

Table 2. Participants' opinion related to components of electoral processes in the NGEs.

The component I think could mostly influence the management of election data in Nigeria.							
	INEC	Security Agencies	Political Parties	Civil Society Organisations	Judiciary	Media	Neutral
Number of respondents with their percentages	58(81.7%)	2(2.8%)	4(5.6%)	1(1.4%)	1(1.4%)	2(2.8%)	3(4.2%)

The electoral component I think has distinguished itself in ensuring effective data management in the NGEs.								
	INEC	Security Agencies	Political Parties	Civil Society Organisations	Judiciary	Media	Neutral	None
Number of respondents with their percentages	11(15.7%)	None	1(1.4%)	28(40.0%)	2(2.9%)	4(5.7%)	4(5.7%)	20(28.6%)

I am satisfied with the combined role of the electoral components concerning the way electoral data is being managed in Nigeria.			
	Yes	No	Neutral
Number of respondents	8(11.4%)	57(81.4%)	5(7.2%)

Table 3. Participants' opinion related to existing voting technology/systems

The rating of the effectiveness of the existing voting technology in Nigeria.					
	Very high	High	Uncertain	Low	Very low
Number of respondents with their percentages	1(1.4%)	6(8.5%)	9(12.7%)	41(57.7%)	14(19.7%)

I agree that it is possible to alter/falsify data (results) in the way elections are currently managed in Nigeria.					
	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
Number of respondents with their percentages	32(41.5%)	34(47.9%)	4(5.6%)	1(1.4%)	0%

The improvement(s) in the existing technology will impact confidence on the electoral processes in Nigeria.					
	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
Number of respondents with their percentages	37(52.1%)	25(35.2%)	7(9.9%)	1(1.4%)	1(1.4%)

The probability for falsification(s) to occur in the use of the existing technology or system in the electoral processes in Nigeria.					
	Very high	High	Uncertain	Low	Very low
Number of respondents with their percentages	21(29.6%)	38(53.5%)	7(9.9%)	4(5.5%)	1(1.4%)

Rating the transparency of results collation and computation during the past general elections in Nigeria.					
	Very high	High	Uncertain	Low	Very low
Number of respondents with their percentages	1(1.4%)	7(9.9%)	10(14.1%)	35(49.5%)	18(25.4%)

The present system is secure enough to ensure that the votes of the electorates count.					
	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
Number of respondents with their percentages	1(1.4%)	3(4.2%)	11(15.5%)	35(49.3%)	21(29.6%)

In comparison, the opinions of these authors and those of the 89.4% of respondents above are similar. The similarity of opinions may have been informed from the PVS, which require manual interventions such as collation, computation and conveyance of data on hard copies from polling unit to collation centre.

A total of 87.3% (52.1% and 35.2%) agree that improving the existing voting technology will impact confidence in the electoral processes. In [20], the authors emphasize that the adoption of SCR since 2015 has reduced election frauds, litigation, as well as increased voters' trust and confidence in election process. Therefore, these researchers' opinions concur with the respondents above agreeing with the improvement of existing voting technology to impact confidence in the electoral processes.

Meanwhile, 83.1% (53.5% plus 29.6%) of the respondents believed there is probability for falsification to occur in the use of the current processes in NGEs. In the studies [26], the authors argue that the existing technology is inefficient; therefore, prone to vote tampering and falsification. Given the foregoing, the opinions of the majority of the respondents during our research (83.1%) and that of the writers are related since both believe there are the chances for falsification to occur in the current voting system in Nigeria.

Considering the statement of rating the transparency of result collation and computation, more than half of the people 74.9% ((low - 49.5% and very low - 25.4%) have low satisfaction for result collation and computation in the current NGEs systems. In [12], the researchers elucidate that little or absence of transparency during election is one of the factors responsible for flaw in NGEs. These researchers' views agree with those of the majority of our study; hence, opinions are alike.

Finally in Table 3, result shows that 78.9% (49.3% plus 29.6%) that forms a greater proportion of the opinion do not believe that the existing technology has the security capability for ensuring vote count. The authors in [21] posit that elections including those held in 2003 and 2007 were marred with frauds during result collation. The common opinion of these researchers agrees with the outcome of this study that the existing voting technology is unable to ensure votes of the electorates to count. A technology that lacks security allows frauds. Therefore, in our research, we believe that it is vital for the FGN to consider adopting a technology that has security capabilities that will ensure vote count in the future polls.

6.3. Findings on the problems of existing voting technology/election data management

This section presents the findings of problems associated with the existing technology for managing election data. Firstly, majority of the respondents affirmed that there are problems with the existing election data management. In [4], the authors posit that there are problems including data alterations, centralization and lack of transparency amongst others facing data management during Nigeria elections. Therefore, it signifies that both opinions are similar.

As shown in Table 4 in statement 2, we found that alteration of results recorded the highest rating on the problems facing election data management, and then followed by centralized control. The authors in [12, 26], the writers states that the NGEs held between 1999 and 2019 were challenged for electoral irregularities including alterations and falsifications of results. Our study's outcomes align with the opinions of these writers regarding the existence of alteration of results in NGEs. However, it differs by establishing that alteration of results is the commonest problems facing election data management in Nigeria. It is therefore necessary for relevant stakeholders of NGEs to examine the causes of alteration of results with a view to proffering solutions.

The third statement in table 4 illustrates that majority of the people believe that the adoption of a technological innovation that guarantees confidentiality and promotes transparency in electoral data management in Nigeria. The authors in [20] discuss the adoption of SCR and its contributions to the Nigeria voting systems. Aligning with our study, they assert that the SCR has made verification and accreditation more transparent; thereby increasing voters' confidence.

Furthermore, respondents respectively rated 95.8% (67.6% plus 28.2%) in recommending the adoption of an innovative technology that will make the collation and computation of election results more transparent in the nation. In [16], the authors postulate that the adopting advanced technology eliminates alteration and further promotes vote count. Therefore, the opinion of these researchers is similar to our findings.

The concluding statement in table 4 investigated the challenge that could mostly prevent the adoption of new technology in Nigeria future election. Consequently, majority of the people (78.9%) believe that biases of the policy makers could mostly inhibits the acceptance of new technology. In [37], the authors discussed about the adoption of new technology into the Nigeria voting system, They posit that the approval and disapproval by the policy makers is subject to the technology meeting the required standards, availability of funds amongst other things. Therefore, when it is disapprove for any reason, the policy makers could

Table 4. Participants' opinion related to the problems of existing voting technology/election data management.

There is problems facing the way electoral data are being managed in Nigeria.					
	Yes			No	
Number of respondents with their percentages	63(90.0%)			7(10.0%)	

The highest rated problem facing election data management in Nigeria.					
	Centralized control	Alteration of result	Stakeholders' cooperation	Inadequate skills for INEC staff	Inadequate voters' education
Number of respondents with their percentages	17(26.6%)	37(57.8%)	5(7.8%)	3(4.7%)	2(3.1%)

The extent of adoption of a technological innovation that guarantees confidentiality and promote transparency in electoral data management in Nigeria.					
	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
Number of respondents with their percentages	38(55.1%)	25(36.2%)	6(8.7%)	None	None

Recommendation for the adoption of an innovative technology that will make the collation and computation of election results more transparent in Nigeria.					
	Very high	High	Uncertain	Low	Very low
Number of respondents with their percentages	48(67.6%)	20(28.2%)	3(4.2%)	None	None

The challenge that could mostly prevent the adoption of new technology in Nigeria future election.					
	Inadequate funding	Biases of the policy makers	Lack of interest from the general populace	Lack of trust in technology	Indifference
Number of respondents with their percentages	7(9.9%)	56(78.9%)	4(5.6%)	3(4.2%)	1(1.4%)

be seen as hindrance to the acceptance of the proposed technology. To this end, the opinions of these researchers affirm our findings.

6.4. Findings on Blockchain technology

This aspect shows the results to RQ4 and RQ5 as illustrated in Table 5.

In the first statement, 68.1% of the participants selected yes indicating that they have heard about blockchain technology while 31.9% chose no meaning they have not heard about it.

Out of the respondents that have heard about the blockchain technology, 15.5% of them are very familiar with it, 45.3% are familiar. In [13], the researchers posit that blockchain is gaining popularity across the globe due to its numerous benefits and applicability in different disciplines; hence similar opinions.

In the third statement of Table 5, majority of our respondents totaling 65.3% (strongly agreed - 28.8% and 36.5% - agreed) believe that blockchain technology has the capability to prevent alterations. We found out in our study that blockchain technology has security capability that prevents alterations. In paper [10], the authors also examined the security feature of

blockchain. They argue that it has a characteristic of cryptography signature that authenticates every transaction (vote), which restrict alterations. Therefore, the opinions of these authors agree with those of our findings.

Further findings in statement 4 of Table 5, total of 71.1% (26.9% and 44.2%) opinions believe that blockchain has the capability in ensuring the votes of the electorates to count in the NGEs. Some authors also discussed on the capabilities of blockchain. In ([10, 11], the authors opine that blockchain does not allow modifications of votes that have been committed. Similarly, the authors in [5], assert that retrieval and deletion of committed votes are impossible in blockchain. Furthermore, [11] postulates that any voting transaction on the blockchain is verifiable and audit-able. Therefore, our opinion on blockchain ensuring vote count in blockchain relates to those of the researchers.

Furthermore, 40.4% of participants recommended very high for the adoption of the use of blockchain technology for NGEs and 38.5% suggested high, making 78.9% opinions altogether. Given the foregoing, majority of the respondents in our study commended

Table 5. Participants' knowledge related blockchain Technology

I have heard about the Blockchain technology.					
	Yes			No	
Number of respondents with their percentages	47(68.1%)			22(31.9%)	
I am familiar with the blockchain technology.					
	Very familiar	Familiar	Neutral	Unfamiliar	Very unfamiliar
Number of respondents with their percentages	8(15.1%)	24(45.3%)	12(22.6%)	8(15.1%)	1(1.9%)
The blockchain technology has the capability to prevent alterations or vote tampering.					
	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
Number of respondents with their percentages	15(28.8%)	19(36.5%)	17(32.7%)	1(1.9%)	None
The blockchain technology can ensure the votes of the electorates counts in the NGEs.					
	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
Number of respondents with their percentages	14(26.9%)	23(44.2%)	15(28.8%)	None	None
Recommendation for the adoption of the use of blockchain technology for the NGEs.					
	Very high	High	Uncertain	Low	Very low
Number of respondents with their percentages	21(40.4%)	20(38.5%)	11(21.2%)	None	None
The challenge that could mostly prevent the adoption of Blockchain technology in Nigeria future election.					
	Inadequate funding	Biases of the policy makers	Lack of interest from the general populace	Lack of trust in technology	Indifference
Number of respondents with their percentages	7(13.2%)	40(75.5%)	2(3.8%)	4(7.5%)	None

for the adoption of blockchain technology. Equally, some authors conducted researches that relates to the implementation of blockchain. In [34], they mention that stakeholders have numerous benefits in implementing blockchain technology into voting system. It thus, suggests their advocacy for the adoption of blockchain; thereby, affirming the result of our study where the majority supported the adoption of blockchain.

Finally, this section evaluates the participants' opinion regarding the statement on the challenge that could mostly prevent the adoption of blockchain technology in Nigeria future election. The opinion data showed a significant margin between biases of the policy makers (75.5%) and its closest, inadequate funding (13.2%). Some authors have also, carried out studies about adoption of blockchain in the nation. In [14], the authors postulate that the policy makers could mostly prevent the adoption of the technology for the reason for fairness. Hence, opinions of these researchers are dissimilar to the outcome of our study.

7. Analysis

This section will examine our hypotheses using the research findings in above section. It will use 50 and above percent opinions as benchmark for testing the hypotheses (i.e. 50% and above opinions will validates while less than 50% invalidates the hypotheses).

Hypothesis 1: Based on Section 6.1, Nigeria citizens believe that INEC has distinguished itself in ensuring effective data management during NGEs. This hypothesis is premised on the facts that INEC is a technocrat in electoral data processes and improved its voting processes by introducing the SCR. In Table 2 of section 5.1, the second statement, few people (15.7%) believe that INEC has ensured effective data management, thereby invalidating the hypothesis. In [3], the author opines that INEC has enormous responsibilities that seem to affect its effectiveness; thereby, supporting the invalidation of the hypothesis. The INEC can simplify its responsibilities by automating some of electioneering process. Since data management in election is one of the processes that involves manual intervention, it would be necessary for the FGN to adopt a technology that

would automate data management; thereby, enhancing INEC's efficiency in managing electoral data.

Hypothesis 2: Based on Section 6.2, many people would rate the effectiveness of the existing voting system in Nigeria to be low. This assumption premises on the violence that arises during elections and after the announcement of results since 1999 NGEs due to allegation of irregularities in the voting processes. In statement 1 of Table 3, respondents totaling 77.4% (low - 57.7% plus very low - 19.7%) believe that the effectiveness of the current voting system in Nigeria is on the low range. The respondents' opinions, which validate the hypothesis, could be based on their experiences as election participants.

Hypothesis 3: Based on Section 6.3, Nigerian citizens believe that there are issues facing election data management in the NGEs. In the data collected, most respondents (90%) feel that there are problems with the management of data in the NGEs. Consequently, the outcome of the research validates this hypothesis. The wide margin between those who believe that there are problems and those that do not believe clearly suggest the need for the FGN and other relevant electoral stakeholders to identify the problems and work out the strategies that would accordingly proffer solutions.

Hypothesis 4: Based on Section 6.4, Small percentage of respondents would be familiar with blockchain technology. We based this hypothesis on the idea that blockchain is not a popular technology in Nigeria. As discussed in section 5.4, the result shows that 60.4% (familiar and very familiar) representing majority of the respondents are familiar with blockchain technology, thereby invalidates the research hypothesis. In [35], discussed on how blockchain has advanced the digital world. The writers assert that the use of blockchain for crypto-currency particularly the Bitcoin has revolutionized its applications in many areas. The opinions of the respondents that corroborated the views of the authors in [35] may have been informed mainly from the application of blockchain in financial services coupled with the fact that some of the respondents might be engaging the technology in their professions.

Hypothesis 5: Based on Section 6.4, people believe that blockchain technology has the capability to prevent alteration of data. In the research outcome as discussed in section 5.4 above, 65.3% individuals opined that blockchain has the capability to prevent data alteration. The outcome therefore confirms the research hypothesis that blockchain technology has the capability to prevent alteration of data, thus, validating the hypothesis. The immutability capability of blockchain makes it impossible to delete or edit any data that is committed to the blockchain. Therefore, considering the blockchain in Nigeria voting system will eliminate the chances of data falsification in its

future election; thereby, making the voting system to be more effective.

Hypothesis 6: Based on Section 6.4, people believe that blockchain technology has the capability to ensure votes count. In section 5.4 above, 70.6% of the respondents' opinions align with the hypothesis. Since 70.6% is well above average, it therefore, validates the hypothesis. Reference to the validation of hypothesis 5 above, every vote that have been committed to the blockchain network cannot be modified, suggesting that all votes are recorded in the ledger as originally verified by the participating nodes; thus, every vote remain unchanged as initially recorded as well as computed and accordingly ensures every vote to count.

Hypothesis 7: Based on Section 6.4, few people would recommend the adoption of blockchain in the elections. This hypothesis is premised on the fact that blockchain is relatively a new technology; thus, its awareness may not have reached a larger populace in Nigeria. However, majority (78.9%) of the respondents as shown in statement 5 of Table 5 recommended the adoption of blockchain technology; thereby, invalidates our hypothesis. In [37], the authors postulate that blockchain is an evolving technology and stakeholders need to clarify their doubts regarding security, legal matters and overall effectiveness of the technology that will endear buy-ins of the populace and policy makers for adoption; thus agreeing with the hypothesis. [5, 13, 34], they argue that blockchain is gaining popularity due to its numerous benefits and areas of use. The assertions of these latter researchers affirm the result of this study where 78.9% of respondents supported the adoption of blockchain; hence, invalidate the hypothesis.

Hypothesis 8: Based on Section 6.4, people believe that policy makers would be the main hindrance to the adoption of blockchain technology. We premised this hypothesis on the fact that blockchain being a new technology, policy makers will have to explore all aspects of the technology in a constitutional manner. When the proposal for adoption is rejected or delayed for any reason, people would believe that the policy makers have hindered the adoption. The result as discussed in section 5.4 shows that 75.5% of respondents feel that the biases of the policy makers would be the most hindrances; thus similar to the hypothesis, thereby validating it. In view of the foregoing, it is necessary for future research to look into acquainting the policy makers with adequate knowledge and capability of blockchain technology in order to promote its adoption.

8. Conclusions

This research work has given significant insight into the Nigeria general election process. It discussed the

components of election process in Nigeria, the existing data management system and its problems. Thereafter, it examined some concepts of blockchain technology. We created questionnaire to identify citizens' opinions on the effectiveness of blockchain technology in the NGEs. The analysis of the findings forms the recommendations.

The study advocates that the adoption of blockchain technology will enable the Nigeria electoral system to secure and manage efficiently its election data. Consequently, it will improve the Nigeria general election process and democracy in ensuring that the electorates' vote would count; thereby significantly preventing violence, killings and destruction of properties that ensues before, during and after elections.

It adds to the academia a vital literature in the use of blockchain technology for efficient data management in Nigeria and roles of blockchain technology in data security. It enriches the software, hardware and political industries with a technology that could solve electoral problems; thus, contributing a huge opportunity for hardware and software industries development.

The research coincided with the period of the Covid-19 pandemic lock-down. As such, the research methodologies and number of respondents were limited. Consequently, the depth and the quality of data collected was somewhat affected.

The proportion of the research participants was small compare to the population of Nigeria, hence it may be unsuitable to generalise on the findings of the research. However, the research was able to ascertain the need for the adoption of blockchain technology.

It is imperative that future studies propose and develop a blockchain framework with a view to demonstrating it to Nigeria policy makers and INEC.

It is therefore recommended that: 1) FGN should encourage the decentralization of election data management to check anomalies and allow the electorate votes to count. 2) The FGN and other relevant electoral stakeholder should consider adopting the blockchain system for eliminating the chances of electoral irregularities. 3) Researchers could consider proposing and developing blockchain framework, its practical demonstration made to all relevant NGEs stakeholders in order to get their buy-ins. 4) The Framework demonstration should suggest a pilot project with the Local Government Elections' (LGEs) primary elections.

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