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THE DECISION TO ADOPT ELECTRONIC VOTING IN SOUTH AFRICA[1]

Colin Thakur, an expert researcher for the Independent Electoral Commission (IEC) of South Africa, ruminated on the recommendation he would make to that committee. The IEC had commissioned him to undertake a neutral comprehensive international study of e-voting implementations and experimentation. His goal was then to advise whether South Africa was in a position to adopt e-voting.

Democracy, introduced in South Africa in 1994, continued as a much-cherished concept. The current electoral paper-based system was resource intensive. The size of the country made election administration a logistically non-trivial process. With the pervasiveness of new digital technology amongst the populace, an increasingly pressing question had arisen: why was this technology not integrated in the electoral process? To this end, the IEC constantly proactively assessed and evaluated new and emerging technologies such as electronic voting (defined as the electronic capture and tally of the vote).

E-voting allowed for fast, unemotional and accurate tallying of the votes. In addition, e-voting systems were easily configurable to cater for multi-lingual as well as multi-abled interfaces. With respect to E-voting, with respect to paper consumption, personnel, or time during the vote-capturing component of the electoral cycle, was not as resource intensive. With respect to paper consumption, personnel, or time utilized during the vote-capturing component of the electoral cycle, e-voting was not as resource intensive. Lastly, e-voting easily catered for multiple elections and the technology could also be used in referendums, shareholder meetings, university, and club elections with short commissioning and decommissioning times. These factors extended the scope of the attractiveness of the e-voting system.

However, e-voting had its own drawbacks, which include a very high initial cost, both for setup and voter education. This high cost generated resistance in the face of competing priorities such as social welfare and education. There was the ever-present threat of malware or hidden code that could manipulate the vote. There was a perceived lack of transparency in vote counting that often manifested itself in lack of voter trust in e-voting.

The decision to make a recommendation to the IEC that Thakur faced was at two-levels. While at one level the decision was to adopt e-voting was purely political, the decision at the second level was pertaining to which e-voting technology had to be adopted. Whereas the political decision would require Parliament to make a legislative change, the technology based decision would require experimentation and a contextual South African analysis. Thakur pondered on what to recommend and how best to present his recommendations.

Voting in South Africa

Oostveen (2007) studied e-voting in Europe and concluded that context really mattered in the implementation of voting. The challenge with traditional elections in the South Africa was the enormous size of the country. South Africa is the 25th largest country in the world by geographical size with over 1.2 million square kilometers (Media Club South Africa, 2015). This made election logistics costly and complicated. Although SA was the largest economy in Africa, the country remained constrained by its enormous unemployment problem, officially listed at 25% (Census, 2011). This made election administration challenging because the cost of conducting any elections would have involved technological change as well as building additional infrastructure that was required to compete with many other urgent government spending priorities in areas such as health, education, and economic development.

Electoral Management Board

The Electoral Management Board (EMB), the organization responsible for elections, was formally known as the Electoral Commission (IEC) of South Africa. The IEC was established by the Constitution of South Africa. Although the IEC received public funding and was accountable to parliament, they were independent of government. The commission was also mandated with the non-trivial roles of compilation and maintenance a roll of eligible voters and of declaring the election results (What we do, 2016). The difficulty the IEC faced was the number of informal settlements with no fixed address where South African as well as foreign nationals co-existed. Despite such difficulties, the IEC had succeeded in maintaining a trusted reputation amongst the voting populace with respect to managing free and fair elections at every level of government.

Additional duties of this commission that were specified by the legislature included: the provision of a register of parties, creation and maintenance of a reliable up-to-date Voter's Roll, promotion and commissioning of research into electoral issues, review of electoral laws and development of recommendations, encouragement of voter education, and cultivation and support of electoral expertise and technology throughout the government (What we do, 2016).

Challenges of Diversity, Youth and Differently-Abled Voters

South Africa was a culturally diverse country with fifteen official languages and significantly high illiteracy rate (Cook, 2013). This cultural and linguistic diversity, along with a large number of candidates, rendered suitable paper ballot design and distribution problematic, thus enhancing the case for e-voting.

As with any type of elections, there were a number of differently-abled and locational-bound voters to whom elections were compelled to cater for. In this context, developing ballots suitable for these voters without compromising electoral principles was a non-trivial task (Alvarez and Hall, 2003). The EMB attempted to reach locational-bound voters using various methods with varying degrees of success and coverage rates. Voters in this category included military and other conscripts in remote places, diplomats, overseas workers, miners and geographically bound mission critical personal (Registration for voters abroad, 2016).

Furthermore, young people were increasingly avoiding participating in elections. E-voting offered the promise of increased youth involvement and turnout in elections (Pammett and Goodman, 2013). Paradoxically, the omission of technology in elections generated distrust among this group who found paper to be a foreign concept (Edelmann, Krimmer, and Parycek, 2008). As Richard Allen asserted, "For

a democracy to command respect it must operate in the same way as people do everything else in their lives (Prachett and Wingfield, 2002:175)". e-Voting fitted into this mode of thinking.

Electoral Violence and Trust

Compounding, even complicating, the problem of elections in South Africa was the new and emerging threat of elections-related violence. Although South Africa had not suffered election-related violence on the scale reported in other countries, the threat of violence and intimidation of voters was present and ominously growing. In the municipal elections of 2016, several voters were afraid of being seen outside their homes to vote with the assumption that their neighbours would monitor their movements and then retaliate against their perceived voting intentions (Powell, 2016).

The trust of the voters in the electoral process was unfortunately tested at the Constitutional Court (News24, 2016), which ruled that the IEC had 18 months to fix unlawful defects on the voters' roll. Constitutional Court Chief Justice Mogoeng Mogoeng, in a measured judgement, asserted that the Electoral Commission's failure to record all available voters' addresses on the national common voters' roll "is inconsistent with the rule of law and the Constitution" and is "invalid." This inconsistency related to the street addresses of voters that were either incorrect or incomplete. Despite this judgement, the court pragmatically ruled that the August 3 2016 local government elections should (and did) go ahead (News24, 2016).

e-Voting

e-Voting is defined as the use of Information and Communication Technology (ICT) to enable the casting of votes by voters and the tallying of these votes during elections. Two different types of e-voting were defined: controlled and uncontrolled e-voting. Voting in a controlled environment occurred in a secure area, which was set up by the EMB, and equipped with voting devices with a clearly defined voting process flow. Alternatively, in an uncontrolled environment, the voter cast their vote in their locality, such as their home or workplace. Uncontrolled environment voting included Internet voting, where voters cast their vote through accessing a designated website via the Internet or cast their vote with a Smartphone application (m-voting) (Krimmer, 2007). Figures 1-3 in Exhibit 1 show pictures of different forms of voting devices used in an uncontrolled environment.

In Brazil, the urna (a portable e-voting machine) was designed to reduce the time and cost of vote counting. With a functional illiteracy rate of 23% of voters, previous voting requirements that voters write down their names and follow written instructions resulted in a great number of blank and error-prone votes being cast. With the urna, the use of technology to guide the voter using candidate photographs as visual aids and the use of error messages to guide voters during the voting process, the number of blank and error-filled ballots was substantially reduced. The Brazilian voting process is complex with multiple ballot papers given to voters for different elections at the same time, and the introduction of an electronic system led to a significant reduction in voter confusion (Fujiwara, 2015). In 2004, the cost of these urnas was US $420 (Wired Staff, 2004). Therefore, the high cost of these machines, along with issues of configuring individual machines off-site for complex elections, made their personal off-site use impractical; instead, these machines were found at pre-allocated ballot sites.

In India, the electronic voting devices, known as EVMs, have been noted for their reliability, simple design, and ease of use. However, they have been subject to criticism due to widespread reports of election irregularities. Much of the machine's design has been kept secret and the machine, with its

software, has never been subjected to a rigorous, independent security evaluation. A security analysis on these machines Wolchok (2010) has concluded that these machines are vulnerable to serious attacks with the potential of violating ballot secrecy and changing election results. The cost of one Indian EVM, at the time of purchase in 1989-90, was Rs 5 500. The initial cost was quickly offset by savings in ballot paper transportation, storage and distribution; not to mention labour savings in vote tallying (Election Committee for India, 2018)

A smartphone internet voting option has the off-site advantages of convenience and of enabling house-bound voters to vote. Other advantages include familiarity, availability, low cost, ease-of-use, easy configurability (as it is done on the administrative side and accessed by the devices), and authentication of the voter by a secure biometric. The use of proposed open-source architecture and software removes the secrecy of the voting process and enables independent security audits, unlike in India. The use of existing technology, which most voters already own, makes it much cheaper than the specialized urnas of Brazil (Thakur, 2016c)

Paper vs. Electronic Configurable Ballot

The paper ballot was initially called the Australian Ballot due to Australia's introduction of the pro-forma or pre-printed ballot paper. Shamos (2004) unambiguously asserted that every form of paper ballot that has ever been devised can and has been manipulated with considerable ease. Among other things, paper was prone to:

- ballot-box stuffing (to add more ballots to the box to support a candidate at the end);
- ballot substitution (to replace genuine ballots with pre-filled ballots); and
- ballot tampering (to subtly modify ballots in a manner inconsistent with the voter's intent).

In democracy, it remained crucial that all participants—particularly the losers of an election—accepted the results. It is therefore telling that there was - to the authors knowledge - no evidence of a court judgment where political participants in an election proved hacking or willful manipulations of e-voting systems to achieve a result (Thakur, 2016c). There had been machine failures but none that were deemed by a court of law to be through nefarious collusion. This was a significant finding as it was the losers of elections who were most likely to accept results and cry foul. The 2016 USA Presidential election faced a recount in at least one state, Michigan through a court challenge. Significantly, the loser Mrs. Clinton did not join the suit, signifying that she accepted the results (Egan and Baldas, 2016).

The use of technology unwittingly created the perception of outsourcing democracy especially where the key developer of the technology was from foreign shores. Thakur speculated this may result in a negative impact of reducing national pride, a key tenant of democracy, and has thus offered in mediation a suggestion that international e-voting vendors use a local partner to gain local expertise and to insource democracy. The use of a local partner may, in turn, introduce further electoral innovations (Thakur and Boateng, 2011).

Trust and Hacking

Given that technology was evolving at such a phenomenal rate, it was necessary to establish an independent focus group that would monitor e-voting and that would provide contextual knowledge to evaluate various options available to the country. The focus group could be virtual and meet at certain points during the electoral process to contextually examine current practices, investigate challenges and opportunities, and provide recommendations.

In developing a recommendation, Thakur wished to leverage the high degree of trust in the IEC as an Electoral Management Board in South Africa to provide legitimacy to the e-voting adoption. However, with respect to e-voting, the IEC faced a classic chicken and egg conundrum. It could not make a decision on any technology that it favoured because it would require a legislative change to allow it to experiment with technology. Yet by its own self-directed mandate and vision, the IEC wanted "to be a pre-eminent leader in electoral democracy." Achieving that vision would demand knowledge and awareness of e-voting.

Studies of e-voting in different countries highlighted the need for countries that adopted e-voting to have a voting populace with inherent trust in the e-voting process and systems. Experience had shown that successful e-voting implementation occurred after the deployment of a series of transparent, phased trials of e-voting (Alvarez, 2009). A further important contribution of pilots was the unravelling of challenges, as they arose. Some of the challenges were either new or existing. The Nigerian example of the deployment of smartcard readers, during the 2015, election to speed voter authentication revealed the lack of local field testing. Some of the card readers did not function adequately due to poor handling by ad hoc staff, inadequate training and insufficient number of technical staff. Furthermore, the level of awareness in the use of card readers among the voters was not sufficient. Technical staff were not present in all the wards or Registration Areas to attend to problems because they were not sufficient in number. The card readers proved to be more than 50% successful in fifteen states during the 2015 elections. The failure of the smart card reader was a result of social and environmental factors.

Although there was always the possibility of hacking any type of e-voting machine (including m-voting), there was no evidence of a hack that materially influenced an election by the addition or deletion of votes or halting of the electoral process. The security practice of limiting access to e-voting technologies in order to reduce the chance of outsiders gaining the in-depth of knowledge of the voting architecture in order to develop a hack had not been proven to improve security (Moynihan, 2004). Australia's practice of opening up its voting architecture and code to the public has been demonstrated to improve security as members of the public were given the opportunity to examine the code or architecture for vulnerabilities and offer the electoral board the opportunity to resolve these vulnerabilities (Chowdhury, 2013). Furthermore, the practice of restricted access had the consequence of both obfuscating the voting and tallying process, thereby reducing voters' acceptance and trust of the election results.

Challenges associated with e-Voting

The introduction of e-voting systems added an enormous initial capital cost. The saving from the recurring massive reduction in ballot production costs, the reduced need for new ballot papers and lower logistics costs would, over time, mediate this cost and, ultimately, provide savings. This had been experienced in Brazil and India. Brazil calls her e-voting machines urnas. On the other hand, e-voting machines required secure storage between elections, although the space requirements had been declining over time. Additionally, the machines could potentially be used or leased for non-political functionalities (Thakur and Boateng, 2011).

Given its legislative directive to develop and promote electoral expertise throughout government, it would be logical for the IEC to have had the power to investigate technological methods of voting such as e-voting, and promote the use of such methods should they be deemed feasible. Furthermore, because the Commission was tasked with voter education, it was responsible for ensuring that the electorate was familiar with new voting technologies that would have been introduced. Another challenge associated with e-voting was the requirement that Parliament concur and adjust the Constitution Law—specifically

the Electoral Act 73 of 1998 (Electoral Act, 2009)—to allow the IEC to pilot, trial and implement e-voting. In particular, the revision would need to allow the IEC, as the custodian of the Act, to further refine and implement contextual requirements that were relevant to SA.

The classic paradigm of ICT systems was to reconcile the sometimes conflicting and sometimes cooperating critical success factors of inter alia confidentiality, integrity, and availability (Neumann, 1993). On an e-voting system, the integrity of the voting system was preserved if the voter declared their identity on the voting ballot. Unfortunately, doing so potentially compromised voter secrecy, representing a threat to confidentiality. ICT also had external dependencies when it comes to availability. These included soft and technical skills, power grid connectivity, system and availability of software engineers.

Such external dependencies accentuated the challenges of e-voting when applied to a large geographical country, such as South Africa. Many areas, like India, also had remote rural areas that lacked ICT infrastructure and suffered rolling electricity blackouts. The cost of establishing suitable ICT infrastructure to hold a machine-based (e-voting or Internet) voting election throughout such a large geographic area was cost-prohibitive. Such an obstacle was presented by the lack of blanket Internet coverage in South Africa. These costs were mitigated by piggybacking on existing infrastructure, such as the use of m-voting. India overcame grid challenges through the development of 1.4m electronic voting machines (EVMs) that ran on 3 AAA batteries. Despite such efforts, India still took 4 weeks to complete the elections due to its humongous 1.1 billion population size.

Challenges of Traditional Paper-Based Voting

Throughout the time of the case, paper-based elections in South Africa had largely been uneventful and even uncontroversial. For a paper ballot election, the ballots had to be reasonably copy-proof; securely produced and stored; securely transported; and securely deployed on election days, with the attendant reverse-logistic to all of its 22 000 voting districts. Further new ballot papers had to be freshly produced for each and every election. During the 2016 local elections, the country experienced a momentary knife-edge incident when some boxes of ballot papers were found ‘unsecured’ at the Eastern Province Counting Centre. The fact that a hung election result was pending made this discovery ominous. Fortunately, electoral sanity prevailed and the abnormality was explained to the satisfaction of all adversaries (Sobuwa and Mgmitama-Diko, 2016).

PESTLE Analysis of E-Voting

In order to analyse the political (P), economic (E), social (S), technological (T), legal (L), and environmental (E) contextual strengths and weaknesses of a proposed solutions, a PESTLE analysis (Zalengera, 2014) was performed on e-voting in South Africa, shown in Exhibit 2.

According to the PESTLE analysis, e-voting, particularly m-voting, offered more advantages. In countries such as the Philippines, e-voting had been demonstrated to reduce election-related violence (Thakur, 2014). The reduction in violence in the Philippines was increasingly having a direct relevance to South Africa where the municipal elections of 2016 created tense atmospheres where voter intimidation was rife (Powell, 2016). In such a tense environment, poll-station voting, whether electronic or otherwise, was not feasible. However, off-site e-voting, such as m-voting, offered a potential solution. M-voting allowed voters to cast their vote at a place of privacy without the knowledge of outsiders; consequently, m-voting reduced the possibility of election-related coercion and violence. Although coercion was still possible with m-voting, it could be mediated with changes to the voting process. For example, Norway had innovatively addressed the problem by allowing repeated voting with the last one counting. M-voting shared with e-voting the ability to adapt its interface with respect multiple languages, voter abilities,

ballots, and referendums. M-voting had additional advantages of an interface that was familiar to most of the populace through pervasive adoption and use of mobile devices.

In 2016, South Africa had 37.5 million unique mobile subscribers, a 68% penetration rate with total subscribers adding up to well over 80 million connections. This is explained by the fact that many people have more than one SIM card across one or more networks (BusinessTech, 2017). M-voting devices such as mobile phones, when viewed positively were already equipped with built-in batteries and, consequently, did not require external power supplies. Besides device familiarity, m-voting reduced the cost of voting in that voting occurred, via a voting application, on the voter's own device (Bring Your Own Device) rather than relying on government-provided voting machines. The majority of phones were self-owned and, consequently, the cost of e-voting machine storage was mitigated (Thakur, 2014. On the other hand, the use of these phones came with new challenges such as configuration issues, supporting alternative operating system versions and potential latency. With respect to latency, there had already been spectacular real-time technology latency-based failures using online polls at M-NET in 2009 and 2016. Thakur (2016a, 2016b) referred to latency issues during his analysis of the intriguing decision by University of the Witwatersrand to consult with its stakeholders on whether or not to continue its academic programme using SMS voting. He pointed to the non-secret nature of the ballot, latency, shoulder browsing or shoulder surfing and remote coercion as possibilities (Thakur, 2016a, 2016b). Shoulder surfing was using direct observation techniques, such as looking over someone's shoulder, to obtain information, often without permission. Remote coercion occurred when a voter tried to cast a vote in his or her home and a dominant personality influences the vote choice. Thakur's analysis had been widely disseminated to various websites within hours of publication, possibly demonstrating society's interest in online voting on real issues.

The electoral board possessed the ability to loan mobile devices to those who do not own one for voting purposes, or to provide unmanned or partly manned voting kiosks where a person could vote on EMB issued phones. This poll-site voting had the advantage of mediating a dominating force in the voter's homestead or work environment. As poll sites have private individual voting, the risks emanating from voting off-site, such as lack of vote privacy and potential immediate pressure from others to vote for a certain candidate, are mitigated Furthermore, m-voting did not require separate voting infrastructure but instead piggybacked on existing mobile phone connection infrastructure that was widespread throughout South Africa, including many remote areas (Anonymous, 2016). Indeed, the advent of a mobile election could serve as an incentive for funding total coverage. However, m-voting raised the risk of voters viewing the elections as 'outsourcing democracy' because the technology and the software was most likely imported. This could be mediated by public private partnerships where the EMB could have allowed overseas expertise provided they partner with local entities.

The Decision

Thakur reflected on the power of different stakeholders and the competing and collaborating role each played. For example, Civil society might support technology but not at the expense of welfare cuts. It was also clear that the youth viewed the omission of technology in elections with distrust (Allen, 2006). In considering what to recommend, Thakur identified a number of possible options that could be considered.

The Status Quo

The easiest path to follow, at least for the short term, would be to persist in the use of paper ballots. This option would avoid the need for legislation and would benefit from the country's existing confidence in the integrity of the electoral process. In addition, recent events in other countries—such as concerns relating to Russian online interference with the 2016 U.S. elections—could potentially undermine confidence in any ICT based solution to voting.

Options for Incorporating e-Voting

For all the options that involved e-voting, Thakur felt that academics, industry and civil society would need to make a concerted effort to lobby Parliament for the government to adjust the law such that it would (at least) allow for experimentation with e-voting. Such authorization would be a prerequisite for keeping the research momentum going and building valuable contextual data. In order to be effective, such legislation would need to combine a number of features that included:

- Amending the relevant electoral legislation to explore e-voting trails and pilots
- Allowing poll-site paper ballots and e-voting in trail sites for non-political decisions
- Expanding this process to include political elections as soon as the law permits
- In the pilots, international successes must be replicated while challenges must be mediated. Both sets must be shared with the electorate demonstrating pragmatic responsiveness (Hafkin, 2009)
- A special adoption of e-voting should be target-based and be aimed at National Defence Force or overseas voters
- Establishing an independent focus group that will monitor e-voting that will provide contextual knowledge to evaluate various e-voting options
- The trails and pilots must opportunistically consider the needs of multilingual and differently abled voters (Smith, 2007)

Assuming such legislation could be enacted, the following number of alternative approaches for implementing e-voting could be considered.

Mixed Mode Solution

A mixed mode election administration, offering both paper and e-voting at carefully preselected voting districts or precincts could be a sensible evolutionary step. This backward compatibility might however have the negative impact of compounding electoral costs at the chosen sites. Given that the country was already cash strapped—as evidenced by recent demonstrations demanding free education to university students—this option raised serious concerns relating to affordability. In addition, since paper ballots would still need to be tallied, this approach would not be capable of delivering near instantaneous results when the polls closed, which was one of the most visible benefits of e-voting.

Piloting

Another option that could be considered was pilot-testing e-voting only in selected groups or regions. To be effective, pilots would need to be focused, auditable, trustable, and inclusive. For example, a pilot could be initially focused on a special group of South African voters such as embassy staff, and take into

account limited rural access, special needs of the differently abled, multi-lingual voters, illiterate voters, and other existing constraints. The vote could have an auditing component that worked to ensure voting is open, transparent and build voter trust in the pilot.

A local partner for the e-voting pilot could be included in order to insource democracy, build and maintain local expertise, ensure improved voter acceptance, and gain public trust. During the e-voting piloting phase, an intensive education campaign could be conducted to increase public awareness of the pilot and to build eventual voter trust in the e-voting system during full deployment.

Naturally, extensive piloting of the e-voting process would slow down adoption, potentially add costs and could also provide opponents of the process time to mobilize. One expected outcome of piloting would be that some approaches would succeed, while others would not work as well as expected. Under-performing pilots could become ammunition for e-voting opponents. On the whole progressive pilots are, however, necessary to gain comprehensive adoption.

Regional Rollout

A variation on pilot testing would be to roll out e-voting by province. South Africa was a country of considerable regional diversity. Some provinces, such as the Western Cape (including Cape Town) and Gauteng (including Johannesburg) had relatively strong Internet and ICT infrastructures. Others, such as Limpopo, the Northern Cape and the Eastern Cape were much less developed. As a consequence, e-voting could be initiated on a province-by-province basis, starting with those where the infrastructure challenges were less daunting.

A potential drawback associated with this approach is that it could lead to a system where different provinces had different voting approaches that persisted for a very long time. While such differences were not unheard of in other countries—for example, in the United States different states could adopt different voting models—it would undermine any sense of national unity in elections and could lead to very slow rates at which election results were tallied (as was often the case in the U.S. elections).

Another drawback is the danger of perceived regional discrimination. A connected province always gets everything first is the prevailing view. A way around this will be to be counter intuitive and actually run the pilots in the less connected areas. The positive legacy benefit or outcome of the pilot will be that these few less connected areas will have improved connectivity. This will be seen as transformative, contextual and responsive.

National Adoption

The boldest approach to e-voting would be to adopt it all at once across the country. The benefits of this would include the sense that all provinces were being treated equally and immediate visibility of the most tangible benefit of e-voting: the speed at which election results were tabulated.

Naturally, the “national adoption” option could not be implemented without extensive testing prior to the rollout. It would also tend to concentrate the costs of replacing paper ballots with ICT solutions into a single period, creating a particularly serious fiscal challenge for the government. Its implementation would also be constrained in one of two ways. In the event that e-voting was to be conducted over the Internet, implementation would need to be postponed until Internet connectivity was universally available across the country; a national priority, but one that had yet to be realized. Alternatively, e-voting machine solutions that did not require continuous online connectivity could be utilized. While these could be

implemented more rapidly and would less likely be vulnerable to external hackers, they were more costly and would not be able deliver election results as quickly as other e-voting approaches (such as m-voting).

Technology Decisions

In addition to the four implementation options that could be considered, Thakur recognized that a related decision involved the previously discussed e-voting technologies. These included:

- *e-Voting polling systems with internal storage*. These systems could store votes locally, and did not require continuous Internet connectivity. Individual voting results for each machine or a local area network of machines were saved to external media that could be transported elsewhere for incorporation in the tally.
- *Internet e-Voting polling systems*. These systems effectively acted as terminals that connected to a server over the Internet, thereby allowing results to be tallied as voters entered them.
- *m-Voting solutions*. Apps that could be deployed on smart phones, desktop & laptop computers and tablets that would allow individuals to authenticate themselves and record their votes.
- *m-Voting polling solutions*. Essentially the same as m-voting solutions but implemented at polling stations. These could be implemented either as an exclusive voting technology (thereby allowing individuals at the polling station to authenticate voter identity) or presented as an alternative for voters lacking the equipment to vote on their own.

Naturally, the implementation option or collection of options chosen would have a significant impact on the most appropriate technology. It might also be possible to deploy a variety of technologies, each suited to local conditions.

Thakur thought it through. Democracy was a process not an event. If e-voting were to be implemented, not only would the transition process take considerable time, it would not succeed without a plan. The challenge was the number of potential paths that plan could take. He knew that his recommendation would carry considerable weight. The question remained: what should that recommendation be?

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Biographies

Dr. Colin Thakur is an expert in e-voting. He was the National Treasurer of the Computer Society of Society of South Africa (CSSA) as well as regional chairman for many years. He served on the inaugural committee of the Complaints and Compliance Committee (CCC) of the Independent Communication Authority of South Africa (ICASA). He is currently Director of the KZN e-Skills CoLab at the Durban University of Technology

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Exhibit 1: Voting Technologies

Figure 1: The Brazilian e-voting machine called the urna[2]

Figure 2: The Indian developed Electronic Voting Machine[3]

Figure 3: A Smartphone internet voting option[4]

[2] https://direitoeliberdade.jusbrasil.com.br/artigos/131347059/a-urna-eletronica-e-realmente-segura

[3] https://timesofindia.indiatimes.com/india/ec-to-announce-evm-challenge-date-today/articleshow/58757982.cms

[4] https://www.johnpatrick.com/canadians-expand-internet-voting/

Exhibit 2: PESTLE Analysis of eVoting

Sphere	Advantages	Disadvantages
Political	Multiple elections possible with minimal setups Referendums and plebiscites and non-political decisions can be leveraged to enhance trust in e-voting	E-voting not fully established in South Africa and the stakeholders do not yet fully understand the benefits or risks
Economic	Long-term savings in administering elections (Thakur, 2012) Cost savings critical in developing countries like South Africa	The initial capital cost is high with respect to equipment purchase, software costs, and infrastructure setup
Social	Easily-configurable ballot caters to diverse linguistic and abled voters (Thakur, 2016c) Addresses, particularly for off-site e-voting, problem of large diversity of voters	High voter education on e-voting required (Thakur, 2015)
Technological	Accurate and quick tallying of votes (Cranor and Cryton, 1997)	Requirement for power supplies for each voting machine (Feldman, 2007)
Legal	IEC mandated to explore options to make elections more effective and efficient	Legislative change needed to allow e-voting pilots
Environmental	Reduction in the amount of Paper, currently about 450 tons (Sampath, 2013)	Although paper is recyclable, the cost of ballots go up in line with increased number of voters

Source: Prepared by case writers