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Towards A Secure Remote Electronic Voting in Tanzania Organizational Challenges

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Abstract

This paper discusses organizational challenges that hinder the implementation of secure remote electronic voting in Tanzania and proposes workable solutions to address the identified challenges. The work presented in this paper complements a proposed secure model that would facilitate the implementation of secure, trustworthy and sustainable electronic voting via Internet and mobile phones in Tanzania. The proposed model together with technical recommendations is presented in a separate research paper titled "A Secure Model for Remote Electronic Voting: A Case of Tanzania". Data was collected using self-administered questionnaires and interviews. The data was collected from (1) experts in the area of information security and information technology, (2) lawyers, and (3) election officials. We also reviewed the election act and constitution of the United Republic of Tanzania.

We conclude that technical solutions alone can not provide a level of assurance that is required for trustworthy, secure and sustainable remote electronic voting system. Non-technical solutions should be considered as well. Thus a holistic approach should be adopted to pave the road to a successful implementation of remote electronic voting in legally binding political elections in the country.

Keywords: *A Holistic Approach, Security, Remote Electronic Voting, Implementation Roadmap, Legally Binding Elections.*

1. Introduction

1.1 Background and Rationale for the Research

Many countries are currently considering introducing electronic voting with the aim of improving various aspects of the electoral process. Electronic voting is seen as a tool for advancing democracy, building trust in electoral management and increasing the overall efficiency of the electoral process [20]. One of the most challenging topics in the area of electronic voting is a remote electronic voting. With the remote electronic voting, voters can vote remotely via mobile phones or Internet. If well

implemented, remote electronic voting solutions can increase accessibility and make voting more convenient for citizens [20]. However, not all remote electronic voting projects succeed in delivering on such promises. Many remote electronic voting projects have failed due to lack of security [4]. It is urged that security has always been a problem because it is normally approached in a pure technical manner rather than being implemented in a holistic way [22]. The main idea of holistic model for secure electronic voting is that various security practices must be seen as an entire system to achieve the maximum level of security. Such a system must incorporate both technical and non-technical security solutions and has to be implemented in accordance with information security best practices. In this way, the level of trust among election stakeholders in the electoral process will be increased and maintained.

Tanzania, being a developing country, also recognizes the need to use ICT to increase citizens' participation in decision making including participation in elections and referendums [15]. Therefore a decision to initiate the implementation of remote electronic voting system should be given a thought. Tanzania should learn from other countries which have implemented electronic voting systems to avoid facing similar implementation problems experienced by these countries.

In this paper, we discuss organizational challenges that hinder implementation of secure remote electronic voting in Tanzania and propose workable solutions for each of the identified challenges. The paper complements a proposed secure electronic voting model to be used for future legally binding elections in Tanzania [10].

Our approach is holistic. We recommend the implementation of the model that considers both technical and non-technical security solutions. In this way, we provide a reasonable assurance of security of

electronic voting system that conforms to principles for democratic elections.

2. Related Work

Electoral systems face two challenges in delivering trustworthy elections. The systems need to deliver elections in accordance with the will of the voters and at the same time provide a reasonable assurance to the election stakeholders that elections reflect the will of the voters [1]. Electoral systems rely more on procedural controls than self-evident proofs of integrity and therefore for the election results to be trusted the entire electoral process must be trusted by election stakeholders [1]. Trust in remote electronic voting can be viewed in the context of general trust in public institutions. There is a relationship between trust in different public institutions such that people with a high level of trust in one institution also tend to trust the other institutions, while distrust in one is related to distrust in others [2]. Trust is a positive expectation regarding the behavior of somebody or something in a situation that entails risk to the trusting party [19]. As illustrated in Figure 1 trust is subjective and varies over time. For an individual to trust an entity, the trust level must be above the cooperation threshold while the noncooperation threshold marks the development of distrust [19].

Fig 1 below shows the variations of trust

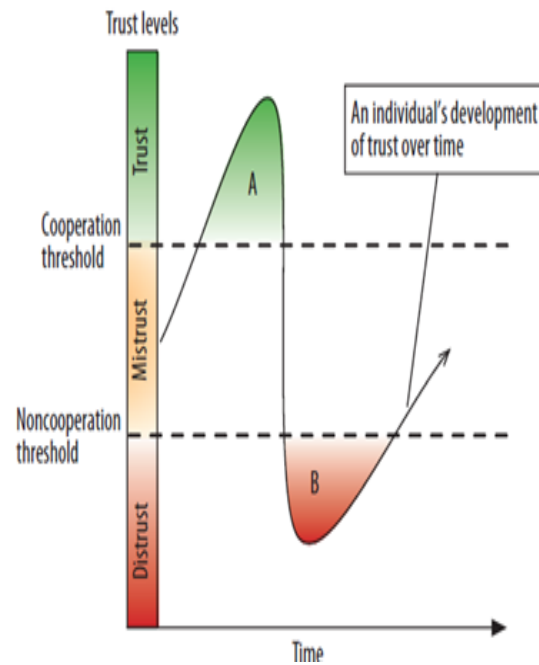


Fig 1: Trust is situational and varies over time. In area A, the individual trusts an entity enough to cooperate. In area B, the individual actively distrusts the entity and will take action against it, convinced that the entity will respond in turn. Between the cooperation and noncooperation thresholds is mistrust, in which the individual believes the entity's intent to deliver a certain service quality but is not certain of the entity's ability to do so, adopted from [19]

Thus a high level of trust in overall administration of election may have influence on the level of trust in remote electronic voting. On the other hand, citizens who exhibited disbelief in the freeness of administration of the election in general may pose a challenge when it comes to the adoption of remote electronic voting systems in any country [10]. Therefore, the reputation and legitimacy of election management authorities and the overall quality of election administration is a fundamental prerequisite for the successful implementation of electronic voting in respective countries. Developing electronic voting system that considers both technical and non-technical controls is a viable approach that can enhance trust in electronic voting. It is claimed that electronic voting will never be error-free and in practice, the risks are too large [17]. Thus there seems to be an emergent consensus that existing technology alone cannot sufficiently conform to the principles of computer security and provide the level of trust that is required [4]. Countries whose electronic voting systems have failed due to security reasons include Brazil, the United Kingdom and the United States of America. Information security management practices

applied when implementing electronic voting systems in these countries were reactive, mainly technologically driven and rarely aligned to core principles for democratic elections [9]. Susha and Kripp proposed a holistic model in an attempt to

address security and trust challenges associated with remote electronic voting [20]. The model is shown in Fig 2 below.

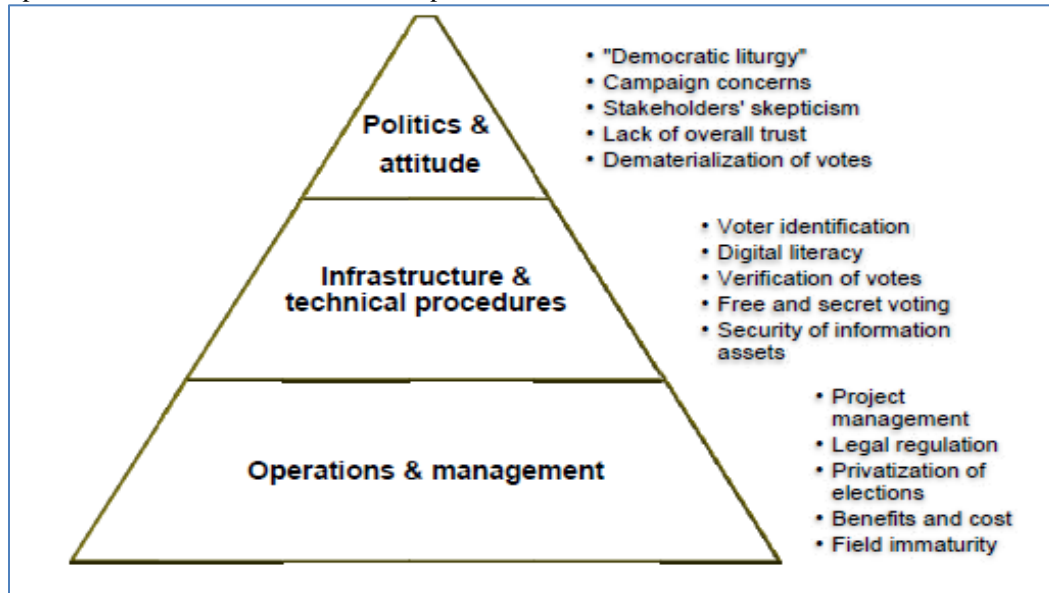


Fig 2: A classification model of challenges to the implementation of remote electronic voting, adopted from Susha and Kripp[20]

The model conveys the idea that the variety of challenges should be considered in a holistic way when implementing electronic voting technologies in legally binding political contexts. As shown in Fig 2, the challenges are classified into three layers as follows: (1) the upper level is the attitude of stakeholders towards remote electronic voting technologies and concerns about transformation effects it can have on democratic processes, (2) the middle layer combines the problems which occur with technical aspects of the remote electronic voting phenomenon, and (3) finally the base layer is the cluster of challenges encompassing practical constraints in the management of electronic voting projects.

In an ideal world, the aim of adopting a holistic approach to information security should be to achieve a state wherein security and usability are perfectly complemented, thereby reducing risks such as data breaches and fraud to an acceptable level [19]

Therefore this paper discusses organizational challenges that hinder implementation of a secure remote electronic voting system in Tanzania and propose workable and clear-cut solutions for each of the identified challenges. The paper is part of an ongoing research which aims at developing a holistic secure model that would facilitate the

implementation of secure and sustainable electronic voting via Internet and mobile phones in Tanzania [9][10]. Our approach is holistic. We recommend the implementation of the model that incorporates both technical and non-technical security solutions. In this way, we provide a reasonable assurance of security of electronic voting system that is trustworthy and conforms to principles for democratic elections.

3. Methodology

To maintain consistency and continuity of our previous research work settings [10], we had to use the same governmental organizations studied earlier.

3.1 Population and Sampling Method

Our sample was drawn from the governmental organizations. We only selected those organizations which have direct responsibility of managing electoral process and supporting role to facilitate elections in the country. These organizations are referred to as organizations A and B. The actual names of these organizations are not revealed in this paper due to confidentiality concerns. Organization A is an independent entity responsible for managing electoral process in the country whereas. Organization B is a government agency responsible

for overseeing the implementation and management of national identity system in the country. The total population was 342. The sample size was computed by the following formula [13]

$$n = \frac{Z^2 \times p \times q \times N}{e^2(N-1) + Z^2 \times p \times q} \dots\dots\dots (1)$$

where N = size of population, n = sample size, e = acceptable margin error (the precision = 0.05), Z= Z value at 95 percent confidence level (1.96), p = sample proportion, q = 1 – p; where q= 0.5.

The calculated sample size of the population was 181. Table 1 presents the estimated number of personnel in each of the selected organizations.

Table 1: Number of personnel in the selected organizations

Position	Organization A	Organization B	Total
ICT and ICT security personnel	16	18	34
Legal officers	5	3	8
Operations personnel	127	132	269
Upper management	10	31	41
Total workforce	158	184	342

3.2 Data Collection

Primary data was collected from (1) experts in the area of information security, (2) lawyers, and (3) election officials using self-administered questionnaires and interviews. We also reviewed the election act and constitution of the United Republic of Tanzania.

3.3 Reliability and Goodness of Fit Measurement

The reliability test was conducted by using Statistical Package for Social Sciences (SPSS) to analyze the internal consistence of the questions; the calculated Cronbach’s alpha was 0.96 and was most suitable. Furthermore, a Chi-square test was conducted to assess goodness of fit for all research questions. The results show statistical significance.

3.4 Data Processing and Analysis

The content analysis technique was used for processing and analyzing descriptive data. We also used SPSS and Microsoft Excel to analyze data and present the results.

4. Discussions and Results

4.1 Organizational Challenges

4.1.1 Lack of Policy, Legal and Institutional Framework for Remote electronic Voting

Elections through remote electronic channel require different procedures from manual voting system. The existing traditional procedures cannot be used under this new voting channel. According to the current Tanzanian legislation, remote electronic voting is not permitted. The National Elections Act Cap 343 (revised in 2010) and its provisions are based on traditional voting procedures by which the voters cast the votes using manual ballot system at polling stations. Lack of the necessary legal and regulatory framework can seriously affect implementation of remote electronic voting as amendment of the law is a lengthy process. If remote electronic voting is introduced as an option, the existing legal and regulatory framework should be amended. Until such amendments have been made, however, opportunity should be given to implement pilot projects regulated by an interim legislation.

4.1.2 Lack of Trust in Election Management Body

Trust in any electoral process is vital for a successful democracy. When there is mistrust among election stakeholders, the integrity of the overall electoral process is likely to be questioned. The freeness and fairness of elections, to a large extent, depend on the trust and confidence that different stakeholders especially political parties and voters have in the election management authority.

Since Tanzania reverted to multiparty political system in 1992, several players in the electoral processes, especially political parties and educated voters have been expressing their doubts and distrust regarding the capability of the national election commission (NEC) to manage elections as a neutral and an independent authority [8]. According to Article 74 of the Constitution of United Republic of Tanzania, executives of NEC shall be appointed by the President. There is no room for such an

appointment to be supported by a decision of parliament. This situation does not reflect good practice because it does not adequately provide a room for the NEC to discharge its duties and responsibilities in an independent manner. If these weaknesses are not well addressed, there is a high possibility that political parties and voters can reject the initiative of implementing remote electronic voting system in the country. Thus for the country to achieve a higher level of remote electronic voting, among other things, the NEC must focus on improving the election stakeholders relationships and trust.

4.1.3 Lack of Experienced Staff to Implement and Manage Remote Electronic Voting System

For remote electronic voting system to be sustainable and operate smoothly in the country, specialized ICT skills are paramount. The majority of the respondents (79 percent) were concerned that since electronic voting is a new technology in the country, these skills may not be available in adequate supply and at a reasonable cost in the local labor market. These skills may be required centrally as well as at the local level in order to deal with problems closer to election period when voting facilities have been distributed. If these skills are in short supply then the use of remote electronic voting technologies may be unsustainable. Apart from lack of technical expertise respondents were also concerned that the existing human resources would not be able to manage the implementation of electronic voting project due to the lack of project management skills. The task of managing remote electronic voting project is very complex as the implementation process is prone to many mistakes due to integration of several systems into a multi-aspect socio-technical process. Thus successful implementation of electronic voting project will require a high level of skilled staff. Currently the country has very few experts who are capable to manage multi-sectoral projects.

4.1.4 Lack of Independent System Testing and Certification Mechanism

The majority of respondents (84 percent) were concerned that, currently Tanzania lacks independent machinery and mechanism to test and certify its information systems. If remote electronic voting system is introduced it will definitely be developed and operate under the same uncontrolled environment. Voting is a critical component of any democratic process; and thus development of electronic voting system should follow best practices for critical system development. Electronic voting

application must first undergo a rigorous evaluation process done by an independent body prior to its use. This will eventually increase voters' confidence in the system.

4.1.5 Language Barrier

The majority of respondents (91 percent) were concerned that language barrier would be a hindrance to the adoption of remote electronic voting in Tanzania. Majority of Tanzanians speak Swahili as their common language while most of electronic voting applications in the market are written in English. If the country is to adopt electronic voting in the market, only few citizens with good English knowledge would be able to participate in electronic voting elections. Generally the ability to communicate in English is poor for the majority of Tanzanians. This finding is similar to [4] which suggests that the language is the biggest barrier in using the Internet due to the reason that almost 90 percent of the websites are in the English language, which is not understood by more than 75 percent of the world's populations. Therefore, the electronic voting system has to support at least two languages (Kiswahili and English) to enable majority of Tanzanians to exercise their voting rights.

4.1.6 Digital Divide Gap

Equality is a critical component in any democratic elections, where all the candidates are treated equally and all eligible voters have the right to vote. Digital divide is one of the main challenges for remote electronic voting as introduction of remote electronic voting is likely to create unequal opportunities for voters to cast their vote especially in those countries where there is a wide digital divide gap [20]. The World Summit on Information Society (WSIS) defines the digital divide as the unequal access to ICTs. The digital divide separates those who have access to ICTs resources and those who don't have. The respondents (74 percent) were concerned that, although the government of Tanzania is striving to bridge the digital divide gap, there is still a substantial digital inequality amongst local communities, economical dimensions being the main reason. The digital inequality exists mainly because of the financial differences between urban and rural communities.

5. Recommendations

5.1 Strategies to address the identified challenges

Based on the findings from this research, we recommend the following strategies to address the identified challenges.

- i. **Revisiting the existing legal and regulatory framework:** The implementation of remote electronic voting technologies should be supported by the existing legal and regulatory framework. According to the current Tanzanian legislation, remote electronic voting is not permitted. The National Elections Act Cap 343 (Revised in 2010) and its provisions are based on traditional voting procedures by which the voters insert a paper ballot in the ballot box at polling stations. Therefore for the country to be able to implement remote electronic voting successfully, the current legal and regulatory framework has to be amended. Amendments should, at a minimum, address the following: (1) technical and procedural aspects of remote electronic voting, (2) testing and certification, (3) audit mechanisms and conduct, (4) transparency mechanisms, (5) data security and retention, (6) voter identification; and (7) access to source code. The process of amending the current legal and regulatory framework, should involve electoral stakeholders, including political parties and civil society. Until such amendments have been made, however, opportunity should be given to run pilot projects regulated by provisional legislation.
- ii. **Reforming country's electoral system.** There is a need to reform the current electoral system to increase stakeholders trust in election authority. The National Election Commission (NEC) which is an election authority in the country need to be revamped in a way that can discharge its electoral duties and responsibilities in an independent manner. Among other things, efforts should be made to ensure the following: (i) appointments of executive members of NEC are done through a consultative process and not through sole prerogative of the president. The appointments of such members should undergo parliamentary scrutiny to ensure wider political support and (ii) the practice of using senior public servants in local government authorities as returning officers is discontinued. Returning officers should be under the full authority and control of the NEC.
- iii. **Enhancing capacity building in project management and technical aspects of electronic voting:-.** To sustain the management and implementation of remote electronic voting system, a clear plan for ICT human resource development need to be formulated and deployed. The country should not depend solely on outsourced service providers to implement and maintain its electronic election system to the extent that it surrenders its control to the private companies Both the management and technical expertise of the ICT staff would need to be scaled up to enhance the capacity for supporting electronic voting systems. Furthermore, the implementation of remote electronic voting system must be preceded by a holistic and integrated project management processes. There is a need to adopt at a national level, a globally accepted project management and ICT governance frameworks to support the implementation of this critical project. Therefore capacity building in project management and ICT governance is paramount.
- iv. **Establishing an independent certification and accreditation body:** Due to the criticality of the electronic voting system and in order to ensure voters' confidence in the system, we recommend that certification process be in place. The process should require for any technical component to be used in electronic voting system be tested and certified. To make this happen, an independent certification body should be established. The entity to be established should assess the system's operability and the system providers' compliance with appropriate security standards to be established and endorsed by appropriate authority. Moreover, any procedures to be followed by the system vendors should be subject to accreditation by accredited certification bodies. The national election commission should therefore only choose accredited providers whose technical solutions for remote electronic voting have been certified. Technical equipment and technical solutions should also be subject to the certification.
- v. **Implementing proper separation of duties in ICT processes:** To achieve a high level of security in remote electronic voting, we recommend that proper separation of duties be implemented. Involvement of multiple stakeholders at all stages of electronic elections and compartmentalization of roles ensures that the opportunities of tampering with an election are more difficult and more likely to be discovered. The possibility for such separation of duties to enable trust among citizens should depend on the selection of responsible parties to conduct those duties. Therefore the entities

amongst which duties are divided should be carefully selected. From the Tanzanian perspective, the government should distribute a number of key components of the proposed remote electronic voting among organizationally independent institutions. The responsibility of managing the entire system should not be left to the national election commission alone. Specifically, we propose that, public key infrastructure identities be issued, validated and maintained by private trusted agencies. Voter authentication portals may be administered by other governmental institutions other than the national election commission. However, Servers on which the various stages of counting and tally take place can be controlled by the national election commission under full supervision of representatives of participating political parties. The encryption key should be divided amongst political parties and a number of audit mechanisms should be established and conducted by different entities entirely independent of governmental institutions

- vi. **Implementing multi-language content to reduce digital divide gap:** For remote electronic voting system to be fully utilized by a majority of eligible voters, it has to support at least two languages (Kiswahili and English). This will in turn reduce a digital divide gap caused by language barrier.
- vii. **Source codes availability and accessibility:** Any system whose security depends on its design and implementation being secret is likely to be insecure. If a system's security is based on a secret design then security is compromised [19]. In other words, security cannot be assured through obscurity principle. Unfortunately, most of the electronic voting system in the market work on this principle .At best, they share limited details about their system designs and keep the source code closed [19]. This provides no way for election stakeholders (election administrators, observers, and candidates, voters) to verify that the software performs as the vendors claim. Unlike in other countries which have deployed electronic voting, the government of Tanzania should consider a possibility to make the source codes for the proposed remote electronic voting to be wholly owned by the government and fully available for public scrutiny to ensure transparency and increase trust in the system.
- viii. **Recommendations on standards for electronic voting:** On 30 September 2004, the Committee of Ministers to the European Council approved a standard on legal, operational and technical

standards for e-voting [3]. The recommendation is a legal instrument, which must be unanimously approved by the Member States, but which is not binding by international law. We recommend that the standard be customized and considered if the opportunity to vote electronically is introduced in Tanzania on a large scale basis.

5.2 Implementation Road Map

The implementation of remote electronic voting is a complex undertaking that should not be given a room for errors. The lessons learned from countries which have introduced electronic voting is that prior preparation and a systematic approach is required for successful implementation of the project. We recommend a phase-wise approach for the implementation of remote electronic voting in the country. The efforts should start with pilot projects. The pilot projects will increase voters' confidence in the voting operations and help to establish technical solutions that satisfy the fundamental security requirements. The pilot project should be done within a well-established project management framework. The proposed phases are described below [16].

5.2.1 Phase One – Project Initiation

To be successful, pilot projects should be managed using established project management framework. The project should start by first establishing a project organization with a mandate, project plan and a budget. The project team should start by first establishing requirement specifications for the electronic voting system. The requirement specifications should be prepared based on information security and electronic voting standards. During this phase, an interim legislation for the pilots should be prepared and establishment of a formal certification system for electronic voting solutions should be initiated.

5.2.2 Phase Two – Voting in a Controllable Environment

Once the prerequisite project management activities are implemented and electronic voting system is developed, the next step is to allow for electronic voting in controllable environments for binding as well for consultative elections. Under this environment voters will cast their votes via Internet or mobile phones under supervision of election officials just like the way it is done in a traditional voting environment. These experiments should focus

on testing user interfaces, performance capacity, user acceptance, and basic security aspects mainly focusing on authentication mechanisms. At this stage in choosing locations for the experiments, account should be taken of the right to a secret vote.

5.2.3 Phase Three – Voting in an Uncontrollable Environment using Controlled Terminal

In this phase, the focus should be on extending voting experiments from controlled to uncontrolled environments using controlled terminal. The experiments should be for binding elections. The main purpose is to test voting in uncontrolled environments in an environment in which the consequences of errors and voting fraud are limited. User acceptance and security are the main issues to be evaluated at this stage. Voting in uncontrolled environments will provide an opportunity to evaluate the consequences related to voters' coercion and vote buying and selling. The duration for conducting the test should depend solely on the experience gained from the second phase.

5.2.4 Phase Four – Voting in an Uncontrollable Environment from Individual Voters Platforms

This phase depend very much on successful completion of the first, second and third pilot phases. If pilots run successful in these phases, the final phase is to conduct binding elections based on voting in uncontrolled environment from the voters' individual platforms.(i.e.,mobile phones or computers)with restricted number of eligible voters. The main goal of this phase should be to systematically and comprehensively evaluate all aspects related to electronic voting including technical, legal, operations and economic aspects. In this stage a complete certification system should be established. Decision to conduct a wide scale binding election will solely rely on successful completion of this phase.[16]

6. Conclusion

This study identified organizational challenges that hinder the implementation of secure remote electronic voting in Tanzania. We also proposed workable solutions to address the identified challenges and a roadmap towards successful implementation of the remote electronic voting in the country. Data was collected using self-administered questionnaires and interviews. The data was collected

from (1) experts in the area of ICT and information security, (2) lawyers, and (3) election officials. We also reviewed the election act and constitution of the United Republic of Tanzania.

From a legal perspective, we see that the National Elections Act Cap 343 (Revised in 2010) and its provisions are based on traditional voting procedures by which the voters insert a paper ballot in the ballot box at polling stations. Therefore the current legal and regulatory framework has to be revisited to support remote electronic voting projects. Until such amendments have been made, however, opportunity should be given to run pilot projects regulated by interim legislations. Another area of concern is about the overall reputation of the national election commission in the eyes of the key election stakeholders including political parties and educated voters. From the results of this study we conclude that there is a high level of mistrust among election stakeholders which undermine the integrity of the overall electoral process. The reputation and legitimacy of any electoral management body and the overall quality of election administration is a fundamental prerequisite for the successful implementation of electronic voting in the country. Thus implementation of remote electronic voting is at stake if the situation will not be addressed. Therefore there is a need to revamp the current electoral system in a way that the electoral management body can discharge its electoral duties and responsibilities in an independent manner to increase the level of trust among election stakeholders.

Generally, we conclude that technical solutions alone cannot provide a level of assurance that is required for implementation of a trustworthy, secure, and sustainable remote electronic voting system. Non-technical solutions should as well be considered. Thus a holistic approach should be adopted. We believe that the implementation of the recommendations presented in this paper will pave the road to success in implementing remote electronic voting in legally binding political elections in the country.

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DrKisangiri Michael received his Ph.D. degree in Telecommunication Engineering (2008) and Master of Science in Telecommunication Engineering (2002), both from WrocławUniversity of Technology - Poland. Since then he has been working as academician with several universities. Currently he works with Nelson Mandela African Institution of Scienceand Technology located in Arusha, Tanzania.His research interests include evolutionary computation in Telecommunication Networks, Antenna design and Triangular mesh modeling.