Towards Improved Adoption of e-Voting – Analysis of the Case of Nigeria

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ABSTRACT
The adoption of e-voting in different parts of the world has been generally problematic, with only few exceptions. Past studies also suggest that e-voting is embedded in the socio-politically context informing variations in the adoption patterns and nature of challenges faced during implementation. While few survey-based empirical studies have been carried out to better understand factors affecting successful adoption of e-voting, there is general paucity of ethnographic studies and analysis providing detailed insights to e-voting adoption in specific contexts. This study offers such ethnography through in-depth analysis of e-voting adoption in the 2011 Nigerian General Elections. Using a multi-level Innovation Adoption Framework as a theoretical lens, we analyze the observations made by one of the authors as a participant in the adoption and implementation of the e-voting initiative as well as the post-election reports. Results from analysis revealed core factors for the different levels of e-voting adoption constructs - socio-political context, organizations, innovation and individual. Results also identified factors and challenges that may negatively impact e-voting adoption.

Categories and Subject Descriptors
H.4.2 [**Information Systems Applications**]: e-Voting Systems.

General Terms
Design, Economics, Human Factors, Legal Aspects, Management, Security

Keywords
E-Voting Adoption; Voters Registration; Innovation Adoption; Ethnography and e-Voting; 2011 Nigerian General Elections

1. INTRODUCTION
Voting is an important foundational element for democratic societies. Consequently, e-voting constitutes a very important aspect of ICT-enabled democratic governance [1].E-voting generally aims at increasing participation, improving the outcomes elections by addressing challenges associated with traditional voting practices. We note here that the use of e-voting often refers to the use of technology to support one or more of the major phases of the electoral process –from registration stage in the pre-voting phase to voting/balloting and verification to counting or tallying after voting [13], [20].Although, the term is often associated with the use of the electronic channels like the Electronic Voting machines or the internet for casting votes, its use for ICT-enabled voter enrollment or registration is gaining popularity particularly in the developing world.

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Generally, there are mixed sentiments regarding e-voting adoption, particularly in the aspects of vote casting or balloting. For example a number of countries such as Netherlands, Germany and Ireland moved away from the use of e-voting for balloting after initial adoption[1].E-Voting using Electronic Voting Machines (EVM) have also remained controversial in the United States remain controversial. Overall, e-voting is perceived as generally risky.

In[2], a risk model for evaluating e-voting was proposed. The framework specifies that risk analysis must take into account factors such as the complexity of the election, the complexity of the voting system and the degree of citizens' confidence in the political system. However, the paper concludes that the benefits from e-voting are not outweighed by the actual risks.

In this light, developing countries have shown significant interest towards the adoption of e-voting. Given that elections in developing countries attract significant controversies and are fraught with several challenges, the idea of trying any credible alternative is a plausible strategy. This position is clearly exemplified by a statement from the former Chairman of the Nigerian Independent National Electoral Commission on the need for electoral reform: *"It defies all logic to continue to do the same old thing, follow the same path and almost under similar constraints all these years and yet at every election we expect different results!"*[13]. Consequently, while not completely oblivious of the risks involved in e-voting, research contributions on e-voting in Africa has largely focused on technological design of e-voting systems. Examples are [14] which describes framework for online voting system and [9] which considers e-voting as a panacea for election irregularities. Despite this sense of urgency, e-voting adoption in Africa remains slow and problematic in countries where it has been adopted. Unfortunately, very few existing work provide in-depth analysis of e-voting experience of African countries with the view to providing deep understanding of the critical factors for improved adoption of this innovation as well as the major challenges involved in its implementation. One of the few works in this area [1] investigated factors that could determine the intention of Electoral Authorities or Management Bodies to adopt e-voting technologies in the South African Context. Another related study examining factors that influence young citizens to adopt e-voting system is described in [21].

This work complements existing empirical research on e-voting by providing an ethnography of e-voting in the Nigerian context. Ethnographic research as one most in-depth research methods possible; offers right insight into the human, social and organizational aspects of information systems [11]. Using a multi-level innovation adoption framework described extensively

in [25] as a theoretical lens, the study draws from the direct involvement of one of the authors as a key participant in the pre-adoption and adoption phase of e-voting to support voters registration in the 2011 Nigerian General Elections. It also relied on the analysis of the carefully post-election review report.

Our goal is to better understand the core factors associated with the different levels of adoption constructs: socio-political context, organizations, innovation (e-voting) and individuals; that strongly contribute to the improved adoption of e-voting. We also wish to identify factors and challenges that may negatively impact e-voting adoption.

The rest of the paper is organized as follows: Section 2 presents a background in e-voting, followed by description of the research approach. Narratives about the use of e-voting in the Nigerian General Elections are structured based on the adoption framework in Section 4. Analysis of the factors associated with each category of adoption constructs are provided in Section 5. Discussions and concluding remarks are presented in Sections 6 and 7.

2. E-VOTING

E-voting is usually associated with the use of electronic devices such as Electronic Voting Machine (EVM) and channels (like the Internet) for casting votes or balloting [16], [20]. E-voting is considered in [3] as digitization efforts related to e-government and e-democracy. In this line of thinking, e-voting will aim at digitizing the different stages of the electoral process including registration, balloting, verification and counting.

According to Chung et al. [3], the possibility to vote remotely is one of the greatest benefits from e-voting since it potentially raises participation in the voting exercise. Qadah et al. [15] supports this assertion claiming that e-voting permits voters to cast their votes at any time from any location and using a variety of electronic devices. In addition, they believe that e-voting generally automates and simplifies the election process, increases participation rates, reduces counting mistakes and minimizes the time it takes to announce voting results.

Different e-voting systems have been proposed and adopted to support voting process. This includes Computer counting, Direct Recording Electronic voting machine (DRE), Online Voting, Poll-site e-voting, Kiosk e-voting and remote e-voting [15], [13].

There are a number of key entities involved in any form of voting including e-voting. These entities include: Voter, Authority, Candidate and Adversary [20]. These entities could be very useful in developing voting model that may underpin an e-voting system. Voters are those eligible to vote by choosing among the Candidates. Candidates are usually pre-specified and often chosen by Voters in a private manner. In addition, final count has to be reliable and verifiable. Authorities are government agencies and offices responsible for conducting the election. An adversary is any malicious entity that attempts to manipulate the voting and tally. Sampigethaya et al. [20] further explains that External Adversary may coerce a voter or buy votes or passively breach privacy of voters. Internal Adversary on the other may try to breach privacy, modify or reveal the partial tally or corrupt the Authority. Designs of e-voting system must preserve important rights of voters and concomitantly prevent malicious activities.

There are strict requirements for any e-voting system [3], [15][20], including:

- *Eligibility*: ensure that only valid voters meeting pre-determined criteria are eligible to vote or take part in the election.
- *Privacy and Anonymity*: Ensure that no one can connect a ballot to its voter
- *Fairness*: Ensure that votes obtained by each candidate cannot be known before the announcement of the election result.
- *Verifiability*: A voter should be able to verify if its vote was correctly recorded and accounted for in the final vote tally.
- *Uniqueness*: must ensure that eligible voter can cast a vote only once in each election.
- *Dispute-freeness*: must provide a mechanism to resolve all disputes in any stage.

In the context work, e-voting focuses on the use of ICT to support the Voter's registration or enrolment and verification process. According to [13], the e-enabled registration process, a voter may register online or visit a polling booth with an attendant Electoral Authority's agent present to guide the voter through the e-registration process. Whichever channel is selected, the voter will complete a registration form that can be captured directly into the Electronic Voters Database. Voter's verification can be done either online or at designated locations with the help of an attendant for instance using Voter fingerprint signatures. Thus, the support voter eligibility is the key requirement for the e-voting system under consideration in this paper.

3. METHOD

This section first articulates the research objectives and next describes the main theoretical framework underpinning the documentation and analysis described in Sections 4 and 5. Subsequently, the approach to data collection and analysis are highlighted.

3.1 Research Objectives

The research aims at providing answers to two basic questions:

1. What are the major factors that contribute to the effective adoption of e-voting to support voters' registration and verification in the Nigerian Context?
2. What are the major challenges that must be addressed to enable effective adoption of e-voting in the Nigerian Context?

Answers to these questions are to be provided through in-depth ethnographic study of 2011 Nigerian General Elections.

3.2 Theory Background

This theoretical framework adopted in this work is rooted in the well-known Rogers Diffusion of Innovation Theory [17] and Technology Acceptance models [22]. Specifically, we adopt the an integrated Innovation model described in [25] to provide a multi-level analysis of the e-voting. The Innovation Model employed was constructed based on 20 theoretical frameworks. The underpinning frameworks consist of theories that address adopting process as well as those that address adoption within the context of implementation, diffusion, dissemination and sustainability.

The model consists of four levels of changes that could be associated with any innovation: External Systems, Organizational-level, actual Innovation and Individual adoption level. Specific constructs were identified under each level as highlighted in Table

1.In the context of e-voting, we map these levels to: 1) the Socio-political context, 2) Electoral Authority, 3) e-Voting Technology and 4) Electoral Actors.

Given the centrality of the e-Voting Technology level, we elaborate on the level here and we refer the readers to [25] for an extensive treatment of the constructs at the other levels. E-Voting as innovation shares has the following attributes: relative advantage, compatibility, complexity, and trialability, cost-efficacy and feasibility, evidence and risk. These characteristics are directly linked to the successful adoption and implementation of the innovation in question. These characteristics are described highlighted below:

- *Relative Advantage* – the degree to which e-voting is perceived as enabler for free and fair elections.
- *Compatibility* – the degree to which an e-voting practice is consistent with the values of Electoral Authority.
- *Complexity* – the degree of difficulty involved in implementing the initiative and communicating the associated benefits to stakeholders.
- *Trialability* – the degree to which experimentation is possible with the initiative.
- *Cost Efficiency and Feasibility* – the cost effectiveness of the initiative with respect to existing comparable practices.
- *Evidence* – availability of research evidence and practice efficacy of the initiative.
- *Risk* – level of uncertainty associated with the implementation and adoption of the initiative.

Table 1: Multi-level Innovation Adoption Constructs

Level	Constructs
Context	Socio-political Environment
	Policies and Regulations
	Incentives
Electoral Authorities	Absorptive Capacity
	Leadership Capacity
	External Relationships and Networks
	Operations Size and Structure
	Norms, Values and Culture
	Training Readiness
	Readiness for Change
E-Voting Technology Enactment	Complexity, Relative Advantage and observability
	Cost-efficacy and Feasibility
	Evidence and Compatibility
	Facilitators and Barriers
	Innovation Fit with User's norms and Culture
	Trialability, Relevance and Ease of use
Electoral Actors	Attitude towards change
	Motivation to use innovation
	Participation and acceptance rate

3.3 Research Strategy

This work adopts an ethnographic research approach in investigating e-voting in the Nigerian context. Ethnographic research is suited to providing information systems researchers with rich insight into human, social and organizational aspects of information system [11],[19]. This approach is able to describe situations rarely observed and for which better understanding may have important consequences [18]. Our decision to adopt this approach is hinged on: 1) the unique positioning of one of the authors as an important actor in the e-voting initiative in Nigeria, and thereby direct access to detailed information on the initiative,2) the opportunity to carry out an in-depth qualitative analysis on the available information based on an extensive set of multi-level innovation adoption constructs that are yet to be investigated at this breadth. The participant author worked at the highest level of technology management at the Electoral Authority responsible for implementing e-voting. Detailed discussions on Ethnography research approach are presented in [11], [18], [19] and [24]. The limitations of Ethnographic research will be highlighted later in Section 6 as part of the discussion of our results.

3.4 Data Collection

Ethnographies are similar to case studies in terms of sources of data. In addition to the use of interview, documentary evidence, report and record inspection, direct participant observation is an important source of ethnographic data. In our case, the direct experience of the participating author (including field notes, archives of documents made when the author was working at the Electoral Authority) in the e-voting adopting process and two major reports on the review of the 2011 Nigerian General Elections [12] and [8].

3.5 Data Analysis

The written accounts and reports (in Section 4 and [8]) were analyzed using contents analysis [7], [6], [23]. Specifically, we adopted a mixed strategy involving two different approaches to content analysis described in [7]: the directed and summative approach. In the directed approach, analysis starts with a theory or relevant research findings as guidance for initial codes. For this, we adopt codes corresponding to constructs under the four e-voting adoption levels in Table 1. We employed the summative approach involving counting and comparisons, usually of keywords or content, followed by the interpretation of the underlying context. We used the summative approach to determine the strength of the identified factors from the analyzed reports and participants notes. Due to the volume of the report, we coded randomly selected reports across the 37 states ensuring representation from each of the 6 geo-political zones in Nigeria. Results of analysis are presented in Table 3.

4. ADOPTION OF E-VOTING IN THE NIGERIAN 2011 GENERAL ELECTIONS

This section presents the details of the narratives of the participant observer organized by the constructs highlighted in Table 1. The narratives highlight the nature of changes associated with the diffusion and adoption of e-voting in Nigeria. A summary of this narrative is presented in Table 2.

4.1 Context for e-Voting

We narrate changes in this section that help to frame the environment in which the Electoral Authority responsible for the implementation of the innovation, the e-voting technology itself

and individuals that will adopt and be affected by the adoption of the technology.

4.1.1 Socio-political Environment

Nigeria with a population of over 150million and over 250 ethnic groups, has a voting population of 73.5million as at the time of 2011 elections. Nigeria seats on a landmass of about 1000 square km. About 15% of the voting points are located in very difficult to reach terrains. Elections took place in Nigeria in 1999, 2003 and 2007. *All of these elections were adjudged not to be free and fair*. At the height of unacceptable elections is the 2007 elections; even admitted by the main beneficiaries of the election, there were understandably major fears about the 2011 elections. The general perception was that elections will always be rigged, balloting materials will be stolen, that voting will not start on time, and that the result of the elections will be altered by the Electoral Authority or the government in power. The political elite also believed that, they had to rig elections to win. The need for a paradigm shift for the electorates to regain the confidence in the elections was clear. The Government of the day looked for a credible individual who was made the Chairman of the Electoral Authority called the Independent National Electoral Commission (INEC) with other men of integrity to serve as Commissioners under him. The old Voters roll was discarded. The power infrastructure was problematic with frequent power outage.

4.1.2 Changes in Policies and Regulations

A number of policies were introduced to open up the space for the introduction of technology. The Electoral law was modified to allow for electronic capture of data and the use of same as evidence in court. The Law was also modified to allow for results of elections to be declared on the spot and indeed a copy of elections to be posted at every polling unit (smallest voting point in Nigeria). Local and International observers were accredited to observe the elections. Stakeholders consultative engagements were set up to allow the Electoral Authority, the political parties, the civil society organization, the development partners to help in the preparation, the monitoring and the conduct of elections. This allowed best practices in elections across the world to be brought to play in the activities leading to the 2011 elections. Representatives of the Electoral Authority who had been found wanting in the discharge of their jobs were relieved of their appointments.

4.1.3 Government Incentives

While the Federal government did not provide any specific incentives towards the adoption of technology to the populace, the *State government offered all kind of incentives and threats to enable the populace register*. One of such is work free days were declared, threats of denial of admission to wards of those who failed to register in Public schools were made. Beyond this is the fact that the politicians offered incentives in kind and in cash to registrants to enable them register for the elections. Other changes were introduced by way of voter education through other governmental agencies and civil society organizations. It is important to note that the Voters Card is acceptable in Nigeria as a means of identification. *This constituted a huge incentive to people who otherwise would not have been registered*.

4.2 Electoral Authorities

4.2.1 Absorptive Capacity

The Independent National Electoral Commission (INEC) before the 2011 elections was perceived as a biased umpire. However there is no doubt in the minds of the electorates that INEC was able to adapt where it had the right leadership. INEC had in the past kept the largest single instance electoral database in the world in her Data Centre. INEC had deployed several communications equipment to the 37 states of the federation and had also deployed VSAT (Very Small Aperture Terminals) infrastructure to all 774 Local Government Areas (LGAs). INEC had conducted an election in 2003 with almost real time declaration of results. To this extend INEC capacity to absorb the technology was not in doubt. However, what was in doubt was the political will to do the right thing. This was achieved through the selection of a Chairman who is reputed to be forthright. This was responsible for the success of the highly technical Electronic voters' roll. 132,000 equipment were rolled out for a registration that lasted for 3 weeks with the capture of facial image and 10 fingerprints. Against this background, it is reasonable to assume that INEC had the significant capability to absorb new innovation such as the e-voting.

4.2.2 Innovation Leadership and Champion

The INEC had a number of Innovation leaders. The Chairman of the Commission was daring. He was supported by an equally daring and consultant and a Director of ICT who just recently acquired a PhD degree in Computer vision. The young software developers volunteers who were motivated for professional recognition were also part of innovation champions. The Chairman believed in his technology team.

4.2.3 Relationship with External Support Entities

The Commission with the help of the United Nations Development Programme hired a formal employee of Google as consultant for activities leading to the 2011 elections. The main technology deployed during the 2011 elections was to deal with the Voters' registration exercise. New software was developed running Ubuntu Linux, using C++, Qt, FBI AFIS, MySQl, PostgreSQL; a collection of open source tools. There was no time for piloting, so we anticipated that the first week of rollout will be full of issues. We prepared by hiring the Volunteer developers, and stationing two software experts in each of the 37 states of the Nigerian federation. In addition two Hardware and Software experts were also sent to each of the 774 local government Areas (LGA's). Recharging and repair camps were set up for every 10 polling units. A huge number of temporary workers were employed and subjected to rigorous training. *The anticipated preparation is considered critical for such huge deployment and operation toward the 2011 elections*.

4.2.4 Operations Size and Structure

The command structure of the deployment had the Chairman on top and advised by two technology experts – the Consultant and the ICT Director. Below this were about 500 permanent technical workers of INEC that held a college degrees or a diploma. These staff members were deployed for support services during the exercise. Other technology experts involved were discussed in the previous section. Besides these individuals the INEC engaged additional 240,000 individual and trained them to operate the Direct Data Capture (DDC) equipment at 120,000 locations across the country. A Central situation control room was set up at the headquarters and smaller Centres were set up at the 37 states of the federation. Technical and Software help was also available at the Local Government Areas and about 12,000 repair camps were set up at the Registration Areas.

4.2.5 Training Readiness

There was a need to train more than 250,000 individuals to operate the equipment. The training modality adopted is Train the

Trainers method. 40 super trainers were trained at the HQ, these 40 were dispersed to the states to train a total of about 800 individuals who went further to train another set of 12,000 individuals, and these ones trained the rest of the 250,000 operators. Training was conducted quite ahead of time, though when the exercise started some untrained individuals were erroneously substituted into the group – this was very unfortunate and had a negative impact on the exercise. A top down communication approach was adopted for the training. Several Communications gadgets (Optical Fibre links) were available to the states. More effectively was the use of Cellular phones. The cell phone numbers of every individual was available in database and these individuals all have cellular numbers of members of technical and managerial support team.

4.3 E-Voting Technology Enactment

4.3.1 Complexity, Relative Advantage and Observability

Despite the fact that the underlying technology deployed was very complex, the objectives of the e-voting initiative were clear to individuals involved. The essence of the e-voting initiative was to have individual's bio data collected with fingerprints and facial image, and in the end obtain a temporary photo ID. Given the country's notoriety for rigged elections, no one was in doubt as to the benefit of the e-voting project. All major stakeholders were aware that the exercise should lead to freer and fairer elections. Every category of staff of INEC and indeed the temporary staff often called the ADHOC staff observed the demonstration of the use of technology before adoption. Software testing was carried using the staffers as officials and registrants.

4.3.2 Cost-efficacy and Feasibility

There was no explicit feasibility study of the cost benefit analysis of the technology adoption. If this is considered against the background of the fact Nigeria had 120,000 voting points and had to deploy required infrastructure and equipment to these 120,000 points simultaneously. *A critical observer would have asked, why did you not buy 40,000 unit and use in three voting points?* This would have been considered more cost-effective. But the prevailing circumstances in Nigeria and the constraints of time as a result of the constitutional regime would not allow for such luxury. In terms of implicit cost benefit analysis, the project was very beneficial to Nigerians. If the subsequent elections were not free and fair, they may have been such violence that is able to threaten the corporate existence of the entity called Nigeria.

4.3.3 Evidence and Compatibility

There was no evidence that the adopted technology would work in Nigeria. Indeed there was huge agitation about the use of Linux which was considered unfamiliar to the typical Nigerian users. This coupled with the propaganda by big software firms brought a lot of doubts about the compatibility of the adopted technology in our environment. However it must be noted that the Software and the Hardware systems were purpose built to suit our environment. The Software was built with the sensibilities of the Nigerians (for instance some people don't know their date of birth and some individual do not have complete fingers). All of these constraints were taken care of in the design and the development of the e-voting solutions. In the case of Hardware, every equipment was supported with 2 Lithium-Ion batteries that is capable of lasting for 12 hours. In addition a generating set was made available for charging equipment for every 10 polling units. These are local peculiarity that has been built into the system. As there had been similar exercise, we believe this technology met the needs of the people. Albeit some part of the country are not very comfortable to have their women being photograph and being attended to by male operators. Voters' education and deployment female operators helped in dousing tension that would have arisen as a result of this cultural sentiment.

4.3.4 Facilitators and Barriers

Facilitators and barriers were determined from lesson learned from earlier unsuccessful deployment of similar technology. Political parties, religious leaders, community leaders, traditional rulers, educational institutions were identified as facilitators. The barriers identified include unscrupulous operators who may be registering after hours – this barrier was dealt with by the use of time stamp. There are other operators who in other to discredit the system will use images of strange objects – this was dealt with by assigning supervisors to look through the daily takings while backing up the data. Other barriers include the Politicians who would like to inflate the voter roll by encouraging his supporters to register many times. Consistent voters' education and demonstration of the technology which immediately identified unintended double registrant was employed. In addition to this there was the threat of criminal prosecution of such offenders. Several training and empowerment program were in place and they helped to a great extent. They helped in reducing the tension especially when the exercise is not going smoothly.

4.3.5 Innovation Fit with User's Norms and Culture

The use of e-voting essentially revolutionized the traditional practices of writing names on tabulated papers. It was obvious to the populace that this was a better option. However they were afraid that data collected could be lost or used against them. The first fear was dispelled by writing names in the traditional way and secondly issuing a temporary voters card with bar code. These actions reassured them that even if the data is lost electronically it could still be obtained from other sources.

4.3.6 Trialability, Relevance and Ease

There was no pilot program. There was no time for a pilot program. However different types of stress testing were conducted. The tests did not bring up all the issues as expected, but the anticipation of regarding the first few days as a kind of trial period helped to deal with the negative impact that lack of a pilot would have brought up. The innovation to a very large extent solved the problem it was intended to solve. Nigerians have huge confidence in the Voters roll. The international organizations elections observers have commended the accuracy of the roll. There was an initial concern on the use of the adopted technology, however because of the attention paid to User friendliness the perception of difficulty of used changed after a few days. The e-voting technology deployment used in Nigeria was a big-bang approach.

4.4 Actors

4.4.1 Voters

There was a very positive attitude by the voters towards the technology change. The voters were very motivated to use the technology. This was to the extent that some voters provided their generating sets, some provided their vehicles for the transfer of defective equipment. The participation rate was about 90% while acceptance was about 80%. It has been noted that, in Nigeria the Voters register attract more respondents than any other registration effort. Voters do know that, without a voters' card they cannot vote. They may not be able to attribute any use to other civil identification efforts.

Table 2: Summary of Participant's Narratives for each Adoption Constructs

Level	Constructs	Observation
Context	Socio-political Environment	o Over 150 million and 250 ethnic groups o 15% of voting points located in difficult terrains and not easily accessible o Entrenched cultural of electoral malpractices and rigging
	Policies and Regulations	o Electoral law to allow for result declarations at the point of voting o Legal reform to allow for e-voting technology adoption o Local and International observers were invited o Stakeholders engagement
	Incentives	o Work free days, educational support for parents o Voters card accepted as ID card
Electoral Authorities	Absorptive Capacity	o Previous technology capacity in OMR based Electronic Register o Several Communication equipment deployment to more than 800 locations o Acceptable leadership to jumpstart innovation
	Innovative Leadership Capacity	o The Electoral Management Body (EMB) chairman is a political scientist with daring flare for ICT o Consultant – a former employee of Google o An ICT Director with a PhD in Computer vision
	External Relationships and Networks	o Multilateral organization helped with funds and project management o Software developers hired as support staff o 2 software experts per state (37 states); 2 tech support per LGA (774) o 10,000 Registration Area support supervisors
	Operations Size and Structure	o Chairman supported by 2 technology experts o 500 Permanent technical staff with degrees in Engineering and Computer Science o 774 Electoral officers; 10,000 Registration Area Supervisors o 240,000 e-voting equipment operator for 120,000 locations
	Norms, Values and Culture	o Culture towards technology adoption is above average
	Training Readiness	o Cascade training adopted ; 40 Master trainer – 800 Electoral officers trained 12,000 RAO trained 250,000 Operators o Too large classes made training less effective o Lack of adequate hands on practice on equipment o Physical communications means available to the lowest level
	Readiness for Change	o Above 80% readiness to adopt e-voting technology for electoral operations
E-Voting Technology Enactment	Complexity, Relative Advantage and observability	o Background technology complex but frontend very simple o Stakeholders aware of e-voting relative advantage in forestalling elections fraud o Electoral law to allow for result declarations at the point of voting o All staff both permanent and temporary observe the use of the technology
	Cost-efficacy and Feasibility	o No explicit feasibility study carried out o Implicit feasibility based on the cost of bad governance and a failed state. o Qualitatively cost effective based on the conduction of free and fair elections
	Evidence and Compatibility	o No pilot to ascertain compatibility but several test conducted o Concerns about the use of open-source software o Efforts made to consider peculiar factors like lack of electricity; Lithium Ion batteries to power DDC for 24 hours and generators o Stakeholders engagement and use of women operators helped about cultural norm of exposing women in some parts.
	Facilitators and Barriers	o Facilitators Political parties, religious leaders, community leaders, traditional rulers, educational institutions o Unscrupulous operators and politicians
	Innovation Fit with User's norms and Culture	o E-voting innovation revolutionized the traditional practices of manual written names o Concerns about eventual use of data and loss of data
	Trialability, Relevance and Ease of use	o No pilot program, but several stress testing of e-voting technology o Innovation solved the intended problem; and huge attention paid to user friendliness o A big-bang approach due to time constraints
Electoral Actors	Attitude towards change	o Very positive attitude towards change by voters, political parties and agents, candidates and other actors.
	Motivation to use innovation	o All actors were motivated to use the technology because of the ultimate objective of a free and fair elections o Motivation was also based on previous fraudulent elections
	Participation and acceptance rate	o Participation and acceptance by all actors was above 80%

The knowledge and skill of Voters as actors increased as the exercise proceeded and indeed they started discovering solutions to some technical problems (like washing of hands before fingerprinting).

4.4.2 Candidates and Agents

Candidates and aspirants were skeptical at first, but later gained confidence in the system after a series of testing for double registrants. The candidates later educated their supporters about the system. The candidates also intensified their campaign strategy, since they knew rigging was unlikely to work. It is needless to say that this had positive impact on the polity.

4.4.3 Electoral Officers

Electoral officers are personnel of the Commission. The general attitude of the electoral officers was firstly that of fear. Their experience of similar technology had not been very successful. With this doubt of the workability of the system they were very concerned about backup and the need to provide alternative list, in case the electronic one fails. Having seen the ease with which the technology worked and the ease that it will bring to their responsibility they embraced the technology wholly. The INEC also did carry them along as the development was ongoing and this helped to own the innovation. The Electoral officers were motivated to use the system after their initial concerns were dispelled. The participation and acceptance rate is more than 95%.

The level of knowledge of the group is close to 98%. Since some of them had to train the operators under them.

4.4.4 Political Parties

The political parties' initial attitude was to act against the introduction of the innovation, as they hitherto benefitted from inaccurate roll. Realizing that there were no alternatives, they had to adoptthe innovation. However attempts to carry out malicious actions to compromise the innovation or the Users persisted. Compromised ICT personnel of INEC were subsequently dismissed. After these initial challenges, acceptance rate ultimately reached about 89%. Party representatives demanded for CD copies of the Electronic list. *The political parties were motivated to use the innovation. In fact after the elections some of them used the innovation as a basis for litigations*.

4.4.5 Civil Societies

The Civil Society Organization in Nigeria had been very active in electoral issues, with strong support from international organizations and development partners. This group of organizations wastrained on the use of equipment. The initial reluctance and skepticism was overcomeby active engagement, accepting the innovation as "sine qua non" to free and fair elections. Members of Civil Society Organizations (CSOs) also assisted in education about the innovation. After conducting their own tests their acceptance rate was over 90%.

4.4.6 Observers

Most international observers were not users of the innovation. For local observers the write-up for CSO's above holds. Often times the local observers are drawn from the CSOs. As indirect users or rather non users, their acceptance of the innovation can only be derived from their reports, which is often not quantitative. The e-voting innovation was rated very highly by these international and local observers [12]. The innovation was accepted as a basis for a credible election.

5. ANALYSIS

This section provides an analysis of the narratives above for the different constructs and the post-election review reports [8] which provides detailed account about the issues and learnt critical success factors for the elections. An interesting aspect of the report is that each of the 37 states of the federation provided separate reports on the issues, challenges and critical factors for future successful elections. As indicated in Section 3, due to the volume of the report, we coded randomly selected reports (16 in total) across the 37 states ensuring representation from each of the 6 geo-political zones in the country.

Analysis revealed a number of patterns across these narratives and reports. Since we were interested in major factors for adoption as well as major challenges, only themes that featured at least twice across the reports were selected as significant. The identified adoption factors are described in Section 5.1 and the major challenges elaborated in Section 5.2.

5.1 Adoption Factors for e-Voting

This section briefly describes the results of our analysis of the factors associated with major adoption construct across the four adoption levels – Context, Electoral Authorities, e-Voting technology and Electoral Actors.

- *Context*–The most important factor identified at this level is the role of the Inter-Agency Consultative Committee setup to coordinate electoral matters and ensure security across various states of the federation. The second related factor is the availability of adequate security for all polling units.
- *Electoral Authorities*–At the organizational level, structural factors like timely receipt and distribution of e-voting materials and men at the polling units, adequate publicity and sensitization of stakeholders, inter-agency collaboration among Electoral authority and other offices and consultation/consultation with stakeholders standout.
- *E-Voting Technology*- Regarding the e-voting technology itself, the belief that the technology will enable better election outcomes was a key factor. The "cultural acceptance" of technology is another important factor. For instance the use of technology that does not require taking photographs of female voters/registrants is important for electorates in the Northern part of the country. Another important factor is user friendliness and use of highly customized (built for purpose) solution to address concrete realities or requirements of the environment.
- *Electoral Actors*–overcoming past fears and experience (e.g. through campaigns and engagement) in addition to clearly communicating the benefits for each category of actors are considered to be major factors for adoption by actors.

As shown in Table 3, the strength of each of these factors is indicated by the number of references supporting them.

5.2 Challenges

This section presents the identified challenges associated with the various levels of e-voting adoption based on the reports, narratives in Section 4 and elaborations by participant.

5.2.1 Socio-Political Context

The 2011 elections were the fourth general elections held since the country's return to civilian rule, which came after more than 30 years of political instability and military coups. Elections in

1999, 2003 and 2007 were each seen as less credible than the previous, a trend that undermined the public's confidence in the electoral process and the legitimacy of elected bodies. *So there were negative perceptions towards the elections and the electoral body*.

Table 3: Identified Factors for Adoption Constructs

Constructs	Critical Factors
Context	
Socio-political Environment	o Adequate security provision (3 refs) o Inter-Agency Consultative Committee on Election Security (7 refs)
Electoral Authorities	
External Relationships and Networks	o Inter-Agency cooperation (3 refs) o Adequate dissemination of information to all stakeholders. (2 ref) o Collaboration/consultation with stakeholders. (3 refs)
Operations Size and Structure	o Timely receipt & distribution of men and material. (6 refs) o Monitoring of Political Party Primaries (2 refs) o Complete receipt of all notices relating to primaries from HQ (3 refs) o Verification of polling units. (2 refs) o Adequate publicity/Sensitization of Stakeholders. (4 refs) o Better provision of logistics (2 refs) o Use of registration areas for camping both officials and materials (3 refs)
Norms, Values and Culture	o Positive orientation of commission staff. (2 refs)
Training Readiness	o Effective training of officials (2 refs) o Voter's education (3 refs) o Personnel were recruited, trained and deployed. (4 refs) o Use/Neutral sourcing of ad-hoc NYSC staff (3 refs)
E-Voting Technology	
Complexity, Advantage and observability	o Strong believe that e-voting will lead to better election outcomes
Cost/ Feasibility	o Investment delivers free&fair elections
Evidence and Compatibility	o e-Voting software and hardware purpose built for local environment
Innovation Fit with /Culture	o Cultural acceptance of technology
Trialability, Relevance and Ease of use	o User friendliness of technology was key to address anxiety about usage
Electoral Actors	
Attitude towards change	o Ability for Electoral officers to overcome past unsuccessful experiences on
Participation and acceptance	o Clear understanding of benefits

Other challenges include:

- The share size, the population and the terrain of the Nigerian nation posed a huge challenge. Some areas like the coastal region, the mountainous and the arid/ desert areas are difficult to reach. The terrain often led to logistical challenges to the distribution of elections equipment, materials and personnel. In 2011 elections this impacted negatively on the conduct of elections. The logistical issues actually led to the postponement of the April 2 2011 elections.
- The Electoral Management Body was inaugurated in June 2010 and was expected to conduct an elections originally in

  January 2011, even when the legal framework was adjusted to April 2011. It was still a huge task to conduct a registration exercise for about 73.5m Nigerians and conduct the main elections within six months. This time constraint may have been responsible for some of the shortcomings.
- Delay in submission of candidates name often delayed the confirmation of production for balloting instruments which creates logistical constraints. This affected the 2011 elections in that candidates' names were supposed to be submitted 60 days and substitution may happen 45 days before elections. These deadlines were found too short.

5.2.2 Electoral Authority

We identified two major challenges related to communication and training with respect to e-voting adoption at this level:

- *Communication between Authority and other stakeholders*- There were a number of shortcomings attributable to the electoral management body. This includes lack of adequate communications between EMB and stakeholders and indeed within the Commission itself. Some of the actions of the Leadership were shrouded in secrecy to the extent that the Leadership assured the nation on the eve of the election, just to postpone the same election the following day.
- *Inadequate Training and Training Needs* - The training conducted to facilitate the adoption of technology appears very inadequate. The effectiveness of the training was limited by the number of persons (about 300) trained on election equipment at a venue, Observers noted that differences in the duration and content of the training programs across the country accounted for different levels of staff knowledge of procedures. While most training sessions included a practicum on the use of Direct Data Capture Equipment, it was often inadequate. In addition, the machines used for many training sessions were different from the ones actually used in registration, and the time allotted for each participant to practice was short. Training did not also include sessions on troubleshooting problems that might arise and instructions on whom to contact for support. Recruitment and cascade training for "Election Day" ad-hoc workers was carried out for about 400,000 polling staff and 1,500 returning officers around the country. This is cited in an observers' report[12]. Inadequate identification for personnel led to untrained persons handling the equipment as proxies.

5.2.3 E-Voting Technology

The adoption of e-voting by the Electoral Authority as a major actor was accompanied with many challenges. There were logistical challenges due to inadequate preparations for the deployment of technology. The Electoral Authority was churning out guidelines to other actors but there was no effort to ensure that the guidelines were being followed. Other challenges include:

- *Technology Deployment* - The technology deployment approach itself posed huge challenge. The "big-bang" approach, without adequate pilot led to huge crisis during the registration exercise. The sensitivity of the fingerprint module

was apparently set too high leading to a demand for unrealistic image quality from the fingerprint device. This led to huge delay in registering voters. Subsequently operators under pressure started bypassing the very soul of the technology deployment – the fingerprint. The Election Authority had to request voters to return to re-register for those whose fingerprints were not captured. This problem was resolved with patches after about 3 days. There was a huge waste of human and material resources during those days, which significantly threatened the success of the technology deployment. The authority purchased 132,000 units of equipment and deployed 120,000 units. This is indeed posed a huge logistical nightmare which led to many units not receiving their equipment until days after the commencement of registration exercise. In addition the storage of these equipments became a huge challenge. The arrangement for re-charging, back-up of data and repairs made by the authority was partly unsuccessful, leading to loss of data. This fact was admitted by the authority in their report [8].

- *Technology vendor* - The technology vendor failed to deliver fully based on their contracts and this led to unavailability of all the equipment as at the commencement of the registration exercise. *A lesson for all Electoral Authorities here is that equipment of these sorts are rarely manufactured and placed on the shelf. Thus, authorities must allow enough time for manufacturing of these devices otherwise the deployment may be bound to fail. The Vendor actor refuse to deliver to contract, this should be expected*.
- *Electoral Officers* – Electoral officers were not as skilled as presumed. The operators of equipment with a university degrees; were expected to have ability to operate a computing equipment. The assumption failed and led to huge challenge.
- *Data Collection and Verification*- also presented challenges, especially during the registration period. The apparent absence of a tracking mechanism to record and report daily registration statistics prevented INEC and other stakeholders from assessing the progress of the exercise. Notably, 82 percent of the observed registration units failed to open on the first day of the exercise because of the late arrival of materials and faulty equipment[12]. INEC admitted that because of late delivery by the suppliers, only 98,000 DDC machines had been distributed to the registration centers by the first day [8].

6. DISCUSSION

Various studies on diffusion of innovation in organizations and technology acceptance by individuals and groups have been carried out. This has also led to the development of many related theoretical frameworks and models across different domains including e-voting. However, only few existing research like [22], [25]and to a large extent [10]have attempted to integrate these fragmented landscape. Unlike [22], which only examines technology (or innovation) adoption only at individuals or groups level, Wisdom et al. [25] and Kamal [10] provide multi-level or multi-faceted perspective to innovation adoption by organizations and individuals/groups taking into consideration the external environment in which the innovation is embedded. In fact, Kamal's IT adoption model in government sector could be easily mapped to Wisdom's Context-Mechanism-Outcome model.

We have leveraged the work by Wisdom et al. [25] to carry out a multi-level analysis of innovation adoption environment for e-voting in the context of the 2011 Nigerian General Elections. Results from our analysis of the adoption of e-voting experience in Nigeria strongly underscore the importance of context and environment in organizational innovation diffusion and innovation adoption by individuals or groups. For instance, the overall outcome of the election was by far more important to stakeholders in their election review report than the efficacy of the e-voting technology. It was interesting to note that the review report only examined structural issues around the e-voting technology but not the technology itself. In addition, the Inter-Agency Consultative Committee for coordination and security of elections was considered as one the most important critical factors for successful election outcomes. This factor enables the availability of e-voting equipment at the different polling units.

By producing a list of critical factors for the different adoption constructs across the 4 levels, we are also in a position to validate some of the adoption constructs presented in [25] *and* [10]. In addition, we provide some measure of importance of these constructs for the e-voting domain. For example explicit identification of coordination through inter-agency committees directly support the claim in [25] that lack of coordination negatively impacts adoption. *Actually, our results enables us produce a more specific multi-level adoption model for e-voting*.

It is plausible to question the generality of results produced form ethnographic style research like ours. First, like any case-based studies, theory testing and building are generally possible in ethnographies. Arguments similar to those by Eisenhardt in [4], [5] are equally valid for ethnography. *Therefore, we can claim that ethnography are appropriate for new topic areas and often result in theories that are novel, testable, and empirically valid*. Thus the process for theory generation described in [4] for case studies could be equally employed for ethnographic studies.

In evaluating an ethnography, Myers [11] offers criteria for evaluating this kind of study, which includes: 1) Is this a contribution to the field?, 2) Does the author offer rich insights, 3) Has significant amount of materials been collected? and 4) is there sufficient information about the research method?

Considering our arguments above, we claim that our work makes concrete contributions to the domain of e-voting and innovation adoption. Our work also operationalizes and validates the multi-level adoption framework in [25] as well as the IT innovation adoption in government model presented in [10]. In addition as indicated above, our analysis offers in-depth insights into the critical factors and challenges in e-voting adoption in context a developing country context similar to Nigeria, that is; those with large population (e.g. Indonesia and to some extent India). As shown in Section 4 and 5, significant materials were collected and available to the researchers. Furthermore, we have argued earlier about the validity of our results based on agreement with factors associated with constructs in [25] in particular.

One of the major drawbacks of the ethnography research in general is the amount of time it takes to analyze materials. For example, we had to carefully sample (stratified) about 50% of the reports from different states of the federation to determine the critical factors and related challenges, in addition to extensive records available to the participating author.

7. CONCLUSION

This work partly responds to the call for more ethnographic studies in IS research [18]. Our results provide a more holistic empirical study of e-voting when compared with past studies on e-voting adoption. In fact, we are unaware of any existing work that has carried out a detailed multi-level analysis of e-voting adoption

in general and specifically in the African or developing world context. We believe that this work contributes to theory building in the domain of e-voting and innovation adoption in government and innovation theory in general. Concrete lessons learnt from this case have been highlighted to guide e-voting adoption in similar environment. As with ethnographic and case study research, findings here are limited to similar context.

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