

The Role of ICT in Electoral Processes: Case of Kenya

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Abstract: Healthy democracies require high levels of explicit participation by citizens in political life of their countries, from voting empowerment to monitoring government performance. ICT is a tool which when used appropriately can help citizens participate in the political affairs of their countries. Through use of information technologies such as database management systems, biometrics voter registration and identification, optical scanning, block chains and digital networks, secure and robust systems for digital voting can be devised. The objective of this paper are to highlight the types of technologies used in electoral systems and results transmission, Investigate the challenges faced in using these technologies and to establish benefits of technology use in electoral processes. The study was conducted through a desk search on elections materials, elections observer reports, international and Kenyan laws on elections and reports by the Kenya's EMB, IEBC. The study concludes that legislative and regulatory items that govern elections in African countries need to be reviewed to cope with new and emerging technologies. When considering technological solutions for electoral processes, Election Management Bodies must conduct adequate feasibility studies and proper strategic planning to ensure that they have sufficient plans and time for the introduction of new technologies

Keywords: ICT, Electoral Systems, Results Transmission

1. Introduction

We are living in an era in which various forms of Information Communication Technologies are relied upon by citizens of many countries around the world on a daily basis, to engage in almost everything from communication, commerce, banking and education to leisure. It is therefore imperative that conduction of elections reflect this modern reality. There is no doubt that the future is digital for many people around the globe, not only for elections but also government citizen interaction i.e. e-citizen, and in other forms of engagement and campaigning. The quality of governance can significantly be enhanced when ICT technological revolutions are harnessed to improve the credibility and legitimacy of electoral processes, which in turn leads to electoral integrity. The use of technologies, in particular ICTs is enabling pioneering countries to set new levels of transparency, facilitating engagement and giving their citizens the advanced democratic tools that they demand and deserve. In many African countries, the utilization of Information Communication Technologies in electoral processes is in response to past experiences where election management has often been characterized by rigging allegations and violence. ICTs when implemented and used properly can modernize and improve the integrity of elections on the continent.

According to [1] over the past decade, Election Management Bodies (EMBs) worldwide are increasingly relying on ICTs to improve the accuracy, security and integrity of their electoral processes. This trend has been particularly noticeable in regard to voter registration, results management including transmission and more recently, the introduction of electronic voting. To achieve this, electoral administrators are adopting several types of technologies into the electoral process.

Philosophically democracy requires that people have the right and capacity, acting either directly or through representatives, to control their institutions for their own purposes. Further, necessary restraints can be imposed only by the consent of the majority and that they conform to the principle of equality. Elections are a means of putting power in the hands of citizens by giving them the ability to choose and replace their leaders. Elections determine political winners and losers, and are an important tool for holding leaders accountable and peacefully resolving political and societal conflict. Therefore good policies complemented by relevant tools which are capable of supporting an election are critical to the strength of a democracy. This is particularly important in countries like Kenya where there exists a deep partisan and ethnic divide necessitating the need for elections that are transparent and trustworthy.

Voting history in many countries of the developing world is characterized by electoral malpractices. These include manipulation of elections in order to influence their outcome. A good voting system therefore whether it is electronic, or one that uses mechanical devices or one that is manual must satisfy a number of sometimes competing criteria. [2] states that because elections determine political winners and losers, electoral processes from voter registration through results reporting, have for a long time been targeted for manipulation by unscrupulous regimes and political actors. These manipulation whether real or perceived, and sometimes the mere threat of it weakens public confidence in democratic processes, erodes the legitimacy of governments, and undermines the will of the people. [17] Observes that voter suppression, incorrect tallying, stuffed ballot boxes and hacked voting systems are some of the challenges that are associated with elections today.

2. Objectives

The main aim of this study was to establish the role of ICTs in electoral systems and results transmission. The study was guided by the following specific objectives

1. To establish the technologies used in electronic voter registration, voting, counting and results transmission
2. To investigate the challenges faced in using these technologies
3. To establish benefits of using ICTs in electoral processes

3. Methodology

The research process involved a desktop research on elections materials and election workshops reports, elections observer reports, conference proceedings and scientific research articles in journals. Other sources of literature reviewed included international and Kenyan laws on elections and reports by the IEBC and the print media.

4. Technology Description

The electorate of African countries including Kenya is increasingly becoming tech-savvy, and therefore the governments of these countries must keep pace with the technological advancements and the electorate's expectations about incorporating new technologies in all electoral processes including voter registration, identification, ballot casting, counting and results transmissions. Most electoral management bodies (EMBs) around the world are modernizing elections by using ICTs with the aim of improving the quality and integrity of

the electoral process. The technologies in use by the EMBs range from the simplest comprising of the basic office automation tools i.e. word processors and spreadsheets to more sophisticated data processing tools, such as data base management systems, optical scanning, biometrics, geographic information systems and block chain technology [3]. According to [4], since people increasingly use technology for a wide range of everyday functions, there is nothing categorically different about using technology as a consumer of goods and services to using technology in elections as a citizen. [4] Further observes that for many countries certain areas of elections management such as voter registration have benefitted from a greater willingness to use new technologies than others, such as ballot casting and counting and results transmission. Election technologies are not standard, off-the-shelf software systems. They are, and will always be context specific, usually complex solutions customized to the specific needs of each electoral management body (EMB). This is because elections are a representation of a country's constitutional and democratic culture, and have their own distinct regulatory frameworks with divergent focus and voting procedures [5].

Many Election Management Bodies have adopted an approach of combining manual processes and electronic technology into suitable hybrid systems, which are influenced by a wide range of factors that may arguably be considered unique for each particular country. [6] States that any combination of manual/electronic voting/ counting and results transmission is possible. In a fully electronic electoral management system, the entire electoral process voter, party and candidate registration; verification of candidate support signatures; ballot production; electoral logistics; voter identification; voting in polling stations or remotely; vote counting; results transmission; and presentation of preliminary and final results of data can all be performed by electronic and digital equipment and with very limited human intervention. Currently, only a few countries, such as Norway and India have achieved this level of automation of election administration [6], with electronic voting machines being exclusively for national and provincial elections. [7] holds the same view and state that there are two dominant voting technologies 1) optically scanned paper ballots and 2) electronic voting machines referred to as direct recording electronic voting machines (DREs) which are essentially touch screen machines. These DREs are deemed to have capability of increasing efficiency and boosting the confidence of voters that their votes are accurately recorded, therefore reducing mistrust in the voting system. A full electronic solution if deployed, involves an electronic voting machine, remote or otherwise, directly recording the preference of the voter through a ballot interface e.g. a touch screen, electronically counting the votes received at the end of polling and providing these results to election officials [6]. Electronic voting and counting technologies cannot, however, eliminate all aspects of electoral fraud but can mitigate some fraud in polling stations or during transmission of results. For example, some electronic voting and counting technologies only allow votes to be cast at a certain speed, thus mitigating ballot stuffing [4] asserts that indeed, speed of the vote count has proven essential to public perception of legitimacy, particularly in developing countries. One of the primary incentives for adopting electronic voting is to increase the accuracy of ballot counting in order to reflect the will of the voters, including preventing fraud such ballot box stuffing. In fact, fraud prevention in electoral systems is a major issue that comes up in many discussions of electronic voting and is seen as a major concern as security of these systems may at times be compromised. Many countries such as Kenya have however combined manual processes and electronic technology into suitable hybrid systems where Information Technologies are used in voter registration, identification, and results transmission to the national tallying center while voting casting and counting remain manual. The technologies that are used in results transmission include digital networks, mainly GSM and satellite technologies.

Electronic voter registration can, in some circumstances, improve the quality of service provided to voters. Voter registration however remains one of the most complex and contested parts of the electoral process. In some countries there are no trustworthy census data, no reliable identification documents and no reliable voter's database or register. In such countries, existing voter registers are often of poor quality, thus opening up avenues for manipulation and putting pressure on electoral management bodies to establish more reliable voter registration and election management systems. Where such challenges are experienced, it is often assumed that biometric technology can provide the required solutions [8]. According to the International Institute for Democracy and Electoral Assistance (IDEA) report on ICTs in Elections, over one hundred and thirty (130) EMBs were surveyed in 2016 and thirty five per cent (35%) of them found to be capturing biometric data as part of their voter registration process. Biometric technology is widely used in the registration process, especially in Africa and Latin America. Biometric technology is widely used in the registration process, especially in Africa and Latin America [8], where in most cases it is used for the establishment of the national voter registration database and the creation of related infrastructure for data transfer and communication such as results transmissions. Biometric voter registration process results in the creation of an electronic voter register (EVR) that comprises biometric data. This can be used to address the issue of double registrations thereby minimizing discrepancies in the electoral process. As such Electronic Voter Register is viewed as a means of ensuring free and fair elections [9]. [6] holds the view that with regard to voter identification possibilities, the use of technology for the voting process allows improved mechanisms for voter identification at the point of polling. This can be done through biometric recognition systems such as automated fingerprint identification systems or the use of multiple factor authentications such as smartcard and personal identification number. This significantly reduces voter registration fraud and ensures that the person voting is the person on the voter register. Accuracy in ballot counting is paramount. Digital voting involves the use of electronic devices to cast votes and is also referred to as e-voting when voting using a machine in a polling station or i-voting when using a web browser on the internet. E-voting involves use of existing devices such as mobile phones, laptops, or specialist equipment at polling stations which allow unsupervised voting is considered a promising and an inevitable development of the twenty first century and has capabilities to speed up, simplify, reduce the cost of elections and the development of stronger democracies [18].

The Internet has been utilized as a voting medium by some countries, to facilitate voting and to increase voter participation in elections. Estonia for instance is a country known to have to allowed online voting for all voters in national parliamentary elections, with the percentage of voters choosing this option having steadily increased from seven percent in the 2007 national election to twenty four percent in 2011 to almost a third of voters in 2015 [4]. But Estonia has built an e-government infrastructure to incorporate technology as a pervasive and widely accepted aspect of people's lives since the 1990s. Thirteen other countries including Canada, France Australia and Norway have conducted online voting trials since 2003. On the other hand countries such as Norway discontinued online voting after trials that were held in 2011 and 2013 because there was no sufficient evidence of increased voter turnout and also because there were concerns about security risks [4]. This is an indicator that for EMBs considering implementing electronic voting systems, the security of digital voting as well as transparency are big concerns. An electoral system's ability to secure data and defend itself against potential attacks should not be doubted because of the monumental decisions they make in putting political power in the hands of individuals. One way the security issues can be potentially solved is through the technology of block chains to distribute an open voting record among citizens rather than to continue trusting central authorities to manage elections. A block chain is made up of a distributed

database of records or a public ledger that comprises of all transactions or digital events that have been executed and shared among participating parties. The open source block chain technology is built on the block chain protocol and is a means of logging and verifying records. It is transparent and distributed among users and could be used in new electronic voting systems in national elections since each transaction in the public ledger is verified by a consensus of the majority of the participants in the system [19]. Information once entered into the system can never be erased. Therefore the block chain contains a certain and verifiable record of every single transaction ever made.

4.1 ICT use in Elections in Kenya

The utilization of technology in Kenya's electoral processes is guided by Section 44 of the Elections Act of 2011. In order to comply with Section 44 (1) of the act, the EMB in Kenya, the Independent Electoral and Boundaries Commission (IEBC) acquired an integrated electronic electoral system referred to as the Kenya Integrated Elections Management System (KIEMS). KIEMS was designed to integrate the biometric voter registration (BVR); the biometric voter identification (EVI); the electronic results transmission (RTS); and the candidate registration systems (CRMS). The three sub-systems (CRMS, EVI and RTS) were procured prior to 2017 General Elections, while the BVR system has been in existence since the 2013 electoral process. Kenya's EMB, IEBC has in the past adopted an approach of combining manual processes and electronic technology into a suitable hybrid system that entails manual procedures for voting and counting with ICTs being used in areas of voter registration and identification on voting day as well as results transmission. The Information and communications technologies', shortened to ICTs when used in the plural, is the term used throughout this study to cover all technology used in electoral administration in Kenyan scenario, including, but not limited to, both computer hardware and software; communications technology such as mobile phones and SMS applications; internet applications; and sensors capable of enrolling biometric data of citizens [1]. [10] Shows that the bio data information of all the registered voters are loaded onto the integrated system, with biometric details of specific voters restricted to polling stations in which they are registered. The identification component of the electronic voter identification is used for authentication of voters on the day elections are conducted at polling stations by searching for the voter record using the finger print. Additionally during the authentication process on Election Day, the EVI does, at regular intervals of about 80 minutes, transmit statistics to the central system. The electronic results transmission (RTS) being part of KIEMS is a module that is used to capture and transmit election results from the various polling stations. At the close of the vote casting process, the election results are transmitted together with an image of the polling station tally sheet through the KIEMS to the central database at the head office of the EMB. The RTS has a feature that is used for tallying the results, validating the results and displaying them in all constituencies tally centers and at the national tally center.

5. Developments

The ICT technologies are a potential tool for increasing citizen's trust in the electoral processes and are perceived as a tool to help overcome barriers of political participation by citizens. Today most Electoral Management Bodies around the world use ICTs with the aim of improving the electoral process. Understanding the factors influencing technology adoption helps Electoral Management Bodies make sound decisions about adopting technologies and managing these in electoral systems. The report by the [1] indicates that high technology integrated solutions can bring efficiencies and cost savings as well as enhance integrity. Achieving both in a sustainable and nationally owned manner is a rare thing. [4] observes that with an increasingly tech-literate electorate, many countries

especially in the developing world are placing greater faith in the precision of technology simply because technology can mitigate against fraud in polling stations. For example some electronic voting and counting technologies only allow votes to be cast at a certain speed, thus mitigating ballot stuffing. Similarly, electronic counting of ballots mitigates fraud during the counting process even though it has been acknowledged that electronic voting and counting technologies cannot completely eliminate all aspects of electoral fraud [6].

Generally the use of biometric in African elections is on the rise. Not less than 25 sub-Saharan African countries including Kenya, Sierra-Leone, Democratic Republic of Congo, Zambia, Malawi, Rwanda, Senegal, Somaliland, Mali, Togo and Ghana have already held elections employing a biometric voter register [11]. Through use of biometric technologies, an automated fingerprint identification system can be established for use in elections as a digital register that is capable of verifying voters, and also eliminate duplications from the register. [12] states that the success or failure of any technology used depends only partly on the procured equipment but equally on a range of other factors, such as the performance and responsibility of its operators, the conditions of operation, the technology's consumables, economies of scale, costs, communication, education, logistics etc. Therefore all departments of an EMB must be closely involved from the very beginning of the process of implementing a technological solution. The following factors have important roles to play in the elaboration of the concept of operations, in the definition of requirements, and in the procurement, evaluation, deployment and support of the technological solution: legal, voter registration i.e. the primary users of any procured solution, operations & logistics, public outreach, and training. According to [12], procurement and deployment of ICT solutions is both expensive and time consuming, therefore adequate feasibility studies and adequate strategic planning should be done to ensure i) an EMB makes informed decisions, and ii) adequate time is allotted for the introduction of new technologies, whether low, medium or high. In situations where an EMB has limited time, the costs and the risks of failure increase significantly. For many EMBs however before deciding to adopt any form of technology they should put into consideration the political and the citizens' environment because the extent to which both these environments accept the technology is crucial in the EMBs decision on whether to implement it or not [13]. Election results assessment and verification tools are also an important component of the electoral process. [2] state that there are six primary goals associated with tools for assessing and verifying election results. The goals of these tools according to [2] include but not limited to detecting electoral fraud, deterring electoral fraud, building confidence in electoral processes, providing a projection of results, and building local capacity for oversight and to verifying of official results.

The rapid transmission of election results electronically from voting locations to a central location, usually election headquarters to get a quick count of votes cast is gaining traction in many countries, and has been done in countries such as Albania, Ecuador, Finland, Panama, and Zambia [4]. Uploading unofficial election results to government websites on election night has become common. In Kenya, The Kenya Integrated Elections Management System (KIEMS) was not only used in voter identification, but was also used for results transmission from polling stations to the central location at the EMBs head office. Presidential election results announced at the polling station level were supposed to be instantly posted online for public view and to be displayed at the National Tally Center. The KIEMS system was supposed to transmit the list of voters identified every three hours to the IEBC's main servers to avoid accusations of ballot stuffing. Additionally presiding officers were required to record and transmit the number of ballot papers issued at regular intervals throughout the day, which should eventually tally, in addition to filling the polling station diary [10]. The open-source block chain technology affords us opportunities for tailor made solutions for creating secure and transparent voting systems. According to [20], the block chain allows the creation of publicly viewable, time stamped and signed

transactions or records that cannot be altered or deleted. It is a form of distributed database where records take the form of transactions, whereby a block is a collection of these transactions. Block chain-enabled e-voting (BEV) would empower voters to do most of the tasks involved in electoral processes themselves since the technology allows them to hold a copy of the voting record. This historic voting record should then not be changed because other voters would see that the record differs from theirs, and illegitimate votes cannot be added, because other voters would be able to scrutinize whether votes are compatible with the rules. Block chain enabled e-voting has the capability of shifting power and control of electoral processes away from central actors such as EMBs and foster the development of a tech enabled community consensus [18; 21]. [18] Observes that block chain enabled e-voting has been used successfully in conducting internal elections of political parties and shareholder votes in Estonia. The concept can therefore be taken a step further such that the block chain-enabled e-voting could be combined with smart contracts to automatically take action under certain agreed conditions. For example the election results could trigger the automatic implementation of manifesto promises or investment choices.

6. Challenges

Many experts on electoral processes believe that in-person voting using paper ballots is the only truly secure and guaranteed way to cast a ballot [21]. Although such manual processes can generally be run without incident by dedicated elections officials, manual human based processes are prone to errors and mistakes [22], implying that technology enabled processes are more reliable. Many countries are therefore seeking to increase participation, credibility, transparency, and access for all voters and are considering the obstacles both concrete and perceived to introducing technology into the democratic process. [1] shows that when applied appropriately information technology as well as other forms of technologies can add major benefits to an electoral process. Although technology cannot replace a lack of trust in the framework of a country's electoral process or build that trust, it can significantly increase credibility where electoral processes are trustworthy. While the use of Information and related technologies can bring great benefits in accuracy, speed, efficiency and effectiveness to the process, they also pose challenges in the areas of implementation and management of Information Technology Projects, costs, security, sustainability, transparency and vendor dependence. [23] observed that most ICT initiatives and projects in developing countries are characterized by implementation lags owing to lack of critical evaluation of social and environment processes within which these projects are framed, which in turn compromises development and use of Information Technologies in elections.

Technology Acceptance of election technology that meets public acceptance is as important as the election itself [23]. Voters are more likely to accept and use election technology when they perceive it as being useful and easy to use. The great majority of voters in Africa especially in rural areas have low levels of education and there is likelihood of occurrence of incidents of difficulty in using election technology especially with older and illiterate people. [6] states that if an electronic voting or counting system is to be properly trusted by electoral stakeholders it is important that the security challenges presented by the use of the technology are understood. Mechanisms should be in place to mitigate these security challenges and any security breaches should be easily identified. ICT security works like preventive medicine: one does not know if it is working or how well it is working until it fails. Moreover, there is no perfect security. Securing electronic systems is an arms race between those trying to protect them and those prepared to invest in breaking into them. Electoral stakeholders often demand the highest possible security standards for election technology, since a country's democracy is at stake when election technology seriously fails or is manipulated [14].

Security issues also address how results that are electronically transmitted from electronic voting or counting machines to a regional or central tabulation facility encrypted to ensure there is no unauthorized access to the results, and how they are verified on receipt to ensure that they are legitimate and they are submitted from an authorized officer or location [6]. When compared to paper balloting systems, electronic voting and counting technologies present various security challenges. For example, electronic transmission of results for tabulation presents the possibility for the system to be hacked and false results being inserted and therefore secure systems of protection and verification for electronic data need to be ensured [6]. [1] Also indicates that a persistent, and often unanticipated, challenge that EMBs face is attracting and retaining skilled ICT staff. The report further states that given that large public-sector ICT projects typically run late and over budget, it becomes clear that EMBs are at risk of failure if they do not adequately plan for the introduction of technology into electoral processes. [8], state that while biometrics can be used to verify the identity of voters, they cannot be used to verify their eligibility. For example, biometrics cannot be used to verify whether a registered voter is underage, or even ascertain their nationality. Such checks require other means of verification and documentation, other than biometrics.

Biometric technology alone does not guarantee comprehensive or inclusive voter registration. For the case of Kenya challenges in the use of ICT are compounded by aspersions that have been cast on election officials. Indeed a as a follow up to the 2013 elections, report by the [15] for instance indicated that the EMB in Kenya, IEBC should audit the entire procurement system with regard to the BVR kits, and have those responsible for purchase of non-functioning machines, dysfunctional batteries, lack of training of officers, and those responsible for faults in the tallying system, which is also a function of computers that could be sub-standard be dealt with in accordance with the law. [1] states that technology can introduce new hitherto unseen problems such the challenges of procurement, recruitment, operation, storage and maintenance whose impact is often underestimated. The use of various technologies, despite the usefulness is also faced with problems of unreliable power supply to facilitate use of electronic equipment while alternative sources of power may not be sustainable for long periods. When it comes to electronic transmission of results one of the main challenges is the network coverage in some remote parts of these countries that don't have 3G GSM network that is often relied upon. According to [1], the director of ICT at the Kenyan Election Management Body, summarized the issue of challenges in use of technologies at a workshop by stating that i) Use of the various ICTs and emerging technologies alone cannot guarantee the integrity of elections without the necessary legal and administrative mechanisms to support their use. ii) Electronic Voter Registration costs should be weighed against the contribution to the perceived credibility of the electoral registration process. According to [9] the problems that are manifested in form of election malpractice for many African countries such as Kenya and Nigeria includes multiple voting, staffing of ballot box with ballot papers, absconding with ballot boxes, mutilation of election result sheets and falsification of election results and election violence. These problems can greatly be reduced or mitigated against when ICT is deployed appropriately. This can be achieved through use of partial electronic solutions which are available whereby paper ballots are marked manually but counted by machine e.g., optical scan solutions or an electronic device is used to create a printed vote which is placed in the ballot box and counted by hand or electronically.

A report by [24] shows that cases of use of or adoption of block chain technology in Africa are very few because of poor understanding and knowledge of the technology especially in sectors other than banking. Bitcoin is beginning to be accepted in some African countries such as South Africa, Ghana, Kenya, Uganda and Tunisia, where it is used mostly for money transfers. Although banks in these countries are beginning to accept

digital currencies and block chain technology, there still exist challenges of acceptance by regulators who in some of these countries have differing opinions on matters such as crypto currencies. Though the block chain offers significant enhancements to the current electoral systems in Africa, it faces significant challenges. According to [17], the technology may face resistance from people in power who have a vested interest in keeping elections flawed, due to its enhanced transparency. Access to the internet is critical for widespread use of this technology, because block chain applications run on the internet but the internet penetration on the African continent remains low. The legal and regulatory environments of many African countries are also important challenges because they have not developed policies to support and facilitate use of block chain technology [24].

7. Business Benefits

The act of conducting an election for any country often involves large and complex logistical operations, and therefore it is understandable for Election Management Bodies to seek ways of reducing the operational burdens and risks involved in implementing such a complex operation. Manual elections are extremely vulnerable, prone to errors and very expensive. According to [13], electronic voting is favorable because of the perception that e-voting systems would reduce operational burdens and risks, reduce human error in the electoral process and also increase transparency in the elections. Electronic voting can also help eliminate other challenges voters are likely to encounter such waiting in long queues at polling stations on election day and intimidation from party agents. [6] states that technology is one of the tools that can be used to assist in efficient, accurate implementation of elections. ICTs when correctly deployed have capability of facilitating registration of voters, identifying voters, tabulating results, results transmission and publishing election results. The use of ICT in elections results in significant improvements over traditional manual voting and counting systems in the following areas according to [16]. 1) Security- Well designed special-purpose systems reduce the possibility of results tampering and significantly reduce fraud. 2) Accuracy- Use of ICT in voting, counting, aggregating and tallying eliminate the introduction of errors that in some way always affect results in a manual election. 3) Speed- Official results can be obtained faster after the polls close. 4) Audit -One of the biggest issues with manual voting is that it leaves a very weak audit trail, with very little or no redundancy of data. In contrast use of ICT in an election provides possibilities of creating a very rich audit trail that cannot be circumvented and capability to verify that the results truly reflect the will of the voters. 5) Cost reduction- The cost of running an election through technological means is significantly lower compared to manual elections, even after taking into consideration the initial investment in technology.

Given the potential benefits of block chain e-voting, the technology will be important in the democratic processes on the African continent if voters are willing to accept or use the technology. The cost of building a block chain e-voting system is substantially less as compared to the cost of running a ballot based system, and by using this technology, it is possible to make sure that those who are voting are who they say they are and are legally allowed to vote. Additionally, anyone who knows how to use a cell phone can understand the technology required for voting using block chains [17; 21]. The block chain offers a significant advantage to the electoral process because it is a peer-to-peer distributed ledger, which means that all records on the ledger are visible to all those within the network. In the voting process, this offers a certain level of security as all records are publicly viewable and verifiable. This means all claims of irregularities can be settled quickly through one look at the block chain since the data in a given block cannot be altered retroactively without altering all subsequent blocks. Due to the transparency of block chain, the whole procedure is open to the public, which in turn leads to more fairness and validity [17].

8. Conclusion

This study aimed at providing a better understanding the technologies used in management of electoral processes, including voter registration, identification, counting results transmission and electronic voting itself. The study looked at the challenges faced in using these technologies as well as the benefits of using such technologies in electoral processes. It is evident from this study that although use of integrated technologies can help achieve efficiency, cost savings and enhance the integrity of the electoral processes, achieving these objectives in a sustainable manner is difficult. A fair electoral process is one of the key factors that leads to an effective and functioning democracy, one in which the public has full confidence that the electoral process accurately represents the views of the people. In view of this, it is necessary that when considering technological solutions for electoral processes, Election Management Bodies would do better when they conduct adequate feasibility studies and proper strategic planning to ensure that they have adequate time for the introduction of new technologies. Additionally further research is necessary to understand technology adoption theories that will provide a better understanding of factors that may influence voters' acceptance of these technologies as well as issues likely to affect adoption and use of ICT in electoral processes ranging from planning, procurement, training and the physical attributes of polling places which are determinants of voter behavior. Block chain technology development is progressing rapidly, and in spite of the few technological challenges that remain to be addressed these technologies can be adopted in electoral processes since they are already being adopted in other sectors such as the financial sectors. Legislative and regulatory items that govern elections in many of these countries also need to be reviewed to cope with block chain becoming a reality. Leveraging technologies such as block chain and the Internet of Things would enable us get the highest possible speed in obtaining, processing and announcing election results, and highest possible accuracy of the results and provide possibilities for maximum transparency of the electoral process, eliminating the possibility of violations of the electoral process such as registration and 'voting' of the dead, multiple voting etc.

References

- [1]. Joint Task Force on Electoral Assistance. (2012). *Information Technology and Elections Management: Informed Decisions for Sustainable Outcomes*. Mombasa: European Commission/UNDP.
- [2] Cowan, G., Smith, E., Robertson, C., & Sahley, C. (2015). *Assessing And Verifying Election Results: A Decision-Maker's Guide To Parallel Vote Tabulation And Other Tools*. Bethesda, Md: Usaid.
- [3] ACE project. (2017). *Elections and Technology*. Retrieved October 15, 2017, from <http://aceproject.org/ace-en/topics/et/onePage>
- [4] McCormack, C. B. (2016). *The Future of Technology in Elections*. Washington: The Atlantic Council of the United States.
- [5] Barrat, J., Bolo, E., Bravo, A., Krimmer, R., Neumann, S., Parreño, A. A., et al. (2015). *Certification of ICTs in Elections*. Stockholm: International Institute for Democracy and Electoral Assistance .
- [6] Goldsmith, B. (2011). *Electronic Voting & Counting Technologies*. Washington, D.C. 20006: International Foundation for Electoral Systems (IFES) .
- [7] Stein, R. M., Vonnahme, G., Byrne, M., & Wallach, D. (2008). Voting Technology, Election Administration, and Voter Performance. *Election Law Journal* , 7 (2), 123-135.
- [8] Wolf, P., Alim, A., Kasaro, B., Namugera, P., Saneem, M., & Zorigt, T. (2017). *Introducing Biometric Technology in Elections*. Stockholm: International Institute for Democracy and Electoral Assistance
- [9] Kuye, C., Coker, J., I.A, O., & C.A., C. (2013). Design and Analysis of Electronic Voting System in Nigeria. *International Archive of Applied Sciences and Technology* , 4 (2), 15-20.
- [10] International Foundation for Electoral Systems. (July 20, 2017). *Elections in Kenya: 2017 General Elections*. Arlington, VA 22202: Unpublished.

- [11] Alebiosu, E. A. (2015). Smart Card Reader and the 2015 General Elections in Nigeria. Federal University Wukari, Nigeria: Unpublished.
- [12] Omoleke, M. (2017). The Challenges of Acquisition and Deployment of Technologies in the Conduct of Elections in Nigeria. *International Journal of Innovation and Research in Educational Sciences* , 4 (3), 2349–5219.
- [13] Achieng, M., & Ruhode, E. (2013). The Adoption And Challenges Of Electronic Voting Technologies Within The South African Context. *International Journal of Managing Information Technology* , 5 (4).
- [14] Catt, H., Ellis, A., Maley, M., Wall, A., & Wolf, P. (2014). Electoral Management Design. Stockholm: International Institute for Democracy and Electoral Assistance.
- [15] Kenya Human Rights Commission. (2015). Kenya Human Rights Commission. Nairobi: Kenya Human Rights Commission.
- [16] Mugica, A. (2015). The case for election technology. *European View* , 111–119.
- [17] Lielacher, A. (2017, August 17). How Blockchain Technology Can Improve The Democratic Electoral Process. Retrieved January 10, 2018, from <https://www.nasdaq.com/article/how-blockchain-technology-can-improve-the-democratic-electoral-process-cm833172>
- [18] Bouher, P. (2016). What if blockchain technology revolutionised voting? *European Parliamentary Research Service*.
- [19] Crosby, M., Nachiappan, Pattanayak, P., Verma, S., & Kalyanaraman, V. (2015). BlockChain Technology- Beyond Bitcoin. Berkeley, California: Sutardja Center for Entrepreneurship & Technology.
- [20] Spanos, N. (2017). Can blockchain make voting more secure and transparent? . Retrieved December 18, 2017, from The Block - Blockchain Technology News: <https://www.blockchaintechology-news.com/2017/10/31/r3-22-banks-build-international-payments-solution-corda/>
- [21] Ayed, A. B. (2017). A Conceptual Secure Blockchain- Based Electronic Voting System. *International Journal of Network Security & Its Applications (IJNSA)* , 9 (3).
- [22] Lohrmann, D. (2017). Government Technology Magazine. Retrieved January 5, 2018, from <http://www.govtech.com/authors/MT-Author-GT-Dan-Lohrmann.html>
- [23] Ahmada, S., Abdullah, S. A., & Arshad, R. B. (2015). Issues and Challenges of Transition to e-Voting Technology in Nigeria. *Public Policy and Administration Research* , 5 (4), 95-102.
- [24] United Nations:Economic Commission for Africa. (2017). Blockchain Technology in Africa. Addis Ababa