 1,2,3,4 \quad (9)$$

where N is the number of performance indices, EF is the eigenvalues and $M_{s,t}$ represents the loading of t^{th} factor on s^{th} performance index. The eigenvalues are the sums of squares of factor loadings and are used to indicate how well each of the extracted factors fits the data from the sample.

TABLE 10: EIGENVALUE OF FACTORS

Factor	Extraction Sums of Squared Loadings		
	Total	% of variance	Cumulative %
1	8.010	33.374	33.374
2	3.512	14.635	48.009
3	2.736	11.400	59.409
4	2.507	10.447	69.856

It is shown in Table 10 that the four factors contributed 69.86% of the current performance of ICT in the Nigerian universities. Factor 1 described as 'Communication and Feedback' contributes 33.37% out of 69.86%. This achievement is attributed to the fact that several universities in Nigeria provide facilities such as Radio and Television which help in no small measure to run free flow communication systems. The strong Global Systems for Mobile (GSM) communication in and around the neighbourhood of the universities is another reason. The substantial contributions of 'Communication and Feedback' reveal that many university systems will fail or suffer to achieve their set goals if effective and realizable ICT based communication and feedback systems are not put in place. Factor 2 described as 'Study Aid' contributes 14.64% of the total contribution. This shows that ICT is important for qualitative study, research and knowledge impartation. The contribution of this factor would have been higher but for the fact that most universities in Nigeria lack sufficient internet and other related facilities for the study needs of students. Where they are available, they offer poor quality and non-affordable services. Factor 3 named as 'Processing and Administration' contributes 11.4% to the performance of ICT in the universities. This suggests the necessity of ICT for smooth administration which is supportive to efficient admission processing, course registration, processing and checking of results and maintenance of financial records. 'Relationship and Management' which is factor 4 contributes a total of 10.45% to the performance of ICT in the Nigerian universities. This exhibits the usefulness of ICT as a tool for good management which is important for campus peace and establishment of linkages with relevant bodies or agencies. The remaining 30.14% is considered as the expected contributions of some extraneous factors that are important but their related performance indices were not considered in the research. Such extraneous factors include but nor restricted to training, security of lives and properties, discipline among students and staff, curriculum and government policy on ICT. The following are typical performance indices that were not considered:

a. Impact of ICT on campus security
b. Impact of ICT on acquisition and procurement
c. Impact of ICT on internally generated revenue
d. Impact of ICT on staff recruitment, promotion and discipline
e. Impact of ICT on students' assessment and grading
f. Impact of ICT on prevention and management of campus hazards
g. Government policies on ICT in the university system
h. Government funding of ICT projects
i. Adequacy of the university curriculum on ICT based courses
j. Competency of the management staff on the use of ICT facilities
k. Competency of the ICT staff and professionals

V. CONCLUSION

Nigerian universities have continued to perform poorly in the webometric ranking of the world universities. One of the reasons attributed to this is their poor state of ICT. The not too impressive attitude of government towards empowering the universities through strong financing of ICT projects easily comes to the fore. Most universities lack stable power supply

which is an essential ingredient for implementing stable ICT systems. This constitutes stumbling blocks to smooth internet operations and access. It also hinders sound teaching and research. In this research efforts have been directed towards the determination of the contributions of some factors to the current level of the performance of ICT in the Nigerian universities with attendant measures for its improvement.

Factor analysis by principal components has been used for the evaluation of the performance index of ICT. Four factors were extracted and each of them loaded on some related performance indices. The initial component matrix generated was subjected to orthogonal transformation with a view to discover reasonable factorization of the performance indices. Factor score coefficient matrix was also generated to serve as basis for determining the degree or extent of soundness of the assessment of every respondent. The eigenvalue of each factor was calculated and used for the evaluation of the percentage contribution of each factor to the current performance of ICT in the universities. The percentage contribution of the four extracted factors was less than 100. This shows that the related performance indices of some extraneous (latent) factors that play significant roles where left out in the administered questionnaire. The results obtained placed high premium on the active use of ICT as tool for communication, feedback, study, processing, administration, relationship and management within the universities. These results corroborated the positions held in [2] and [7] that ICT is a practical tool for service delivery and management. The results equally agreed with the conclusion drawn i[8] that ICT is a tool for proper planning, monitoring, implementation and management in any system for active participation of community of users. For the sustenance of these results, issues like active and adequate funding and monitoring of ICT projects, engagement of qualified and competent ICT professionals, politically stable and peaceful operational environment, good electricity supply, ICT oriented curriculum among others are very essential ingredients that need adequate attention of government and university managements for increasing contributions from ICT to the Nigerian university system.

In principle, there are many corporate organizations in Nigeria who should assist government in financing ICT projects in the universities. A very strong monitoring, control and policing system could be put in place to ensure that the purposes of their assistants are achieved. The focus of the future research is to increase the number of the performance indices so as to extract more factors and perhaps increasing the contributions of the factors extracted in this work.

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