Modeling the Influence of Information Technology (IT) Adoption Factors on the Electronic Voting (E-Voting) Technology Using Partial Least Squares-Structural Equation Model (PLS-SEM) Methods

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ABSTRACT
Although there are many factors influencing the organizational adoption of information technology innovations, the lack of knowledge as to those that affect the adoption decision of Electronic Voting technology in the organizational context, especially from the perspectives and perceptions of developing countries remains fundamental and of necessity if such adoption decision is to succeed. This paper discusses the theoretical and empirical model that identifies the relevant determinants factors within the context of an electoral management organization that might influence Electronic Voting technology adoption in Nigeria. Six theoretical constructs derived from diffusion of innovations; technology-organization-environment; Iacovou et al. theories and other relevant literatures on organizational adoption of technology were identify and consider. The research instrument were validated in a survey of managerial and operational staff of the Independent National Electoral Commission of Nigerian and tested against the model using Partial Least squares Structural Equation Modeling-PLS-SEM method of data analysis. The predictive tendency of the factors is quiet substantial (84%) and represents higher variance in the adoption of Electronic Voting technology with good model fit. The study produced useful insights into the factors that influence organizational adoption of Electronic Voting technology and provided new ideas in the understanding of information technology innovation adoption in the organizational context.

Keywords: Modeling, e-voting, information technology, innovations

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1. INTRODUCTION

The Paper voting systems or Non-electronic voting systems, the oldest and most popular voting system used by democratic countries the world over has not been able to establish the voter's intent and to accurately translate the intents into a final tally or count in a convenient way for voters due to the scale and complexity of the elections. This has brought about decline in the voters turnout and apathy towards elections in most democracies [13]; [20]. This has equally lead to vote manipulation, ballot stuffing, ballot snatching, and outright vote stealing among others in most developing democracies, especially on the African continent [19]. The adoption and implementation of E-Voting technology into the conduct of election in some advanced and developed democracy has reduced voter's apathy, improved voters turnout during election, and ensured to greater extent the accuracy of vote count. The adoption of E-Voting technology by developing democratic countries is not only expected to, but to eliminate or at best reduce problems of ballot stuffing, ballot snatching, votes and voters record manipulations among others [47]; [4]; [6];[1].

Nigeria has over the years used the manual system of voter's registration and paper ballot for her registration and voting activities. The successes of the process in relation to fairness, freeness, and transparency of elections were a mixed bag. Elections were fiercely contested and results disputed. This most times moved the country into situations were violent reactions to election outcomes, destruction of properties, detention of opponents, and at a point in history, a civil war. In these elections, the politicians improved on the ways and means of electoral manipulations. Nigeria joined other countries with the recommendations of the 2005 National Political Reform Conference, and the decision to adopt E-Voting technology by the Independent National Electoral Commission (INEC) [17]; [33]. The technology is yet to be implemented and doing so requires an organizational adoption study in other to better the understanding of how to effectively introduce the technology within the organizational context [39]. Therefore, we use this gap from the literature as our starting point.

Literatures on Information Technology (IT) adoption show that many studies have been conducted with only a few on developing countries, such as Nigeria. Our understanding of the determinants of IT adoption is limited by little empirical research that covers issues from the perspectives of these countries within the organizational context.

It is important to understand how organizations adopt technology in developing countries and how to readily determine those factors that support the adoption processes. This research is aimed at developing a suitable conceptual model using existing theories and methods of IT adoption in the organizational context to study E-Voting technology adoption by INEC, Nigeria with different organizational attributes and attitude towards a technology.

We use three established theoretical models, i.e. Diffusion of Innovations (DOI) [39], Technology-Organization-Environment (TOE) framework [46], and Iacovou et al. model [1995] to develop our conceptual model for the study. Additionally, we introduced two contingent factors: User Participation in Systems Development and ICT Training and Skills. Identifying and quantifying these contingencies possess an important challenge for this research, because previous literatures have proclaims their importance but, the empirical research of their use in the theoretical models that studies IT adoption in the organizational context is rather limited. This equally, helps us fill a gap.

In addition, Partial Least Squares, Structural Equation Model (PLS-SEM) using SmartPLS application software [38] approach to model estimation was use to analyzed our survey data and to investigate the relationships between the independent latent constructs and the dependent latent construct of our study. The research objectives, therefore is to:

1. Discuss and assess eleven hypotheses on the relationships between the seven latent constructs using partial lease squares and
2. Examine the possibility of mediating (Indirect) effect among the constructs

To achieve these objectives, the paper is structured as follows: section two reviewed relevant literatures on factors influencing IT adoption in the organizational context. The third section describes the research methodology process. The fourth section deals with data analysis and results. We discuss the findings and implications of the study in section five and the conclusion in the final section.

2. THEORETICAL FRAMEWORK & CONCEPTUAL MODEL

The need to understand IT adoption factors in the organizational context has witnessed the development of theories on the subject matter [46]; [39]; [26]. Research findings equally shows that combining related factors and integrating constructs of similar or same factors for IT adoption study to develop a conceptual model assist in better understanding of the determinants factors influencing such adoption [49]; [43]; [34]; [7]. This study adapted and integrated factors (constructs) from Diffusion of Innovations (DOI) proposed by [39], Technology-Organization-Environment (TOE) proposed by [46],[26], proposed by [26] to suit the peculiarity and complexity of the domain of our study (Figure 1).
Literatures on IT adoption have also suggested the importance of constructs such as, User Participation in System Development [9]; [29] and ICT Training and Skills [24]; [18] in IT adoption study. Therefore, the conceptual model of our research is a combination of four constructs, namely, Technological Readiness (TR), Organizational Readiness (OR), Perceived Benefits (PB), and Environmental Factors (EF) derived from DOI [39], TOE [46], [26] and two other contingent constructs, Users Participation in System Development (UPSD) and ICT Training and Skills [9]; [29]; [24]; [18]. These constructs are defined and explained below.

(1) **Technological Readiness** (TR) is the degree to which the organization is ready technologically to adopt Information Technology innovations. [36] defined Technological Readiness as "the tendency of people to accept and use new technologies to achieve goals at work and at home." Tornatzky and Fleischer [1990] describe technological factor (Readiness) in terms of the availability and characteristics of the technologies (internal and external) relevant to the firm or organization. Findings of [34] confirm that, technological capacities among other factors played an important role in the IT diffusion process at organizational level. [5], [45] identify aspect of technology such as its reliability, its level of security and its relationship with existing technology contributing to the overall framework of factors of IT adoption. TR is the most self-evident factors that an organization must establish and asses in relation to its present organizational structures and culture in order to make an explicit adoption decision of its readiness and ability with regard to happenings in IT adoption [5]. TR is an enabler of all organizational processes and plays a key role in the adoption and implementation phases of an organization, therefore people's perception about technologies was that, it has characteristics, which influence the decision to adopt and how they will be implemented [12]. TR is expected to measure the technology metrics such as reliability, user ability, connectivity, flexibility, and security of E-Voting as a key determinant in the adoption process. The variable will also measure the readiness of INEC in term of local IT industry support, availability of internet resources necessary to achieve E-Voting adoption success [40]; [41].

(2) **Organizational Readiness** (OR) define the degree to which the organization is ready for IT innovation. [46], describe organizational context (readiness) as the characteristics and resources of the organization, such as including the size of the organization, the extent of centralization, the amount of formalization,

structure of the management, the degree of slack resources, linkages among the employees and amount of human resources. [39], include interconnectedness as a significant construct to measure organizational factors of IT adoption. Reviewed literatures on IT adoption establish OR as a crucial determinant factor to the successful adoption of an IT innovation. [3], confirmed OR especially human resources among other constructs as more influential than environment factors in the adoption processes. OR acts as a catalyst and a driving force to organization intention to adopt a technology. OR is positively correlated to the IT adoption [5]. The OR variables in the proposed research model is expected to measure Centralization, Compatibility, Public Education, Staff Attitude to change, Organizational slack, Interconnectedness, corporate governance, and Awareness [40]; [41].

(3) **Environmental Factors** (EF) construct establish those factors external to the organization that can influence the successful adoption of IT innovation. The environmental context is the place in which the business of an organization conducted. This includes the industries or organization that offers similar services (competitors), government policies and regulations and other external factors peculiar to the organization. These are factors external to an organization that present limitations or restrictions and prospects for technological innovations [14]; [46]. Environmental Factors will operationalize five construct: (1) Organizational Independence; (2) Political Party Support; (3) Voters attitude; (4) Legal framework; (5) Government regulation [40]; [41].

(4) **Perceived Benefits** (PB) describe the understanding of the benefits to be derived from adoption of IT innovation. It is a variable derived from [26] model. Perceived benefits refer to the expected advantages that IT adoption can provide to the organization concerned. The benefits can be direct and indirect in nature. Direct benefits measure operational cost savings and other internal efficiencies arising from the IT adoption, while indirect benefits measure the opportunities that originate from the IT adoption, including satisfactory service delivery and the possibilities for process reengineering. At the level of the technology, the perceived benefits take into consideration the appropriate benefits of an IT adoption [15]. The research model is expected to measure indirect benefits of E-Voting technology to the organization under study in terms of, Accuracy of vote count, Stoppage of multiple registrations, and elimination of multiple voting, Ballot stuffing, Vote manipulation, and Ease of use [40]; [41].

(5) **User Participation in System Development** (UPSD): Previous studies on IT adoption that use UPSD defined as User Participation shows that it can be used to predict the adoption success of an IT system within the organizational context [28]; [29]; [9]. [10] examined the common assumption that user involvement (participation) result in system usage or information satisfaction in a survey of 200 production managers. The result shows that user involvement in the development of information system will improve both user's satisfaction and system usage. They affirmed that User participation had long been a key variable in the successfully development of an information systems, but past research failed to clearly demonstrate its benefits. [29], observed that thou, past researcher's attention had been drawn to the relationship between user participation and information systems (IS) success, much of the empirical research so far has not been able to demonstrate its benefits. [28] studied the influence or effect of user satisfaction and user involvement (participation) in the design of a forecasting decision support system (FDSS). The study shows that user participation in the design of FDSS increases the user's satisfaction with the system. [51] examined the role of key users and stakeholders in the development of e-Commerce applications. The study established a consistent correlation between the user participation and user satisfaction. [32] carried out a survey of New Zealand organization with 200 full employees in other to assess the level of practice of user participation in Information Systems (IS) development project taken into consideration the management perspectives. [25] reviewed fourteen published empirical research [1995 – 2002] that investigate the significance of user participation on system success. Their findings indicate that user participation in systems development process correlate with the system success and which is a critical systems success factors. [37] empirically examined the relative effectiveness of user participation in software project performance from user and developer perspectives. Their findings show that user participation generates high levels of developer and user satisfaction. [21] investigated the influence of user participation in relation to human resources (HR) information systems satisfaction. The empirical evidences confirmed a positive relationship between user participation and satisfaction with human resources (HR) information system. [31] examine the relationship between user participation and technology acceptance in the post-implementation phase of an IT system. Analysis shows a positive relationship between user participation and technology acceptance (user affective and cognitive technology acceptance).

(6) **ICT Training and skills** (ICTSKILL), is a crucial component for continuous improvement of individuals and organization. Training also helps to improve employee participation and involvement in quality programs through propagation of priorities and missions of the organization [24]. Without training, the implementation and adaptation of IT

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adoption will be more problematic and frustration will be higher in the use of a new IT. Development of a training plan and acquisition of basic skill set is a critical determinant of an IS adoption success [52]. Widening access and providing training are obviously important factors in enhancing adoption and use [18]. ICTSKILL was introduced into the research model as a mediator as suggested by [11] that, mediator can be investigated when the relationship between the independent variable and the dependent variable are statistically significant as shown in the Bi-Variate Analysis of the preliminary results [40].

We therefore hypothesized the casual relationships between these six research constructs as defined above and our object of study (E-Voting adoption) as stated below and as shown in Figure 1.

- H1: Technological Readiness will have positive influence on the adoption success of E-Voting technology.

- H2: Organizational Readiness will have positive influence on the adoption success of E-Voting technology.

- H3: Environmental Factors will have positive influence on the adoption success of E-Voting technology.

- H4: Perceived Benefits will have positive influence on the adoption success of E-Voting technology.

- H5: Users Participation in System Development will have positive influence on the adoption success of E-Voting technology.
- H6: ICT Training and Skills will have positive influence on the adoption success of E-Voting technology.

- H7: ICT Training and Skills will have indirect effect on the relationship between Technological Readiness and the adoption success of E-Voting technology.

- H8: ICT Training and Skills will have indirect effect on the relationship between Organizational Readiness and the adoption success of E-Voting technology.

- H9: ICT Training and Skills will have indirect effect on the relationship between Environmental Factors and the adoption success of E-Voting technology.

- H10: ICT Training and Skills will have indirect effect on the relationship between Perceived Benefits and the adoption success of E-Voting technology.

- H11: ICT Training and Skills will have indirect effect on the relationship between Users Participation in System Development and the adoption success of E-Voting technology.

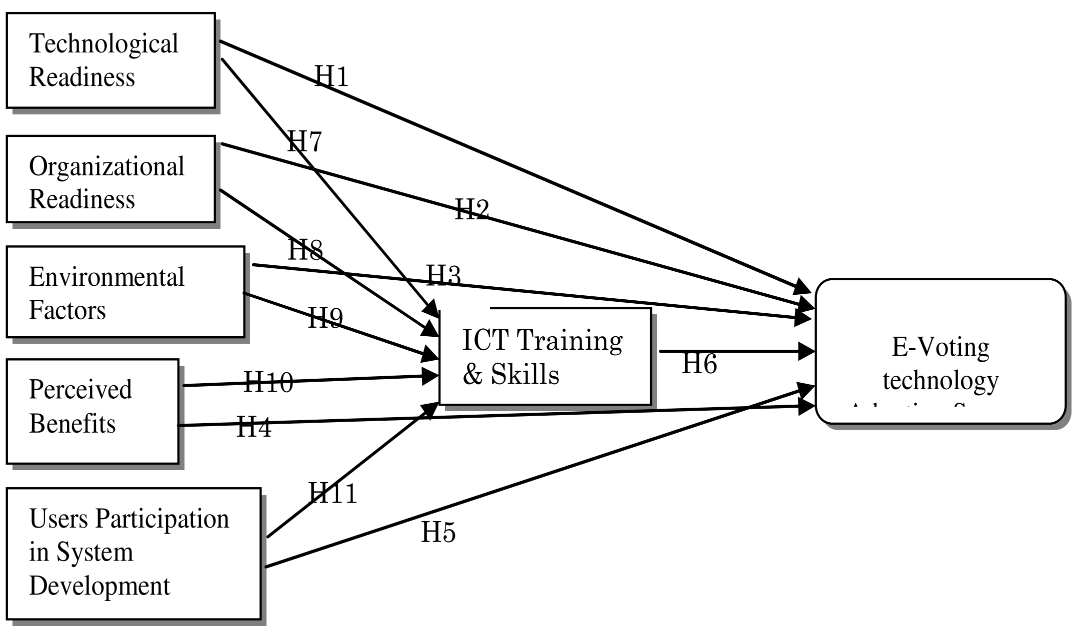

Figure 1. Hypothesized Research Model

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3. RESEARCH METHODS

We conducted a cross- sectional survey study using quantitative approach at the Independent National Electoral Commission (INEC) of Nigeria. The aim of our study was to draw a sample (n) from the population (N) of the managerial and operational staff of the electoral commission to elicit their perception on the adoption of E-Voting technology by the commission to test our research hypotheses. Data collection was conducted using a self-administered questionnaire on a 5-Point Likert scales ranging from strongly disagree (1) to strongly agree (5). Existing instruments were adapted to suit the context of our study. We use PLS Structural Equation Modeling (PLS-SEM) to estimate our theoretical model using SmartPLS application software [38]. PLS-SEM approach was chosen instead of Covariance-Based SEM (CB-SEM) because (1) it is good for model development and prediction; (2) can be use when normality assumption of data are not met; (3) can be used for model with large number of indicator (observed) variables; (4) can be used for model with formative and reflective constructs; and (5) suitable when the phenomenon under investigation is new and measurement model need to be newly developed [48].

Our model estimation was carried out in two major phases, first the PLS algorithm procedure was performed to determine the reliability and validity of the measurement model constructs, then we assessed the R-Square to determine the ability of our model to explain and predict the two endogenous latent constructs. Secondly, we evaluate the structural model of the relationships by (1) assessing our structural model for collinearity issues and then, Bootstrapping to assess the significance of the path coefficients-minimum of 5,000 bootstrap samples was used as recommended [23]; (2) We examine the effect sizes (f^2) of each path coefficients when included in and excluded from the model on the R^2 ; (3) Blindfolding technique was used to obtain cross-validated redundancy for each constructs-this determine the predictive relevance (Q^2) of our endogenous constructs [23]. Finally, we conclude the results of our PLS analysis with discussion and implications for the study.

4. ANALYSIS AND RESULTS

We distributed 500 questionnaires among the managerial and operational staff of INEC, Nigeria using disproportionate stratified random sampling [44]; [27] in other to accommodate each strata (group) in the population for our estimated sample size (n=375). Three hundred and eighty (380) responses were eventually collected, representing 76%. The demographic characteristics shows that 60.52% of the respondents are from five departments (i.e. Human resources and management, ICT, Operations, Training, and Public affairs), while 55.79% of the respondents are in the age of 25-40 years. 46.32% had between 5 and 10 years working experience, while 65.53% are male. 55.26% are first-degree holders (BSc/HND), while 86.05% are married. Around 44% belong to the senior staff categories.

4.1 Detection and Management of Outliers

Outliers (observations) are data point(s) that deviate significantly from others and which often causes important changes in the results (outcome) of an empirical research, they are far from the regression line. They are observations or measures that are much smaller or much larger when compared with the vast majority of the observations [50]; [16]; [2]. Outliers can be categorize into three major types: (a) Errors Outliers- data point(s) far from the rest because of inaccuracies, accuracy due to error of sampling, errors in observations, errors in recording, errors in preparing data, errors in computation, errors in coding, or error of data manipulation; (b) Interesting Outliers- data point(s) identified as outlying observations, but not an error outliers and which need to be further investigated; (c) Influential Outliers- Outliers already confirmed as interesting outliers and investigation shows that they cause important changes in the outcome of the data analysis, this outlier(s) could be as a results of respondents bias or errors as a results of items or questions engineering. Therefore, reporting how outliers are defined, identified, and handled is very important to the conclusion or outcome of an empirical research [2].

Two major techniques was used to identified and handle the error outliers for the collected data as suggested by [2]. (a) Single constructs techniques which examines extreme values within each individual constructs using visual tools (boxplots) and followed with a quantitative method (percentiles analysis) to identify the potential error outliers. Visual inspection was conducted on the boxplot graphs generated from IBM SPSS(20) for each constructs and cases (observations) listed in Table 1 in the appendix A were identified as potential error outliers. Then, we used the percentiles analysis techniques of IBM SPSS(20) to identify more potential error outliers based on the recommended [2] cut-off values of above or below 25% (two-tailed, $\alpha = .05$) using the multiplier formula:

$$Q2 + (2.2 * Q2 - Q1) = \text{Upper boundary} \quad (1)$$
$$Q1 - (2.2 * Q2 - Q1) = \text{Lower boundary} \quad (2)$$

Where Q2 = 75% upper value; Q1 = 25% lower value, to determine error outliers within this categories; (b) Multiple constructs techniques was used to assess the distance of an observation from the centroid of data points computed for two or more constructs. The scatter plots graphs for each independent (exogenous) variable (i.e. TR, OR, EF, PB, UPSD, ICTSKILL) against the dependent (endogenous) variable (EAD) was visually examined for potential error outliers. Next, we identified potential error outliers based on residual scores using the generalized Cook's Distance scores. Values greater than $4/(n-k-1) = 4/(380-6-1) = 0.0107$ as suggested by [42] were treated as potential error outliers, where n= Sample size and k= number of predictors in the model.

In all, 81 potential outliers were identified and were investigated. Investigation shows that these outliers are not error outliers because they are not as a result of coding error or data entry error but, due to the responses to the items in the questionnaires by the respondents, therefore the outliers was treated as potential interesting outliers which need to be investigated further. The potential interesting outliers was investigated as influential outliers by checking if their removal from the initial PLS-SEM model specification changes the model fit values of the endogenous variable EAD (R^2 =0.775) and moderating variable ICTSKILL (R^2= 0.489), were n= 380. The 81 cases was remove from the data sets leaving 299 cases (n=299) and our model re-specified. The re-specified model results show an increase in the values of our model fit parameters (EAD-R^2 = 0.841; ICTSKILL-R^2 = 0.483). There were equally changes in the inner model prediction (path coefficients) values for the exogenous constructs. This confirmed our potential outliers to be influential outliers and a bad one that need to be removed to improve the model fit and the prediction scores of the exogenous latent variables on the endogenous late variables.

4.2 Evaluation of Measurement Model

We evaluated our reflective measurement model by carrying out unidimensionality, reliability, and validity of the constructs. The unidimensionality of the remaining items of our scales for each constructs was assessed using principal component analysis (PCA) of SPSS 14 [35]. Table 2 (Appendix) shows that, the items on each scale load only on their constructs with Eigenvalue exceeding 1.0 and a loading coefficient above .6 which is considered high [48]; [35]. The internal consistency reliability and indicator reliability was assessed by examining the composite reliability and indicator loadings. The composite reliability values for the constructs ranges from 0.802 to 0.901, while the indicator loadings is also above the threshold of 0.5 as shown in Table 3 (See Appendix) respectively[48]; [22].

We assessed the convergent validity of our seven constructs using the Average variance Extracted (AVE) and the discriminant validity using both the Fornell-Larcker and Cross Loadings Criteria. All the seven reflective constructs have high levels of internal consistency (Composite Reliability) ranging from 0.802 to 0.901. The AVE values representing the convergent validity of the constructs is higher (0.504 - 0.550) than the minimum recommended value of 0.50. Results of discriminant validity (Fornell-Larker) indicate that the square root of AVE of each constructs is higher than its correlation with any other constructs (Table 4 in Appendix). In addition, the indicator's outer loadings of each constructs (Table 5 in Appendix) is higher than all its cross loadings with other constructs [22]; [48]; [23]. Therefore, our measurement model was successfully validated based on the results of reliability and validity of the constructs.

4.3 Evaluation of Structural Model

With the reliability and validity of our constructs confirmed, next we carry out the assessment of the structural model relationships between the constructs of our model. This involves the examination of the predictive capabilities and relationships between the constructs of the model. We adopt a systematic approach [Hair et al. 2014]. First, the structural model was assessed for collinearity among its predictor constructs by copying the PLS latent variable scores results into an IBM SPSS 20 file for a linear regression analysis of the exogenous constructs against each of the two endogenous construct in the model. The results of collinearity for using EF, ICTSKILL, OR, PB, TR, UPSD as predictors of EAD shows all the VIF values to be below the recommended threshold of 5.0 and the tolerance levels values > 0.20 threshold. Equally, the collinearity for using EF, OR, PB, TR, UPSD as predictors of ICTSKILL show likewise, the VIF to be below the threshold of 5.0 and the tolerance levels > 0.20 [22], see Table 6 and Table 7 below.

Table 6. Collinearity among Exogenous Constructs (EF, OR, PB, ICTSKILL, TR, and UPSD) as predictors of EAD Endogenous Construct

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	9.461E-08	.023		.000	1.000		
	EF	.158	.036	.158	4.404	.000	.424	2.361
	ICTSKILL	.053	.032	.053	1.629	.104	.517	1.935
	ORD	.043	.036	.043	1.197	.232	.416	2.404
	PB	.005	.039	.005	.138	.891	.357	2.798
	TR	.753	.031	.753	24.162	.000	.559	1.788
	UPSD	.005	.030	.005	.173	.863	.609	1.641

a. Dependent Variable: EAD
b. Predictors: (Constant), UPSD, TR, PB, ICTSKILL, EF, ORD

Table 7. Collinearity among Exogenous Constructs (EF, OR, PB, TR, and UPSD) as predictors of ICTSKILL Endogenous Construct

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-7.291E-08	.042		.000	1.000		
	EF	-.065	.064	-.065	-1.010	.313	.425	2.352
	ORD	.107	.065	.107	1.647	.101	.420	2.382
	PB	.330	.068	.330	4.889	.000	.387	2.587
	TR	.268	.054	.268	4.968	.000	.606	1.649
	UPSD	.209	.052	.209	3.979	.000	.642	1.557

a. Dependent Variable: ICTSKILL; b. Predictors: (Constant), UPSD, TR, PB, EF, OR

The results confirmed that, there is no problem of collinearity among the predictors constructs of the model. Therefore, we proceed to the next step of the analysis. In the second step, we assessed the significance and relevance of the structural model relationships. We applied the SmartPLS-SEM algorithm [38] to estimate the structural model relationships (path coefficients). Before examining the sizes of the path coefficients, we first examine their significance by running the PLS bootstrapping for the structural model relationships using the sample size of n=299(without outliers) and a threshold bootstrap sample size of 5,000 cases (n=5000). The results indicates five structural paths are significant with two-tailed (t> 1.96) i.e. TR –> EAD, EF –> EAD, PB -> ICTSKILL, and TR ->ICTSKILL, UPSD -> ICTSKILL. The remaining paths coefficients are non-significant at two-tailed threshold but positively correlated with E-Voting adoption. [22]; [48]; [21]. The results are depicted in Table 8 and Figure 2.

Table 8. Results of Significant Relationships

Path Relationship	Std. Beta	SE	t-Value	Remark
Environmental Factors(EF) -> E-Vote Adoption(EAD)	0.158	0.044	3.585***	Significant
Environmental Factors(EF) -> ICT-Training(ICTSKILL)	-0.065	0.073	0.895	Not Significant
ICT-Training(ICTSKILL) -> E-Vote Adoption(EAD)	0.053	0.036	1.470	Not Significant
Organizational Readiness(OR) -> E-Vote Adoption(EAD)	0.043	0.034	1.286	Not Significant
Organizational Readiness(OR) -> ICT-Training(ICTSKILL)	0.107	0.073	1.464	Not Significant
Perceived Benefits(PB) -> E-Vote Adoption(EAD)	0.005	0.039	0.137	Not Significant
Perceived Benefits(PB) -> ICT-Training(ICTSKILL)	0.330	0.089	3.713***	Significant
Technological Readiness(TR) -> E-Vote Adoption(EAD)	0.753	0.053	14.340***	Significant
Technological Readiness(TR) -> ICT-Training(ICTSKILL)	0.268	0.065	4.146***	Significant
User Participation(UPSD) -> E-Vote Adoption(EAD)	0.005	0.029	0.175	Not Significant
User Participation(UPSD) -> ICT-Training(ICTSKILL)	0.209	0.053	3.931***	Significant

Note: ***p< 0.01, Std. Beta=Path Coefficient, SE= Standard Error

Next, we assess the predicting strength of the exogenous constructs on the two endogenous constructs in other to determine their level of significance. The perceptions of Technological Readiness of INEC (TR = 0.753) is the most important determinant factor (direct relationship) of E-Voting adoption, followed by Environmental Factors (EF= 0.158). ICT Training and Skills (ICTSKILL= 0.053) and Organizational Readiness (OR= 0.043) have positive correlation, but not significant (direct relationships) on E-voting adoption (EAD). In contrast, User Participation in System Development (UPSD= 0.005) and Perceived Benefits (PB= 0.005) are not a good predictor of E-Voting adoption but were positively correlated. Technological Readiness (TR= 0.268), Perceived Benefits (PB= 0.330), and User Participation in System development (UPSD= 0.209) are the primary driver of ICT Training and Skills. Organizational Readiness (OR= 0.107) and Environmental Factors (EF= -0.0065) are very weak predictors of ICT Training and Skills (see Figure 2).

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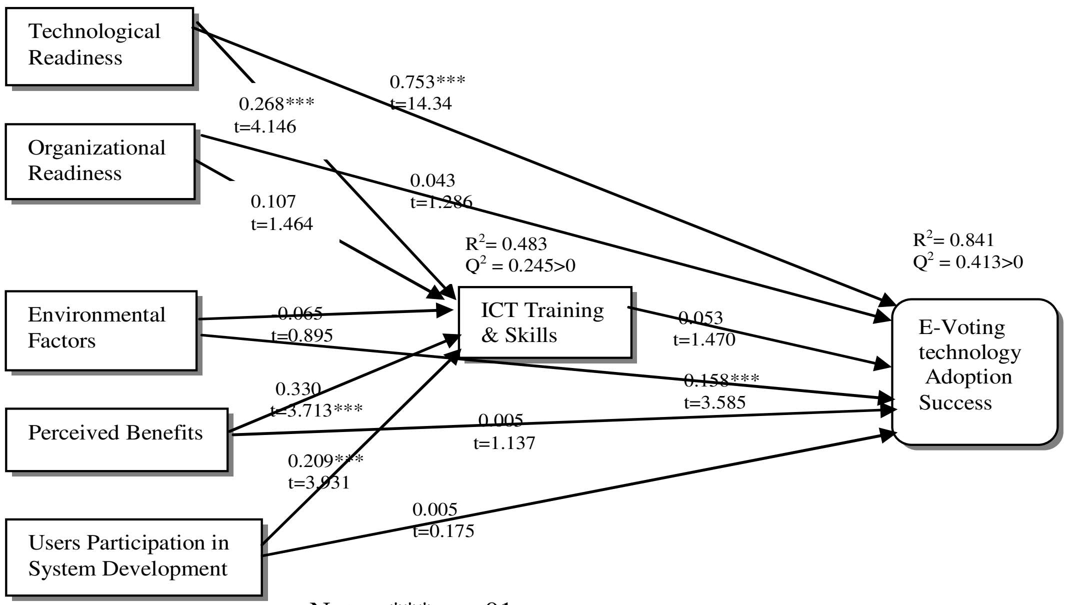

Figure 2. The Results of Structural Model (Weighted) of E-voting Technology Adoption

In the third step, the coefficient of determination (R^2) and predictive relevance (Q^2) was assessed using default report of PLS Algorithm and default report of PLS Blindfolding techniques respectively. The R^2 measure the explained variance of all the exogenous latent variables relative to their total variance, while Q^2 measure the predictive relevance of all the exogenous constructs for each endogenous constructs under consideration [48]; [23]. In the research model, ICT Training and Skills (Indirect Effect Variable) explain 48% (R^2 = 0.483) of the exogenous constructs and can be considered moderate, while E-Vote Adoption variable explain 84% (R^2 = 0.841) which is considered high.

Consequently, the exogenous path coefficients of research model explain 84% (R^2 = 0.841) of variance in E-Voting technology adoption success, likewise they accounted for 48% variation in ICT Training and Skills sets endogenous construct, both are considered to be substantial (Fig. 2). The default report of PLS Blindfolding (cross-validated redundancy) indicate that, the predictive relevance Q^2 of ICTSKILL has a value of 0.245 (Q^2 >0) while Q^2 for EAD is 0.413 (Q^2 >0) which means that the model has medium and large predictive relevance for the exogenous constructs, thereby providing support for the research model's predictive relevance for the two endogenous (ICTSKILL, EAD) constructs.

We then evaluate the effect size (f^2) for each exogenous path on the R2 of the two endogenous constructs by eliminating one path at a time and then re-estimate the model. The results shows that of all the endogenous paths pointing to the ICT Training and Skills(ICTSKILL), Technological Readiness (f^2= 0.081), Perceived Benefits (f^2= 0.079), and User Participation in System development (f^2= 0.055) has small effect size (impact) which is greater than the recommended threshold of f^2= 0.02 [53]; [22]; [48]; [23], Organizational Readiness and Environmental Factors have no effect on ICT Training and Skills endogenous construct(see Table 9). The effect size on E-Vote Adoption (EAD) indicate that Environmental Factors has small impact (f^2= 0.054), while Technological Readiness has large impact (f^2= 2.009), the remaining path coefficients have no impact.

We equally evaluate the effect size (q^2) of each path on the predictive relevance using the cross-validated redundancy scores Q^2 for the two endogenous when they are part of the model and when one is removed at a time from the model and the model re-estimated. The results indicate that only Technological Readiness has medium (q^2= 0.267, where $q^2 \geq$ 0.15) predictive relevance on EAD, while others path coefficients have no predictive relevance on EAD. Perceived Benefits, Technological Readiness, and User Participation in System Development has small ($q^2 \geq$ 0.02) predictive relevance on ICTSKILL when EAD is removed from the model and the model re-estimated. Environmental Factors and Organizational Readiness have no predictive relevance on ICTSKILL [53]; [22]. See Table 9 below.

African Journal of Computing & ICT

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Table 9. Summary of Results - Path Coefficients, Effect Size-f^2, and Effect Size-q^2

	E-Vote Adoption(EAD)			ICT Training and Skill (ICTSKILL)		
Exogenous Construct	Path	f^2 effect	q^2 effect	Path	f^2 effect	q^2 effect
	Coefficient	size	size	Coefficient	Size	size
Environmental Factors(EF)	0.158	0.054	0.007	-0.065	0.004	0.005
ICT-Training and Skills (ICTSKILL)	0.053	-0.001	-0.002	-	-	-
Organizational Readiness(OR)	0.043	-0.001	-0.001	0.107	0.008	0.002
Perceived Benefits(PB)	0.005	-0.001	-0.002	0.330	0.079	0.031
Technological Readiness(TR)	0.753	2.009	0.267	0.268	0.081	0.028
User Participation in System Development(UPSD)	0.005	-0.001	-0.002	0.209	0.055	0.020

Finally, we carried out Importance-Performance Matrix Analysis (IPMA) as a means of extending our PLS-SEM structural model results, which only identifies the relative importance of our research constructs by estimating the direct, indirect, and total relationships to include the actual performance of each constructs in the model using the latent variable scores of our PLS-SEM results. [22], describe IPMA as a contrasts of total effects (importance) and the average values of latent variable scores (performance) in other to show the significant areas for the improvement of management activities or the specific focus of the research model. First, we obtained the total effect (direct and indirect effects) of the relationships between the constructs of the model (exogenous and endogenous) from the results of our previous analysis. Next, we obtain the performance values by rescaling the latent variable scores values for each observation on a scale of 0 (lowest) to 100 (highest) for a scale of 1 to 5 using the formula in equation 3 below [22]:

$$Y_i = \frac{(Yi - Minscale\,[Y])}{(Maxscale\,[Y] - Minscale\,[Y])} * 100 \qquad (3)$$

Where, Y_i is the i^{th} data point (observations) of a specific latent variable in our PLS-SEM path model, Minscale= 1, and Maxscale=5 for our latent variable scores. Then, we run PLS algorithm using the rescaled latent variable scores to obtain from the PLS-SEM default reports, the index value (mean value of the rescaled scores of each latent variable on a scale of 0 to 100) of their performance. See Table 10 and Figure 3 below.

Table 10. Index Values and Total Effects for the IPMA of EAD

Construct	Importance (Total Effect)	Performance (Index Values)
Environmental Factors(EF)	0.160	73.992
ICT Training and Skills(ICTSKILL)	0.050	73.142
Organizational Readiness(OR)	0.050	74.310
Perceived Benefits(PB)	0.030	72.449
Technological Readiness(TR)	0.760	67.636
User Participation in System Development(UPSD)	0.020	61.975

Vol 7. No. 2 - June, 2014
African Journal of Computing & ICT

www.ajocict.net

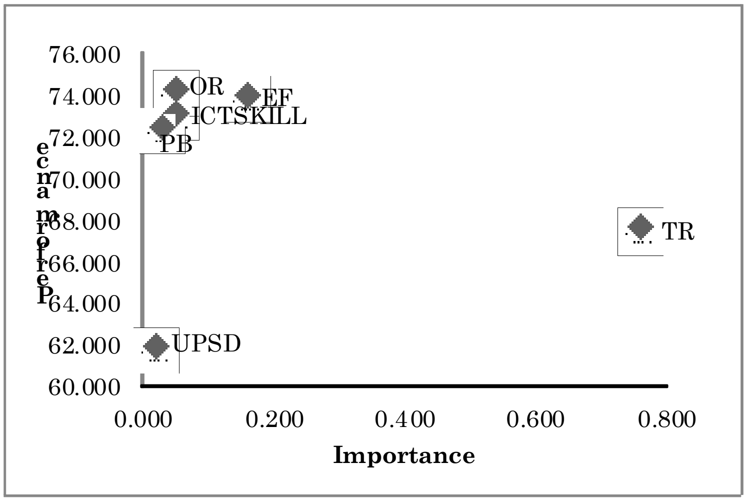

Figure 3. Results of Importance Performance Matrix Analysis

Table 10 and Figure 3 shows that, Technological Readiness (TR) is the primary important construct for achieving organizational adoption of E-Voting technology. However, its performance is lower when compared with other constructs, with the exception of User Participation in System Development construct. Environmental Factors (EF) is next on the order of importance, but has higher performance compared to TR. User Participation in System Development(UPSD) construct has little relevance both in terms of performance and importance. Therefore, there is need for an electoral management organization to focus on improving the performance of TR in other to achieve success in the adoption of the E-Voting technology. Likewise, Organizational Readiness (OR) exhibits the highest performance on EAD, followed by Environmental Factors (EF), ICT Training and Skill (ICTSKILL) and Perceived Benefits (PB) constructs, but of little (importance) or no effect on EAD. There is also the need to focus on improving the importance of these constructs based on an IPMA of their construct's indicators, since these are very important drivers of any organizational IT adoption.

5. DISCUSSION

The aim of the study was to develop a model to determine the influence of IT adoption factors on the adoption of E-Voting technology in the organizational context and test empirically the model using data collected from INEC, Nigeria. The results showed that the predictive tendency of the factors are quiet substantial and represented higher variance in the adoption of E-Voting technology ($R^2 = 0.841$), meaning that the model could effectively explain the adoption of E-Voting technology by INEC, Nigeria.

The model explains the underlying relationships between the exogenous variables and the endogenous variables, thereby providing an insight into how the adoption of E-Voting technology are further explain and facilitated. The findings of the study showed that Technological Readiness has the highest significant and positive relationships (direct) with INEC staff perception on the adoption of E-Voting technology, with a path coefficient of 0.753 ($p < 0.01$), supporting our hypotheses (H1). The results also indicated that the direct relationships between Environmental Factors and E-Voting adoption are positively significant ($p < 0.01$) thereby supporting our hypothesis H3. However, our hypothesized direct relationships H2, H4, H5 and H6 although not significant, positively correlated with the predictor variable (E-Voting technology) and therefore considered supported as suggested by [49] (see Table 11 in the Appendix).

We found empirical evidence that ICTSKILL did no mediate relationships between all exogenous constructs and EAD endogenous construct based on Barron and Kenny 1986 approach to mediation analysis, however using the 2009 Preacher and Hayes bootstrapping method, the results shows that ICTSKILL had indirect effect on the relationships between Organizational Readiness (OR) and E-Voting technology adoption (EAD), also on the relationship between Environment Factors (EF) and E-Voting technology adoption (EAD). This indicates that hypotheses H8, H9 are supported, while H7, H10, and H11 are not supported (see Table 11 in Appendix).

6. CONCLUSION

IT adoption of E-Voting technology in the organizational context is a new area of research. The results suggest that the model could be a good tool for predicting the E-Voting technology adoption success in the organizational context. In the context of this study, technological readiness and environmental factors are the most important determinant factors of E-voting technology adoption. These two factors are consider critical for successful adoption of electronic voting technology in the organizational context since hardware, software and other infrastructures such as internet connectivity, power supply needs to be put in place by the management, the technical skills already acquire by the staff in preparation for the eventual implementation of the electronic voting technology, securing voter's data during elections, there must be adequate voters education and political parties support if the adoption process is to be considered successful.

The systematic integration of the determinant factors of technological readiness, organizational readiness, environmental factors, perceived benefits, and the extension of these basic factors with two others, user participation in systems development and ICT training and skills into a single drivers of E-voting technology adoption in the organizational context makes for difference in literature, and provides richer theoretical basis for explaining and predicting information technology or technology adoption, thereby promoting and facilitating improved explanatory and predictive capabilities of IT adoption.

The validated model provides a framework for researchers to further extend the model with other relevant and important organizational factors in other to better the understanding of E-voting technology adoption. The empirical model offers a strategic decision support for management of the electoral commission on how best to implement the E-voting technology for future election in the country and can be applicable in setting with similar attributes as that of the Independent National Electoral Commission of Nigeria.

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APPENDIX

Table 1: Demographic characteristics Summary

Department	**Frequency**	**(%)**	**Work Experience**	**Frequency**	**%**
Human Resources & Management	71	18.68	Less than 5 Years	44	11.58
ICT	68	17.89	5 - 10 Years	176	46.32
Training	25	6.58	10 – 20 Years	79	20.79
Research & Documentation	2	0.53	Above 20 Years	81	21.32
Voters Education	12	3.16	**Position**	**Frequency**	**%**
Audit	16	4.21	Top Management	8	2.11
Servicom	15	3.95	Director	22	5.79
Voters Registry	2	0.53	Deputy Director	42	11.05
Operations	38	10.00	Assistant Director	53	13.95
Procurement	14	3.68	Senior Staff	166	43.68
Finance & Account	14	3.68	Junior Staff	89	23.42
Logistics & Transport	10	2.63	**Qualification**	**Frequency**	**%**
Estate & Works	17	4.47	Certificate	20	5.26
Store	15	3.95	Diploma	62	16.32
Compliance	4	1.05	BSc/HND	210	55.26
Public Affairs	28	7.37	Master	71	18.68
PPML	1	0.26	Others	17	4.47
Security	6	1.58	**Gender**	**Frequency**	**%**
International Desk	2	0.53	Male	249	65.53
State Coordination	5	1.32	Female	131	34.47
Others	15	3.95	**Age**	**Frequency**	**%**
Marital Status	**Frequency**	**(%)**	Under 25 Years	16	4.21
Married	327	86.05	25 - 40 Years	212	55.79
Single	53	13.95	41 - 56 Years	137	36.05
			Above 56 Years	15	3.95

Table 2. Summary of Principal Component Analysis

Items	**Eigenvalue (>1.0)**	**Variance Explained (%)**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
EAD13	2.053	51.321	0.827						
EAD6			0.685						
EAD7			0.674						
EAD8			0.668						
EF1	3.857	55.098		0.791					
EF10				0.776					
EF11				0.760					
EF12				0.751					
EF3				0.732					
EF7				0.704					
EF8				0.676					
ICTSKILL10	2.017	50.437			0.728				
ICTSKILL11					0.722				
ICTSKILL14					0.711				
ICTSKILL16					0.680				
OR2	2.528	50.561				0.786			
OR3						0.753			
OR4						0.676			
OR5						0.674			
OR6						0.657			
PB10	5.095	50.949					0.768		
PB11							0.755		
PB12							0.755		
PB13							0.753		
PB14							0.751		
PB2							0.722		
PB3							0.666		
PB6							0.665		
PB7							0.648		
PB9							0.639		
TR7	1.664	55.460						0.754	
TR8								0.751	
TR9								0.729	
UPSD1	2.707	54.142							0.810
UPSD17									0.798
UPSD2									0.785
UPSD4									0.755
UPSD7									0.677

Vol 7. No. 2 - June, 2014
African Journal of Computing & ICT

www.ajocict.net

Table 3. Results of Measurement Model

Construct	Scale	Item	Loadings	AVE	CR
E-Vote Adoption	Reflective	EAD13	0.622	0.511	0.805
		EAD6	0.830		
		EAD7	0.684		
		EAD8	0.706		
Environmental Factors	Reflective	EF1	0.729	0.550	0.895
		EF10	0.739		
		EF11	0.786		
		EF12	0.769		
		EF3	0.739		
		EF7	0.754		
		EF8	0.673		
ICT-Training and Skills	Reflective	ICTSKILL10	0.712	0.504	0.802
		ICTSKILL11	0.749		
		ICTSKILL14	0.663		
		ICTSKILL16	0.712		
Organizational Readiness	Reflective	OR2	0.704	0.504	0.835
		OR3	0.708		
		OR4	0.744		
		OR5	0.676		
		OR6	0.715		
Perceived Benefits	Reflective	PB10	0.774	0.509	0.901
		PB11	0.736		
		PB12	0.739		
		PB13	0.705		
		PB14	0.738		
		PB2	0.650		
		PB3	0.682		
		PB6	0.683		
		PB7	0.657		
		PB9	0.759		
Technological Readiness	Reflective	TR7	0.793	0.553	0.787
		TR8	0.715		
		TR9	0.721		
User Participation in Sys. Dev.	Reflective	UPSD1	0.767	0.531	0.849
		UPSD17	0.724		
		UPSD2	0.763		
		UPSD4	0.762		
		UPSD7	0.615		

Table 4. Discriminant Validity –Fornell-Larcker Criterion

Construct	1	2	3	4	5	6	7
E-Vote Adoption	**0.715**						
Environmental Factors(EF)	0.543	**0.742**					
ICT-Training and Skills	0.577	0.495	**0.710**				
Organizational Readiness	0.595	0.533	0.556	**0.797**			
Perceived Benefits	0.570	0.493	0.407	0.513	**0.714**		
Technological Readiness	0.580	0.565	0.552	0.552	0.517	**0.744**	
User Participation in Sys. Dev.	0.473	0.540	0.515	0.511	0.514	0.438	**0.729**

Note: Values in the diagonal represent the square root of the AVE while the off-diagonals represent the correlations.
1 = E-Vote Adoption, 2=Environmental Factors, 3=ICT Training and Skills, 4= Organizational Readiness, 5=Perceived Benefits, 6=Technological Readiness, 7=User participation in System Development.

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Table 5. Discriminant Validity-Loadings and Cross Loadings Criterion

	EAD	EF	ICTSKILL	OR	PB	TR	UPSD
EAD13	**0.622**	0.426	0.319	0.323	0.325	0.431	0.303
EAD6	**0.830**	0.556	0.490	0.492	0.451	0.565	0.376
EAD7	**0.684**	0.404	0.397	0.562	0.498	0.539	0.349
EAD8	**0.706**	0.446	0.421	0.307	0.346	0.583	0.322
EF1	0.544	**0.729**	0.452	0.597	0.563	0.440	0.398
EF10	0.441	**0.739**	0.335	0.395	0.449	0.390	0.366
EF11	0.482	**0.786**	0.398	0.398	0.553	0.435	0.353
EF12	0.446	**0.768**	0.330	0.473	0.569	0.385	0.436
EF3	0.492	**0.739**	0.396	0.539	0.455	0.442	0.505
EF7	0.456	**0.754**	0.350	0.457	0.449	0.423	0.425
EF8	0.456	**0.673**	0.276	0.391	0.419	0.403	0.307
ICTSKILL10	0.407	0.286	**0.712**	0.367	0.357	0.349	0.301
ICTSKILL11	0.531	0.405	**0.749**	0.442	0.401	0.486	0.365
ICTSKILL14	0.321	0.323	**0.663**	0.347	0.513	0.319	0.337
ICTSKILL16	0.356	0.379	**0.712**	0.412	0.463	0.394	0.455
OR2	0.445	0.525	0.378	**0.704**	0.538	0.394	0.418
OR3	0.542	0.499	0.352	**0.708**	0.554	0.477	0.362
OR4	0.323	0.290	0.421	**0.744**	0.497	0.310	0.423
OR5	0.413	0.571	0.416	**0.676**	0.543	0.422	0.321
OR6	0.360	0.329	0.408	**0.715**	0.381	0.333	0.288
PB10	0.423	0.535	0.449	0.530	**0.774**	0.388	0.373
PB11	0.324	0.424	0.432	0.445	**0.736**	0.293	0.354
PB12	0.370	0.469	0.479	0.450	**0.739**	0.347	0.420
PB13	0.360	0.463	0.486	0.385	**0.705**	0.349	0.411
PB14	0.346	0.448	0.472	0.441	**0.738**	0.336	0.375
PB2	0.380	0.467	0.409	0.500	**0.650**	0.354	0.402
PB3	0.459	0.396	0.427	0.582	**0.682**	0.403	0.295
PB6	0.541	0.562	0.359	0.507	**0.683**	0.468	0.340
PB7	0.373	0.519	0.384	0.407	**0.657**	0.338	0.260
PB9	0.459	0.543	0.431	0.633	**0.759**	0.392	0.428
TR7	0.578	0.548	0.455	0.460	0.433	**0.792**	0.360
TR8	0.522	0.349	0.386	0.508	0.413	**0.715**	0.338
TR9	0.589	0.335	0.385	0.253	0.299	**0.721**	0.274
UPSD1	0.328	0.196	0.433	0.362	0.319	0.326	**0.767**
UPSD17	0.316	0.487	0.296	0.357	0.338	0.316	**0.724**
UPSD2	0.235	0.313	0.389	0.295	0.362	0.226	**0.763**
UPSD4	0.292	0.431	0.348	0.328	0.378	0.266	**0.762**
UPSD7	0.484	0.518	0.374	0.467	0.441	0.411	**0.615**

Table 6. Results of Hypothesized Relationships

S/N	Direct Relationship	Std. Beta	SE	t-Value	Remark
H1	Technological Readiness (TR)->E-VoteAdoption (EAD)	0.766	0.049	15.602***	Supported
H2	Organizational Readiness (OR)->E-VoteAdoption (EAD)	0.052	0.034	1.527	Supported
H3	Environmental Factors (EF)->E-VoteAdoption (EAD)	0.144	0.041	3.493***	Supported
H4	Perceived Benefits (PB)->E-VoteAdoption (EAD)	0.029	0.037	0.777	Supported
H5	UserParticipation (UPSD)->E-VoteAdoption (EAD)	0.021	0.029	0.728	Supported
H6	ICT-Training (ICTSKILL)->E-VoteAdoption (EAD)	0.053	0.036	1.470	Supported
	Indirect Relationship	**Std. Beta**	**SE**	**t-Value**	**Remark**
H7	Technological Readiness (TR)->ICT-Training->E-VoteAdoption (EAD)	0.014	0.012	1.230	Not Supported
H8	Organizational Readiness (OR)-> ICT-Training->E-VoteAdoption (EAD)	0.007	0.006	1.025	Supported
H9	Environmental Factors (EF)-> ICT-Training->E-VoteAdoption (EAD)	-0.003	0.005	-0.635	Supported
H10	Perceived Benefits (PB)-> ICT-Training->E-VoteAdoption (EAD)	0.017	0.013	1.396	Not Supported
H11	UserParticipation (UPSD)-> ICT-Training->E-VoteAdoption (EAD)	0.011	0.008	1.348	Not Supported

Note: ***$p< 0.01$