

## Factor Analysis of Post-Implementation Review of Student Information Systems in Nigeria

<sup>1</sup>A.W. Osazuwa and <sup>2</sup>S.C. Chiemeké

<sup>1</sup>Department of Mathematics and Computer Science, Benson Idahosa University, Benin City, Nigeria

<sup>2</sup>Department of Computer Science, University of Benin, Benin City, Nigeria

**Abstract:** The aim of this research, is to evaluate the critical factors that may enhance the successes and failures encountered after implementation of the student information systems within 4 universities (two private and two public), in Edo State, Nigeria. The 4 schools used for this study are University of Benin, Ambrose Alli University, Benson Idahosa University and Igbinedion University. This study was carried out using a user-centered post-implementation review exercise on the critical areas of usage of student information system. An online questionnaire was designed using Macromedia dreamweaver, PHP and Mysql to gather data from the users of the system. Analysis of data gathered was carried out using SPSS 10 and the statistics that was used is factor analysis in assessing the thirty identified system's attributes. Four factors were identified amongst the thirty scaled items and all 4 factors are necessary for true measurement in implementing Student Information System (SIS) when tested using Cronbach's alpha scale reliability with an overall output (total alpha) of 0.87. The total percentage variance accumulated by the 4 factors was 63.80%. This, however, indicates that the remaining 37.20% are extraneous variables, which could be attributed to many environmental factors such as management support, maintenance, accuracy, power supply and network connectivity.

**Key words:** SIS, post-implementation review, ICT, IT, IS, university, Nigeria

### INTRODUCTION

The effective management of Nigerian universities depends, to a large extent on how university administrators have utilized available human and material resources. A lot of data on Students, Staff and Finance abound in these universities. The organization and processing of these volume of data to generate valuable information for dissemination to all who might need it has become a very serious issue in the universities (Nwamarah, 2002).

With increasing knowledge and development of Information and Communication Technology (ICT) in these universities, the need to harness the effectiveness of core business processes has brought to the fore the importance of the Information Technology (IT) functions through the systematic evaluation of computer based system. Although, according to Gemmel and Pagano (2003), there are a relatively small number of studies reported in the literature evaluating Information Systems (IS) implementation.

The Nigerian university system makes use of a portal system. The portal is basically a web based database for

the university administrative system. A university portal is one-stop client-oriented website that personalizes the portal's tools and information to the specific needs and characteristics of the person visiting the site, using information from university databases ([http://www.usask.ca/web\\_project/uwebd/portals\\_faqs.html](http://www.usask.ca/web_project/uwebd/portals_faqs.html)). Some of the goals of a university portal system are to make it easy for people to find university information targeted specially at them and also to use a single consistent web-based front end to present information from a variety of back-end data sources. Information about people is stored in many different databases at a university. This includes student information, employee information, course information, alumni information, library information, calendaring and scheduling software. Student Information Systems (SIS) is a system of online applications, maintenance and updates of students' data and information services on a portal system.

The initiative to organize things in the Nigerian university sector started with the MIS project, which was sponsored by the National University Commission (NUC) about ten years ago. NUC is the regulating agency of Nigerian Universities. It is empowered among other things

to establish minimum Academic Standards in Nigerian Universities (Chiemeké *et al.*, 2006). Poor infrastructural facilities in our universities were a major constraint in the realization of the dream of that project. NUC gave a directive for the Nigerian universities to meet up with the Management Information System's (MIS) based technique in their campuses to function in the outlined areas:

- To act as the central point for collection of data from individual Nigerian universities on students and staff, building a comprehensive statistical database.
- To have that data utilized by the Nigerian Universities Commission and Federal Ministry of Education for the purpose of planning and development of infrastructure and for the production of statistics such as student registrations, staff/student ratios, gender and geographical distributions.
- To provide support to individual universities for the purpose of processing examination results and transcripts (<http://www.egov4dev.org/success/case/misuniv.shtml>).

However, most Nigerian universities have implemented the Student Information Systems (SIS) and have not been able to meet up with the expectations as

proposed by NUC for a smooth running and updates of the university information at a particular time. There are successes and failures encountered at different levels of the systems review in order to check necessary area(s) of improvement because organization learns through the identification of mistakes. Hence, the need to evaluate the already existing SIS in some universities in Edo State, Nigeria, to be able to know the factors that contributes to the success and failure of the system. The main objective of this research work is to measure the specific areas of contribution of the factors that either contributes to the success or failure of the implementation of the SIS in two private and two public universities in Edo State, Nigeria using 30 variables identified. The universities used for this study include the University of Benin (UNIBEN), Ambrose Alli University (AAU), Benson Idahosa University (BIU) and Igbinedion University (IUO). The two public universities are UNIBEN and AAU and the two private universities are BIU and IUO.

In evaluating the student information system, we adopted the work of Gemmell and Pagano (2003), whose work was based mainly on the 24 systems attribute in Post Implementation Review of Student Information system in the UK Higher Education Sector. These attributes are as shown in appendix. Six attributes that relate to our local context was added. Thus, 30 decision variables were used for the evaluation.

Table 1: Grid of attributes used in the system's evaluation

Attribute number	Attribute name	Description
1	Business process	The level of support to the business processes carried out in the universities by users
2	Necessity	The level of requirement to use the system in order to perform business processes
3	University strategy (1)	The system's ability to support the university strategic plan
4	University strategy (2)	The system's ability to support the development of the university strategic plan
5	University strategy (3)	The system's ability to support the promotion of the university
6	Improvement Operation	The system's ability to improve university operation
7	Information System Enhancement	The system's ability to enhance the university goals
8	Accuracy	The quality of information held on the system
9	Constraint control	The control on user's interaction to prevent them from making errors on the system
10	Effectiveness	The usefulness of the system
11	Navigation	The ease at which user's are able to search the various system forms in order to find the information they require
12	Ease of use	The simplicity and learnability of the system
13	Transparency	The different components of the system are integrated, appearing as one
14	Communication	The publicizing and explanation of the system to users
15	Reporting (1)	The availability of reports provided by the system
16	Reporting (2)	The relevance of reports provided by the system
17	Training	The availability of comprehensive and informative training
18	System maintenance	The upkeep and regular upgrading of the system
19	System presentation	The presentation of the visual layout of the system forms
20	Goal oriented	The system's ability to achieve the organizational set goal
21	User improvement	The involvement in the planning and implementation of the system
22	Skilled project staff	The possession of the necessary skills to perform tasks involving planning and implementation of the system, by the project team staff
23	Project management	The control and planning of the information project
24	Training manual	The quality of documentation provided to the users of the system
25	Focus	The direction of the project team with regards to the design, development and implementation of the system
26	Reliable service	The provision of a dependable service which users are able to rely upon
27	Understanding	The appreciation of users' problems and needs regarding the system, by the project team
28	Response	The rapidness of response to users problems and needs regarding the system, by the project team staff
29	Visibility	The users' perception of the present state of the system
30	Timeliness	The appreciation of the system's recent meaningful information

**MATERIALS AND METHODS**

The questionnaire was our instrument designed to elicit responses from the users of the student information systems. This questionnaire was designed using Macromedia Dreamweaver, PHP and MySql to gather data from the users of the system. The questionnaire was presented and administered online in the context of an evaluation study to ascertain users' (student or management) opinion on the use of the information system. The users' were made to visit the website powered by internet technology and located at www.questionnaire.43i.org to evaluate their student information system base on the criteria that were given. The questionnaire was open for validated users' responses for a period of 4 Months, February to June 2007. No items were added or removed during the period of administration. Analysis of data gathered was carried out using SPSS 10 and the statistics that was used is factor analysis in assessing the thirty identified system's attributes (Table 1 for grid of attributes used in the system's evaluation).

Scale reliability was assessed by calculating coefficient alpha. Alpha coefficient ranges from 0-1 and are used to describe the variability of factors from our multi-point formatted questionnaires or scales (i.e., rating

scale: 1 = poor, 5 = excellent). Our reliability estimate is 0.70. Table 2 represents the scale for evaluating the system's attributes. Six additional attributes were included to the 24 attributes of the work of Gemmell and Pagano (2003). Improvement Operation, Information System Enhancement associated to Process attributes, System Presentation, Goal Oriented associated to Product attributes and Visibility and Timeliness associated to Service attributes.

**RESULTS AND DISCUSSION**

**User's profile:** The four universities used for this research work in Edo State of Nigeria include University of Benin (UNIBEN), Ambrose Alli University (AAU), Benson Idahosa University (BIU) and Igbinedion University (IUO). Edo State is situated in the South - South Zone of the six geo-political zones of Nigeria. In carrying out the analysis, a total of 169 users responded to the online questionnaire. Fifty five percentage responses were male and 45% were female, this shows a non-biased gender responses to the questionnaire. Fifty-one were from BIU (31.0%), 42 (25.0%) were from UNIBEN, 42 (25.0%) were from AAU and 30 (18.0%) were from IUO. A number of users of the Student Information Systems (SIS) in the 4 universities, comprising 70.0%. One hundred and seventeen of the undergraduate students responded to the questions asked, indicating a greater use of the system. One hundred and twenty five (75.0%) of the respondents were of the opinion having a

Table 2: Scale for evaluating the system's attribute

Scale-point	Performance				
	1	2	3	4	5
Description	Poor	Average	Good	Very Good	Excellent

Table 3: User's profile

Age group									
16-21	22-27	28-33	34-39	40 and above					
24.0%	45.0%	17.0%	8.0%	6.0%					
Gender									
Male	Female								
55.0%	45.0%								
Marital status									
Single	Married	Separated/Divorced							
79.0%	20.0%	1.0%							
Educational background									
Diploma	Under graduate	Graduate	Post-graduate	Others					
2.0%	70.0%	14.0%	13.0%	1.0%					
University									
UNIBEN	AAU	BIU	IUO	Others					
25.0%	25.0%	31.0%	18.0%	1.0%					
Faculty/designation									
Physical sciences	Life sciences	Basic and applied sciences	Medical sciences	Social sciences	Law	Education	Arts	Administration	Others
13.0%	4.0%	22.0%	2.0%	24.0%	6.0%	7.0%	4.0%	7.0%	10.0%
Year of computer experience									
1-2	3-5	6 and above							
33.0%	42.0%	25.0%							
Frequency of use									
Daily	Weekly	Monthly							
47.0%	27.0%	26.0%							

Table 4: KMO and Barlett's Test

Kaiser-Meyer-Olkin measure of sampling			
Adequacy			0.937
Bartlett's Test of Sphericity	Approx. chi- square	2886.189	
	df	435	
	Sig.		0.000

Table 5: Communalities

Attribute	Initial	Extraction
Business process	1.000	0.548
Necessity	1.000	0.664
University strategy (1)	1.000	0.747
University strategy (2)	1.000	856
University strategy (3)	1.000	0.785
Improvement operation	1.000	0.602
Information system enhancement	1.000	0.594
Accuracy	1.000	0.549
Constraint control	1.000	0.566
Effectiveness	1.000	0.621
Navigation	1.000	0.481
Ease of use	1.000	0.612
Transparency	1.000	0.615
Communication	1.000	0.631
Reporting (1)	1.000	0.659
Reporting (2)	1.000	0.636
Training	1.000	0.639
System maintenance	1.000	0.581
System presentation	1.000	0.660
Goal oriented	1.000	0.688
User improvement	1.000	0.616
Skilled project staff	1.000	0.615
Project management	1.000	0.740
Training manual	1.000	0.565
Focus	1.000	0.717
Reliable service	1.000	0.689
Understanding	1.000	0.743
Response	1.000	0.660
Visibility	1.000	0.410
Timeliness	1.000	0.651

computer experience for 1-5 years. Based on the users' responses, it is ascertained that the system is used daily with a percentage response of 47% as against weekly (27%) and monthly (26%). Table 3 shows the demographic variables, users' profile.

**Factor analysis of post-implementation review of sis survey responses items:** Table 4 shows the Kaiser-Meyer Olkin (KMO) measure of Sampling and Barlett's test. The Kaiser-Mayer Olkin (KMO) test produces a measure of 0.937, which confirms the adequacy of the sample population. The Barlett's Test of Sphericity produces a Chi-square ( $\chi^2$ ) of 2886.189 with a significant level of 0.000, which indicates the adequacy of the sample population. The results obtained from the KMO and the Barlett's test are good indication of the suitability of the application of factor analysis (Akinyokun and Chiemeke, 2006).

Table 5 presents the communalities and it ranges between 0 and 1, where 0 indicates that the common factor explained none of the variance and 1 indicates that all the variance is explained by common factors.

Table 6: Eigenvalues and percentage variance

Rotation sums of squared loadings			
Factors	Eigen value	Percentage of variance	Cumulative (%)
Factor 1	14.958	49.859	49.859
Factor 2	1.607	5.355	55.215
Factor 3	1.294	4.312	59.527
Factor 4	1.281	4.270	63.797

Table 7: Varimax-rotated factor matrix

Attribute	Factor 1	Factor 2	Factor 3	Factor 4
Business process	0.541	-	-	-
Necessity	0.514	0.501	-	-
University strategy (1)	-	-	0.768	-
University strategy (2)	-	-	0.866	-
University strategy (3)	-	-	0.806	-
Improvement operation	-	-	0.537	-
Information system enhancement	-	-	0.529	-
Accuracy	-	-	-	-
Constraint control	-	-	-	0.520
Effectiveness	-	-	-	0.638
Navigation	-	0.508	-	-
Ease of use	-	0.645	-	-
Transparency	-	0.558	-	-
Communication	-	0.602	-	-
Reporting (1)	-	0.558	-	-
Reporting (2)	-	-	-	-
Training	0.535	-	-	-
System maintenance	0.591	-	-	-
System presentation	0.748	-	-	-
Goal oriented	0.722	-	-	-
User involvement	0.624	-	-	-
Skilled project staff	-	-	0.508	-
Project management	-	0.568	-	-
Training manual	-	0.548	-	-
focus	-	0.706	-	-
Reliable service	-	0.585	-	-
Understanding	0.649	-	-	-
Response	-	-	-	0.633
Visibility	-	-	-	0.610
Timeliness	-	-	-	0.586

For example, the communalities of "Effectiveness" is 0.621 (62.1%) which implies that 62.1% of the variance in "Effectiveness" can be explained by the extracted factors while the remaining 37.9% is attributed to other factors which are extraneous to the post-implementation evaluation indices.

Table 6 presents the eigenvalues and percentage (%) variance. Thirty scale items were included in the final factor analysis. Four factors with eigenvalues greater than 1 emerged from the Varimax-rotated factor matrix. Only variables with loadings equal to or greater than 0.5 and percentage variance greater than 1 are considered meaningful and extracted for factor analysis. Table 7 shows the factor matrix for the loadings.

**Factor 1:** It was named "Business Process and User Involvement." It consisted of the following variables (and their scale item shown in parenthesis):

- BUSINESS PROCESS (The level of support to the business processes carried out in the universities by users).

- NECESSITY (The level of requirement to use the system in order to perform business processes).
- TRAINING (The availability of comprehensiveness and informative training).
- SYSTEM MAINTENANCE (The upkeep and regular upgrading of the system).
- SYSTEM PRESENTATION (The presentation of the visual layout of the system forms).
- GOAL ORIENTED (The system's ability to achieve the organizational set goals).
- USER INVOLVEMENT (The involvement in the planning and implementation of the system).
- UNDERSTANDING (The appreciation of users' problems and needs regarding the system, by the project team). Factor 1 had an eigenvalue of 14.958 and accounted for 49.86% of the variance among the 4 factors.

**Factor 2:** It was named "Documentation and Project Management." It consisted of the following variables (and their scale item shown in parenthesis):

- NECESSITY (The level of requirement to use the system in order to perform business processes).
- NAVIGATION (The ease at which users are able to search the various system forms in order to find the information they require).
- EASE OF USE (The simplicity and learnability of the system).
- TRANSPARENCY (The different components of the system are integrated, appearing as one).
- COMMUNICATION (The publicizing and explanation of the system to users).
- REPORTING (1) (The availability of reports provided by the system).
- PROJECT MANAGEMENT (The control and planning of the information management).
- TRAINING MANUAL (The quality of documentation provided to the users of the system).
- FOCUS (The direction of the project team with regards to the design, development and implementation of the system).
- RELIABLE SERVICES (The provision of a dependable service which users are able to rely upon).

Factor 2 had an eigenvalue Of 1.607 and accounted for 5.36% of the variance among the 4 factors.

**Factor 3:** It was named "Support and Skilled Project Staff." It consisted of the following variables (and their scale item shown in parenthesis):

- UNIVERSITY STRATEGY (1) (The system's ability to support the university strategic plan).
- UNIVERSITY STRATEGY (2) (The system's ability to support the development of the university strategic plan).
- UNIVERSITY STRATEGY (3) (The system's ability to support the promotion of the university).
- IMPROVEMENT OPERATION (The system's ability to improve university operation).
- INFORMATION SYSTEM ENHANCEMENT (The system's ability to enhance the university goals).
- SKILLED PROJECT STAFF (The possession of the necessary skills to perform tasks involving planning and implementation of the system, by the project team staff). Factor 3 had an eigenvalue of 1.294 and accounted for 4.31% of the variance among the 4 factors.

**Factor 4:** It was named "Control and Timeliness." It consisted of the following variables (and their scale item shown in parenthesis):

- CONSTRAINT CONTROL (The control on user's interaction to prevent them from making errors on the system).
- EFFECTIVENESS (The usefulness of the system).
- RESPONSE (The rapidness of response to users problems and needs regarding the system, by the project team).
- VISIBILITY (The users' perception of the present state of the system).
- TIMELINESS (The appreciation of the system's meaningful information).

Factor 4 had an eigenvalue of 1.281 and accounted for 4.27% of the variance among the 4 factors.

In the aggregate, these 4 factors account for 63.80% of the variance among the 30 scale items. This high explained variance lead us to believe we had a reasonable coherent set of measures and that our clear identification of the 4 factors involved gave us a set of measures which would give us professional and intellectual insight and possible strategies to improve the performance of student information systems.

**Scale reliability measurement:** Good reliability of measures is necessary to be sure that the measures are stable and adequate (Yaffee, 2003). In order to assess the reliability of scales used, we used Cronbach alpha. The computation of Cronbach's alpha, which measures "internal consistency of items in scale" and/or responses to questions that were designed to represent a construct (Garson, 1999), is given by the following Eq. 1:

$$\text{Cronbach } \alpha = \left( \frac{k}{k-1} \right) \left( 1 - \frac{\sum_{i=1}^k S_i^2}{S_p^2} \right) \quad (1)$$

where:

- k : Number of items in scale.
- $S_i^2$  : Variance of item I.
- $S_p^2$  : Variance of total score.

from which it can be seen that alpha measures true variance over total variance (Yaffee, 2003). The range of the alpha is from 0 to 1.0; if a negative alpha is obtained, it means that the items are inconsistently coded; consistent coding means all items have to be coded so that high values on the items correspond to high values on the total scale scores; if the item-total correlations are negative, then the coding of the items needs to be reviewed and corrected before computation of the alpha; the alpha of a scale should be greater than 0.70 for items to be used together as a scale; the alpha for the total score is also computed assuming that the item under examination is deleted; if the alpha increases over the current total scale alpha when an item is deleted, then the rule of thumb is to delete the item unless it is theoretically necessary for the analysis. When you have a variable generated from your set of questions or construct, that return a stable response, then your variable is said to be reliable (Reynaldo and Santos, 1999).

In our reliability measurement from the 4 factors extracted and identified, reliability tests were run on scales for each factor and on the composite measures of satisfaction. Scale reliability as expressed by Cronbach's alpha stated in parentheses, is generally quite high:

- Business Process and User Involvement:  $\alpha = 0.8352$ .
- Documentation and Project Management:  $\alpha = 0.8455$ .
- Support and Skilled Project Staff:  $\alpha = 0.8206$ .
- Control and Timeliness:  $\alpha = 0.8377$ .
- Composite measures of overall satisfaction:  $\alpha = 0.8708$ .

It can be seen from our reliability test that the overall output (total alpha) to two decimal places is 0.87 which is good considering that 0.70 is the cutoff value for being acceptable and it is greater than the alpha for each of the 4 factors, this indicate a true measurement of our scale. Our test result also shows that the alpha for each of the 4 factors is greater than 0.70 and less than 0.87 (overall output), thus indicate that none of the factors can be deleted and therefore all 4 factors are necessary for true

satisfaction in implementing Student Information System (SIS). All of our items comprise a fine scale.

### CONCLUSION

In this research work, we identified 4 factors which had a high explained variance out of the 30 set of variables (attributes) of our test measurement. All 4 factors extracted, respectively: "Business Process and User Involvement", "Documentation and Project Management", "Support and Skilled Project Staff" and "Control and Timeliness" indicates a true measurement of our scale items. Our reliability measures are stable and adequate. The total percentage variance accumulated by the 4 factors was 63.80% and this gives us professional and intellectual insight and possible strategies to improve the performance of Student Information Systems in the Nigerian universities. The test results, however, indicates that the remaining 37.20% are extraneous variables, which could be attributed to many environmental factors such as management support, maintenance, accuracy, power supply and network connectivity.

The Nigerian university system needs to put into consideration the 4 factors extracted as necessary for a successful implementation of Student Information Systems (SIS). Continuous maintenance and review is important for a smooth running and updates of data services of the system. In Gemmill and Pagano (2003), their primary concern was on the improvement of data quality and the attribute 'Accuracy' was rated low in performance of the system in their findings. Our application of factor analysis on the performance of the system in our Nigerian university shows that out of the 4 factors extracted, the attribute (variable) 'Accuracy' was not selected amongst the factors considered for reliable services in implementing SIS. Attention is therefore needed on the quality of information held on the system (accuracy) and there is need for an improvement in the data services and access in the use of the system.

### RECOMMENDATIONS

Based on the findings of this study, we recommend the following:

- The Nigerian University Regulatory Body, NUC, the Management of the Universities and other bodies concerned could be of aid in ensuring that the extraneous factors identified are properly taken into consideration to prevent failures of the systems.
- The university administration should pay adequate attention to Student Information Services in carrying

out their administrative and business processes, as this would enable them have prompt and accurate data output when properly applied at minimal time.

- Funds should be allocated to the university budget for maintenance of the system should the system needs some upgrading as new technology emerges in this age.
- There should be periodic evaluation of the SIS, to cater for changes as at when required.
- The networking connectivity of the system should be enhanced so as to reduce or fade out the rate of failure in using the system.

Further studies are recommended on the evaluation of students' information system using other software engineering methodology, to see if there is significant improvement on SIS.

#### REFERENCES

- Akinyokun, O.C. and S.C. Chiemeke, 2006. IT Projects Performance Indices and Evaluations. *J. Testing Evaluat.*, 34 (6): 515-521. [http://journalsip.astm.org/Journal/Testeval/Pages/60.htm\(USA\)](http://journalsip.astm.org/Journal/Testeval/Pages/60.htm(USA)).
- Chiemeke, S.C., F.A. Egbokhare and S.C. Daodu, 2006. Labour Market Expectation of Nigerian Computer Science / Information Communication Technology (ICT) Graduates, *Afr. J. Online, Infor. Technologists*, [www.ajol.info](http://www.ajol.info), 3 (1): 1-7.
- Garson, G.D., 1999. World Wide Web URL: <http://www2.chass.ncsu.edu/garson/pa765/reliab.htm#intraclass>
- Gemmell, M. and R. Pagano, 2003. A Post-Implementation Evaluation of a Student Information System in the UK Higher Education Sector. *Electronic J. Infor. Syst. Evaluat.*, 6 (2): 95-106, [www.ejise.com](http://www.ejise.com).
- Nwamarah, G.M., 2002. Networking the Nigerian University System", *The UNN Experience. Seminar on Trends in the Development of ICT in the Nigerian University System*, University of Jos, pp: 9.
- Reynaldo, J. and A. Santos, 1999. Cronbach's Alpha: A Tool for Assessing the Reliability of Scales. *Extension J.*, 37 (2): 5. [www.joe.org/joe/1999april/tt3.html](http://www.joe.org/joe/1999april/tt3.html).
- Yaffee, R.A., 2003. Common Correlation and Reliability Analysis with SPSS for Windows Statistics and Social Science Group, Academic Computing Facility, New Yoek University, pp: 19. <http://www.nyu.edu/acf/socsci/Docs/intracls.html>.