A scheme of analysis for eVoting as a technological innovation system

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Abstract
This paper seeks to determine whether the introduction of technology in the electoral processes can be regarded as a technological innovation system. This is done by analysing and evaluating eVoting systems using data obtained from interviews and reviewing documentation relating to a multicase study of the Namibian and South African context. The study reveals that the adapted scheme of analysis proposed for technological innovation systems can be successfully applied to an eVoting system to obtain insights into the functions of the system, the electoral processes involved, and the process of introducing the innovation (techno-change process). From the analysis, it can be deduced that an eVoting system may be classified as technological innovation system as the researcher was able to analyse, identify, and link the 6 steps of the scheme of analysis to the electoral processes. This analytical process is expected to provide improved insights into the techno-change processes and the electoral processes and enhance adoption of the eVoting system. The findings not only explain how to improve the usability of the electoral system and its efficiency but also help in crafting policies and strategies that can counter the barriers of implementing and adoption of the technology.

KEYWORDS
eVoting, technological innovation system, techno-change, analytical scheme, multicase study

1  |  INTRODUCTION

1.1  |  The introduction of eVoting in Africa

Electoral management bodies (EMBs) are adopting strategies that embrace innovation to keep abreast with technological trends and improve their business processes. The general definition of innovation is "... the process of making changes, large and small, radical and incremental, to products, processes, and services that results in the introduction of something new for the organization that adds value to the customers and contributes to the knowledge store of the organization" (O'Sullivan & Dooley, 2008, p. 4). Innovation may involve manufacturing new or improved products or services or be the design of a new process (Leiponen, 2005; Lundvall, 2009). Either the customers or manufacturer can decide whether the product can be regarded as entirely new or as an improvement. For innovation to take place, there must be an identified problem or generation of new ideas in the product, process, or service. For example, the introduction of technology in the electoral process may involve manufacturing or improvement of products such as electronic voting machines (EVMs) but will inevitably also require process innovation improvement that may result in fast counting and tallying of votes.

Over centuries people who were racial discriminated against in Namibia and South Africa fought for their independence and for equal voting rights (http://www.sahistory.org.za/). This eventually led to wars of liberation and Namibia got its independence in 1989. That is when the first nondiscriminatory Namibian elections were held under the supervision of the United Nations. South Africa first held nonracial democratic elections in 1994, and since then, elections have been held every 5 years.* Historically, Namibia was once governed by South Africa, so these 2 countries share a culture and values to some extent. For both of these countries, holding exemplary elections is of supreme importance and

*The 1996 Constitution of South Africa’s founding principle is “Universal adult suffrage, a national common voter’s roll, regular elections and a multi-party system of democratic government.”
is closely associated with their struggles for universal emancipation. Hence, it is not surprising that, as part of improving their electoral processes, these two Southern African Development Community (SADC) countries have separately introduced technology in some of the electoral processes.

However, this process is not a simple one. Electoral management bodies in Africa have frequently been confronted with electoral challenges both when using manual and electronic voting systems. For example, Kenya (https://www.voanews.com/a/electric-voting-system-at-center-of-kenya-pre-election-fears/3672046.html) tried to implement eVoting technology during the 2013 Presidential elections without success. Given these challenges, some African EMBs are trying to find innovative but practical ways to improve the electoral processes. Examples where electoral processes using eVoting technology have largely been accepted and adopted exist outside Africa in the emerging economies of India, Brazil, and Estonia (Achieng & Ruhode, 2013, p. 2; Unt, Sovlak, & Vassil, 2017).

1.2 | Challenges in changing electoral processes

Despite successes in these identified cases, a possible reason for difficulties encountered elsewhere is that highly industrialised, Western countries are often seen as the pace setters of technological innovation systems while countries with emerging economies tend to be followers (Avgierou, 2008). These “developing” countries mostly import technology that does not suit their business needs well and do not manufacture entirely new technological products or services.

However, a second reason is insufficient attention being paid to the innovation development and implementation process or technocr change processes.1 When implementing newly imported eVoting technological systems, there is a need to ensure that there is adequate technological knowledge transfer between the countries exporting and importing the technologies. However, during technoc change attention also needs to be given to the organisational culture (Brown, Rose, & Gordon, 2016; Fearon et al., 2013) and national culture (Hassan & Mouakket, 2016). The assumption is often made that African countries do not give adequate time to evaluate the systems before the actual elections, that the training of the Electoral Management Board (EMB) staff is inadequate, and that these countries do not undertake intensive voter education programs. The basic technology does exist. However, the use of technology in sensitive and complex processes may be made particularly difficult if due attention is not paid to the local context and culture (Hall, 2012). This applies particularly in politically sensitive and complex electoral processes.

For an EMB to adopt technology, decision makers from both parliamentary structures and within the EMBs are the key drivers and game changers. Their decisions play an extremely important role in the purchase and successful implementation of an eVoting system. However, in many cases (not restricted to the actual voting process), transformational ideas by decision makers meet with resistance (Brown et al., 2016; Chatterjee & Pata, 2014; Kotter, 1995). Thus, it takes time and extensive communication to bring about technological change in this context. Some actors in the system may feel that the existing arrangement is serving them well; for example, voters and activists may be satisfied with a manual voting system if it is perceived to be producing a desirable result and, therefore, should the EMB propose introducing an eVoting system they may oppose the proposal. Hence, a third reason for failure is insufficient efforts to identify and resolve opposition or resistance to changes of electoral process.

It is claimed that very few organizations in Africa adopt clear strategies and policies focusing specifically on innovation systems as compared to developed countries (Aerni, Nichterlein, Rudgard, & Sonnino, 2015) (Aerni et al., 2015). This could be attributed to different cultures (Jauhiainen & Hooli, 2017). However, there are other African countries that are being innovative in technology implementation and adoption but are not aware of how to align their strategies or policies to well-established theories or business models (Siyanbola et al., 2016, p. 4).

1.3 | Problem statement

Bengt-Åke Lundvall and Joseph (2011, p. 1) poses two critical questions about innovation systems in developing countries “... is the innovation system a useful concept for understanding and explaining what goes on in a developing country? Can it be used as a tool and framework for agents and agencies in charge of designing public policy and business innovation strategy?”

This paper contributes to the discussion relating to these 2 questions. There have been changes internationally in the technological innovation process—both in the way the initial research is organized and the way the new technology is commercialized (Dasgupta, Sahay, & Gupta, 2009). The traditional linear approach where research and development, prototyping, manufacturing start-up, marketing, and distribution all occur in-house has given way to less vertically integrated structures that involve collaboration with other industry participants (Pisano & Teece, 2007). The successful commercialization of technological innovation is, to a large extent, determined by the utilization of complementary assets and knowledge, which might (or might not) be embodied in the firm’s own marketing, manufacturing, and after-sales support activities. The extent that the complementary assets are critical or are favourably positioned to compete with rival products decides the firm’s strategy with respect to the sourcing of those services (Basant, 1997; Basant & Chandra, 2002). Many innovation-based strategies are based on the unique application of an existing, integrated set of technologies rather than requiring a technological breakthrough (Berman & Hagan, 2013). Hence, an analysis of the networks and how the various components and stakeholders influence one another in terms of adoption is another aspect of the study that is important.

1Techno-change is explained by Markus (2004) as, “Using IT in ways that can trigger major organizational changes creates high-risk, potentially high-reward, situations that I call techno change (for technology-driven organizational change).”
Technology is evolving at a very fast pace, yet most EMBs in Africa are not using it fully (Ahmada, Abdullahb, & Arshadc, 2015; Gibson et al., 2016). However, some EMBs (Brazil, India, and Estonia) are acknowledging trends within their environments by embracing technology in all the electoral processes under their control to enhance the credibility of elections (Achieng & Ruhode, 2013, p. 2; Unt et al., 2017). As current environments generally have high usage of technological products such as mobile phones, banking, and the Internet, EMBs are encouraged to be proactive in technology implementation to counter some of the challenges (frauds, spoilt papers, and credibility) in manual voting systems (Aljarrah, Elrehail, & Aababneh, 2016; Gibson et al., 2016) and low voter turnout (Crothers, 2015). Confirming that elections are free and fair has been a goal of independent election observers for many years. At least reducing grounds for disputing election results is important as election results that cannot be clearly shown to be accurate have resulted in violence in Africa.

1.4 | eVoting as a technological innovation system

Technological innovation systems have been applied in fields like the biomedical and chemical industries, but little research has been performed in innovation relating to the Information System (IS) field especially in Africa (Iizuka, 2013). This paper is motivated by studies that were performed by Jauhiainen and Hooli (2017), which highlight the importance of incorporating indigenous knowledge in innovation systems for Namibia and another from http://unpan1.un.org/intradoc/groups/public/documents/CPSI/UNPAN027810.pdf, which refers to South Africa and emphasises the importance of knowledge development in South Africa.

1.5 | Objectives of the research and of this paper

This paper seeks to determine whether the introduction of technology in the electoral processes can be regarded as a technological innovation system. This is done by analysing and evaluating the eVoting system using data obtained from interviews and reviewing documentation relating to a multiple-case study of Namibian and South African situation (the full research project). However, the paper does not adhere to the objectives of the full project or describe the case studies and findings in detail. This has the limitation that the validity of those findings has to be accepted at face value since no quotations from the interviews or source documents are included. As a result, this paper may be considered to be conceptual rather than empirical. Namibia and South Africa are used as examples to develop a better understanding of eVoting system as a technological innovation system, and the authors’ conclusions and claims are not supported explicitly by data. The next section is a literature review, followed by methodology. This is followed by the central (or most critical) section labelled Analysis of Findings, which is an extensive section where the analytical scheme is applied to the findings and includes or is combined with the discussion. This section culminates in recommendations regarding policy but these are not explored in depth as this is considered to be beyond the scope of this paper. The final section presents conclusions.

2 | LITERATURE REVIEW

This section discusses concepts related to technological innovation systems and how to analyse an organisation’s use of these systems.

2.1 | A theory of technological innovation systems

Many governments in the SADC region are exploring ways to improve processes, services, and products by the use of technology, and this may require system innovation. The concept of the innovation system stresses that the flow of technology and information among people, enterprises, and institutions is key to an innovative process (Lundvall, 1985). It requires interactions between the actors to turn an idea into a process, product, or service on the market. System innovation can have major implications for policy development and is mission oriented (Soete, Verspagen, & Weel, 2010). System innovation allows changes to occur in processes or services where improvement will otherwise never be likely to happen or where there is a costly delay in implementing change. A conceptual framework of systems of innovation proposed by Edquist (2001) as a way to investigate innovation and technological change explicitly acknowledges the emergent properties and the nonlinear nature of the innovation process. Systems innovations can be classified as national, regional, and technological innovation systems. National innovation systems are performed at country level (like in South Africa) and a regional example is the SADC level.

Carlsson and Jacobsson (1991, p. 2) defines a technological innovation system as a “network of agents interacting in a specific technology under a particular institutional infrastructure and involved in generation, diffusion and utilizing of technology.”

Bergek, Jacobsson, et al. (2008) describes a technological innovation system as innovation that pertains to products, services, and production processes that are related to basic activities. The expected results of technological innovations systems are an improvement of or a new product, process development activities, and market development or service improvement activities.

According to Van De Ven (1986) and Hung (2004), innovation or the newness of an idea can relate to both technological innovation (new technologies, products, and services) and administrative innovations (new procedures, policies, and organizational forms). Innovations such as mobile phones, computers, EVMs, and data communication equipment are completely technology based; however, innovations of new products, processes, or services in elections (voter registration or internet voting) can be facilitated by technology. Hence, when technological innovation occurs, there is no clear division between it and process innovation; they each influence the other.
Technological innovation systems theories are concerned with the identification of regularities and patterns in the full innovation development and implementation process to clarify the conditions under which new technologies develop quickly and become a success or fail (Markard, Hekkert, & Jacobsson, 2015). Hence, it is proposed that technological innovation systems theory can be used to provide useful insights in the systematic analysis and evaluation of eVoting systems.

From the technological innovation system theory point of view, innovation is viewed as a competition between a new technology and established technologies and possibly further emerging technologies (Markard & Worch, 2009). For example, if there is an existing technology in the electoral process, new technology can still be developed that would compete with the existing technology.

As noted earlier, conceptually, technological innovation systems can be viewed as a set of networks of actors and institutions that interact and contribute to the development of a novel technology (Carlsson & Jacobsson, 1991; Markard & Truffer, 2008). Technological innovation systems involve collaboration and networking, which enhances trust, capabilities, and cooperation across functions, products, and divisions. Since technological innovation systems are initiated by the interaction of networks of stakeholders and institutions, for innovation to take place, it is important to combine the knowledge of the key actors (stakeholders) (Planko et al., 2017). In the case of eVoting, this involves the knowledge of active participants in research and development, government, political players, and the EMB as well as knowledge about the needs of the users.

Technological innovation may involve many companies, some supplying the materials or partially developed products. Rarely do you find an organisation completely manufacturing everything from the component level up to the final product. Complementary innovations are usually required before a particular technology is suitable for commercial application (Van de Ven, Angle, & Poole, 2000). For example, to successfully transmit election results in an eVoting system, the improvement of data communication services are required. In other words, the service providers of data communication services need to provide complementary and support services by improving or introducing technologies, which guarantee proficient and reliable transmission of results. Adoption may be influenced by the rate of innovation. If the rate of adoption is high, then the level of innovation is also assumed to be high (Borkovich, 2015).

2.2 Narayanan stages of technological innovation system development and implementation

Technological innovation systems development and implementation consists of 4 broad stages of problem recognition, namely, idea generation, technology selection, detailed solution development, and implementation (Narayanan, 2007). The idea generation involves the creative process which an organisation embarks on to identify and solve the challenges being faced (Berg & Nylokken, 2013). An example is an EMB solving electoral challenges. The technology selection involves choosing and assessing the appropriate technology and its limitations when used in the business processes (Cresswell, Bates, & Sheikh, 2013) (for example, appropriate technology for the electoral processes). Successful implementation of innovative technology involves technical, social, organisational, and wider consultations. Technical factors are related to the usability of the technology, accessibility to the users, system performance, the cost of the technology, and compliance with standards or regulations. The social considerations involve the expectations and attitude (for example, voters’ resistance to the technology, training and support, and the integration of the innovative system with the legislation). During solution development, decision makers should choose the alternative, which might not necessarily be technology, which is best able to solve the business challenges. Organisational aspects involve managing change internally and externally, planning, communication, learning, and evaluation. Wider consultations entails consultations with other organisations, eg, other EMBs, industry, universities, research and development institutions, the economic environment, and international bodies and organisations.

The next section will discuss the 7 functions of technological innovation systems, which allows policymakers to analyse and evaluate technological changes (product, process, or service) in an organisation (Hekkert et al., 2007). Although this is an alternate view, it is not incompatible with that of Narayanan (2007) given above.

2.3 Seven technological innovation system functions (Hekkert et al., 2007)

The 7 technological innovation system functions suggested by Hekkert et al. (2007) are entrepreneurial experimentation, knowledge development, knowledge exchange, guidance of the search, resource mobilisation, market formation, and support from advocacy coalition (column 1, Table 1).

2.4 Schemes of analysis

Various proposals have been made regarding how to analyse and evaluate a technological innovation system. Hekkert et al. (2007), Bergek et al. (2008), Markard and Truffer (2008), and Jacobsson and Jacobsson (2014) propose different analysis and evaluation methods. Two proposals from Hekkert et al. (2007) and Bergek et al., (2008) are summarised in Table 2 and will be discussed and the latter adopted in this paper.

A scheme of analysis proposed by Bergek et al. (2008) and Hekkert et al. (2007) of an innovation system is depicted in Table 2. As shown from Table 2, the scheme of analysis for the innovation system takes into account that it has many system functions like entrepreneur activities, generating knowledge, development and diffusion of new technology and products, guidance of the search, market formation, resource mobilisation, and creating legitimacy. Bergek et al. (2008) expanded the seventh function to include the development of positive externalities that entails the analysis of the political power, resolution of uncertainties and information flow. It is important to note that the indicators given by both Hekkert et al. (2007)

Note that the sequence of the functions has been changed in Table 1 from those listed above to make it easier to relate it to the functions used in Table 2.
TABLE 1  Analysis of the technological innovation systems functions (Hekkert et al., 2007)

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
<th>Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrepreneurial experimentation</td>
<td>Risk of implementing the new technology should be evaluated by bringing in new insights and scientific results to the market.</td>
<td>• Prototyping or pilot testing</td>
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<tr>
<td></td>
<td></td>
<td>• Practical experiments and demonstration projects</td>
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<td></td>
<td></td>
<td>• Stakeholders adopting or moving towards new technology</td>
</tr>
<tr>
<td>Knowledge development</td>
<td>Knowledge development and diffusion gathers and shares new insights and technological discovery and is one of the key functions to achieve the overall goal of the system.</td>
<td>• Initiating a research program or relevant technologies at universities and other public research institutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Undertaking basic R&amp;D</td>
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<td></td>
<td></td>
<td>• Cooperation between an institution or organisation and public research to develop new knowledge</td>
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<tr>
<td></td>
<td></td>
<td>• Organization of (international) gatherings to exchange ideas and present new developments</td>
</tr>
<tr>
<td>Knowledge exchange (diffusion)</td>
<td>Knowledge exchange within networks.</td>
<td>• Establishing knowledge transfer between science and industry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Build knowledge sharing between users and industry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Institute knowledge sharing with the International community</td>
</tr>
<tr>
<td>Guidance of the search</td>
<td>Guidance of the search influences the rate and direction of research. Innovation is one of the key functions to achieve the overall goal of the TIS.</td>
<td>• Setting collective goals for resource efficiency in the region</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Sharing expectations by determining stakeholders such as government, activists, large corporates, media, and political parties</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The formulation of a vision on the future by stakeholders</td>
</tr>
<tr>
<td>Resource mobilisation</td>
<td>Resource mobilization is needed to enable and fund other functions and is therefore one of the main enablers of the system.</td>
<td>• Investigating the availability of funding from government, donors, loans</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Matchmaking to bring together funds and innovative ideas</td>
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<tr>
<td></td>
<td></td>
<td>• Setting up public private partnerships or collaborative funding</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Identifying related laws, standards, and regulations</td>
</tr>
<tr>
<td>Market formation</td>
<td>Market formation creates a demand for the technology that is developed within the system.</td>
<td>• Public procurement to stimulate market formation</td>
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<tr>
<td></td>
<td></td>
<td>• Changing impeding regulations or institutional set-ups</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Setting up market standards</td>
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<tr>
<td>Support from advocacy coalition</td>
<td>There should be a clear strategy or policy to counter resistance to the new technology by the stakeholders.</td>
<td>• Identifying activists, media and nongovernmental organisations advocating for new technology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Political pressure to implement the technology</td>
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<tr>
<td></td>
<td></td>
<td>• Creating advocacy coalitions to drive the technology</td>
</tr>
</tbody>
</table>

TABLE 2  Indicators for measuring performance at the level of subfunctions of an innovation system

<table>
<thead>
<tr>
<th>Functions</th>
<th>Hekkert et al. (2007)</th>
<th>Bergek et al. (2008)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrepreneurial activities (Hekkert et al.); Entrepreneurial experimentation (Bergek et al.)</td>
<td>Number of new entrants; Number of diversification activities of incumbents; Number of experiments</td>
<td>Number of new entrants and diversifying established firms; Number of different types of applications; breadth of technologies used</td>
</tr>
<tr>
<td>Knowledge development</td>
<td>R&amp;D projects; patents; R&amp;D investments</td>
<td>Bibliometrics, number, size and orientation of R&amp;D projects; patents; learning curves</td>
</tr>
<tr>
<td>Knowledge diffusion</td>
<td>Number of workshops; conferences; network size and intensity</td>
<td>Facilitate information and knowledge exchange</td>
</tr>
<tr>
<td>Guidance of the search</td>
<td>Targets set by government; Number of press articles that raise expectations</td>
<td>Identify problems, Belief in growth potential; incentives from taxes (factor prices); regulatory pressure; expression of interest of leading customers</td>
</tr>
<tr>
<td>Resource mobilization</td>
<td>Whether or not inner core actors perceive resource access as problematic</td>
<td>Volume of capital and venture capital; volume and quality of human resources; complementary assets</td>
</tr>
<tr>
<td>Market formation</td>
<td>Number of niche markets; specific tax regimes; environmental standards</td>
<td>Market size; customer groups; actor strategies; role of standards; purchasing processes; lead users</td>
</tr>
<tr>
<td>Creation of legitimacy</td>
<td>Rise and growth of interest groups and their lobby actions</td>
<td>Alignment with current legislation; standard; visions and expectations; depiction in newspapers Political power; resolution of uncertainties; pooled labour market; specialised intermediaries; information flows; counteract resistance to change</td>
</tr>
</tbody>
</table>

and Bergek et al. (2008) shown in Table 2 are quantitative. The analysis of eVoting as an innovation system performed in this paper is based on qualitative data and hence diverges in that respect from the Bergek scheme of analysis.

Bergek et al. (2008) further illustrate how to analyse the innovation system as shown in Figure 1 by developing a 6-stage model. The first stage helps to identify the technology in focus. Step 2 distinguishes the interactions between stakeholders that may either promote the innovation or impede its progress. The functions described in step 3 correspond with the functions of Hekkert et al. (2007) (see Table 1) although the naming differs slightly. Steps 3 to 6 are a form of functional analysis. However, the 6 stages in the model are not linear as there will be a number of iterations between the technology and process analysis. This paper will apply the 6-stage model as suggested by Bergek et al. (2008), as it helps to
analyse large transitions involving the growth and decline of several technologies that can be integrated or standalone and which are associated with the electoral process.

Technological innovation system functional analysis allows the processes in the technology to be understood and mapped. The process approach, discussed in Section 2.5, can be used to map processes.

### 2.5 Process approach

The 6 stages\(^6\) (Figure 1) of Bergek et al. (2008) is an example of a process approach. The process approach conceptualises development and change processes as a sequence of events and explains outcomes as the result of this order of events (Hekkert et al., 2007). It encompasses (a) continuous and discontinuous causation, (b) critical incidents, (c) context, and (d) effects of formative patterns. Hence, the process approach presents a story line of how any 1 of the 7 functions (3a in Figure 1 and column 1 in Table 1) influences technology development at the same time as all the other functions. As a result, the process approach creates a great deal of insight into the underlying mechanisms that determine technological change over time.

The basis of the process approach is the event. Events (see column 3 in Table 1) are what the central subjects do or what happens to them. For example, in a manual electoral process, after publishing results (event) irregularities may be discovered that occurred earlier in the counting of ballots (event), thus prompting a disputed election. In the quest to solve the dispute (event), technology may be selected as a solution.

Hence, Table 1 is an allocation scheme, which assigns the events of the electoral processes to the 7 functions of the technological innovation system (in this case, eVoting). This allows the researcher to check the validity of the events. Hekkert et al. (2007) argue that when many events are difficult to allocate to any one of the functions, it is a clear indication that the list of events is not complete or is all together senseless. In addition, when only a very small number of events relate to one specific function, this function might not be relevant to understand the technological change being studied.

Events can either positively or negatively contribute to the functioning of the innovation system. For example, in a country where ballots are cast and counted manually, issues of spoilt papers or vote rigging may be of concern and this would negatively impact on the whole electoral process although other stages in that process, like transmission and publishing of results, might be using technology positively. Therefore, events are categorised as being either positive or negative but may change during different phases of the project. For example, knowledge development events (function 4 in Table 1) are positive when research projects start, for example, finding appropriate innovative technology to solve a problem, but the knowledge requirement for the research and development personnel might change when new tasks of improving the technology are implemented. Furthermore, events that are categorised as the search (function 1 in Table 1) may be positive or negative depending on whether they express a positive or negative opinion regarding the technology.

\(^6\)Not to be confused with the 7 functions.
3 | METHODOLOGY

This paper uses already interpreted data from a multiple-case study based on grounded research and involving two SADC countries, Namibia and South Africa. As this multiple-case study (the “full” research project) uses grounded theory, a new theory or a fit to existing theory is expected to emerge while the data are analysed. This paper does not look at the first level of analysis, which studies the raw data (quoting from the interviews or the documents). Instead, the already completed initial interpretations of the data are related to an existing theoretical framework (the scheme of analysis). Hence, this is a second iteration using the “coded” or interpreted data and fitting it to a theoretical model. In looking for a theory that fits with the data collected, a process was undertaken to understand the applicability of the technological innovation system in the eVoting system.

The choice of the two countries is based on the historical background as at one time South Africa annexed Namibia. Hence, there is a probability that similar knowledge and culture could be high.

Although the raw data are not used in this paper, the collection process is described here as the validity of the second level of analysis depends on the validity of the raw data. The raw data were collected by interviewing 11 decision makers and reviewing documentation. Documentation (historical data) gave the researcher an opportunity to collect information on the events that took place before, during, and after the implementation of the new technology. This documented information was collected from newspaper archives, professional journals, and reports. A historical database was constructed in which all relevant events (such as workshops on the technology, the start of research and development projects, expectations about the technology expressed in the press, and announcements of resources available) related to a specific trajectory were mapped. The empirical data collected during the full research project are not given in this paper, but instead, it is presented in detail in the tables as it was interpreted by the researcher and is intended primarily to illustrate the validity of this analytical scheme for this example of technology innovation.

As noted in Section 2.4, the analysis of eVoting as an innovation system performed in this paper is based on qualitative data and hence diverges in that respect from the Bergek et al. (2008) scheme.

4 | ANALYSIS OF FINDINGS

The 6 stages proposed by Bergek et al. (2008) (see Figure 1 and Section 2.4), based on the 7 functions of a technological innovation system, is used as a scheme of analysis of an innovation system. The 6-stage model is used systematically to analyse and evaluate the complete research and development, resource mobilisation, knowledge development and sharing, legitimisation, and diffusion process relating to an eVoting system as discussed below. This analysis is an application of the theory of the scheme of analysis of an innovation system as discussed in Sections 2.3, 2.4, and 2.5. Sections 4.1 to 4.7 correspond with the 6 stages given in Figure 1 (there are 2 separate sections for stage 5, Section 4.5 describes the barriers, and Section 4.6 describes inducements).

4.1 | Defining technology in focus

This corresponds with the first stage given in Figure 1. During the discussion with the EMB decision makers in both Namibia and South Africa, they revealed the technology in focus as an eVoting system, which is used in the registration and identification of voters, ballot casting, counting, transmission, and publication of the electoral process. The technology involves the following processes: registration (pre-election) and identification of voters, ballot casting and counting, result transmission, and announcement (election), this is also supported by Okediran, Omidiora, Olabiyisi, Ganiyu, and Alo (2011, p. 135). The eVoting system has the following advantages over the manual system: allows for more efficient and effective voter registration, which enables more eligible voters to vote, fast counting and transmission of results, no spoilt ballots and cost-effective as it may be reused in subsequent elections.

Table 3 shows the electoral processes that use the eVoting system and that still apply the manual system as revealed during interviews and documentation. Namibia is implementing an eVoting system for registration and voter identification using a biometric system while South Africa uses a barcoded system. In Namibia, voters cast their ballots electronically and votes are counted electronically whereas South Africa uses a manual system for both of these activities. In the case of disputes, currently Namibia can use the EVMS to verify the results while South Africa will count and recount votes manually. Hence, both countries implement parts of the eVoting system at various stages but are still to achieve an end-to-end of technology.6

4.2 | Identification of the structural components of the technological innovation system

This corresponds with the second stage given in Figure 1.

The interviews and historical information gathered from Namibia and South Africa identify the potential actors (including both local and external actors) in an eVoting system (Table 4).

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6Namibia's electronic voting machines do not have a provision of a voter verified paper audit trail (VVPAT), and the law clearly stipulates that until such a provision is availed (VVPAT) on the EVMs that when it will be enforced.
From the discussions and documentation, the institutional outcomes, which were regarded as very important in the electoral process, are the international laws, constitution, electoral act, regulations and standards. The social units (the citizens of Namibian and South African) also played a major role as their values, norms, and beliefs were highlighted as influential in the implementation of technology. The decision makers further illustrated how actors, institutions, and society influence the implementation and adoption of an eVoting system as depicted in Figure 2.

Hence, Figure 2 shows that institutions (included as actors) play a crucial role in an eVoting system as they set the rules and regulations (institutional outcomes). The Actors influence the implementation and adoption of the innovative service. The social culture, values, norms, and beliefs have a major impact on the functions shown in the next stage of the scheme of analysis (Figure 2) especially on knowledge development and diffusion, market formation, and legitimization.

Networks involve actors and are identified as either internal or external. Internal networks may include decision makers, research and development personnel or committees tasked with the search and identification of innovative technology. The external network may include other EMBs, industry, and other research institutions. The actors may interact through conferences, workshops, or other collaborative networks at local, national, or international level to discuss innovative technologies. The interactions between actors is influenced by the institutions and cultural values and beliefs, which may either impede or promote (that is, influence) the use of an eVoting system. For example, the media might publish negative information about the lack of a voter verified paper audit trail (VVPAT) on the EVM (influenced by beliefs within society), and this can also refer to the legislation (one of the institutional outcomes) on what it says about VVPAT. Hence, as noted by Edquist (2001), the structural components of the eVoting technological innovation system participate in a nonlinear process and have emergent properties. Emerging properties of the technological innovation system are the expectations of the stakeholders when using the eVoting system, such as security, transparency, trust, privacy, verifiability, and accessibility.

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6Namibia's electronic voting machines do not have a provision of a voter verified paper audit trail (VVPAT), and the law clearly stipulates that until such a provision is availed (VVPAT) on the EVMs that when it will be enforced.
4.3 Functions of an eVoting system

This corresponds to stage 3 given in Figure 1. Table 5 highlights the system functions and indicators to achieve a credible end-to-end eVoting system. In the entrepreneurial experimentation function, it was observed that third-world countries typically do not manufacture their own technology except for South Africa. Countries like Namibia rely heavily on imported technology. Experimentation in Namibia is done through by-elections. The limited capacity for manufacturing eVoting systems in Africa forces EMBs to purchase systems, which might not be a perfect fit to their own context.

It was discovered that decision makers in both countries are developing the knowledge of their staff by sending them to local or international institutions. Knowledge is also being shared through conferences, workshops, suppliers and developers exhibitions, and collaborative networks, but the major obstacle in the knowledge development and sharing is that companies that manufacturer eVoting systems have patented their products and some are not willing to share the source code of the technology.

### TABLE 5 System functions and indicators to achieve a credible system

<table>
<thead>
<tr>
<th>Functions</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrepreneurial experimentation</td>
<td>To achieve success and credibility of using innovative technology, the EMBs of Namibia and South Africa are experimenting in by‐elections on the use of innovative technologies so as to achieve an end‐to‐end eVoting system.</td>
</tr>
<tr>
<td>Knowledge development</td>
<td>The EMBs are involved in Research and development activities to develop staff’s capability using local or international institutions. Namibia attached some of its staff to an Indian company that supplied them with the EVMs. While South Africa visited Brazil, India, and Venezuela for feasibility studies.</td>
</tr>
<tr>
<td>Knowledge diffusion</td>
<td>Knowledge is being shared through workshops, conferences and collaborative networks.</td>
</tr>
<tr>
<td>Guidance of the search</td>
<td>It was observed that there was a need to continue influencing the expectations of the stakeholders and there were no agreed standards on the implementation of an eVoting system which makes it difficult to benchmark against any system. Hence, the need of technological innovation in both countries. South Africa has its own vision for 2018 the objective being to increase innovation and use cutting‐edge technology.</td>
</tr>
<tr>
<td>Resource mobilisation</td>
<td>Funding for elections in SADC countries is usually done by the government, but private companies or donor communities may also assist. The governments of Namibia and South Africa fund elections, including the purchase of technology, though resources are limited. The available infrastructure may limit the technology that can be deployed (for example Internet voting requires internet services to be available in all parts of the country).</td>
</tr>
<tr>
<td>Market formation</td>
<td>Namibia used EVMs during by‐elections, by carrying out voter education. The same machines were later used by the whole nation during the 2014 Presidential and National Assembly elections and the 2015 regional and local council elections. South Africa has managed to use the Barcoded voter registration and identification machines for the past two general elections.</td>
</tr>
<tr>
<td>Legitimation</td>
<td>The electoral laws and regulations are always reviewed to comply with the requirements of innovative technologies in both countries. The two countries have also adopted an innovative culture where the EMBs are making relentless efforts to educate interest groups about new technologies.</td>
</tr>
</tbody>
</table>
### TABLE 6  Assessment of how well the functions have been achieved

<table>
<thead>
<tr>
<th>Functions</th>
<th>Measure</th>
<th>Namibia</th>
<th>South Africa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrepreneurial activities and experimentation</td>
<td>Identification of Actors present in the election industry</td>
<td>The most relevant actors are: decision makers, government, activists, voters, political parties, media, law makers, researchers, developers, observers, monitors, industry, donors, funders, regional bodies (SADC, African Union), international bodies (United Nations, Commonwealth Organizations) and service providers’ representatives. The involvement and presence of these actors necessitated the initiation of the technological innovation system by setting up a committee. Product identification was carried out in various countries including Brazil and India. The actors mentioned above have led to the successful implementation of Biometric Voter Registration System and the Electronic Voting Machines for ballot casting and counting. Pilot studies which were part of experimentation was carried out on the EVMs during the by-election enabled the production and implementation of the system on a wider scale. Also to note is the VVPAT which is still under experimentation in India will be used with the EVMs. Namibia is still to implement an end-to-end eVoting system.</td>
<td>The main actors in the implementation of the eVoting system are: decision makers, government, political parties, voters, activists, media personnel, observers, monitors, law makers, researchers, developers, regional bodies (SADC, African Union), international bodies (United Nations, Commonwealth Organizations), service providers’ representatives. Some of the actors like the researchers, developers and industry were involved in the research and identification of the requisite technology. These actors have led to the successful implementation of the Barcoded Voter Registration System, Encrypted Results Transmission, and Geographical Information System for results publication. The Biometric Voter Registration system is still under experimentation. The use of EVMs in ballot casting and counting is still under Research and Development.</td>
</tr>
</tbody>
</table>

Knowledge development Number of patents and publications (from structural analysis) | The eVoting system was imported from and patented in India. Decision makers visited India for a feasibility study and saw how the EVMs were manufactured and quality tested. Other staff members were sent to India for knowledge development where the process of manufacturing the EVMs were clearly explained including demonstrations of the functionality of the machines. After the demonstrations, the decision makers were convinced that the EVMs would work in Namibia after some of the local personnel had been trained by Indian experts. The Biometric Voter Registration system was imported from South Africa and used during the November 2014 Presidential and National Assembly elections. | South Africa developed and patented its own Barcoded Machine to register and identify voters. The country has the expertise and knowledge to design and develop its own systems. Various workshops and conferences are continuously conducted with the key stakeholders (voters, operators, media, activists, observers, monitors and academics) to enlighten them on the idea and intended use of the new technology. The EMB also involves the South African Bureau of Standards in the environmental and quality testing of the desired technology. |

Knowledge diffusion Type of networks | Technological experts are local and from India. The Indian experts assisted the Namibian EMB during elections and they continue sharing knowledge with their counterparts so that the EVMs can easily be used correctly. The NEC trained voters and operators in various workshops, advertise both in print and electronic. Activists and the media were also actively involved in the publicity of the eVoting system. Also the EMB conducted rigorous awareness campaigns and training of users to allay their fears on the use of the eVoting system. | South Africa relies on its local expertise. There is a good working relationship on technological exchange of information between the industry, research institutions, other EMBs. The EMB works in harmony with the industry and the South African Bureau of Standards to design and develop systems that meet the South African environmental conditions. Not only has South Africa relied on internal expertise but it has also visited countries (Brazil, India and Venezuela) to share knowledge on the implementation of the eVoting system. |

Guidance of the search Regulations, visions, government’s and key actors’ expectations | Electoral challenges led the EMB to improve the election processes. An eVoting system was considered to be the best option and a system that closely resembled the current manual ballot system was chosen to improve its acceptability by voters. A new law allowing the use of an eVoting system was passed in October 2014. All the stakeholders expected the new system to enhance the electoral processing by fast counting and collation of results, fewer spoilt ballots and greater credibility. | The South African Constitution, electoral laws and regulations currently meet the requirements of the technology used in the electoral processes in place. The stakeholders are satisfied with the status quo as evidenced from the observers and monitors election reports. Although the EMB is still pursuing the objective of having an end-to-end eVoting system in all its electoral processes this is being done at a very slow pace. |
The guidance of the search was motivated by the decision makers’ willingness to continue improving the expectations of their stakeholders (voters, political parties, government, and activists). For example, South Africa’s Vision 2018 is to increase innovation and use cutting-edge technology in the electoral process.

Resource mobilisation is limited due to funding in both countries, which also affect the infrastructure development.

### 4.4 Assessment of how well the functions have been achieved

This corresponds with the fourth stage given in Figure 1. Table 6# reflects data that were collected from interviews, observers and monitors reports, and Namibian and South African reports. The first column lists the 7 functions of the technological innovation system, the second identifies what should be measured in each of the functions (derived from Bergek et al., 2008), the third and fourth are the countries that were studied. The findings also revealed that some of the contents of the data collected overlap into other functions e.g. knowledge development and diffusion.

Although Table 6 highlights some challenges in the implementation of an end-to-end technology in the electoral process for both Namibia and South Africa, it can be seen that efforts are being made to address these issues through initiatives by stakeholders (government, EMBs, political parties, and other players).

---

# Table 6 (Continued)

<table>
<thead>
<tr>
<th>Functions</th>
<th>Measure</th>
<th>Namibia</th>
<th>South Africa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource mobilisation</td>
<td>Financial resources (investments, venture capital)</td>
<td>Namibia used only government funds to procure the eVoting system and all the resources for the eVoting system. The eVoting machines estimated cost is N$ 30 000 000.00 (USD 2 295 300.00). The major challenge facing Namibia is the infrastructure (rail, road, air and sea) as some areas are inaccessible during election periods. This makes the transmission of results very difficult. Efforts are being made through government, public private partnerships and donor communities to address these issues.</td>
<td>All major resources used by the EMB are acquired from government funding although the EMB got private funding for electronic results display units. South Africa still has infra-structural challenges - some areas are inaccessible due to geographic limitations but this is being addressed. The barcode registration and identification system has been widely accepted. A feasibility study is being carried out re adding to the eVoting system for casting ballots and vote counting.</td>
</tr>
<tr>
<td>Market formation</td>
<td>Projects installed (site allocation) and constructed</td>
<td>Pilot testing was accomplished during bye-elections to assess the functionality, environmental adaptability and acceptability of the technology. EMB reports revealed that about 3500 eVoting machines (EVMs) were used for ballot casting and counting of votes in fixed polling stations and mobile units. The use of mobile units enhanced the accessibility of the eVoting system to the voting populace. From the reports it was also discovered that areas with geographic limitations were reached by air and boats. The EVMs and the BVR system have been used successfully on a massive scale during the 2014 Presidential and National Assembly Elections and 2015 Regional and Local Council Elections.</td>
<td>The Barcoded system was used during bye-elections prior to the general national elections. The registered voter population of South Africa based on the 2014 estimate for the National and Provincial election was 25 300 000. The EMB uses the barcode system nationally as the front end of the electoral process. The EMB also use the encryption and geographic information system (GIS) successfully during transmission and publication of results.</td>
</tr>
<tr>
<td>Creation of legitimacy</td>
<td>Formation of coalition and advocacy</td>
<td>The Namibian population embraced the eVoting system despite some resistance that had been reported by the media and some political parties citing the challenges that had been faced in Germany and Ireland. From the Namibian reports there were no court challenges regarding the results from the eVoting machines, thus have produced a credible result. Namibia crafted a law that was used with the EVMs and the BVR system during the 2014 Presidential and National Assembly elections.</td>
<td>Electoral laws and regulations have been crafted to comply with the innovative technologies in use. For example, South Africa has incorporated the use of the barcoded voter registration and identification system in its legislation. The country has set up its own environmental standards for technologies.</td>
</tr>
</tbody>
</table>

The guidance of the search was motivated by the decision makers’ willingness to continue improving the expectations of their stakeholders (voters, political parties, government, and activists). For example, South Africa’s Vision 2018 is to increase innovation and use cutting edge technology in the electoral process.

Resource mobilisation is limited due to funding in both countries, which also affect the infrastructure development.

---

# The EVMs were used at large scale during the 2017 Presidential and National Assembly.
net connectivity and other communication services thus affecting the transmission of results and accessibility during elections.

mission of results from polling stations. Some areas in South Africa and Namibia are not fully developed in terms of infrastructure especially Inter-

results before publication.

Africa/kenya

2017 Presidential Elections where the server storing results was alleged to have been hacked (https://www.nytimes.com/2017/09/20/world/

the transparency on the EVMs source code, and privacy and confidentiality of the system.

continuous experimentation.

also that there are no agreed international standards on the eVoting system; hence, each country has its own limited standards. This advocates for

countries as there are some areas that have limited communication services such as the Internet and accessibility by road or rail. The other barrier is

of casting and counting of ballots due to the credibility of the existing system. Financial resources and limited infrastructure are also affecting both

Financial resources and limited infrastructure do not want to share the source code, because of patents, making it difficult for both Namibia and South Africa to access the required knowledge to

In Namibia, the EVMS do not have a voter verification paper audit trail (VVPAT)\(^1\) to verify ballots cast by printing votes cast into a ballot box. Currently, research and development on the VVPAT is taking place in India from where the Namibian EVMS were imported. In South Africa, the casting and counting of the ballot paper are done manually. Hence, the process of verifying the votes cast can also only be done manually.

From the interviews, the decision makers highlighted the blocking mechanisms that are affecting the implementation of technology (Table 6). These include limited number of suppliers and developers of the eVoting system, the dependence on external suppliers and developers for customization and additional development of the system, which might lead to an EMB getting "tied into" contracts, thus the supplier becoming too powerful. Knowledge development and diffusion is also limited in both countries due to patented products. Companies who sell eVoting systems often do not want to share the source code, because of patents, making it difficult for both Namibia and South Africa to access the required knowledge to develop the eVoting system further or to customize it to the context.

Security is becoming a major threat to both countries and the world over after the alleged hacking of the United States of America November 7, 2016, Presidential elections by the Russians (https://www.nytimes.com/news-event/russian-election-hacking) and the disputed Kenyan August 2017 Presidential Elections where the server storing results was alleged to have been hacked (https://www.nytimes.com/2017/09/20/world/africa/kenya-court-election.html). Because of these security threats, most EMBs are skeptical to implement end-to-end eVoting systems.

The findings reveal that the barriers are the same in both countries (Namibia and South Africa) except regarding the guidance of the search where Namibia is affected by bureaucratic purchasing procedures and currently South Africa has no political pressure to change the manual process of casting and counting of ballots due to the credibility of the existing system. Financial resources and limited infrastructure are also affecting both countries as there are some areas that have limited communication services such as the Internet and accessibility by road or rail. The other barrier is also that there are no agreed international standards on the eVoting system; hence, each country has its own limited standards. This advocates for continuous experimentation.

Legitimising the whole electoral process using technology in both countries is still being impeded by resistance from the media and activists, the transparency on the EVMs source code, and privacy and confidentiality of the system.

Table 7 summarizes the inducements that are being adopted by both countries to implement technology in the manual processes.

\(^1\)The VVPAT allows votes cast electronically to be immediately printed and also be inserted into a ballot box for future manual validation if the need arises.
**Table 8** Inducements mechanisms to counter blocking mechanisms

<table>
<thead>
<tr>
<th>Functions</th>
<th>Key Activities</th>
<th>Actors</th>
<th>Inducement Mechanisms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Entrepreneurial activities</strong></td>
<td>Identification of Actors and Institutions</td>
<td>Government, EMB, judiciary, political parties, voters, observers and monitors, media, activists, constitution, electoral act. Regulations and standards</td>
<td>Collaboration and interactions among the actors, networks and institutions for the initiation of experimentation on the use of innovative technologies in the remaining manual processes of the electoral process for both countries.</td>
</tr>
<tr>
<td><strong>Knowledge development: to acquire (locally and internationally) technical knowledge about eVoting in the remaining areas of the electoral processes</strong></td>
<td>Research &amp; development</td>
<td>EMB, universities, research institutes, private organizations, Advanced users, government ministries, scouting EMB (decision makers), industry, government ministries</td>
<td>Namibian and South African EMBs set up committees to search for new technology (innovation), locally and abroad that could be implemented in the manual processes of the electoral process.</td>
</tr>
<tr>
<td></td>
<td>Technology development &amp; demonstration</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Technology identification manufacturing/importation &amp; adaptation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Technology benchmarking Knowledge sharing</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Knowledge diffusion: nurturing skills for innovation for internal knowledge development or hiring experts to facilitate innovation</strong></td>
<td>Educating the workforce with relevant scientific and business skills Attracting and retaining highly qualified people from other countries.</td>
<td>EMB higher tertiary education private companies private public partnerships</td>
<td>Most of the technical staff have worked for their EMBs for at least ten years and their skills are continuously being developed both academically and technically to meet the current challenges by attending workshops, conferences, collaborative activities to share knowledge internally and externally.</td>
</tr>
<tr>
<td><strong>Guidance of the search</strong></td>
<td>Meeting the expectations of Stakeholders</td>
<td>EMB, industry, research and development institutions, standards organizations</td>
<td>Both countries have set up committees to carry out feasibility studies on new technologies. Both countries want to continuously improve on the expectations (credibility) of their stakeholders (voters, political parties and so on). In its vision for 2018 South Africa envisage strategic objectives that increase innovation and leveraging on cutting edge technology (IEC, n.d.)</td>
</tr>
<tr>
<td><strong>Market formation: to promote the use eVoting in the electoral processes and counter resistance</strong></td>
<td>Identifying &amp; addressing conflicting policies and regulations</td>
<td>EMB, government ministries NGOs/ voters, media, activists, political parties</td>
<td>Namibia and South Africa are conducting pilot studies on the new technologies before implementing on a wider scale. The voter education and training department carries out publicity and training on the use of technology to influence mass acceptance.</td>
</tr>
<tr>
<td></td>
<td>Identifying &amp; assessing public demand for innovation</td>
<td>EMB, parliamentarians, judiciary, political parties</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Quality testing technology performance</td>
<td>EMB, research and development institutions (universities, industry, independents)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diffusion of information on technology advantages</td>
<td>EMB and standards organisations</td>
<td></td>
</tr>
<tr>
<td><strong>Resource mobilisation: to source funds for the implementation of technology in the electoral processes</strong></td>
<td>Providing funding for research &amp; technology development and demonstrations through collaboration, grants, donors or other funding Providing financing to support the growth of innovative firms or adoption of innovative technologies into existing firms. Improvement of the infrastructure</td>
<td>Government ministries Private companies Donor community NGO’s</td>
<td>It was discovered that the Government is the major funder of elections including the technology used, although sometimes a few companies and other donor organisations offer some equipment to the EMBs. In Namibia experts came from India as part of the technical human resources of the EMB. Resources are still being mobilised to meet the infrastructure development such as communication, road and rail services in both countries.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>(Continues)</td>
</tr>
</tbody>
</table>
4.6 Development of inducements that may overcome blocking mechanisms (barriers)

This section also corresponds with the fifth stage given in Figure 1. The inducements are ways of encouraging the institutions to overcome the barriers or blocking mechanisms that will be affecting the systems functions of the technological innovation system.

Both Namibia and South Africa are introducing initiatives to develop knowledge within their EMB using internal and external skills (see Table 8). Research and development activities are taking place in other manual processes to introduce technology in the whole electoral process for both countries.

The government is the major funder of elections in both countries, and with the demand for resources in other areas such as infrastructure, it is very difficult to implement new technologies, such as Internet voting, which demand robust and reliable infrastructure. Funding policies that allow
other donors to assist the government are being developed. For successful implementation and adoption of technology and legitimisation, the legal framework should regulate the use of such systems.

The next section will discuss recommended policies that may be put in place by decision makers to counter the barriers that may be affecting the implementation of an end-to-end eVoting system.

4.7 | Set policies that will drive or block the desired functional pattern

This is the sixth and last stage of the scheme of analysis. The 7 functions (see Tables 1 and 2), the barriers (see Table 7), and measures already being put in place to address the barriers (Table 8) have already been discussed. The main objective of the decision makers is to implement a credible eVoting system that may increase voter participation (turnout), adoption by the institutional stakeholders and improve the credibility and quality of user experience (Brown et al., 2016; Fearon et al., 2013; Hassan & Mouakket, 2016) of the electoral process. This section includes policies and strategies used to implement those policies as depicted in Figure 3.

Decision makers have the task of developing policies that facilitate, regulate, and hopefully ultimately implement the implementation of an eVoting system. These may include allowing “public private partnerships” so that the EMB can partner with private companies in the joint development of eVoting systems while still safe guarding the integrity of the EMB, the electoral process and the eVoting system.

“Research development and collaboration policies” will allow EMBs to join hands with universities, research institutions, industry, and other EMBs in the design, development, monitoring, and evaluation of eVoting systems.

“Innovation policies” should not only guide but also encourage the processes associated with adopting new technology such as their development, implementation, and adoption in the electoral processes and must take into account the expectations of all the stakeholders. To achieve the degree of technological innovation and local focus required (that is, to meet local conditions and requirements), adequate funding should be found. Hence, there is a need to have “funding strategies” that will promote the innovation to take place. However separate innovation strategies such as those included in a governmental ICT policy are also required.

The “infrastructure” in the local environment such as roads, railway, and sea might be limited in terms of accessibility especially in third world countries forcing voters to travel long distances to vote or failure to have communication services hence a need to improve on such. The culture in terms of values, norms and belief play a crucial role in the implementation and adoption of new technology a thorough voter education program needs to be put in place to educate the citizens about the benefits of such a system. These all need funding and hence are covered by the "financial and infrastructure development policy."

eVoting is still only being used in a few countries, and there are no agreed international standards to use as a benchmark—hence, a country may set up its own "national standards," including "environmental standards and quality standards" to satisfy the stakeholders.

A “change management strategy” should be developed during which accuracy, robustness, accessibility, and security can be credibly demonstrated to build the trust that underlies acceptance of change. Hence, these demonstrations are part of change management. As part of the change management policy should allow transparency, accessibility, and verifiability of the code. For change management to be successful the local environment, context and culture should be carefully considered to communicate effectively and address local values, expectations and social patterns (Brown et al., 2016; Fearon et al., 2013; Hassan & Mouakket, 2016). Clearly an eVoting system should also comply with legislation and other “regulatory frameworks.” The change management policy should incorporate but not be limited to publicity, education and training programs for the eVoting system.

5 | CONCLUSION

It was observed that the Namibian and South African eVoting systems can be analysed in-depth using the scheme of analysis suggested by Bergek et al. (2008), and it is proposed that this supports the claim that eVoting is a technological innovation system. These two Southern African countries are seen as being at the forefront in Africa in using information and communication technology in their quest to improve the electoral processes. Namibia was the first country in Africa to harness technology for ballot casting and counting and this can be seen as technological innovation. This view is supported by Hung (2004, p. 4) who states that the technological innovation system scheme of analysis can be used for different technologies, either in a broad sense or for specific technologies. In this case, eVoting systems may be classified as encompassing both broad and specific technologies where the broader technology can be data communication services (internet voting) and the specific technology is EVMs used at mobile or fixed polling stations.

In this paper, we assess full eVoting systems in two countries, which include voter registration, voter identification, ballot casting and counting, transmission, and publication of results. It could be argued, however, that limiting the discussion to only one technology used in a subset of the electoral processes, for example, ballot casting and counting using EVMs, would suffice. Comparing the eVoting system of the two SADCs countries, Namibia and South Africa, has value as this enables the decision makers concerned to fully understand the strength and weakness of the system in each country. Bergek et al. (2008) point out that researchers and policymakers involved with a particular technological innovation system ought to perform analyses of similar system being developed elsewhere or of systems in related areas to make informed decisions.
The paper makes recommendations for practical improvements in the implementation of eVoting. As explained in Section 4.7, an entirely new set of beliefs and processes in crafting policies and strategies is needed to promote the implementation of new technologies. Also, new research and development policies need to be formulated that explicitly allow experimentation, environmental monitoring, performance evaluation, and continuous improvement. The importance of innovation should be stressed in these policies. A systematic analysis and evaluation of the entire development and implementation process relating to a new eVoting system will assist in improving the techno-change processes, the electoral processes and enhancing the adoption of the system.

Application of the scheme of analysis helped the researchers to identify the system failures or weaknesses and to express them in functional terms. The main advantage of using the scheme is that it focuses on what has been achieved in terms of the use of technology in the electoral processes, rather than on the structure of the system (the goodness of which is difficult to evaluate without referring in a systematic way to the processes).

It was discovered that functional analysis and process mapping can assist in the successful implementation of the eVoting system as it identifies the gaps and barriers affecting the implementation of technology. The functional perspective permits systematic mapping of determinants of innovation and increases the analytical power of the innovation system approach especially when doing longitudinal analysis. Each function influences the others and hence iterating between functions can help to refine the setting of goals or development of policies to achieve the desired functional pattern. By applying the scheme of analysis, decision makers in the EMB can compare performance between innovation systems with different institutional set-ups. The advantage of the scheme of analysis perspective is that an EMB will be able to set up a clear strategies and policies to achieve objectives and to identify the instruments that can be used to attain the desired objectives.

It can be concluded that both countries that were studied are applying a technological innovation system in the eVoting system but this occurs only at some stages of the electoral process. From the findings, there is no African country that has achieved an end-to-end technological innovation on the use of an eVoting system. It is interesting to note that the barriers that are affecting the implementation of technology such as infrastructure (communication, rail, roads and air) are common to both governments studied.

It is also interesting to note that the scheme of analysis as suggested by Bergek et al. (2008) incorporates the 4 stages of technological innovation system development and implementation by Narayanan (2007).

The scope of this paper is necessarily restricted, and it cannot address all matters of interest arising from the multiple-case study on which it is based. The paper focuses specifically on the analytical process with a narrative description of the findings (which are presented, including those relating to policy, intended simply to provide a real-life scenario). In other words, a full discussion of the barriers to full implementation of eVoting in Namibia and South Africa and the policies needed to overcome these is beyond the scope of the paper. A subsequent paper will be devoted to the blocking mechanisms (barriers) and associated policy issues.

REFERENCES


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