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by: Therese LAANELA***

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## ***Introduction***

Technology is essential to the conduct of modern elections. Technology is used at every stage of the election process, for compiling voters lists, drawing electoral boundaries, employing and training staff, printing ballots, conducting voter education campaigns and publishing election results. The appropriate application of technology to elections can increase administrative efficiency, reduce long-term costs and enhance political transparency.

Technologies used for elections can be “old” ones like printing presses, ball-point pens, manual typewriters, electronic calculators and radios, or “new” technologies such as computers, optical scanners, digital mapping and the internet. Without access to technology, the logistics of modern large-scale elections would be beyond our abilities.

The complexity of technology used for elections around the world varies enormously. The rate of technological change is so fast that election management bodies (EMBs) must regularly re-evaluate their use of technology to determine whether they should adopt new or updated technology to improve their performance.

## ***What do we mean by ‘technology’?***

‘Technology’ can be defined simply as any thing involving the application of science and engineering. This is a very broad definition that could cover any manufactured item.

To keep this topic manageable, we will limit our definition of ‘technology’ to include primarily electronic or mechanical devices including but not limited to computerized devices. This definition can include existing or ‘old’ technology, as well as emerging, developing or ‘new’ technology.

## ***Deciding when to adopt new or upgraded technology for election purposes***

There are many aspects to consider when deciding when to adopt new or upgraded technology for election purposes. Here are some of the main ones.

## ***Elections are a high risk activity-will your technology work?***

Elections have to be done properly, open to public gaze, and they have to be done right first time. Unlike other applications of technology, where systems can be introduced gradually with extended testing and implementation schedules, many election systems will only be used ‘live’ once, and the systems must work correctly first time, or the entire election may fail.

## ***Do you really need to upgrade your existing technology or introduce new technology?***

In some cases, the costs or the risks may be too great, and it may be appropriate to decide to continue with your existing systems.

***Can you afford to upgrade your existing technology or introduce new technology?***

Using technology for election processes can be costly, especially at the implementation stage, but technology can also save money in the long term, particularly where a low-cost technological solution can be found to replace a high-cost, low-tech application. You need to weigh the costs and savings associated with introducing technology. When doing so, you must keep in mind not only the initial costs involved in purchasing hardware and software and employing consultants to set up your new system, but also the ongoing maintenance and management costs.

***Is it worth adopting new or upgraded technology?***

Many technological solutions may cost significantly more than the equivalent manual processes that they replace. It may not always be cost effective to implement new technology where relatively minor improvements do not justify the extra cost. You do not have to implement a high-cost, high-tech solution if a low-cost, low-tech alternative is acceptable in your particular circumstances.

***Can you get the funding you need?***

Before entering in to a technology purchase, you need to be sure that you have the funds for the initial implementation stage and for the ongoing maintenance costs. This will generally involve obtaining commitments through the relevant government budgetary process.

***How sustainable is the technology you are considering?***

You may want to ensure that the technology you adopt for next year's election, will still be useful at the election after that. Adopting new technology for each election may prove expensive and unsustainable in the long term. On the other hand, technology is improving at such a rapid rate that this year's technology may be out of date by the time the next election comes along in 4 year's time. Personal computer processing power is a good example of how 'state of the art' technology can rapidly be overtaken by technological improvements. Where change is rapid, it may be more cost-effective to lease equipment rather than purchase it to ensure that you optimize your capabilities at each successive election.

***Is the local physical environment and infrastructure able to support new or upgraded technology?***

Your physical environment and infrastructure may limit the appropriateness of some technologies. A country with an international power supply, for example, may not be an appropriate location for implementing a wide area network of personal computers that requires a reliable power source. High humidity or high levels of dust or sand may also restrict the choice of appropriate technology.

### ***How secure is the technology you are considering?***

The level of security of a technology can be crucial in an election. Particularly where technology is used for recording, tallying or transmitting voting data, the technology must be at least as secure as the equivalent manual processes. Ideally, a technological alternative should be more secure than the manual processes it replaces.

### ***Have you consulted your stakeholders?***

Before new technologies are introduced, it is wise to consult with all the stakeholders who are likely to be effected by the change. EMB staff must be willing and able to implement any changes they will be responsible for. Participants in the election process, such as political parties, candidates, members of parliament and the media will need to be consulted if the change will effect them. For example, where an electronic voting system is being considered. New technology may also require changes to the relevant electoral laws and rules. These changes need to be negotiated and guaranteed before you can commit to the new technology.

### ***Do you have enough time for the implementation of new technology?***

It is common for EMBs to underestimate how long the implementation of new systems will take. Time is needed for consultation with stakeholders, identifying your needs, for selecting the specific technology you will adopt, for implementing the new system, for testing it to make sure it will work effectively when it is needed and for training those who are going to use it. If system implementation is rushed, the risk that the system will fail at a crucial time is magnified.

### ***Are you attempting too much too quickly?***

Instead of taking a quantum leap and implementing a radically new technology in one step(compared to the existing local technology), it may be more appropriate to gradually implement change over a series of electoral events.

### ***Implementing new or upgraded technology***

Once a decision has been taken to adopt new or upgraded technology, what do you need to do to implement? Here are the main steps to follow.

#### ***Develop a business case.***

Analyse your needs and make a case for your chosen technology. Consult relevant stakeholders. Seek approval from relevant authorities. Secure funding for the technology.

#### ***Prepare an implementation plan.***

This should include expected outcomes, timelines, allocation of responsibilities, checklists, standards, quality controls and an implementation budget.

***Follow a structured selection and purchasing process.***

Develop system specifications and evaluation criteria. Appoint a qualified evaluation panel. Use an appropriate tendering process and follow probity principles. Remember to take into account sustainability and whole-of-life costs. Exchange a contract with the chosen technology supplier and include appropriate performance guarantees.

***Ensure the selected technology is suited to your needs.***

Work with the chosen supplier to ensure the product is suitable for its intended purpose. Where custom hardware or software is being developed, this may mean the EMB working with the development team to ensure the product meets the specifications.

***Test your technology.***

After the technology has been delivered, it may be useful to undertake a pilot program, to test the new system on a small scale. After small scale tests, one of the last steps before bringing a system into production might be a full-scale ‘load test’, where the system is tested by conducting a mock exercise that is as close as possible as the real thing.

***Train those who will use the technology.***

An essential aspect of implementing new technology is training those who are going to use it. For systems that will only be used ‘in-house’ it may be necessary only to train relevant staff. Where the technology is being used by external users- for example, if an electronic voting system is introduced- the external users will also have to be trained. Where the external users consist of the entire voting population, this ‘training’ may involve a mass communication campaign. Time for conducting user training must be built into the implementation plan.

***Have contingency plans and back-ups in place.***

Any technology, new or old, can fail. When new technologies are implemented, the risk of failure can be higher than with tried and tested systems. Consequently, contingency plans must be in place in case the technology fails. Often this will involve having manual back-up systems in place that can kick into operation at short notice if the technology fails. For example, where ballots are being counted electronically, plans should be in place to enable a switch to a manual count if the electronic system fails. Computer systems should also be designed with their own back-up systems, for example, by using mirrored servers, making regular back-up copies of data, and storing copies of data off-site.

If you follow these steps, and provide adequate resources, your election technology should perform effectively when it is needed. With an election, there is often no second chance.

### ***What types of technology can be used for electoral purposes?***

Elections are complex, many-faceted events. To organise and run an election, material has to be designed, purchased, stored, distributed and returned; personnel have to be employed, trained, deployed and paid; ballots have to be designed, printed/manufactured, distributed, used by voters, returned, counted, tabulated and reported; voters have to be informed, educated and motivated; candidates must play their parts; the media must be kept informed; and so on.

Technology can be used to facilitate all these different aspects of election management. As these tasks vary widely in nature and scope, a broad range of technologies have electoral applications.

Here are the main types of technology with electoral applications.

### ***Electronic/Mechanical Voting Systems***

There are several different kinds of electronic and mechanical voting systems. Some of them use technologies developed specifically for electoral purposes. Electronic or mechanical voting is used widely in the United States and to a lesser extent in a number of other countries around the world.

The main types of electronic or mechanical voting systems include.

- Mechanical voting/tabulation systems
- Punchcard voting/tabulation systems
- Machine readable (optical scanning) voting/tabulation systems
- Direct recording electronic systems

### ***Scanning***

Electronic scanning systems are used to convert data marked manually on paper into electronic form. While scanning is often used to capture voting data, such as lists of electors who have voted or details shown on forms.

There are four main types of optical scanning technologies:

- Optical Mark Reading (OMR)
- Optical Character Recognition (OCR)
- Intelligent Character Recognition (ICR)

### ***Identification Systems***

There are several stages in the election process when a need arises to reliably identify a person. The obvious stage is when a person votes, but identification systems may also be needed when a person registers to vote, or where an employee needs access to a workplace or a computer system.

Some countries rely on the honesty of their voters, and do not require voters to provide proof of their identity. Others do require proof, leading to a need for an identification system.

As electronic voting becomes more widespread and more automated, particularly where voting is introduced on the internet or by telephone, identification systems become crucial to ensure that only eligible voters are able to vote when they are entitled to.

There are several different kinds of identification systems:

- Identity cards
- Personal Identity Numbers (PINs)
- Bio-identification systems (including voice, hand, finger/thumb, retinal identification systems)
- Digitised photography
- Barcoding
- Public Key Infrastructure/Electronic signatures
- Passwords

### ***Internet***

The internet-the world-wide network of computers accessible by anyone with the necessary technology-can be used for electoral applications of the internet include:

- Publishing information for voters, candidates, the media and other clients
- Electronic Voting
- Email
- Voter registration
- On-line commerce
- Election results publishing
- Campaign finance reporting and disclosure
- In-house intranets

### ***Communications***

- Communications are essential to the conduct of modern elections. In order to organise and run an election, a range of communication methods need to be employed. Voice, data, documents and images can all be transmitted electronically. The technology used for these purposes ranges from tried and relatively simple ones, like the telephone or radio, to newer, more sophisticated ones, such as microware or satellite transmissions.

Some of the electronic communications methods used for electoral applications include:

- Telecommunications lines (phone/fax/cable/internet/intranet/data lines)
- Radio
- Television

- Satellites
- Microwaves

### ***Geographic Information Systems***

Geographic Information Systems (GISs) are computerised processes for storing, manipulating and displaying geographic data, particularly maps and data with an address component, such as voter registration data, voting statistics and demographic population data. Some electoral applications of GISs include:

- Determining electoral boundaries
- Producing maps
- Registering voters
- Election planning
- Displaying electoral results

### ***Office Automation***

Personal computer-based office automation software has become an indispensable part of election management in many countries. Word processing programs have replaced typewriters; spreadsheet programs have replaced ledger books; database programs have replaced paper-based electoral rolls, inventories and staff lists; and personal organizer programs have replaced paper diaries.

Starting with basic, cumbersome word processing and spreadsheet programs in the 1970s, by the 1990s office automation programs had become very sophisticated. These programs have served to empower ordinary office workers by enabling them to complete tasks in-house that once had to be sent off-site to be completed by specialists.

For example, desktop publishing programs allow relative novices to produce professional-quality publications, where once even the simplest of typesetting tasks had to be sent to professional typesetters and printers. Database and spreadsheet programs running on high-powered personal computers allow ordinary users to input, store and use data in ways that once would only have been possible on large main-frame computers operated by specialist programmers.

A typical 'suite' of office automation software could include some or all of the following kinds of programs.

- word processor
- spreadsheet
- database
- desktop publisher
- project manager

- presentation
- computer file manager
- e-mail
- internet browser
- internet publisher
- personal organizer
- financial management system
- personnel management system

### ***Specialised electronic/mechanical devices***

In addition to standard computers and electronic voting devices, there is a wide range of specialised electronic/mechanical devices that can be used for electoral purposes. These include:

- Counting machines
- Letter openers
- Mail inserting machines
- Label printers
- Overhead projectors
- Televisions/videos
- Electronic whiteboards
- Date stampers
- Automatic numbering machines

### ***Non-Electronic Innovations***

Some uses of technology for election purposes are not electronic or mechanical. Most of these uses involve innovative use of manufactured materials. For example:

- Plastics, for ballots boxes, voting compartments and security seals
- Cardboard, for ballots boxes, voting compartments and polling place furniture
- Tamper evident materials
- Dyes and inks to prevent multiple

### ***What does technology hold for the electoral process in the 21<sup>st</sup> Century?***

The technology developed in the 20<sup>th</sup> Century, particular computer technology, has in many ways dramatically altered the way in which elections are conducted. While the basic election

tasks of voter registration, voting and vote counting have conceptually remained much the same since the beginnings of the modern democratic process, the extension of the franchise, growth in population numbers and the increased reach of democracy throughout the 20<sup>th</sup> Century have meant that the logistics of modern elections depend very much on technology.

New technology has the potential to continue to change the way in which elections are conducted in the 21<sup>st</sup> Century.

### ***What changes will technology bring to elections in the future?***

Here are a few predictions:

#### ***The demise of the paper ballots.***

Paper ballots have served the election process well. They are relatively easy to produce, easy to mark and easy to count. They can also be expensive to print and distribute, can only be used once and are not a particularly good use of resources. They can be an imperfect means of recording a vote and counting paper ballots manually can also be an imperfect process. They also need a physical method of distribution. They can be relatively easy to use fraudulently. The development of cheap, easily delivered, reusable, reliable electronic voting methods may gradually replace the paper ballot in many countries.

#### ***The demise of the polling place.***

The physical polling place, that has to be rented, staffed and equipped, might become an expensive anachronism in many places where alternative electronic delivery mechanisms can be used. The move to putting government facilities 'on line' on the internet and in public places may replace the need for a physical polling place.

#### ***The rise of electronic voting methods.***

As electronic devices become cheaper, more powerful and more secure, it will not be long before a variety of inexpensive, reliable electronic voting methods become widely used.

#### ***Internet voting.***

While security and identity concerns lead many to preach caution toward internet voting in the 2000s, it should not be too long before these concerns can be answered and internet voting becomes safe, secure and widespread. The potential of the internet to change the dynamics of both the election process and the wider political process should not be underestimated.

#### ***Internet referendums and initiatives.***

The widespread accessibility of the internet could also lead to the rise of 'digital democracy', whereby ordinary citizens could vote directly on issues and legislative proposals. Such votes could be taken as indicative or binding. In this way voters could take control of the political process in a way never feasible before. Whether such moves would be good for the democratic process is debatable.

### ***Electronic identities.***

As this is being written, electronic identity systems are being developed to ensure that citizens can participate in the new electronic world of commerce and government. As more and more “necessities” of life in the modern world come to be delivered electronically, the need for secure, reliable electronic identity systems will see the development of country-wide if not world-wide methods of uniquely identifying people by electronic means. We are already putting microchips in our dogs and cats-will it be long before we are all micro-chipped at birth? George Orwell must be smiling.

### ***Electronic information delivery.***

The 20<sup>th</sup> Century has often been described as the information age. Never before has so much information been readily accessible to ordinary people. The continuing development of the internet and other electronic means of information delivery will see the amount of information accessible to people continue to expand. This may have a profound impact on the democratic process as the opportunities for information dissemination and retrieval expand beyond the traditional methods dominated by mainstream media. For election management bodies, the emerging electronic information service delivery methods will expand the options available for reaching voters and other clients with a wide range of information products.

### ***Electronic service delivery.***

In addition to the possibilities of electronic service delivery for the voting process and for the provision of information, many other services provided by election management bodies have the potential to be provided electronically. Voter registration, political party registration, candidate nomination, disclosure of donations and expenditure, provision of expert advice and any number of other services provided by electoral authorities can lend themselves to electronic delivery.

### ***Wireless electronic infrastructure.***

Many people reading this may think, this is all very well for developed countries, but what about less developed countries without appropriate infrastructure? It is possible that the development of wireless electronic infrastructure, delivered by satellite, microwave or radio transmission, could allow electronic service delivery in the most remote locations. Combined with cheap, mass-produced electronic registration and voting devices, such wireless electronic delivery systems could see electronic voting systems reach any person, anywhere in the world.

### ***Remote service delivery.***

With electronic service delivery, there is no need for the service provider to be in the same suburb, city or even country as the user. Perhaps the 21<sup>st</sup> Century will see the demise of the local election management body, as services become remotely delivered by internet, wireless transmission or by whatever arises to replace current technologies.

It really is a brave new electoral word.