Modeling User Acceptance of Electronic Voting: An Extended Technology Acceptance Model (TAM) Approach

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Authors' contributions

This work was collaborative effort of all the authors. All the authors did the collection of the data obtained via the administered questionnaire. Author OOO developed the extended TAM model while author AAS carried out the statistical analysis. Authors MOO and WBW carried out a thorough literature search and catered for all the reference materials used. All the authors were involved in the empirical testing of the model. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Election voting has emerged as a significant alternative to conventional voting methods with testimonials of its implementation showing various degrees of success in some countries of the western world. Lately, many developing countries are also looking at its prospects as a replacement or supplement for traditional paper balloting which is, the principal voting method in most of these countries. However, the voting populace' acceptance of this technology is a major factor that needs to be considered before its actual introduction owning to factors that includes, digital divides, low literacy level, norms and beliefs, high poverty level and so on. From another viewpoint, due to the peculiarity of contextual ICT infrastructural challenges of developing

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countries, there is a need to investigate the factors that will influence adoption decision and eventual usage when planning to introduce electronic voting so that the evolving system will not end up being impractical for the target users. In this study, an empirical investigation of the factors influencing the adoption decision of electronic voting was carried out. More specifically, this study aimed at examining the possibilities and intents towards mobile voting (which is a type of electronic voting), among a selected sample population of electorates in Nigeria. In the study, an extended Technology Acceptance Model (TAM) that integrates Subjective norm, Perceived compatibility, Perceived privacy, Perceived security, Perceived price value and Perceived trust into the original TAM constructs was proposed. A total of 1364 sample data were collected from a selected population of electorates who had at one time or the other participated in at least an electioneering process in Nigeria. The data was then analyzed statistically using Partial Least Square Structural Equation Modeling (PLS-SEM). The results obtained show that all variables have significant effect on the electorates' behavioural intention to use mobile voting except for perceived privacy.

1. INTRODUCTION

The attendant shortcomings of conventional voting systems that include traditional paper ballots, mechanical devices, or electronic ballots are several and severe. Some of them includes: allegations of violence, intimidation, ballot stuffing, coercion, under-age and multiple voting, counting error, complicity of the security agencies and the absence or late arrival of election materials on Election Day, lack of information on physical location of voting poll sites, social discrimination, natural causes like advanced age, physiological disability, terrain, floods and poor communication infrastructure and so on. Furthermore, the cost and process of manual voting are both increasing geometrically and tedious to execute [1] and there has been a declining participation rate due to: inconvenience of manual system of voting that includes: inaccuracy in ballot counting and delayed announcement of election results [2,3]; loss of significant time during ballot counting [4]; unacceptable percentages of lost, stolen and miscounted ballot papers, votes loss through unclear or invalid ballot marks and limited accommodations for people with disabilities [2,5,6].

In Nigeria, different voting systems that were based on paper ballots have been deployed for general elections at different times. Some of these voting schemes include: Open Ballot System, Open-secret Ballot System, Option-A4, Modified Open Ballot System and lately, Re-Modified Open-Secret Ballot System (REMOBS). These voting systems have littered the electoral history of this nation with example of elections being manipulated in order to influence their outcome. Consequently, this has led to a rapid decline in voters' participation in elections. Records of the various elections conducted since the nation's independence, showed that about half of the number of registered voters actually voted during elections [7]. This worrisome from a democratic point of view in that, if the reasons for the decline are left unchecked, the mandate of those elected to hold the positions might eventually be questionable. Furthermore, in the developing world, participatory democracy is a major requirement for achieving the millennium development goals (MDGs), particularly, where the majority of the citizenry is disenchanted with the electioneering or democratic processes or governance.

Encouragingly, diverse Information and Communications Technology (ICT) solutions have emerged in election voting (e-voting) to proffer alternatives to these conventional voting systems. E-voting is any voting method whereby at least the voter's intention is expressed or collected by electronic means [2,8,9,10]. It encompasses all forms of electronic voting techniques and equipments that include voting over the internet and electronic counting of paper ballots [9]. Other terms, for example, e-election (electronic election), i-voting (internet voting) and mobile voting (m-voting) are used in order to clarify the specific contents of e-voting. Many countries in the western world have made significant steps to examine and review existing electoral procedures with recommendations that electronic voting be made available to a voting population as a form of voting to guarantee their citizens the freedom to vote, secrecy of the vote,

non-modification of the expressed intention of the vote and lack of intimidation during the voting operation [11].

With the emergence of e-voting as a significant alternative to manual voting systems, its implementation in developing countries may however be flawed given the peculiarity of the contextual ICT infrastructural challenges faced by developing countries. General, developing countries are low ICT resourced countries where poverty, deficit in infrastructures, digital divides and low literacy level is still very significant. However, the increase in affordability, accessibility and adaptability of mobile phones has created a breeding ground for development innovations, which target key areas of economic and social impact. Mobile phones and infrastructures such as mobile telecommunications networks have proliferated [12,13,14]. In Nigeria, for example, the proliferation of mobile phones has resulted in their use even within impoverished rural homesteads. Mobile phones are easy to use, increasingly able to bypass the barriers of illiteracy and affordability, and provide access to a wide range of very useful services. Thus, mobile phones can be considered a good candidate for voting platform in the developing world. Any voting process whereby the voting process/ballot casting is by using a mobile electronic device is referred to as m-voting. M-voting is an additional platform to any e-voting system. It is a mobile government (m-government) initiative with tremendous potentials to enhance democratic participation [15]. It can also serve as an enabler and a convenient way to involve citizens in political decision making.

It may be noted that in developing countries like Nigeria, the voting populace' acceptance of this technology is a major factor that needs to be considered before its actual introduction owning to factors that includes, digital divides, low literacy level, norms and beliefs, high poverty level, and so on. From another viewpoint, due to the peculiarity of contextual ICT infrastructural challenges of developing countries, there is a need to investigate the factors that will influence adoption decision and eventual usage when planning to introduce electronic voting so that the evolving system will not end up being impractical for the target users. In this study, an empirical investigation of the factors that influences the adoption decision to use m-voting by a selected voting population in Nigeria was carried out.

2. THEORETICAL BACKGROUND

2.1 E-voting: A Panacea for Electronic Participation (E-participation)

One of the digital developments being facilitated by many governments around the world today is electronic participation (e-participation). The adoption of ICT in governance is aimed at the provision of better information and services to citizens with fewer resources through optimization of available resources and infrastructures. This aim could only be achieved through effective e-participation between the governed and the government. E-participation is a technology-mediated interaction among the citizens, formal political spheres and central governing spheres. The mission of e-participation is to endow citizen with privileges of ICT to respond in bottom-up decision processes and develop social as well as political responsibility for their choices [16]. Citizens' participation in electronic governance could be in the following context: information provision, consultation, campaigning, deliberation, polling, electioneering and voting using different electronic methods. E-participation through e-voting is the use of ICT in the context of public voting in elections or referenda. It has emerged as a significant alternative to conventional voting systems.

Many e-voting schemes have been proposed and used with various degrees of successes in a number of countries during local elections and referenda. Also, many pilot e-voting schemes have been developed and tested. These schemes have proven that e-voting can undoubtedly enable voters to cast their vote from a place other than the poll site in their voting district, facilitate the casting of the vote by the voter, facilitate the participation in elections by those who are entitled to vote, widen access to the voting process for voters with disabilities or those having other difficulties in being physically present at a poll site, increased voter turnout by providing additional voting channels, reduce overtime, the overall cost to the electoral authorities of conducting an election, deliver voting results reliably and more quickly amongst many other benefits [2,8]. Also, e-voting can enhance polling and votes' security, confidentiality, sincerity and increased cost savings on reduced manpower, logistical materials and tools; and above all instant analysis and reporting.

Furthermore e-voting can enhance accuracy of all valid votes and final outcome; permit voting once for only eligible voters; allow independent verification of all voters; it can also improve voters' turnaround as it flexibly allows a voter to login and vote from any workstation [17]. Therefore, electronic based voting technologies would expand the reach and range of potential voting population.

2.2 The Choice M-voting Over Other E-Voting Options

M-voting is any voting process whereby the voting process/ballot casting is by using a mobile electronic device. It is an additional platform to the electronic voting [11]. It is not a replacement for e-voting, but rather a complement [18,19]. It is a cheaper, convenient, and a simple to administer voting alternative. The use of mobile devices in political participation simplifies and eases access to and the integrating of persons and institutions in political processes.

There exist many channels of ICT that are being utilized for e-participation; Smart televisions, Internet and broadband, personal computers, laptops, satellites and so on. Nevertheless, mobile phones are in the forefront of ICTs for development. They have been the most accepted and used medium of communication over the world with its infiltration and diffusion more than all other information and communication devices summed together [19]. The rate of penetration of mobile phones exceeds those for internet users, broadband subscriptions and fixed phone lines. The international Telecommunication Union (ITU) in its annual report of 2018 stated that there are 172.7 million mobile-cellular telephone subscription and a penetration rate of 88.18 per 100 inhabitants in Nigeria.

When compared to other ICT tools, mobile phones are advantaged in its suitability for the under-developed local conditions. They have been proven to be of immense assistance in enhancing productivity both individually and collectively within resource-constrained settings as it increases efficiency, effectiveness, and access and coverage [20,21]. Mobile phones is the only ICT tool that is not affected by the problem of viability for the poor in geographically deprived locale owning to lack of enabling environments that majorly boarders on infrastructure and capital.

Therefore, m-voting has the potential to increase election turnout by providing voters with a convenient voting mode that does not require them to leave their homes or offices. Even geographic distance is no longer a limitation on participation in elections as soldiers, students, tourists, and business persons can exercise their civic right and vote from anywhere around the world regardless of any time differences. Since many democracies are faced with an ever decreasing voting rate, the opportunity to turn the tide and increase turnout seems particularly promising. There is no doubt that m-voting offers a convenience that would be appreciated by many people. M-voting enables citizens to participate electronically in democracy and provides them with more information about candidates and the election/survey they are being asked to participated in.

2.3 Technology Acceptance Model (TAM)

In this paper, the Technology Acceptance Model (TAM) which was developed by [22] was applied to investigate the factors influencing the adoption decision to use m-voting. Davis in [22] founded his model on the psychological model, the Theory of Reasoned Action (TRA). TRA is based on the theory that the individual attitude has a significant function in determining the behaviour towards adopting a particular technology [23]. Nevertheless, TAM is widely regarded as a more flexible technique due to its ability to give permission to the capturing of a number of essential psychological elements that influence producers in adopting or not adopting the technology. The model has been appraised to be not only an authoritative model for denoting the determinants of system usage, but it is a helpful tool for system planning, in view of the fact that system designers have to an extent, control over easiness and usefulness [24].

Fig. 1 depicts the original TAM. It's an information system acceptance theory, whose core rationale is basically to predict and explicate the user acceptance of information technology. TAM is built from a number of indicators that includes Perceived Ease of Use (PEOU), Perceived Usefulness (PU), Attitudes towards Using (ATU), Behavioural Intention (BI) and Actual Usage (AU). These indicators are defined as follows: Perceived Usefulness (PU) refers to
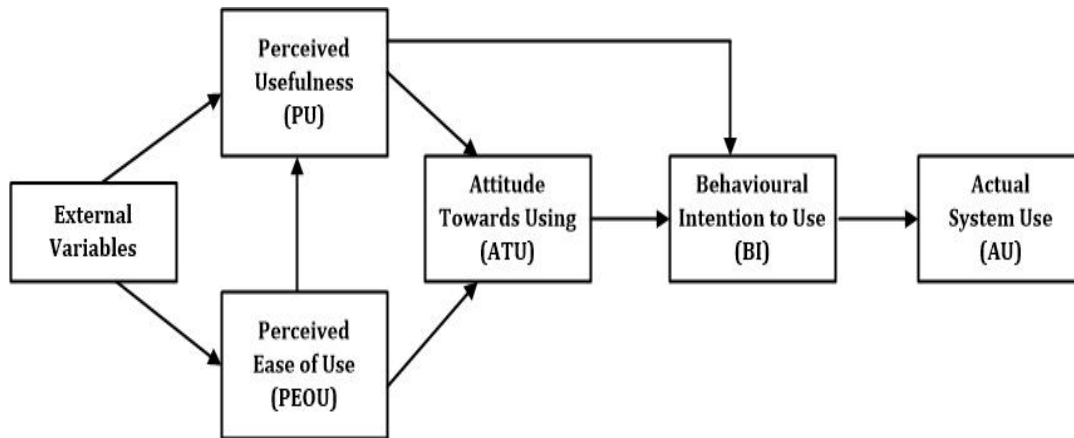
Fig. 1. The original technology acceptance model [22]

the extent to which an individual believes that his/her job performance could be improved by utilizing an IT system [22,25,26]. Perceived Ease of Use (PEOU) is the degree of believe of an individual that the usage of an information technology would be effort free [27]. Attitudes Towards Using (ATU) is defined as a function of beliefs, positively or adversely towards the behaviour [26,28,29,30]. Behavioural Intention (BI) is defined as target objectives and anticipated reaction to the attitude object [26,28,29]. Actual Usage (AU) is defined by [31] as the rate of utilizing a new technology system, for example, mobile voting and the estimated frequency the user uses it over a specific duration [26,28,29].

It was suggested by a number of researchers that TAM needs to be supplemented by additional constructs in order to realize a sturdier model [32]. TAM2 was proposed as an expansion of TAM by [33]. The authors integrated social influence and cognitive instrumental processes, but left out ATU owing to weak predictors of either AU or BI. Their proposition is in consonance with the previous work of [24] which specified that both social influence processes and cognitive instrumental processes extensively determined user acceptance and that PEOU and PU indirectly determined AU through BI.

The focus of this paper is on the investigation of the factors that determines the acceptance of an information and communications technology application, mobile voting; consequently, an appraisal of previous studies suggested the theoretical basics of used in the formulated hypotheses of this work. Furthermore, it was

highlighted in several research, that it is of significant importance, to incorporate additional construct(s) to TAM so as to enhance its prediction of system use [34,35]. Towards this end, the following external constructs were introduced to TAM in this study to investigating the factors that have effects on the adoption decision of mobile voting among a selected sample population of electorates in Nigeria: Subjective norm, Perceived compatibility, Perceived privacy, Perceived security, Perceived price value and Perceived trust. These variables are defined as follows:

Subjective Norm: was proposed in [28] by Fishbein and Ajzen (1975) in the Theory of Reasoned Action (TRA). The authors defined it as a person's perception that majority of the people who are important to him approve or disapprove his performing a given behaviour. Furthermore, this construct was posed as a direct factor determining to behavioural intention to use in the Theory of Planned Behaviour (TPB) proposed in [36] by Ajzen (1991). In [37], Dillon and Morris (1996) defined subjective norm as 'the person's perception that most people who are important to him think he should or should not perform the behavior in question'.

Perceived Compatibility: According to [38], compatibility refers to the degree to which an innovation is seen to be compatible with principles, experiences, beliefs and needs of individuals adopting it. This variable encompasses a user's perception of the comparison of the innovation with their lifestyle.

Perceived Privacy: Privacy is the denial of access to information (that is access control) by

unauthorized individuals. Westin [39] defined privacy as the claim of individuals, groups, or institutions to determine for themselves when, how, and to what extent information about them is communicated to others.

Perceived Security: Khalifa and Ning shen [40] defined security as the safety of exchanged information regardless of the level of privacy involved. Also, Ghosh and Swaminatha [41] said that security is the safety of exchanging information regardless of the level of privacy involved. Trusting beliefs determine user attitudes toward online systems. These beliefs encapsulate concerns related to privacy and subsequent use of user information by the vendor [42,43]. Thus, when security and privacy policies are clearly disclosed, users increase their trust, which in turn enables online transactions [44].

Perceived price value: Perceived price value can be viewed using two perspectives according to [45]. One, the initial price of acquiring devices (in the context of this work, mobile phones) and two, the price of subscribing both from the mobile network provider and the service provider. These authors defined this variable as the willingness to pay for a service.

Perceived Trust: Gefen et al. [46] defines trust as the expectation that the trusted party will behave in an ethical, dependable and socially appropriate manner and will fulfill their expected commitments in conditions of interdependence and potential vulnerability. Dahlberg et al. [47] and Grandison and Sloman (2000) showed that trust is the key to success and major facilitator of wireless transactions because of the natural human needs to understand the social surroundings of the virtual environment. Bhattacherjee (2002) theoretically conceptualized and empirically validated a scale to measure individual trust in online firms. He found that one's willingness to interact with an online firm may be predicted by additional variables, above and beyond trust, such as perceived usefulness and perceived ease of use of such interactions. Dahlberg *et al.* (2003) proposed the application of trust enhanced technology acceptance model in order to investigate user acceptance of internet applications.

3. RESEARCH METHODOLOGY

3.1 Proposed Research Model and Hypotheses Formulation

The proposed research model of this study is depicted in Fig. 2. The model integrated external variables that include Subjective norm (SN), Perceived compatibility (PC), Perceived Privacy (PP), Perceived security (PS), Perceived price value (PPV) and Perceived trust (PT) to the original TAM.
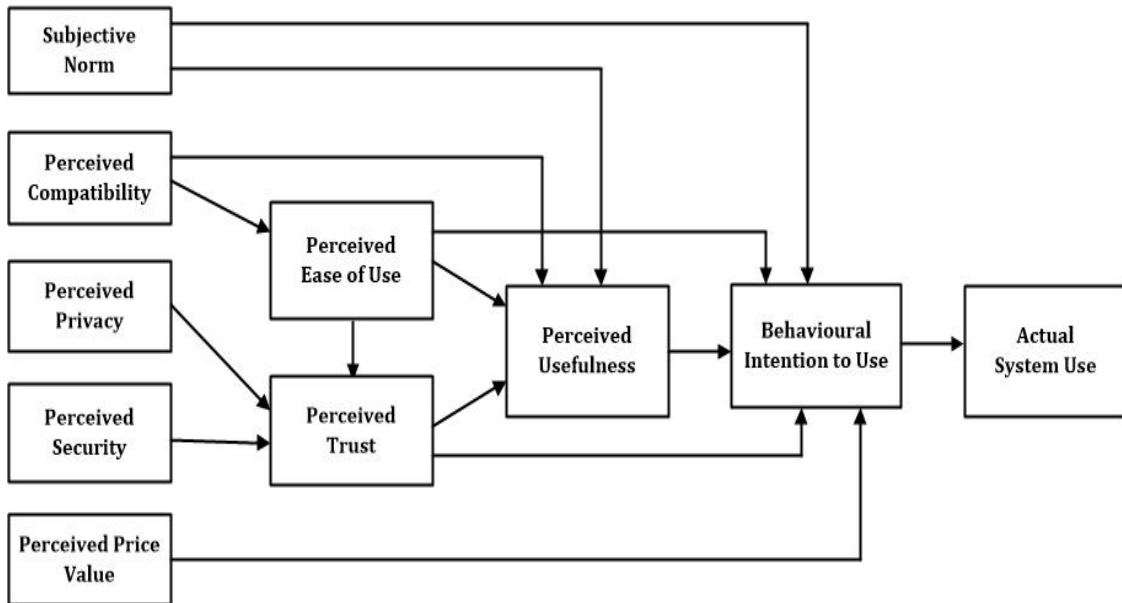

Fig. 2. The proposed research model

After evolving the research model of this study, the following hypotheses were formulated and then later tested to establish the effects of the introduced external variables and their corresponding relationship with the original TAM:

H_1: Behavioural intention to use m-voting has a significant positive effect on the future actual use.

H_2: Perceived usefulness has a significant positive effect on behavioural intention to use m-voting.

H_3: Perceived price value has a significant positive effect on behavioural intention to use m-voting.

H_{4A}: Subjective norm has a significant positive effect on behavioural intention to use m-voting.

H_{4B}: Subjective norm has a significant positive effect on perceived usefulness of m-voting.

H_{5A}: Perceived ease of use has a significant positive effect on behavioural intention to use m-voting

H_{5B}: Perceived ease of use has a significant positive effect on perceived usefulness of m-voting.

H_{5C}: Perceived ease of use has a significant positive effect on perceived trust of m-voting.

H_{6A}: Perceived trust has a significant positive effect on the perceived usefulness of m-voting.

H_{6B}: Perceived trust has a significant positive effect on the behavioural intention to use m-voting.

H_{7A}: Perceived compatibility has a significant positive effect on the perceived usefulness of m-voting.

H_{7B}: Perceived compatibility has a significant positive effect on the perceived ease of use of m-voting.

H_8: Perceived privacy has a significant positive effect on the perceived trust of m-voting.

H_9: Perceived security has a significant positive effect on the perceived trust of m-voting.

The proposed research model with hypothesized paths for determining the factors influencing the adoption decision of m-voting among the selected sample population is depicted in Fig. 3.

3.2 Data Collection and Measurement Scales Utilized

The participants used for this study were selected across six States in Nigeria that include: Oyo, Osun, Ogun, Ondo, Kwara and Edo States. A questionnaire consisting of 24 items was administered to interview 1500 registered voters. The items which describe the ten variables presented a graduation following the Likert-type scale from 1 (Strongly disagree) to 5 (Strongly agree) or 1 (Strongly disapprove) to 5 (Strongly approve) or 1 (Never) to 5 (Always) or 1 (None) to 5 (Severe) depending on the item. The data collected were then analysed using Partial Least Squares Structural Equation Modeling (PLS-SEM).
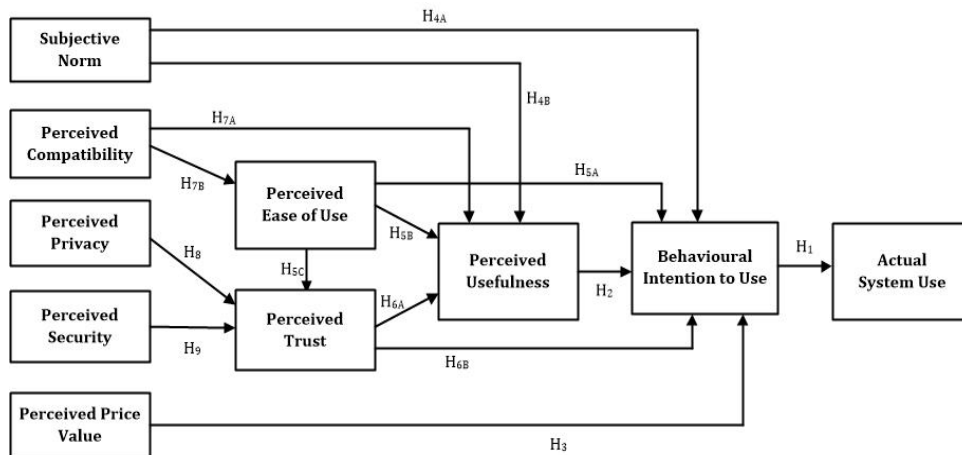

Fig. 3. The proposed research model with hypothesized paths

4. RESULTS AND DISCUSSION

4.1 Descriptive Statistical Analysis of Respondents

A questionnaire consisting of 24 items on a five-point Likert rating scale was employed to collect the data used in this study. The items which is depicted by questions on the questionnaire describes the nine constructs which are AU, BI, PEOU, PU, SN, PC, PS, PPV, and PT. Out of the 1500 questionnaires that were administered, 1364 were returned with complete responses. The respondents' profile is detailed in Table 1.

4.2 Measurement Model Evaluation

4.2.1 Internal consistency analysis of variables

A post-data collection analysis was carried out to test for the internal consistency of the Likert rating scale items on the questionnaire using Cronbach's alpha reliability coefficient. These Likert scale items were group differently into ten to form the ten variable used in the model. The reliability coefficients of the ten groups depicting the ten variable of the model were measured. The values of the alpha reliability are presented in Table 2. The values ranged between 0.7220 and 0.8214 which indicated that the data collected through the rating scale have satisfactory reliability, with values above 0.7 which is considered as adequate benchmark for survey items [48].

4.2.2 Convergent validity and reliability

As earlier mentioned, the formulated hypotheses were tested using PLS structural equation analysis. In the PLS analysis, the reliability of the variables was evaluated using the Composite Reliability and Average Variance Extracted (AVE) for each variable. This is presented in Table 2. According to [49], a value of 0.7 or higher is the acceptable benchmark. Therefore, from Table 2, the composite reliability values for each variable showed that all the variables exhibit acceptable degree of internal consistency. The other reliability measure utilized in the PLS analysis is the AVE. This reliability measure indicates the total amount of variance in the items catered for by the underlying variable [50]. When compared with composite reliability, the AVE is a more conservative reliability measure,

hence, an acceptable benchmark value of 0.5 or higher is suggested for AVE by [51]. From Table 2, all the variables surpassed this criterion.

4.2.3 Discriminant validity evaluation

Discriminant validity evaluation was carried out by evaluating both cross loading and square root AVE values. This study found all of its indicators having greater loading factor from its associated variables when compared to other variables. This result meets the requirements as stipulated in [52]. Furthermore, the square root of AVE values of every variable was greater than any correlation towards other latent variables in the research model [53]. Consequently, the proposed research model of this study has met discriminant validity evaluation as exhibited in Table 2.

4.3 Structural Model Evaluation

Coefficient of determination analysis and hypotheses testing constitutes the components of structural model evaluation carried out in this study. Evaluation results from coefficient of determination analysis showed that actual usage was influenced by behavioural intention to use by coefficient of determination value (R^2) of 30.98%. However, there was a more significant influence on behavioural intention by its independent variables with R^2 value of 71.76%. Similarly, very significant R^2 values were returned for perceived usefulness (72.49%) and perceived ease of use (78.95%). These three original TAM variables have values greater than 67% which translates to a strong correlation from their various independent variables [52]. Furthermore, hypothesis testing was carried out by estimating the t-value on each path coefficient. A hypothesis is acceptable if it has a t-value higher than 1.96 at a significance level of 0.05 [53]. The summary of the hypotheses testing results is presented in Table 3.

The results obtained from this study indicated that the actual usage of m-voting can be explained indiscernibly through behavioural intention R^2 = 30.98%. Furthermore, results from this study showed that perceived usefulness and perceived ease of use both have effect on behavioural intention concomitantly. However, perceived usefulness has a greater influence (with path coefficient of 0.6431) when compared to perceived ease of use (with path coefficient of 0.4188).

Table 1. Profile of respondents

Attribute	Category	N	%
Gender	Male	887	65.03
	Female	477	34.97
Age	18-25 years	309	22.65
	26-35 years	372	27.28
	36-45 years	274	20.09
	46-55 years	267	19.57
	56-65 years	128	9.38
	Over 66 years	14	1.03
Educational Level	Primary	83	6.09
	Secondary	434	31.82
	Tertiary	847	62.09
Possession of Mobile Phones	Yes	1351	99.05
	No	13	0.95

Table 2. Convergent validity, reliability and internal consistency analysis

Variable	Cronbach's α	Composite Reliability	Average Variance Extracted (AVE)
Subjective Nom	0.7613	0.9251	0.8723
Perceived Compatibility	0.7419	0.8476	0.7915
Perceived Privacy	0.7220	0.8317	0.8107
Perceived Security	0.7826	0.8519	0.7884
Perceived Price Value	0.7512	0.9024	0.8331
Perceived Trust	0.8105	0.8813	0.7953
Perceived Ease of Use	0.7724	0.9322	0.8839
Perceived Usefulness	0.8214	0.9285	0.8923
Behavioural Intention to Use	0.7387	0.9193	0.8564
Actual System Use	0.7256	0.8910	0.7812

Table 3. Hypotheses testing results

Hypothesis	Path	Path Coefficient	T-value	Conclusion
H_1	BI→AU	0.5729	2.8671	Significant
H_2	PU→BI	0.6431	5.9034	Significant
H_3	PPV→BI	0.4297	3.5295	Significant
H_{4a}	SN→BI	0.5523	5.0962	Significant
H_{4b}	SN→PU	0.3362	3.7246	Significant
H_{5a}	PEOU→BI	0.4188	4.3792	Significant
H_{5b}	PEOU→PU	0.3945	2.8128	Significant
H_{5c}	PEOU→PT	0.5014	3.1903	Significant
H_{6a}	PT→PU	0.2933	4.0572	Significant
H_{6b}	PT→BI	0.4806	2.9453	Significant
H_{7a}	PC→PU	0.4538	3.9394	Significant
H_{7b}	PC→PEOU	− 0.0361	0.9127	Not Significant
H_8	PP→PT	− 0.0475	0.8245	Not Significant
H_9	PS→PT	0.3985	2.2103	Significant

From the viewpoint of external variables introduced to the original TAM, three of the variables, subjective norm, perceived price value and perceived trust all significantly influence behavioural intention. Perceived trust has a significant influence on perceived usefulness with a path coefficient of 0.2933 while perceived security in turn has a significant influence on perceived security. Subjective norm, perceived ease of use, perceived trust and perceived compatibility all significantly influence perceived usefulness. It may be noted however, that

perceived compatility and perceived privacy have insignificant influence on perceived ease of use and perceived trust respectively.

5. CONCLUSION

This study extended the TAM in a bid to investigate empirically, the factors influencing the adoption decision of m-voting. Consequently, six external variables which are: Subjective norm, Perceived compatibility, Perceived Privacy, Perceived security, Perceived price value and Perceived trust were integrated into the original TAM.

A total of ten variables were proposed as significant determinants that could influence the electorates' decision of adopting m-voting; with perceived ease of use, perceived usefulness and perceived trust being the leading mediating variables. With these variables, fourteen hypotheses were formulated to analyze the relationships between the variables. The results obtained showed that all hypotheses were supported except for hypothesis H_{7B} (Perceived compatibility has a significant positive effect on perceived ease of use of m-voting) and H_8 (perceived privacy has a significant positive effect on perceived trust of m-voting) while perceived privacy was the only variable that has an insignificant effect on the selected sample electorates' behavioural intention to use mobile voting.

The results obtained from this study showed that: first, perceived usefulness has a positive significant effect on behavioural intention to use. This translates that the merits of the value adding features and functions of m- voting services should be utilized by service and content providers. Second, with perceived ease of use having positive significant effect on behavioural intention and perceived usefulness, the design of easy-to-use and user friendly interface should be one of key objectives of developers in order to enhance user acceptance of m-voting. Third, subjective norm has a positive significant effect on behavioural intension to use m-voting. This translates that voters may choose to perform the behaviour even if they are not favourable to perform and if they believe that voters who are important to him think he/she should or should not perform it. Fourth, perceived trust has a positive significant effect on behavioural intention to use m-voting and indirectly influences the actual usage through behavioural intention. This

means the voters are willing to rely on the service/contents provider and the electoral body.

Fifth, aside developing easy to use systems, mobile Information Technology/Information System designers should focus more on analysis of user requirements in order to determine their expectations and requirements. It may be noted that if voters have higher perception in compatibility with prior or present beliefs, experience, values and so on, there is better chances of achieving successful acceptance. Sixth, perceived price value has a positive significant effect on behavioural intention to use m-voting. This translates that the voters believes that the benefits of m-voting services is worth paying for as long as it is affordable. Seventh, voter acceptance, adoption and use of m-voting can be anticipated from the voters' behavioural intentions, which are significantly influenced by perceived usefulness, perceived ease of use, subjective norm, perceived trust, perceived compatibility and perceived security (indirectly through perceived trust) . Lastly, the results also indicated that among the selected sample voting population, behavioural intention to use m-voting has a positive significant effect on actual use.

In conclusion, this study can serve as guide to information systems designers and developers at the requirements definition stage when designing m-voting systems as factors that includes Perceived ease of use, Perceived usefulness, Subjective norm, Perceived compatibility, Perceived security, Perceived price value and Perceived trust should be prioritized in order to fulfill its implementation as obtained from the results of this study. This study may be extended in future by investigating other factors such as Computer self- efficacy, Social influence, Perceived risk and so on that may influence the adoption decision of m-voting.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ibrahim S, Kamat, M, Salleh M, Abdul-Aziz S. Secure Voting Using Blind Signature; 2003.
    Available:http://eprints.utm.my/3262/1/IEEE02VS_full_ paper_ ver14Nov. pdf
2. Okediran OO, Ganiyu RA. A framework for electronic voting in Nigeria. International

Journal of Computer Applications, New York, United States. 2015;129(3):13-16.

3. Kalaichevi V, Chandrasekaran RM. Secured single transaction of E-Voting protocol: Design and implementation. European Journal of Scientific Research. 2011;51(2):276-284.

4. Akinyede RO. Nigerian voting system: Present and future states. Proceedings of 23rd National Conference of Nigeria Computer Society. 2010;21:77-81.

5. Ayannuga OO, Folorunso O. Electronic Voter's authentication management system (eVams). Proceedings of 23rd National Conference of Nigeria Computer Society. 2010;21:105-110.

6. Manish K, Suresh KT, Hanumanthappa M. and Evangelin GD. Secure Mobile Based Voting System; 2005.

7. Azeta AA, Azeta VI, Oluwaseun O, Azeta AE, Ayeni GA. Implementing an E-democracy system in Nigeria. Proceedings of the 11th International Conference on Electronic Government and National Security, Nigeria Computer Society (NCS), Osun State, Nigeria. 2013;98–103.

8. Buchsbaum TM. E-voting: International developments and lessons learnt. Proceedings of workshop on electronic voting in Europe – Technology, Law, Politics and Society, Austria; 2004. Available:www.subs.emis.de/LNI/Proceedings/ Proceedings47/Proceeding.GI.47-4.pdf.

9. Magi T Practical security analysis of Evoting systems. Master of Information Technology Thesis, Department of Informatics, Tallinn, University of Technology, Estonia; 2007.

10. Nestas LH. Building trust in remote Internet voting. M. Sc Thesis, Department of Informatics, University of Bergen; 2010.

11. Okediran OO Mobile Phones: A Panacea for the Implementation of E-voting in Nigeria, Asian Journal of Research in Computer Science, Science Domain. 2019;4(1):1-15.

12. Mcnamara K, Belden C, Kelly T, Pehu E, Donovan K. Introduction: ICT in Agricultural Development, ICT in Agriculture, The World Bank. 2011;3-14.

13. Deloitte. Transform Africa: Agriculture sector study sector assessment and opportunities for ICT. Deloitte; 2012.

14. Okediran OO, Ganiyu RA, Badmus TA. An m-agriculture framework for agriculture information services delivery. LAUTECH Journal of Engineering and Technology. 2018;12(2):72-79.

15. Heide B, Baumberger P. Using mobile technology to support e-democracy. Proceedings of the 36th Hawaii International Conference on System Sciences; 2003. Available:http://www.csdl. computer.org/comp/ proceeding/hicc/2003/1874/05/187450144 b.pdf

16. Dimitrios Z, Dimitrios L. Securing e-Government and e-Voting with an open cloud. Government Information Quarterly. 2011;28:239-251.

17. Alan DS, John SC. Revolutionalising the voting process through online strategies. USA Journal on Online Voting. 2005;29(5):513-530.

18. Wallace S. M-government Gets Serious; 2005. Available:http://www. the feature archives .com/topic/technology /m-government-getserious.html

19. Okediran OO, Omidiora EO, Olabiyisi SO, Ganiyu RA. An M-voting system framework for electronic voting. Proceedings of the Second International Conference on Engineering and Technology Research, Lautech, Ogbomoso, Nigeria. 2013;2:241-245.

20. Burrell J. "Livelihoods and the Mobile Phone in Rural Uganda". Available:http://www.Rameen foundation.applab.org/section/ethnographic-research; 2008.

21. Qiang CZ, Kuek SC, Dymond A, Esselaar S. "Mobile Applications for Agriculture and Rural Development", ICT Sector Unit World Bank, Washington D.C; 2012.

22. Davis F. Perceived Usefulness, Perceived ease of use and user acceptance of information technology, MIS Quarterly. 1989;13(3):318–339.

23. Ajzen I, Fishbein M. Understanding Attitudes and Predicting Social Behaviour. Prentice-Hall, Englewood Cliffs, New Jersey; 1980.

24. Taylor S, Todd P. Understanding information technology usage: A test of competing models, Information Systems Research. 1995;6(2):143–176.

25. Davis FD, Bagozzi RP, Warshaw PR. User acceptance of computer technology: A comparison of two theoretical models. Management Science 1989;35: 982–1003.

26. Davis FD, Cosenza RM. Business Research for Decision Making. Third Edition. Belmont, CA.: Wadsworth Inc; 1993.
27. Adams D, Nelson R, Todd P. Perceived usefulness, ease of use, and usage of information technology: A replication. MIS Quarterly. 1992;16(2):227–247.
28. Fishbein M, Ajzen I. Belief, Attitude, Intentions and Behaviour: An Introduction to Theory and Research. Addison-Wesley, Boston; 1975.
29. Fishbein M, Ajzen IA. Theory of Reason Action: Some Applications and Implications, in Howe H. and Page M. (Eds): Nebraska Symposium on Motivation, University of Nebraska Press, Lincoln, NB. 1979;65–116.
30. Yogesh M, Dennis F. Extending the Technology Acceptance Model to Account for Social Influence: Theoretical Bases and Empirical Validation'. Thirty-Second Annual Hawaii International Conference on System Sciences, IEEE; 1999.
31. Chen L, Gillenson M, Sherrell D. Enticing online consumers: An extended technology acceptance perspective. Information and Management. 2002;39(8):705–719.
32. Legris P, Ingham J, Collerette P. Why Do People Use Information Technology? A Critical Review of the Technology Acceptance Model, Information & Management. 2003;40(3):191–204.
33. Venkatesh V, Davis F. A theoretical extension of the technology acceptance model: Four longitudinal field studies. Management Science. 2000;46(2):186–204.
34. Szajna B. Empirical Evaluation of the revised technology acceptance model. Management Science. 1996;42(1):85–92.
35. Lucas HC, Spitler VK. Implementation in a world of workstations and networks. Information & Management. 2000;38(2): 119–128.
36. Ajzen I. The theory of planned behaviour. Organization Behaviour and Human Decision Processes. 1991;50:179-211.
37. Dillon A, Morris M. User Acceptance of Information Technology: Theories and Models. In: M. Williams (ed.) Annual Review of Information Science and Technology, Medford NJ: Information Today. 1996;31:3-32.
38. Rogers EM. Diffusion of Innovations. The Free Press, New York; 1995.
39. Westin AF. Privacy and freedom. New York: Atheneum; 1967.
40. Khalifa M, Ning Shen K. Drivers for transactional B2C mobile commerce adoption: Extended theory of planned behavior. Journal of Computer Information Systems. 2008;48(3):111–117.
41. Ghosh AK, Swaminatha TM. Software security and privacy risks in mobile e-commerce. Communications of the ACM. 2001;44(2):51–57.
42. Liu C, Marchewka JT, Lu J, Yu C. Beyond concern – a privacy-trust-behavioral intention model of electronic commerce. Information & Management. 2005;42(2): 289-304.
43. Salam AF, Iyer L, Palvia P, Singh R. Trust in e-commerce. Communications of the ACM. 2005;48(2):72-7.
44. Chellappa RK, Pavlou PA. Perceived information security, financial liability and consumer trust in electronic commerce transactions. Logistics Information Management. 2002;15(5-6): 358-68.
45. Cheong J, Park M. Mobile Internet Acceptance in Korea, Internet Research: Electronic Networking Applications and Policy. 2005;15:125–140.
46. Gefen D, Karahanna E, Straub D. Trust and TAM in online shopping: an integrated model. MIS Quarterly. 2003;27(1):51–90.
47. Dahlberg T, Mallat N, Öörni A. Trust enhanced technology acceptance model – consumer acceptance of mobile payment solutions. Proceedings of the Stockholm Mobility Roundtable, Stockholm; 2003.
48. DeVellis RF. Scale development. Newbury Park, CA: Sage Publications; 1991.
49. Thompson RL, Higgins CA, Howell JM. Influence of experience on personal computer utilization: Testing a conceptual model, Journal of Management Information Systems. 1995; 11(1):167-187.
50. Cheung C, Lee M. Trust in internet shopping: A proposed model and measurement instrument. Proceedings of the Sixth Americas Conference in Information Systems. Long Beach, CA; 2000.
51. Fornell C, Larcker DF. Evaluating structural equation models with unobservable variables and measurement error. Journal of Marketing. Research. 1981;18:39-50.

52. Chin W. The partial least squares approach to structural equation modeling. Mod methods Bus Res.1998;295:295–336.

53. Hair JF, Ringle CM, Sarstedt M. PLS-SEM: Indeed a Silver Bullet. J Mark Theory Pract. 2011;19:139–152.

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