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AUTOMATED TELLER MACHINE AND ELECTRONIC PAYMENT SYSTEM IN NIGERIA: A SYNENTHESIS OF THE CRITICAL SUCCESS FACTORS

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ABSTRACT

This study investigates the effects of ATM infrastructure on the success of e-payment. The study is motivated by the apparent low level of satisfaction with the level of the e-payment services irrespective of the increased deployment of ATM by banks and the need to isolate the critical factors responsible for this. In carrying out the study, banks that are on the interswitch network formed the population. The analysis is based principally on primary data collected from users of the ATMs. A total of one thousand, one hundred and forty-one users of ATM were sampled. Weighted scores of their responses to success factors identified in the literature were analysed using the Factor analysis simulation model. Five strategic decision clusters were modeled, in which inadequate availability of quality infrastructure was identified as the most critical limition to efficient e-payment system via ATMs. The conclusion therefore is that provision of adequate infrastructure such as power is critical for effective integration of the Nigerian banking system to the global network of electronic payment via ATMs, however for this to be possible, concerted effort must be made by stakeholders to resolve the lingering crisis in the energy sector.

Key words: e-payment, ATM, infrastructure, eigenvalue, principal component, varmax rotation.

INTRODUCTION

The purpose of banking is to enrich society through the provision of infrastructure for savings, investments and settlement/payment of exchanges. A more pragmatic definition of purpose of banking would be to meet society's need for efficient payment system (reliability at minimum cost). The responsibility of bank management is to establish priorities and objectives as well as monitor performance in the desired direction.

Banks in the advanced countries have over the years developed roadmaps to quality financial services delivery. They have identified application of ICT as strategic to achieving global competitive advantages (reduced operational costs, improve service quality, increased market, shorten service cycle time, increased capacity to respond to changing environmental and socioeconomic y drivers of profitability) (Aral *et al*., 2006).

The banks operating in Nigeria have of recent joined the trend but this is not without some problems. This range from resistant from employees who tend to believe that ICT application may lead to job loss to the near lack of socioeconomic, technological and legal infrastructure needed to support the policy. Global competition according to Kouvelis, *et al.* (2006) has created need for transformation of modern organizations from multi-layered, hierarchical, fat ones to networked, flat, thin ones. These are aimed at helping organizations to face adverse environmental conditions such as economic recession, global competition and deregulation. In the process of making these transformations, organizations tend to have identified ICT application as a necessary requirement (Bardhan, 2007). The above misgivings may have slowed the pace at which the Nigerian banking industry responded to the need for ICT application to their operations.

However, there have been near lack of empirical research efforts geared towards assessing the successes attain in ICT application by banks in Nigeria. With the successful consolidation of banks in Nigeria, the industry is pursed to operate at global best practices. Hence ICT facilities especially the ATM are massively being deployed at remote stations by banks. It therefore follows that the need to investigate the critical success factor of this policy on the overall realization of the objective of banking in Nigeria is timely, hence the need for this study.

OBJECTIVE OF THE PAPER

The central objective of this paper is to investigate the extent to which the policy to expand geographical coverage through ATM deployment has helped banks to enhance their efficiency in e-payments. The specific objectives therefore include:

- Identification of decision factors for successful deployment of ATMs by banks;
- To assess the extent to which deployment of ATMs by banks has affected e-payment system.

RESEARCH QUESTIONS

In order to realize the above stated objectives finding answers to the following question is paramount:

- What are the critical decision factors for successful deployment of ATMs by banks?
- To what extent has deployment of ATMs by banks increased the success level of e-payment system in Nigeria via ATMs?

THE PLACE OF ICT IN MODERN BANKING

Globalization has brought major changes to banking with respect to resources, markets, processes, and business strategies. This situation has led to a paradigm shift in operations. ICT (information communication technology) application has become strategic for supporting investment and operational decisions (Banker et al, 2006).

Over the years ICT has grown its support role to banking activities. At first, banking activities performed using computers were the very few simple ones, but presently, ICT supports almost all activities through the financial service cycle, including product design, development and marketing chain. E-Payment is a specific area of banking where ICT has found wide application. One area where ICT application has helped the operational environment of banking is the use of inter switch Automated Teller Machine (ATM) systems which integrates all licensed banks into a network, thereby reducing or eliminating the limitations of traditional branch-based nature of banking and making the promised real-time-on-line concept of globalised banking a reality.

On the other hand, there still remain some doubts among experts as to whether the real results obtained with the ICT application is significant enough to justify the huge capital and the risk associated with the application (Ramasubbu *et al*., 2007). However, ICT application to banking have been widely

acknowledged as having the potential of making significant positive impacts and opening horizons for improved operating environments for banks, if effectively applied.

Automated Information System (AIS) has become a vital part of financial service delivery. Today, high-speed networks efficiently link many parts of the bank, enabling managers to efficiently generate and apply the vast amounts of information that are needed to support decisions in the areas of financial product/service design, cost/benefit analysis of designed products/services, finance/accounting, marketing and general administration.

The success side of IT application in business in the opinion of Thurm (2007) hinges on the fact that it provides means for business enterprises to enjoy the benefits of advanced tools and techniques of decision making, such as simulation, modeling, and robotics, which affords managers the latitude of dependable future predictions as well as sensitivity of possible changes in the decision factors and environments. All these help the manager to leverage the immediate action based on existence of a flexible, robust and result oriented database as well as lessons learnt. Other threats include environmental and technological risk such as (virus, internet fraud, systems' collapse etc. which may lead to stoppage of further operations of the business without prior warning). However, more importantly, IT is the changing agent that is driving modern business enterprises to respond more quickly to new threats and opportunities more than ever before. Financial service providers cannot afford to ignore AIS and the changes it brings (Gosain *et al.,* 2005). However they must understand the modern enterprise as an integral business operation consisting of many activities, with strong interdependence between all functions, and is reflected by a great volume of information flow between them.

In former times, specific hardware and software systems are acquired for isolated individual operations, however, with the increasing pressure to reduce cost of operations, there is presently a strong need to integrate all isolated information systems of into a decision network in order to meet operational cost, schedule and quality requirements (Chung *et al*., 2004).

ICT had been seen as the key enabler to this new way of delivering bank services. Hitherto, banks used to compete in the market place and the effectiveness of the business processes (enabled by information) determines who leads and who trails (Dedrick *et al*., 2003). One of the critical success factors (CSF)

was optimization of the business processes in order to enhance key business drivers (reduction of cost, cycle time, etc). Revolution in technology in the later part of the last century in the opinion of Zhu and Kraemer (2002) has further redefined the CSF for remaining and competing in the global financial system. This has resulted in banks now competing both in the market place and the cyberspace (Ramasubbu *et al*, 2007).

A firm with the state-of-the-art business processes that are geared towards the conventional market place will be relegated and probably disabled in this century. A shift from one-dimensional to two-dimensional competition mode took place very lately in the last century. Whereas many companies differentiated themselves in their business using one-dimensional (conventional) business process, they are now also required to learn and differentiate themselves in two-dimensional (conventional and electronic) business processes in the market place and space (Grant and Baden-Fuller, 2004).

Automated Teller Machines (ATM) in *Banking Telematics Services*

ATMs are the most immediately visible type of retail banking technology. They play a key role in any retail banks' efforts to use technology as a quality weapon to defeat competition. This facility provides a major role in offering convenience, speedy and round the clock services (Barua and Mukhopadhyay, 2000). ATMs capabilities include balance and transaction enquiries, withdrawals, deposits and accounts transfer. A banking application should have facilities for on-line, real-time connection at ATM network. Also as fundamental to worldwide scene of ATM is the concept of shared ATM network.

Any bank participating in a shared ATM network according to Chung *et al.* (2004) will enjoy the following advantages:

- The bank's customer will enjoy access to far more than the bank alone could ever provide.
- The bank is able consequently to make substantial cost saving compared with the cost of continually extending its ATM network on an independent basis.
- The bank may benefit from the branding of the shared network.
- The shared network will probably have more financial resources.
- It does help for international ATM sharing.

DATA COLLECTION AND ANALYSIS

This paper is designed in such a way as to allow for objectivity in the assessment of the effect of ATM deployment on payment systems and the extent to which it affect the realization of payment effectiveness of banks. The above imply that the factors to be considered while deploying ATMs are analyzed to see the nature of their contribution (whether positive or negative). However to form basis for viable and reliable decisions, effort is made to assess the intensity of the joint effect of the factors. The field survey approach was adopted for data collection, which took the researcher to randomly selected ATMs located in PortHarcourt, Owerri, Aba, Enugu, and Umuahia that are connected to the interswitch network as a way of reaching the targeted audience as well as having first hand information through observation.

Besides, the paper adopts a deterministic approach by way of responses weighting, maximum likelihood extraction, Varimax rotation for iterations, Kaiser Normalization and regression analysis. The Objective Evaluation Questionnaire (OEQ) is the principal instrument used for data collection. The respondents are in two categories- e-payment staff of banks and customers of banks who make use of ATMs. To this end a total of one thousand, one hundred and forty-one (1141) respondents were sampled, made up seventy-six (76) bank staff and one thousand and sixty-five bank customers who use ATMs. Valid responses were gotten from a total of forty-one (41) made up of twelve (12) bank staff and twenty-nine ATM users. This therefore constituted the sample size for analysis. Twelve (12) success factors of IT application to business identified by Barua, and Mukhopadhyay (2000) as well as Wagner (2006) were used in developing the questionnaire (see appendix 1). The process of administration is the personal interview contact, which allows for a one-on –one approach in asking and answering of the questions.

DISCRIPTION OF SUCCESS FACTORS

s/n	Factors of ATM Deployment	Code
1	organisational commitment and leadership	X1
2	Accessibility and proximity to user location	X2
3	Infrastructure availability	X3
4	Technical and technological capacity of bank staff	X4
5	Cost of service delivery	X5
6	Technical and technological capacity of bank customers	X6
7	Customer willingness to use the facility/service	X7
8	Risk of robbery	X8
9	Observance of codes, standards and regulations	X9
10	Reliability of the operational time of the system	X10
11	Reliability of the internal control measures	X11
12	The risk of fraud	X12

In analyzing, the data collected, weighted score of respondents to each of the success factors were generated. For the purpose of this paper, factor analytical techniques were adopted to assess the significance of the twelve factors affecting ATM deployment by banks. Factor analysis is a method of quantitative multivariate analysis with the goal of representing the interrelationships among a set of continuously measured variables (usually represented by their interrelationships) by a number of underlying. Linearly independent reference variables called factors. Factor analysis therefore seeks to collapse the numerous operating variables into fewer dimensions of interrelated attributes called principal components. The eigenvalue determines the principal components, which is arthogonally varimax, rotated to obtain more evenly distributed variables among the components.

The mathematical procedure of factor analysis assumes that an n x n matrix “A” has eigenvalues “λ” if there exists a non-zero vector “X”, called an eigenvector associated with λ, for which:

$Ax = \lambda x$ . . . 3.1

From equation 3.1, it follows that the matrix $A - \lambda I$ is singular and therefore that:

$\det (A - \lambda I) = 0.$ - - - 3.2

Equation 3.2 is a polynomial equation in λ of degree n from which it follows that A as at most n eigenvalues. The polynomial $\det (A - \lambda)$ is called the characteristic polynomial of "A". Some roots of this characteristic equation are repeated and we have the algebraic multiplicity of the eigenvalue in the same way as the multiplicity of roots of polynomials. In the event that the multiplicity of an eigenvalue is greater than the dimension of the vector space spanned by its associated eigenvalues, then the matrix is becomes defective.

Solving the eigenvalue problem, i.e finding eigenvalues and associated eigenvectors is in general best achieved by solving the characteristic equation.

RESULTS AND DISCUSSIONS

The estimation of the level of success in ATM deployment by banks is done using the cumulative weighted score generated across the four phases of the e-payment process based on maximum likelihood extraction Analysis.

Table 4.3: Explanation of Variance in ATM Deployment by Decision Factors

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.772	31.435	31.435	3.438	28.651	28.651	2.794	23.286	23.286
2	2.075	17.289	48.723	1.367	11.388	40.040	1.965	16.376	39.662
3	1.642	13.684	62.407	1.250	10.414	50.453	1.486	12.384	52.046
4	1.243	10.359	72.766	1.533	12.771	63.225	1.341	11.179	63.225
5	.800	6.669	79.434						
6	.679	5.655	85.089						
7	.585	4.872	89.961						
8	.477	3.979	93.940						
9	.322	2.685	96.625						
10	.247	2.057	98.682						
11	.112	.937	99.619						
12	.046	.381	100.000						

Extraction Method: Maximum Likelihood.

A total of four (4) principal components have been extracted. The clustering of decision factors for ATM deployment within the four components generated normalised cumulative variance explanation of 63.225% as shown by the rotated cumulative sums of squared loading of 63.225; implying that the four decision clusters depicts 63.225% of the characteristics of the twelve (12) isolated factors.

Test of Reliability

Table 4.4: Goodness-of-Fit Test

Goodness-of-fit Test

Chi-Square	df	Sig.
30.225	24	.177

The 63.225% variance explanation is tested for reliability using the Chi-Square test. The result of the test shows that within 17.7% level of maximum error/tolerance, the predicted level of variance is reliable.

Table 4.5: Normalized Factor Loading Matrix

Decision factors	**Decision Clusters**				
	1	**2**	**3**	**4**	
X_3	0.873				
X_{10}	0.845				
X_7	0.738				
X_2	0.730				
X_5		0.900			
X_6		0.820			
X_4		0.646			
X_8			0.923		
X_9			0.716		
X_1			0.536		
X_{11}				0.807	
X_{12}				0.804	
Variance Explained	**23.29**	**16.38**	**12.38**	**11.18**	

Source: Result of Analysis with SPSS for Windows Version 11.0

Table 4.5 shows the loading of the factors into four principal decision clusters. With factor X_3 (Availability of infrastructure being the first factor that enters the matrix); while the last to enter is X_{12} (risk of fraud). It therefore follows that availability of infrastructure (building, power etc.) is the most

critical factor that that influences the decision to deploy ATM at any location by banks. On the other hand, risk of fraud is given the least consideration.

ANSWERS TO RESEARCH QUESTION

The research questions are answered using the factor load matrix as shown on Table 4.5. The top ranking of factor X_3 (Availability of infrastructure) in principal decision cluster 1 shows that availability of infrastructure (building, power etc.) is the most critical factor that influences the success of ATM deployment for enhanced e-Payment service delivery.

The effect of the ATM deployment on efficient e-Payment system by banks is analysed using the association between the total estimated total score for level ATM deployment (X) and the weighted score of level of success in e-Payment (Y) attain by banks based on the opinion of our respondents. This analysis is carried out using the regression tool of SPSS.

Results

Table 4.7: Model Summary

Model	R	R square	Adjusted R square	Standard Error of Estimate
1	0.751[a]	0.564	0.552	0.688

Source: Result of Analysis with SPSS for Windows Version 11.0

Table 4.8: ANOVA[b]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1.	Regression	23.809	1	23.809	50.367	0.000[a]
	Residual	18.435	39	0.473		
	Total	42.244	40			

Source: Result of Analysis with SPSS for Windows Version 11.0

Table 4.9: Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	sig.
	B	Std. Error	beta		
(Constant)	3.488	0.107		32.483	0.000
X	0.386	0.054	0.751	7.7097	0.000

Source: Result of Analysis with SPSS for Windows Version 11.0

Where X = Weighted Score for level of Success in ATM Deployment

INTERPRTATIONS

Based on the above results 75.1% correlation exists between level of ATM deployment by banks (X) and achievement of efficient e-payment system (Y) as indicated by the R value of 0.751 in Table 4.7.

Also 56.4% of the variation in achievement of efficient e-payment system (Y) is explained by variation in the level of level of ATM deployment by banks (X). When the above level of variance explained is adjusted for possible errors due to estimation, it is reduced marginally to 55.4%. The R Squared and adjusted R Square values respectively indicates these.

The above is further captured in equation 4.1, which establishes a significant positive association model for explaining the nature and effect ATM deployment (X) and achievement of efficient e-payment system (Y) by banks:

$$Y = 3.488 + 0.386X \quad . \; . \; . \quad 4.1$$
$$(7.097)$$

Conclusions and Recommendations

Based on the results of the analysis, the following conclusions are made:

- The four phases based on twelve (12) decision factors are critical to successful deployment of ATMs by banks for e-payment delivery.
- The use of the above four phases explains 63.225% of the success of ATM deployment by banks.

- 56.4% of the variation in e-payments service delivery by banks is associated to the level of success in ATM deployment.
- Availability of functional infrastructure is the most critical factor for successful e-payment service delivery via ATMs.

Based on the above conclusions the following recommendations are made as way of enhancing the efficiency of ATMs for e-payment in Nigeria:

- CAPACITY BUILDING: There is need for intensification of the ICT skills of bank customers' and staff through continuous training.
- POWER INFRASTRUCTURE : There is need for the Bankers Committee in partnership with the government to reactivate the level of public power supply as the high cost of private power supply affects the success of ATM deployments.
- TOP MANAGEMENT SUPPORT: There is need for top management of banks to equally intensify effort at strengthening the internal control system of e-payments via ATMs as the risk of fraud is equally high. This can be achieved through collaborative effort with security agencies and professional bodies in the relevant areas of Information Technology.

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Appendix 1: Quantification of the Extent of ATM Service Delivery for e-payment

Respondents	Phase 1	Phase 2	Phase 3	Phase 4	Total Score (X)
1	-2.87636	1.01120	.72846	.23434	-.90
2	1.22735	2.21480	.01644	-.23800	3.22
3	.92299	-.41579	.03737	.08415	.63
4	.34544	.85488	1.08740	-1.19904	1.09
5	-.19855	-.67378	.75437	-1.07112	-1.19
6	.38673	-.74956	-1.88638	-.27844	-2.53
7	-1.14673	-1.46305	.89293	1.87809	.16
8	-.20854	-.61354	.73578	-1.08144	-1.17
9	-.14483	.41532	-1.05210	-.20797	-.99
10	.75988	.41741	-.48114	1.27449	1.97
11	.47910	.44299	.71557	1.54756	3.19
12	.41718	.61985	.91474	.18031	2.13
13	.42142	.59260	.92179	.18418	2.12
14	.99596	-.63324	-.14874	1.45999	1.67
15	-.63736	-1.34469	-1.31189	-.03771	-3.33
16	-1.02747	.28304	-1.58140	-1.66587	-3.99
17	1.16880	-.29285	-1.20820	-.21613	-.55
18	-1.44713	1.10790	-1.14016	1.14236	-.34
19	.04394	-1.74951	1.09945	-.88085	-1.49
20	-2.88354	1.05041	.71448	.22766	-.89
21	1.22974	2.20548	.01862	-.23636	3.22
22	.92360	-.42093	.03977	.08500	.63
23	.34783	.84555	1.08958	-1.19740	1.09
24	-.20393	-.65000	.74761	-1.07526	-1.18
25	.38552	-.73928	-1.89119	-.28014	-2.53
26	-1.14374	-1.47751	.89752	1.88058	.16
27	-.20377	-.63219	.74014	-1.07815	-1.17
28	-.14244	.40600	-1.04993	-.20632	-.99
29	.76227	.40809	-.47897	1.27613	1.97
30	.48209	.42853	.72015	1.55005	3.18
31	.41060	.65392	.90317	.17448	2.14
32	.42202	.58746	.92419	.18503	2.12
33	.98521	-.58567	-.16225	1.45172	1.69
34	-.64216	-1.31481	-1.32369	-.04275	-3.32
35	-1.03584	.32129	-1.59274	-1.67250	-3.98
36	1.15863	-.23918	-1.22677	-.22531	-.53
37	-1.45311	1.13682	-1.14932	1.13737	-.33
38	.04035	-1.72990	1.09246	-.88419	-1.48
39	.93196	-.45918	.05111	.09163	.62
40	.34185	.87448	1.08041	-1.20238	1.09
41	-.19496	-.69339	.76136	-1.06778	-1.19

Source: Generated from Factor Simulation Analysis using SPSS Package

APPENDIX 2: Questionnaire

S/N	Opinion	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1.	ATM deployment has led to timely withdrawal from accounts					
2.	Successful deployment of ATMs depends on the level of top management support, commitment and leadership					
3.	Successful deployment of ATMs depends on the level of manpower training and development undertaking by bank customers					
4.	Successful deployment of ATMs depends to a large extent of acceptance of the philosophy of automation among bank customers.					
5.	Successful deployment of ATMs depends on the extent of understanding of current technical and technological developments in process automation					
6.	Cost of withdrawal fro ATM is a critical factor in tracking the effectiveness of ATM deployment					
7.	Vendor commitment to the IT philosophy is a critical factor in successful deployment of ATM					
8	Consumer satisfaction is important for the overall operation of ATMs					
9	environmental specific factors are important in successful deployment of ATMs					
10.	Observance of codes, standards and client's requirements are critical in the deployment of ATMs					
11.	The quality of process design and specifications affect the deployment of ATMs					
12.	Implementability is a major factor affecting the deployment of ATMs					
13.	ISO standard provides an excellent baseline for deployment of ATMs.					