

Technology Spotlight: Delivering End-to-End Election Modernization Roadmaps

WHITE PAPER

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INTRODUCTION

"Large-scale democracy is a procedure and/or a mechanism that (a) generates an open polyarchy whose competition on the electoral market (b) attributes power to the people and (c) specifically enforces the responsiveness of the leaders to the led," argues Giovanni Sartori, emeritus professor at Columbia University and one of the most important political science scholars to study democracy in the second half of the 20th century. For centuries elections have been the common mechanism by which a population chooses an individual or a group of individuals to hold office and represent their interests. Elections fill offices not only in national, regional, and local governments, but also in many other private, education, and business organizations.

Election management bodies (EMBs), such as electoral commissions, ministries of interior, and local councils, are increasingly expected to conduct elections that are democratically acceptable for all stakeholders, so that results are considered a valid representation of voters, while facing challenges in handling the different phases of the electoral process in an efficient way. The acceptability of elections is dependent on a number of factors as outlined below:

- Ensuring full process security and transparency to eliminate fraud and increase trust:
 - The equality and accuracy of voter registration
 - The convenience and security of casting ballots
 - The accuracy and integrity of result consolidation and reporting
 - The overall transparency and auditability of the end-to-end process, including financing of electoral operations and political campaigns
- Increasing voter participation.

Even though in some countries voting is compulsory and in other cases there is a minimum level of voters (quorum) mandated to validate an election, the democratic validity of elections is often questioned in case of low turnouts, particularly in developed countries. For example in the U.K., one of the oldest Western

democracies, voter turnout for parliamentary elections fell from 78% in 1992 to 66% in 2010. This is an indication as to how voters are losing interest in elections and highlights the need to find new ways to contribute to the democratic process, particularly in mature democracies. In fact, the U.S. Census Bureau survey of the November 2012 presidential election, asking non-voters why they decided not to cast their ballot, found that the main reasons for not voting were a lack of interest (15.7%) or "did not like candidates or campaign issues" (12.7%), while others cited challenges related to casting the vote.

Overseas, disabled, and illiterate voters are segments of a country's population that are particularly disenfranchised and face privacy issues as they will often have to delegate their vote to a person they trust.

While voters are losing interest in elections or facing difficulties in exercising their right to vote, governments are trying to figure out new ways to engage them in the democratic process.

- Making the voting process efficient:
 - Increasing the speed of the vote counting process
 - Minimizing delays in the publication of election results
 - Streamlining post-election audit processes
 - Eliminating duplication of voter registration records
 - Reducing ballot printing and logistics costs

Efficiency is important both for emerging countries that are eager to modernize their election processes (and to conform to democratic election standards set by OSCE, the European Union, and other international institutions) and for developed countries that are under pressure to control government expenditure.

The 2013 parliamentary elections in Italy, carried out with traditional paper voter lists, paper ballots, and with digitization limited to result reporting, cost approximately €390 million, or over €8.30 per voter, when considering paper, stationery, and officers and agents, and an estimated €73 million for the opportunity cost of police agents patrolling polling stations.

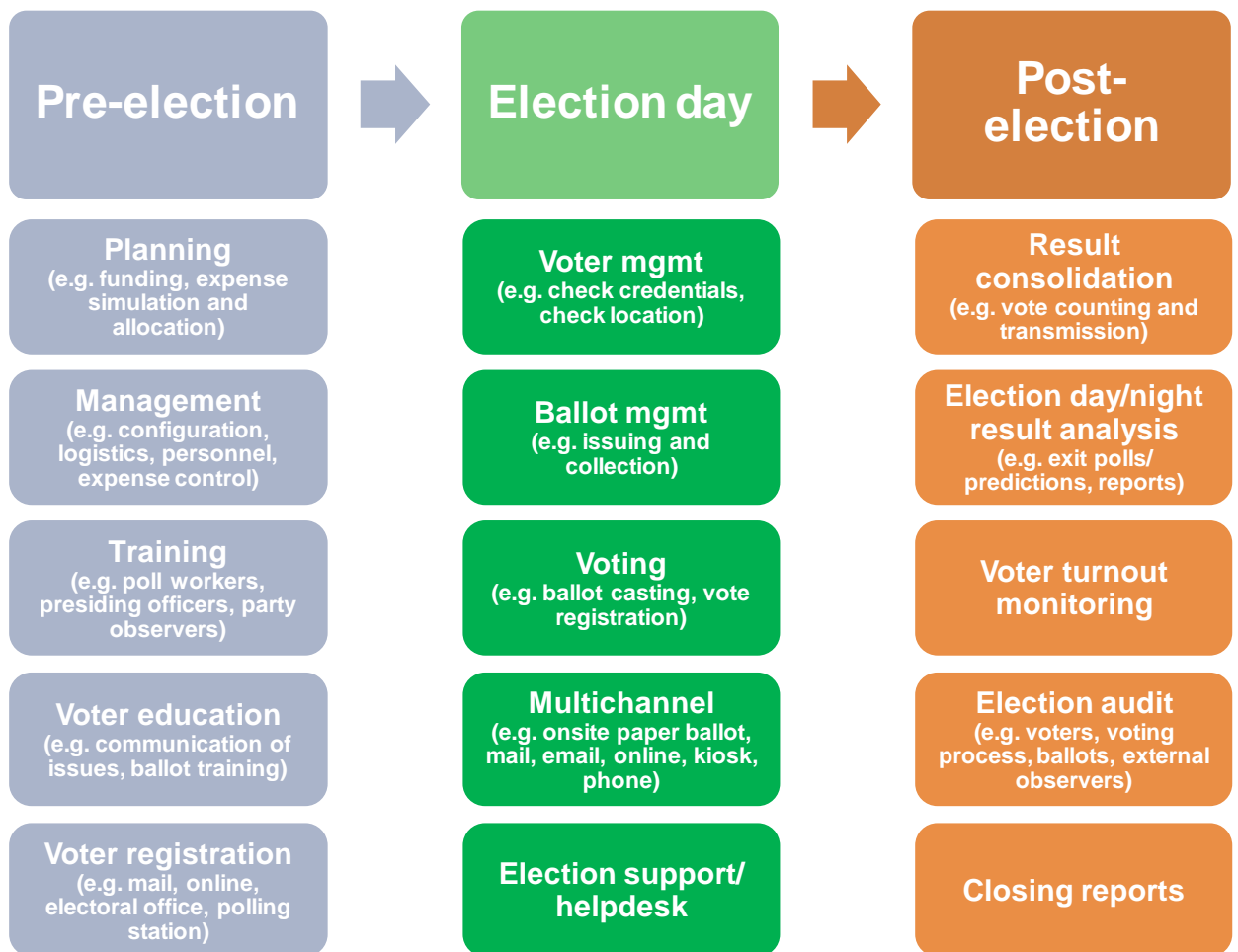
Information technology solutions have the potential to improve electoral operations across the end-to-end process by reducing risks and costs, enhancing transparency and convenience, both for voters and officials managing the process.

1. ELECTION MODERNIZATION

Applying information technology solutions to support election modernization involves much more than electronic voting (evoting). It refers to the option of using electronic means to manage the electoral process from pre-election activities, such as election configuration and voter registration, to election activities, such as casting the vote, to post-election reporting and auditing (see Figure 1). As a result, assessing the effectiveness of election modernization programs would require the analyzing of all phases, by looking at multiple outcome indicators, such as rejected absentee ballots, disability-or-illness-related voting problems, voter registration rate, turnout, and completeness and accuracy of data.

FIGURE 1

The End-to-End Election Process — Map of Key Activities for the Three Main Phases



Source: IDC Government Insights, 2013

2. INFORMATION TECHNOLOGY SOLUTIONS FOR ELECTION MODERNIZATION AND THEIR KEY BENEFITS

As governments are traditionally risk averse, over the past 15 years the deployment of information technology solutions for election modernization has been case-specific across geographies.

Historically, priority has been given to digitizing pre-election activities, such as voter registration — to securely and accurately manage large databases of citizens — or results consolidation and reporting to accelerate the announcement of the final results and avoid, in some cases, fraud and violence.

Election day activities, being more sensitive and subject to cultural changes among the voters, is where there has been a slower though increasing adoption of voting technologies. While most of the existing cases of electronic voting are in the form of supervised electronic voting machines, an increasing number of countries are adopting remote, unsupervised electronic online voting as a solution to decreasing voter participation.

It is interesting to note that on one side emerging countries such as Ecuador and Costa Rica are leapfrogging from paper-based and not fully transparent and democratic processes to adopting end-to-end election modernization systems. On the other side, more mature democracies such as Switzerland and Norway are taking a more siloed approach by implementing systems to fill functional gaps and complement existing electoral processes leveraging existing legacy solutions that they cannot always afford to rip-and-replace.

However, as early government adopters stimulate others to embrace technology, the opportunity to leverage innovative capabilities and best practices in all phases of the election process is increasing.

2.1. Pre-Election

- Currently, governments mostly use spreadsheets or project management systems for **election planning** activities. But since planning involves multiple people and sometimes multiple "races" in the same day, there is an increasing need for online collaboration, rigorous version control, and the ability to check availability and performance of staff in different scenarios through simulation. Legacy standalone applications do not fully cater to these requirements.
- **Election management** activities are sometimes handled through spreadsheet-based expense recording systems. These enable supervision of election operational expenses and political campaign financing, but with limited flexibility to consistently track costs related to changes in the number of polling stations, ballot configuration, ballot reprinting, and itemization of campaign

funding. For example, some jurisdictions also set up websites to track the campaign expenses of parties, but they rarely provide detailed itemization of those expenses, or the ability to drill down into the amount of money collected from each donor.

- **Training** of polling station workers is currently mostly done live or through printed manuals. Neither approach allows the thorough tracking of progress of trainees and both waste a lot of money and time on travel. eLearning capabilities could be of significant help to resolve these issues.

U.S. counties have been making greater use of online training, while the U.K. and Ukrainian governments have recently started to use elearning to train polling station workers.

- **Voter education** activities have historically taken place through traditional media, such as TV news and newspapers, but the popularity of the Internet and mobile technologies now enables election management bodies to make election information increasingly available online and through mobile devices, which requires web content management capabilities.
- **Voter registration** activities can be carried out in two ways: through a continuous registration process, whereby voters are automatically registered when they reach voting age, or through multiple registrations every time there is an election. In the latter case particularly, manual registration can be cumbersome, for example for overseas voters. Electronic registration, for instance through online self-service, makes it easier to register and vote, increases accuracy, and reduces the risk of eligible voters being disenfranchised due to inaccurate or incomplete voter records.

In Arizona, registration rates among 18–24 year olds rose from 29% to 53% after the state introduced online registration. Since the 2012 general elections, an increasing number of U.S. states are considering online voter registration and are currently making legislation changes to facilitate the registration of overseas and military voters. Electronic voter registration also reduces costs; for instance online registration forms in the U.S. are estimated to cost 3¢ to process compared with 83¢ for a paper form. In emerging countries, such as Kenya, Ghana, Yemen, Fiji, and Nepal, where voters sometimes do not even have birth certificates or other proof of ID, there is an increased drive to use biometrics, which could be integrated with voter registry solutions.

2.2. Election Day

- **Voter list management** activities are currently mostly paper-based. This translates into significant costs for printing and shipping. Also authenticating the voter takes a lot of time, which creates long waiting times. Interest in these capabilities is increasing both in mature democracies and emerging countries, such as Kenya, Colombia, and Pakistan. In addition, a growing

number of countries such as New Zealand, the U.S., and Taiwan are allowing or considering allowing citizens to vote at any polling station (those not assigned to the voter). This makes it significantly easier for people to vote and makes paper rosters less practical. Increasing the convenience through "anywhere voting" is important, as shown by the U.S. Census Bureau survey of the November 2012 presidential election. The survey asked non-voters why they decided not to cast their ballot and showed that many had a busy or conflicting schedule (18.9%), others were affected by illness or disability (14%), were out of town (8.6%), had transportation problems (3.3%), or found it difficult to get to their nearest polling place (2.7%).

- **Voting** activities can be supported by electronic means in two main ways:
 - Through onsite, supervised electronic voting, which includes votes marked by hand, but registered and counted electronically through punch cards, precinct count optical scanners (PCOS), and digital pens, and votes marked electronically through electronic voting machines, typically with buttons, touchscreen, or audio command, for example for visually impaired voters, voters with literacy issues, or in multiple languages for minorities. These systems reduce the cost of printing (or reprinting ballots), and the cost of shipping them while accelerating the vote counting process.

For example, in the 2011 Federal National Council (FNC) elections for the United Arab Emirates, over 700 online voting kiosks and 340 electronic ID verification stations were deployed across the country. As a result, the UAE became the first country in the Middle East to fully automate elections nationwide and voter turnout in the national election increased by approximately 80% from the previous election.

Beyond accessibility, electronic voting can also be more convenient in terms of the quality of the vote. For instance, automatic feedback can be provided to the voter as it helps detect potential problems, such as under-voting and over-voting, which could result in a spoiled ballot.

- Through remote, unsupervised voting, which includes email, web self-service, phone/smartphone, and Internet TV.

Switzerland has been progressively using online voting since the beginning of the 2000s. The systems initially developed by the cantons of Zurich, Neuchâtel, and Geneva have been made available to other cantons since 2009 thanks to intercantonal agreements, while the scope was extended to eligible Swiss voters abroad. Since then, a clear majority of 18 cantons has decided to introduce electronic voting. On average, around 150,000 eligible voters per election were entitled to use electronic voting, with up to 60% of voters making use of the online system. The Federal Council recently set the course for

the future development of the project through the extension of electronic voting to all eligible voters after new, more rigorous security requirements have been implemented around voter verifiability.

Remote voting is particularly helpful to make it easier for voters outside the country, such as emigrant workers and the military. For most of these, going to an embassy costs time and money, while sending ballots via regular mail can cause delays. Making it easier for emigrants to vote is an increasingly important issue, as there are an estimated 200 million migrants out of a world population of approximately 7 billion.

In the U.S., the Military and Overseas Empowerment (MOVE) Act was signed into law in October 2009. The law requires state election officials to provide online access to registration and ballot request forms, electronic options for blank ballot delivery, downloadable write-in ballots in case of late ballot arrival, and voter status tracking services. The online delivery of ballots has cut the voting time for overseas voters by more than half, but they still have to return their ballots by paper/mail, which is expensive and susceptible to postal delays. A number of states are considering allowing voters to return their ballots by email, following the example of Alaska, which implemented the process during the 2012 presidential elections.

2.3. Post-Election

- **Result consolidation** activities usually take several days, sometimes weeks, and are vulnerable to manual errors and tampering. First results are transmitted by phone, and then all ballot boxes will have to be returned before consolidation. Having a system in place that can handle result consolidation electronically speeds up the process and helps avoid election fraud. In the case of particularly turbulent elections, publishing results within a few hours or days can help avoid election violence.

In the 2010 Brazilian presidential election, which recorded more than 135 million votes, mostly using electronic ballot boxes, the results were consolidated 75 minutes after the close of voting.

During the 2010 general election in Bosnia and Herzegovina, 3.1 million voters elected their representatives to the Bosnian and Serbian Presidency and National Assemblies and to 10 Cantonal Assemblies. The Central Election Commission (CEC) put in place an Integrated Information Election System (IIES) to consolidate election results from 5,273 polling stations at 142 Municipal Election Commissions. This allowed the CEC to announce the first preliminary election results only a few hours after the polls closed.

- **Election night reporting** activities are all about easy to consume visuals. Traditionally, administrators published static results with

no drilldown capabilities by region, local authority, or polling station, which limited transparency. It must be noted that the landscape varies significantly by geography, with emerging countries uploading spreadsheets or scanning paper reports onto a website, while in developed countries EMBs provide visually rich dashboards that complement newspapers and other media outlets.

- **Election audit** activities can be supported by case management systems that enable election officials to verify election outcomes and identify and fix weaknesses in their procedures and identify common voter mistakes, making the process fairer and more reliable.

3. INFORMATION TECHNOLOGY SOLUTIONS FOR ELECTION MODERNIZATION: KEY CONCERNS

The modernization of any process will always have a number of inherent challenges, particularly when new technologies are used to underpin that process; election modernization is no different.

3.1. Security

Security is the primary area that IDC believes governments should be aware of when undertaking this type of process. Given the importance of a free and fair election process as a core principle for any democracy, there is an understandable wariness from voters when that election is run using an underlying technology platform for the first time. IDC believes that a reliable election modernization system should ensure the following key areas are covered as it specifically relates to security:

- *Vote integrity and authenticity.* This is critical for the overall credibility of the outcome of the election. Digital signatures ensure that the votes cannot be modified without detection, thus ensuring their integrity. The use of digital certificates and strong voter authentication methods guarantee the authenticity of the cast votes, so that it can be verified that they have been cast by eligible voters. Voters' personal credentials, which are used to digitally sign the votes, have only to be accessible for them in order to guarantee the integrity and authenticity of the votes.
- *Voter privacy.* Most governments favor a basic decryption approach where clear-text votes can be correlated with encrypted votes, but this can compromise voter privacy as it runs the risk of votes being connected to the voter. One of the more sophisticated techniques to ensure voter privacy is homomorphic tallying, which ensures that encrypted votes are not individually decrypted and cannot be correlated with the options selected by each individual voter. The result is the decryption of the operation of all encrypted votes. Some election processes also use mixnets, which ensure that encrypted votes are shuffled and partially decrypted (or re-

encrypted) several times before obtaining the clear-text votes. This ensures that clear-text votes cannot be directly correlated by position with the encrypted votes, as they were sent by the voters, preserving voter privacy.

- *Audit.* This is about ensuring that both election auditors and voters can accurately audit the election by leveraging the following technologies:
 - Immutable logs that ensure all sensitive operations are registered in cryptographically protected logs that cannot be manipulated.
 - Verification across two parameters:
 - Cast as intended — using cryptographic mechanisms to allow voters to individually verify that the vote recorded by the voting server contains the voting options originally selected. These mechanisms protect the votes from manipulation by malicious software installed in the voters' devices, since any such manipulation will be detected.
 - Counted as cast — using universal verifiability, which allows observers or independent auditors to verify the proper decryption of the votes by using cryptographic proofs (e.g., ZKP) generated by the decryption process, ensuring that voters are able to verify that their votes have been included in the final tally.

The combination of individual and universal verification provides end-to-end verification to ensure an accurate audit of the entire election process.

- *Results accuracy.* The key focal point in terms of counting the votes at the end of the election is transmission of the results to a central location. In this area, governments need to be wary of just focusing on network encryption, where voting options are only encrypted while transmitted through the network but processed in clear at the voting server where they are received; in this scenario, the options are vulnerable to attackers that have access to the server. A more secure approach is to put in place application-level encryption, where voting options are encrypted in the voting terminal and remain encrypted until the electoral board decrypts them; in this scenario, they are much less vulnerable to server and transmission attacks.
- *Voter coercion and vote buying.* Remote voting can open the door to coercers forcing voters to vote in a specific way, or to voters demonstrating how they voted to a vote buyer, unless the right countermeasures are put in place. One possible countermeasure is to allow the voter to vote multiple times and for different channels, so that the last vote, or the one cast from a supervised channel, is the one that counts. This way coercers or vote buyers cannot guarantee that a voter votes as he or she claims.

3.2. Other Concerns

There are a range of other areas that need to be addressed in terms of running an election on a technology platform, such as integration with legacy systems and processes, change management in terms of educating civil servants and polling station workers in how to use new technologies and educating citizens on how to use and trust new technologies. Additional costs may be incurred in terms of additional equipment maintenance and storage expenses for technologies such as voting machines. Finally, legislation will have to be adapted to allow the use of technologies such as electronic voting.

- **Change management and governance.** As with the majority of information technology programs, election modernization is accompanied by a significant amount of technical but, most importantly, organizational and business change, both in terms of process workflows and competences, resources, and motivation of civil servants that are necessary to create the capabilities to manage new processes. They can also create significant political and reputational risks; therefore there is a need to involve much higher levels of management to define and negotiate outcomes and to make someone accountable for training, communication, and documenting changes in business processes.
- **Market fragmentation.** The wide range of available hardware and software solutions make the election modernization ecosystem market very fragmented, few companies having developed end-to-end commercial off-the-shelf packages that encompass comprehensive workflows and analytical capabilities. Some governments have tried custom-based solutions, which can sometimes create security, reusability, interoperability, and scalability gaps and could be subject to patent infringements.

For instance, in 2004, India adopted electronic voting machines for its parliamentary elections. It had two government-owned defense equipment manufacturers, Bharat Electronics Ltd. and Electronics Corporation of India Ltd., build identical systems that were developed to the specifications of the Election Commission. India has provided voting machines to Bhutan and Nepal, and a third model of the Indian voting machine is under development, including voter paper trails. But scalability is still an issue as the system only allows a maximum of 64 candidates and has impeded Nepal from using the machines in its upcoming elections.

This market fragmentation has also resulted in an increased risk of overlapping solutions and potential functionality gaps. In turn, the fragmentation of the election modernization software market resulted in fragmented service offerings for deployment, testing, and maintenance.

- **Lack of reliable measures and objective data to assess value for money.** The early stages of maturity of the election modernization

solution market have hindered the development of a comprehensive assessment of the value, risk, and total cost of ownership of such solutions, for example leaving the door open for uncertainties about the cost of software validation, compiler trust validation, installation validation, delivery validation, ongoing maintenance of solutions, cost of storage, and so forth.

- **Usability concerns.** Particularly with less-IT-literate groups of voters, electronic voting solutions can present challenges if appropriate training for agents and education for voters and helpdesks are not provided. Usability concerns can be overcome by proper training and design. This was illustrated in the 2007 national election in the Philippines — 95% of those overseas voters who used the online voting system that were interviewed said the system was very easy to use.
- **Need for regulatory changes.** Allowing election processes to be carried out electronically requires changes to a country's electoral legislation. Considering the critical aspect of elections, countries should approach these legal changes gradually, starting with small scale implementations before considering a change in the legislation.

The French Ministry of Foreign Affairs, for example, has implemented online voting progressively since 2003 before allowing the changing of the legislation and allowing more than 1 million French overseas citizens to vote online as of the 2012 legislative elections.

In 2006, the Dutch Minister of the Interior withdrew the license for 1,187 voting machines, about 10% of the total number to be used, because it was proven by the General Intelligence and Security Service that one could eavesdrop on voting from up to 40 meters using Van Eck phreaking. The Netherlands is currently reconsidering the use of evoting machines. A national commission was created and is expected to publish its findings in November 2013. It will evaluate the feasibility of implementing evoting machines in the country, make a risk mitigation assessment, and establish the requirements for hardware and software.

4. CONSIDERING SCYTL FOR ELECTION MODERNIZATION

Scytl provides secure online voting and election modernization software solutions to help public administrations organize elections across the full election life cycle. Scytl is a privately owned company headquartered in Barcelona, Spain, with offices and clients around the world. It was founded as a spin-off from the election cryptography research department at the Autonomous University of Barcelona in 2001. Scytl therefore has a heritage very much focused on security and auditability.

IDC believes that Scytl's value proposition is based on the following:

- It has a comprehensive solution for the entire election process (and beyond). This is based on an end-to-end platform that also allows a modular approach and integration with third-party systems.
- It is able to develop unique and specific election modernization roadmaps for individual governments, which enables an "evolve as you need" approach.
- It provides a range of alternative security options, all tailored to specific use cases and compliance requirements at various stages of the election process. Scytl treats security as its core competency, having over 40 patents in election technology security, the largest patent portfolio in the industry.
- Over the past 12 years, Scytl has built an impressive set of global reference clients in its European home market and in North and South America, the Middle East, and Asia/Pacific. This gives the organization an in-depth understanding of election challenges — a critical success factor in determining best practices in this fast-evolving market.
- It has in-depth and specific experience in providing online voting capabilities, having gained over 75% of the market share in 18 of the 20 countries that have implemented online voting in binding public elections (including France, the U.S., Norway, Switzerland, Mexico, Canada, and India).
- It offers multiple delivery models: SaaS or on-premises. This choice is critical, particularly for governments that have minimal budget for upfront expenditure but can pay for use of the software for a specific election.

4.1. CHALLENGES FOR SCYTL AND LESSONS LEARNED FROM DISCUSSIONS WITH CUSTOMERS

The Scytl offering, which is focused on election modernization and provides unique competencies, particularly in security, delivers value for money solutions to customers. However, depending on functional requirements, legacy solutions, available budget, and other business and technical needs, potential customers should consider the following:

- Emerging countries that are starting election modernization from scratch and want to implement the Scytl end-to-end suite must make sure they have internal capabilities to deal with change management, training, and system implementation, as Scytl is still developing an ecosystem of partners.
- Mature economies that have legacy solutions to automate parts of the election process and want to buy certain Scytl modules to fill the gaps must work closely with Scytl engineers to facilitate data and process integration and leverage the opportunity to innovate

that comes from knowledge transfer from Scytl. This is particularly important for Scytl's security capabilities, which are very sophisticated but not easy to handle for all users and administrators accustomed to less sophisticated custom-built solutions.

- Mature economies that are considering the Scytl end-to-end suite to rip-and-replace legacy solutions must assess Scytl's capabilities against their mature business requirements and then set up an experienced project management office to deal with data migration and change management involved in modernizing existing systems.

5. CONCLUSION

IDC believes that a major opportunity exists for governments around the world to leverage technology proactively as part of a broader modernization of their election processes. The potential benefits are extensive, including greater transparency, lower costs, and increased voter participation (particularly in mature economies). The examples highlighted in this document all clearly illustrate that this approach is the way forward for democracies young and old.

However, each country will have its own set of constraints in terms of maturity, available funds, and existing legislation. Countries therefore need to develop personalized election modernization roadmaps that allow them to rationalize and integrate applications across the end-to-end election process based on their own requirements. In addition, governments embarking on election modernization programs must pay very close attention to change management and approach regulatory changes, such as the validity of remote electronic voting, on a step-by-step basis. Given the potential risks associated with leveraging technology to modernize elections, IDC believes that only this type of due diligence throughout the entire election process will deliver an outcome that is acceptable to candidates, voters, and external observers.

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