Adoption of Voting Technology

A Guide for Electoral Stakeholders in Indonesia

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Foreword

Secure voting is a cornerstone of electoral democracy and in the 21st century a plethora of voting technologies, from voting machines to results transmission systems, have become an inherent part of elections all over the world. Although initially criticized, these technologies have increasingly demonstrated that they can comply with the high standards set by election administrators and other stakeholders. In some cases, these technologies have reduced electoral fraud and increased the accuracy of election results. Results can be made available to the public earlier and in more detail, thereby increasing the credibility of those elections.

However, adoption of these technologies has in some electoral systems had the opposite effects: an increasing number of electoral disputes, less transparent and less accepted election results, the undermining of trust, greater electoral violence and an overall weakening of electoral integrity. Although regrettable, these negative outcomes nevertheless serve as valuable lessons for the future.

International IDEA has long-standing experience of transforming practitioners' experiences and lessons learned into general principles, guidelines and methods for improving electoral processes. In the successful use of voting technology, as with any component of democratic elections, the application of general principles in specific countries requires contextualization and adaptation. This can then inform and stimulate domestic debates about which technologies are locally appropriate and acceptable. These debates are essential because voting technologies often fail, and mainly due to a lack of public and stakeholder consensus rather than technical shortcomings.

The long-standing cooperation between Perludem and International IDEA has now yielded this *Adoption of Voting Technology: A Guide for Electoral Stakeholders in Indonesia*. The Guide not only presents relevant country examples and global

principles, but also connects them to the Indonesian experience and the specific needs of this country's vast electoral process.

I hope this Guide will provide a valuable contribution to the ongoing debate about the future of election technology in Indonesia and further boost the integrity of Indonesia's democratic process.

Kevin Casas-Zamora
Secretary-General, International IDEA

Abbreviations

admins	administrators
AETA	Acting for Transparent and Appeased Elections (Agir pour les Elections Transparentes et Apaisées)
AI	artificial intelligence
AIVD	Netherlands' General Intelligence and Security Service (Algemene Inlichtingen- en Veiligheidsdienst)
AMAN	Indigenous Peoples Alliance (Aliansi Masyarakat Adat Nusantara)
Bawaslu	Election Supervisory Agency (Badan Pengawas Pemilihan Umum)
BIN	State Intelligence Agency (Badan Intelejen Negara)
BPPT	Agency for the Assessment and Application of Technology (Badan Pengkajian dan Penerapan Teknologi)
BSSN	State Cryptography and Cyber Agency (Badan Siber dan Sandi Negara)
CENCO	The Catholic Bishops Conference
CENI	Congolese Electoral Commission
Comelec	Commission on Elections
CRG	Congo Research Group

DPT	the electoral roll (Daftar Pemilih Tetap)
DRC	Democratic Republic of Congo
DRE	direct recording electronic
EBP	electronic ballot printer
ECI	Election Commission of India
ECP	Election Commission of Pakistan
e-KTP	electronic resident identification cards (Kartu Tanda Penduduk)
EMB	electoral management body
e-recap	electronic recapitulation
EVC	Electronic Voting Committee
Fortuga	Seven Three Forum
Gerindra	Grand Indonesia Movement
ICR	intelligent character recognition
IEBC	Independent Electoral and Boundaries Commission
IT	information technology
ITU	International Telecommunication Union
JPPR	The People's Voter Education Network (Jaringan Pendidikan Pemilih untuk Rakyat)
KIEMS	Kenya Integrated Election Management System
KIPP	Independent Committee for Election Observations (Komite Independen Pemantau Pemilu)
KPU	General Elections Commission of Indonesia
MK	Constitutional Court of Indonesia (Mahkamah Konstitusi)

MOIKR	Ministry of Interior and Kingdom Relations
NADRA	National Database and Registration Authority
NEC	Estonia National Electoral Committee
NEDAP	Nederlandse Apparaten Fabriek
Netgrit	Network for Democracy and Electoral Integrity
OCR	optical character recognition
ODEP	Public Expenditure Observatory (L'Observatoire de la dépense publique)
ODIHR	The Office for Democratic Institutions and Human Rights
OMR	optical mark recognition
OOC voters	out-of-country voters
PCOS	Precinct Count Optic Scan
Perludem	Association for Elections and Democracy (Perkumpulan untuk Pemilu dan Demokrasi)
PKS	Justice and Prosperity Party (Partai Keadilan Sejahtera)
PPUA Penca	Centre for Election Access of Citizens with Disabilities (Pusat Pemilihan Umum Akses)
PSA	public service announcement
RMS	result management system
RTS	result transmission systems
SADC	Southern African Development Community
SBC	Brazilian Computer Society (Sociedade Brasileira de Computação)
Sidalih	Indonesia's Voter Data Information System (Sistem Informasi Data Pemilih)

Silog	logistics information system (Sistem Informasi Logistik)
Silon	Indonesia's candidacy information system
Sipol	political party registration system (Sistem Informasi Partai Politik)
Siskohat	Integrated Hajj Communication System (Sistem Komunikasi Haji Terpadu)
Situng	electronic recapitulation technology (Sistem Informasi Penghitungan)
Siwaslu	Election Monitoring System (Sistem Pengawasan Pemilu)
TePI	Indonesia's Voters' Committee (Komite Pemilih Indonesia)
TNO	Netherlands' Organization for Applied Scientific Research (Toegepast Natuurwetenschappelijk Onderzoek)
TSE	Tribunal Superior Electoral
USSD	Unstructured Supplementary Service Data
VPN	virtual private network
VSDU	VVPAT status display unit
VVPAT	voter-verified paper audit trail

1. Introduction to election technology

With the implementation of technology, complex electoral management and administration processes can be made simpler and easier to organize. Advances in technology can thus speed processes up and reduce the workload of electoral managers. In many countries, technology is seen by the electoral management body (EMB) also as a means of minimizing the potential for errors, or as a tool in problem solving.

Indonesia has one of the five largest populations in the world, and currently uses technology in the process of registering close to 200 million voters (190 million in the 2019 elections). A database was created as part of validating and verifying the registration process and achieving a more accurate register. In Brazil, similarly, the vote recapitulation process involved so many people that the process became marred with allegations of vote manipulation practices. To tackle this issue, electronic voting machine or e-voting technology was implemented in the voting and vote counting process.

Learning from the bitter experience of irregularities and associated violence in its 2007 elections, Kenya decided to implement a range of election technologies, including biometric voter registration and a result transmission system (RTS) or electronic recapitulation (e-recap) based on recommendations of the Kriegler Commission. By contrast, Germany's Constitutional Court decided that the implementation of e-voting technology is unconstitutional and infringes the principle of the public nature of an election (German Federal Constitutional Court 2009). In the Netherlands, the implementation of e-voting technology met with severe criticism and triggered a protest movement famous for its slogan 'We Don't Trust Voting Computers'. In 2017, a few months before polling day in France, the government decided to prohibit the implementation of Internet voting technology for voters abroad, due to the risk of cyberattack.

These experiences serve as a reminder that the nature and extent of electoral technology should be tailored to the specific needs, goals and risks facing each country. Technology offers tempting advantages of speed and efficiency, advantages that are first of all viewed in the context of helping an election authority in doing their job. However, issues of adoption readiness, and their full implications, are often overlooked—with negative consequences for the credibility of the election process. Therefore, it is important to identify and prepare all phases of implementing election technology, including research and technical trials, before deciding to implement any specific technology.

Since the 2014 elections, Indonesia has started to implement various technologies in its electoral process. There are at least three categories of information technology (IT) implemented by the General Elections Commission of Indonesia (KPU): (a) technology used in the preparation phase such as the budgeting system and the election laws document and information network; (b) technology used in the implementation phase, such as voters' roll information, political party registration, campaign funds reporting, and vote recapitulation systems; and (c) technology used after the election, such as the election organizers' strategic programme information system.

Since the 2014 elections, stakeholders have also started to express their desire to implement e-voting technology. At the time of writing—ahead of the concurrent local elections (Pilkada) of 2020—KPU has issued a statement that they are planning to use a new version of the current preliminary electronic vote recapitulation system (Situng) as the official election result system in future. In previous elections, Situng was only used as a tool for transparency and as a database of election results that did not determine the official result, which was based instead on the manual recapitulation process. This raises several questions, including: How well is KPU and the current Situng prepared for this change? What aspects should and have been considered? What type of technology is to be implemented? What are the implications?

Hence the need for this publication: to help the election authorities to implement the appropriate technology in accordance with the existing electoral principles; and to stimulate constructive debate between KPU, civil society and other electoral stakeholders. Specifically, this resource has been produced in an attempt to meet the following four goals:

1. to elucidate the development of the various voting and counting technology by way of country examples;
2. to elaborate every aspect that needs to be considered and prioritized when adopting such technologies, including the required implementation procedures;

3. to elucidate the various election technologies implemented in Indonesia specifically; and
4. based on global and Indonesian experiences, to provide recommendations on what to consider when adopting election technology in Indonesia in the future.

1.1. Definitions of election technologies

There are at least four terms that should be clearly distinguished (see Figure 1):

1. *Election technology*. IT used in the electoral process, either wholly or partially in certain electoral stages.
2. *Voting technology*. IT used during the voting and vote counting at polling stations, and vote recapitulation stages.
3. *E-voting*. IT used during the voting and vote counting at polling stations. International IDEA defines e-voting as a system of recording, casting and counting votes in a political vote or election that uses IT (International IDEA 2011: 6).
4. *Internet voting (also online voting)*. The use of the Internet to conduct voting, vote counting and vote recapitulation processes.

The four terms above refer to the application of election technology according to electoral stages. It is important to note that there may be a difference between the global definition and the definition commonly used in Indonesia regarding 'e-voting technology'; in Indonesia this usually refers specifically to the vote recapitulation process only. This is understandable given that the vote recapitulation stage in Indonesian elections is more complex and arduous compared to the other stages (see Figure 2) and recapitulation technology is regarded by many as the practical solution that could render this process more efficient and accurate.

Figure 1. Global definitions of election technologies by electoral stages

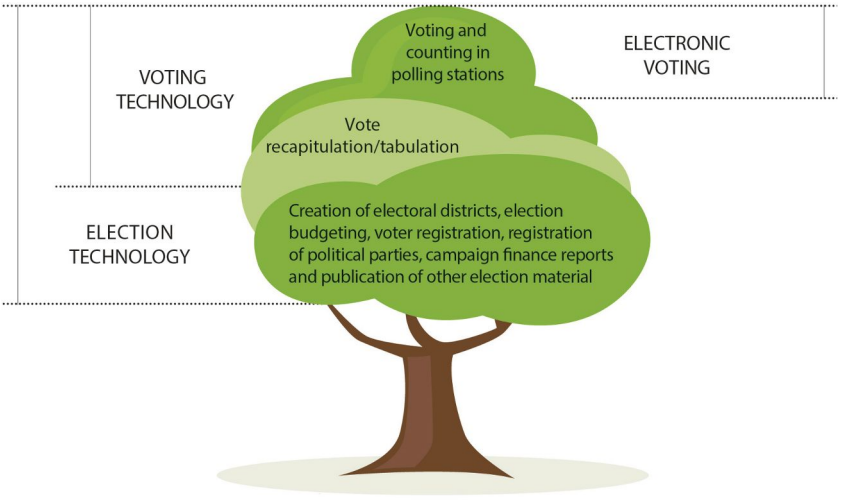


Figure 2. Vote counting-recapitulation scheme in Indonesia

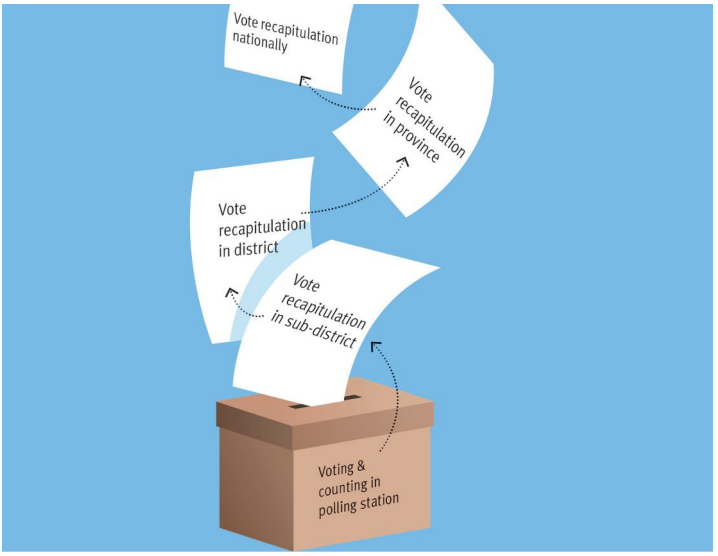


Table 1. Benefits and risks of voting technologies

Technology	Benefits	Risks
DRE (direct recording electronic)	Expediting the process of voting, counting and recapitulation of votes. In the 2010 presidential election in Brazil, the election result was announced only 75 minutes after the voting period ended (Haynes 2014: 2). Reducing margin of error in the process of voting and vote counting by reducing the amount of invalid votes. Preventing fraudulent practices such as submitting illegal ballots to the ballot box, and vote buying during the recapitulation process. Reducing the number of workers needed during vote counting. DRE allows voters with disabilities and illiterate persons to cast their vote independently.	DRE without VVPAT may lower the credibility of the DRE.[1] In the United States, use of DRE without VVPAT decreased from 38 per cent of votes in 2006 to just 25 per cent in 2016.[2] Without proper introduction and inclusive public education, illiterate voters may have difficulty casting their vote.
EBP (electronic ballot printer)	Expediting the process of voting, counting and recapitulation of votes. Reducing margin of error in the process of voting and vote counting by reducing the amount of invalid votes. Preventing fraudulent practices such as submitting illegal ballots to the ballot box, and vote buying during the recapitulation process. Reducing the number of workers needed during vote counting.	Without proper introduction and inclusive public education, illiterate voters may have difficulty casting their vote.[3]
E-pens	Expediting the vote-counting process. The device does not significantly alter the traditional way of voting so it does not require elaborate introduction/explanation to the public.	There is the possibility of misreading votes.
OMR (optical mark recognition) and OCR (optical hacracter recognition)	Expediting the vote-counting process.	The OMR and OCR machine may fail to read the ballot correctly. Special ballots that can be read more accurately by the machine carry additional cost.

Technology	Benefits	Risks
Internet voting	Serving voters who live abroad, and other voters who face physical difficulties in coming to the polling station to cast their vote. The application of Internet voting can be easily designed to cater to voters with disabilities.	Susceptible to cyberattack at a large scale. Difficult to make transparent and understandable.
E-recap	Expediting the vote counting and recapitulation processes.	There is a chance of cyberattack.
Open data and result publication	Increasing public confidence in the electoral process. Allows more public participation in safeguarding and monitoring the election. Open data can be linked to e.g. smartphone apps to educate voters on how to vote, or a website containing information about candidates.	Cyberattack on election information system may injure the integrity of the data collected; this may in turn lead to lower public trust in the credibility of the electoral process as a whole.

The ultimate purpose of implementing voting and counting technology is to make the elections process more efficient, more accurate and swifter, and to increase integrity and trust in the process. Several conditions that often arise that compel electoral authorities to adopt e-voting and e-counting technology are the following: an over-complicated election system; excessive numbers of candidates; lack of access for voters in remote areas; a voting method that is non-inclusive of people with disabilities; and a complex vote recapitulation process. The latter requires the EMB to hire a lot of temporary staff and also increases the risk of manipulation. IT is often considered to resolve these problems but, while it can improve the process, technology cannot fix overall integrity issues.

Therefore, it is not enough to know what types of voting and counting technology are implemented in various countries (e.g. in Table 2). It is also important to know the context, benefits and risks from implementing these technologies, so that better judgements can be made. All IT carries a certain degree of risk (see Table 1), especially if prepared and developed poorly, or operated in ways that fail to meet nationally acknowledged standards.

Table 2. Varieties of voting technology

Type of technology	E-vote	E-count	E-recap	Country examples
DRE (direct recording electronic)	Yes	Yes	optional	Bhutan (since 2007) Brazil (since 1996) Bulgaria (since 2017) India (since 2000) Iran (since 2017) Japan (2002–2009) Namibia (since 2014) Peru (since 2011) Venezuela (since 2004) USA (since 2002)
EBP (electronic ballot printer)	Yes	optional	optional	Argentina (some areas, 2003; 2005) Belgium (2003) Democratic Republic of Congo (2018)
E-pens	Yes	Yes	Yes	Hamburg, Germany (2008)
OMR (optical mark recognition) and OCR (optical character recognition)	No	Yes	optional	Honduras (2017) Iraq (2018) Kyrgyzstan (2017) Mongolia (since 2015) The Philippines (since 2010) USA (since 1988)
Internet voting	Yes	Yes	optional	Australia (since 2001) Canada (since 2016) Estonia (since 2005) Mexico (2012) New Zealand (since 2014) Pakistan (since 2018)
E-recap	No	No	Yes	Indonesia (since 2014) Kenya (since 2013) Pakistan (since 2018)
Open data	No	No	No	Indonesia (2014, 2015, 2017, 2018)

1.2. Types of voting technologies in polling stations

Voting devices in polling stations can be categorized into three types:

1. *E-voting*: technology used for casting the vote, vote counting, and often also for vote recapitulation.

2. *E-counting*: technology used specifically in the vote-counting process at polling stations after voting has been performed manually by voters. This technology may include the technology used for vote recapitulation at the national level.
3. *E-recapitulation*: technology used specifically in the vote recapitulation process at all polling stations. Voting and vote-counting procedures may be performed manually at polling station level, but the result is processed digitally from polling stations up to the national level during the recapitulation process.

Each of the three types of election technology has different levels of complexity and financial costs depending on its functions and features. For example, DRE and electronic ballot printer (EBP) machines are more complex than the e-recap technology developed in Indonesia and Kenya. DRE is used to facilitate three electoral activities: voting at the polling station, vote counting which is done automatically after voting at the polling station, and the recapitulation of the vote-counting results from all polling stations. Recapitulation technology, meanwhile, is only used to facilitate the vote recapitulation process to determine the election result.

In general, any technology that requires every polling station to install a device is more expensive. This requires a large number of devices, and reliable power and communication infrastructure in polling stations.

Electronic voting and vote-counting technology are expensive because of their high security needs. An EMB will not only have to prepare specific machines or hardware, but also have to ensure that the machine is equipped with extra layers of security features, stable performance capability, and ideally long usage life.

Electronic counting technology is less complex than electronic voting, depending on the type of e-counting device/technology used. Electronic counting machines are usually implemented integrally with e-recap in order to expedite the process of calculating and creating the election results tabulation across districts. There are generally four types of e-counting technology:

1. *Optical mark recognition (OMR)*. OMR is usually used to scan the ballot marked by the voter with a box or circle sign. OMR is usually used with a special paper ballot designed specifically to be scanned by the OMR machine.
2. *Optical character recognition (OCR)*. The OCR scanning system uses special software to recognize handwritten numbers or letters, and then automatically translates and stores the scan result as data that can be read by computer. If the vote-counting results were written by hand, then the election authority should verify the OCR's scanning accuracy manually, in

person. This is because handwriting can vary greatly from one person to another and the OCR is not a device equipped with machine learning capability (Chugh and Krueger n.d.).

3. *Intelligent character recognition (ICR)*. ICR is the smarter version of OCR. ICR applies complex logical text that allows the device to translate handwritten text in a document into machine-readable formats. ICR is developed with artificial intelligence (AI) technology known as neural network technology that is capable of updating the handwriting pattern database, in order to generate a more efficient scanning process and result. ICR is also capable of recognizing special spellings, grammar and contexts in order to interpret a document accurately. In order to work properly, ICR software should be run with a very fast computer. In practice, however, ICR is considered less efficient than manual data entry.
4. *Seven segment*. Seven segment is very similar to ICR. The difference is that seven segment provides a means of display whereby the machine can read a document more accurately. As with OCR, an EMB will still need to manually verify the accuracy of seven segment scanning results in person before submitting the result to be recapitulated at the next electoral stage.

E-recap technology is used as a means to expedite the recapitulation of vote counts from polling stations, so that the election authority can get the election result faster. The most common way to conduct e-recap is for election committee members or operators at polling stations, or at the EMB's office at province or regency/municipality level, to input the election result data manually. The data are submitted to a special application, either a desktop or web-based application. The data are then transmitted to the national result tabulation system.

Data entry can be done with cellular devices, mobile phones, tablets, laptops or desktop PCs. Cellular communication technologies, such as mobile applications, mobile Internet, SMS, and Unstructured Supplementary Service Data (USSD) can be used to gather data from these devices.[4, 5] Mobile applications require an Internet network to transmit data to the tabulation centre. Lastly, e-recap can also be done by fax machine. This method requires only a fax machine at local level rather than any digital application. A digital application is only needed to convert the data transmitted with the fax machine into electronic data, and this application is provided at the votes-recapitulation data centre. The fax machine method requires electricity and landline access.

The decision on what e-recap technology to implement should be made according to the availability of infrastructure, human resources, acceptability to the public and financial resources. An election authority should also consider the type and format of the form used to record the counting result at polling stations.

For example, if the counting result is written manually, then it would be better to use the OCR, ICR or digital data input rather than using the OMR technology.

1.3. Experiences of voting technology

1.3.1. Countries with DRE e-voting

The DRE machine consists of a keyboard, touchscreen, or other electronic device to input and save voters' choices automatically. DRE machines then send the saved data via the Internet, memory card and/or printed paper to the data centre, where the data will be recapitulated with the data from other DRE machines. DRE can be implemented with or without voter verified paper audit trail (VVPAT, see Box 1).

Box 1. Voter-verified paper audit trail (VVPAT)

Voter verified paper audit trail (VVPAT) is a verifiable track document for voter audit documents. VVPAT is printed by a VVPAT printer machine, which is separate from the DRE machine. VVPAT is intended to provide physical evidence of votes cast by voters. Therefore, VVPAT provides an efficient method for transparently verifying election results.

In general, the verification of election results with VVPAT is done by random assignment. VVPAT is itself subject to a recount procedure, along with a mechanism for resolving potential differences between manual and electronic calculations.

If VVPAT is not implemented, then the credibility of the voting system depends entirely on the rigor of system certification before the voting system is used (International IDEA 2011: 24).

Brazil

In Brazil, DRE consists of a voting machine and a biometric voter identity verification machine (see Figure 3). The voting machine has a screen and numeric buttons; and *branco* (blank), *corrige* (correct), and *confirma* (confirm) buttons. Brazil's DRE is not complemented with VVPAT machines and, therefore, an auditing process cannot be applied to votes.

Figure 3. Voting machine Brazil

Source: Wikimedia Commons, <https://commons.wikimedia.org/wiki/File:Urna_eletr%C3%B4nica.jpeg>, accessed 8 May 2020.

Brazil can be used as an example because there are similarities between that country and Indonesia. Although they have different forms of government—Indonesia is a unitary republic while Brazil is a federal country—the governance systems are similar, both being presidential, with multi-party legislatures. Brazil and Indonesia also both implement the open-list proportional representation electoral system, and with electorates of not dissimilar size. In the 2019 Indonesian elections, participating voters totalled 192,828,520, while in Brazil during the 2018 presidential election there were 147,306,275 voters (Clarin 2018).

Since 1994 Brazilian public discourse on e-voting has been led in large part by the Tribunal Superior Electoral (TSE), part of the specialist electoral courts within the judicial system (the latter have judiciary, administrative and legislative functions, among them electoral dispute resolution—see Filho and Marcacini 2015: 68). TSE, which had responsibility to revise the elections law and submit the revision to the legislative body for approval, was looking for a solution to eradicate fraud and manipulation in the votes recapitulation process. TSE, along with election participants, voters and other stakeholders, considered the recapitulation process to be inefficient, overly complex, unaccountable, and responsible for violations of free and fair election principles. However, only TSE saw the introduction of election technology as a potential solution. Armed with high public confidence in the institution, and successful past experience in implementing technology for, among others, voter registration between the

period of 1994 and 1995, TSE included a revision in the elections law that mandates every election to be conducted with the help of election technology (Goldsmith and Ruthrauff 2013: 236–38).

The Brazilian Parliament approved the proposal although the new elections law did not give specifications for the e-voting machine and how it should work. The revised election law only specifies that any voter shall input the candidacy number of her/his preferred candidate, and that the portrait of municipality mayoral candidates is to be displayed on the monitor. The law also mandates that TSE shall, 120 days before the election day, allow and help any political party or company contracted by a political party to audit the code used in the machine (Goldsmith and Ruthrauff 2013: 240).

After the election law was passed, TSE started to gradually introduce the voting technology and DRE was first used in 1996. It was subsequently applied to district level elections in 1998 and 2000 and in the 2002 elections to serve more than 100 million voters. In this election, Brazilians in all regions used more than 400,000 DRE machines (Filho and Marcacini 2015: 70). With DRE, the election result was known just one day after the end of polling day, and TSE verified the result within just five days. Vote tabulation was done offline and published online (International IDEA n.d.).

The implementation of e-voting in Brazil initially received almost no criticism from the public. The main concern expressed by the public is that they think the DRE machine is not secure enough, because even developed countries refuse to use the first-generation DRE machine adopted by the Brazilian Government. Many people also criticized TSE for adopting the e-voting machine too hastily, without sufficient time for the public to deliberate and openly debate the change. When the e-voting machine was introduced by TSE and the (pre-2016) Brazilian Government, this achievement was seen as a symbol of progress and a source of pride within the country. For some on that side of the debate, those who criticize the e-voting are considered unpatriotic. As a way to inform the public, the Electoral Court issues public service announcements (PSAs) through television, radio and newspapers every two years and a few months before election day. The PSAs inform the public on how to use the e-voting machine and the benefits of implementing it (Filho and Marcacini 2015: 65–71).

The debate surrounding the implementation of e-voting is mostly about the use of VVPAT. Election experts and politicians want to use VVPAT as an auditing mechanism. In 2002, Congress passed Law No. 10.408 mandating TSE to implement VVPAT technology in the 2002 election. However, TSE refused to implement it on the grounds that using VVPAT with DRE machines could increase the rate of error, posing the same problems as using paper ballots, and that it would be more costly. Congress then revised the regulation by issuing The Election Law No. 1.503 in 2003 that cancels the use of VVPAT (Goldsmith and Ruthrauff 2013: 240). Auditing then is performed by, first, allowing external

parties (election observers) to check DRE devices; and, second, requiring all DRE machines to generate a file called a Digital Ballots Register. This file is used to verify that the total votes are equal to the total number of voters who came to the polling station and cast their vote (Filho and Marcacini 2015: 73).

The regulation survived until 2009 when Congress, through the influence of the Working Democratic Party, required TSE to implement VVPAT in the 2014 elections. Congress also required the e-voting machine *not* to be equipped with a voter identity verification machine. TSE challenged this rule by filing a judicial review request to the Supreme Court. TSE argued that if the voter identity verification machine and the e-voting machine were not connected, voters could cast their vote an infinite number of times. The judges of the Supreme Court also expressed their concern that if the VVPAT printer got jammed, any election official might be able to see voters' choices when he/she repaired the printer, and that this would surely compromise the confidentiality principle (Goldsmith and Ruthrauff 2013: 241).

Another debate arose in 2010 when Congress asserted that pure electronic counting is unconstitutional because it does not satisfy the publicity principle. The Electoral Court then initiated an anti-VVPAT campaign. According to TSE, VVPAT slows down the voting process, is prone to technical error, is expensive, and opens up the possibility of manipulation (Filho and Marcacini 2015: 74–75). The Supreme Court then approved TSE's argument.

In November 2013, the Supreme Court unanimously decided that the printed auditing trail paper method as specified in the VVPAT Law is unconstitutional. The Supreme Court held that the voting machine works by printing a unique identification number from the voter's paper ballot, which is connected to the voter's digital signature, and that this procedure violates the confidentiality principle. In this many election and legal experts in Brazil think the Supreme Court is mistaken (Filho and Marcacini 2015: 82–84).

As the institution responsible for facilitating the electoral process, TSE works with the Brazilian Computer Society (SBC) to maintain their election technology system. SBC is helping TSE in its effort to build, research and improve computational technology for elections (Goldsmith and Ruthrauff 2013: 241). DRE programming is designed to separate the counting of votes for each type of election. For example, if a voter inputs the mayoral candidate number incorrectly that renders her/his vote invalid for that contest, but her/his vote for the governor's election will remain valid. Invalid votes and votes not to choose any of the listed candidates are separated from the total votes (Shalders 2018a).

The DRE machine in Brazil is also designed to facilitate voting for those with disabilities. The Braille alphabet system is used on the keypad of the machine, and the voting booth can also be equipped with an audio system by request. In the state of Sao Paolo, for example, every polling station prepared headsets (Shalders 2018b).

As regards auditing the e-voting machine, stakeholders have the right to appoint independent auditors to audit the software code used. The appointed auditors audit all the code with computers provided in a special room controlled by TSE headquarters. In order to gain access to all the necessary documents and source codes, the auditors are required to sign a non-disclosure agreement (Filho and Marcacini 2015: 75).

Another auditing method used by the Electoral Court since 2002 is the parallel voting method (*votação paralela*). One day before the election day several e-voting machines are randomly selected by the election authority for each state. These machines are replaced in polling stations with other machines to be used in the election and the selected machines are delivered to the authority for public testing. The test is conducted during polling day and can be monitored by all stakeholders. The election authority performs the test by also processing the votes cast by voters, then comparing the result with the result generated by the e-voting machine at polling stations (Filho and Marcacini 2015: 77).

Box 2. Direct recording electronic (DRE) and public trust

The lack of VVPAT technology caused some problems in Brazil's 2018 national elections. The presidential candidate from the Liberal Social Party, Jair Bolsonaro, expressed a suspicion that the DRE machines used since 1996 had been tampered with. Bolsonaro, a legislator for 30 years, had previously proposed revising the Elections Law to make it mandatory for the elections authority to install VVPAT to enable manual audit of election results.

Bolsonaro and his supporters were outraged when Eduardo, Bolsonaro's son, shared a video on Twitter depicting a voter voting for candidate number 1, but the e-voting machine recommending him to vote for candidate number 13, the biggest rival of Bolsonaro from the Workers Party, instead. TSE and the Brazilian Government said that the video was a hoax, which only further enraged Bolsonaro's avid supporters. The Elections Tribunal of Brazil continue to reject the idea of using audit paper trail devices on grounds of maintaining voters' confidentiality.

Learning from this experience, care should be taken before deciding to implement DRE technology, especially in a society with political polarization, where hoaxes are widespread, and literacy rates are low. Brazil has been implementing the DRE technology since 1999 and 2018 was the first time the public expressed major dissatisfaction.

Brazil's experience shows that although e-voting technology has been implemented for several decades, there will always be criticisms that have to be answered. Criticisms in Brazil (see also Box 2) occurred not only because of the

lack of social dialogue and public acceptance, but also because the election authority had failed to provide the necessary information to the public regarding the technology to be used and its available alternatives. The decision issued by the Brazilian Supreme Court needs to be highlighted. The decision to reject VVPAT technology because it allegedly violates the confidentiality principle is an example of lack of understanding about the technology implemented. Without an auditing mechanism approved by all stakeholders to verify that the result is accurate, and that election technology is not violating any of the election principles, election results will only be subject to more disputes.

India

The Indian experience is interesting for three reasons. First, the fact that like Indonesia, India has a high population, although far higher in fact (900 million voters in the 2019 elections). Second, India similarly has a two-chamber parliament system. Third, India has long experience of implementing e-voting.

E-voting was first implemented in the legislative election in Kerala, in the electoral area of Parur, in May 1982. DRE machines were installed at 50 polling stations. These machines were then used in legislative elections in 10 other electoral areas during 1982–1983. However, implementation had to be stopped because its only formal backing was a Notification Letter of the Election Commission of India (ECI); at the time there was no mandate in law to adopt e-voting. In its ruling, the Supreme Court mandated the election authority to repeat the ballot at those polling stations that had used e-voting. Further, the Supreme Court stated that the use of electronic machinery shall conform to the rules contained in the laws. In December 1988, the Parliament of India revised the Representation of the People Law of 1951. In Article 61A, it is specified that ECI is allowed to implement e-voting in elections (ECI 2018).

The amendment of the law was then followed by the amendment of the ECI regulations. The regulations specify that every voting machine shall have a control unit and a voting unit, and the voting machine design requires approval from ECI. The regulations also specify in detail how to prepare the e-voting machine, how to record votes with the e-voting machine, the procedure to seal an e-voting machine after the voting process, and the procedure to transport the e-voting machine to the election authority at regency/municipality level (Bailey and Sharma 2015: 96).

The implementation of e-voting in India is considered important by ECI because manual voting poses two problems. First, technical difficulty in printing and distributing paper ballots. In every election, the election authority was faced with similar problems such as mis-delivery of ballots, design printing errors, and the absence of voting signs in the specified place on the ballot. Second, the high cost of organizing an election and procuring its logistical requisites, due to the

high number of voters. E-voting is considered as the appropriate solution to those problems (Bailey and Sharma 2015: 92–94).

The DRE machine as used in India before implementation of VVPAT was mandated—that is, before 2014—was composed of two units. These were the ballot machine (or balloting unit) with 16 buttons to choose electoral candidates (identified by symbol as well as name and number, for disability inclusion), and the control machine. The two machines were connected with a 5-metre cable (Puri, Singh and Kaushal 2017: 44). Before 2006, four balloting units could be used at the same time at one polling station (a choice of up to 64 election candidates), connected with one control unit. After 2006, the capability was upgraded so that one control unit could be connected with 24 balloting units (a choice of 384 election candidates). Votes are automatically counted by the control unit (ECI 2018).

ECI is proud of the simplicity and low cost of the technology developed by Indian companies as compared with DRE machines used in other countries (ECI 2018). The machine also does not require an electricity connection as it uses battery power (Biswas 2019). E-voting was implemented throughout all of India for the first time in the 2004 elections (Bailey and Sharma 2015: 97).

As in Brazil, debate over VVPAT also occurred in India. During a meeting between political parties and the ECI held on 4 October 2010, all parties said that they were satisfied with the implementation of DRE e-voting machines. However, several parties demanded that ECI implement VVPAT to make the election process more transparent and verifiable (ECI 2018). At that time, there was even a Public Interests Petition submitted to the High Court of Delhi demanding that ECI introduce VVPAT so that every voter could be assured that the machine would record her/his vote correctly. According to some, VVPAT is very useful in the case of e-voting, and a prerequisite for satisfying free and fair election principles where DRE is used (Bailey and Sharma 2015: 97).

After the 2010 meeting with political parties, ECI followed up the recommendation provided by political parties and the Technical Experts' Committee. ECI asked two companies, Electronics Corporation of India and Bharat Electronics Limited, to develop an e-voting machine prototype equipped with a VVPAT system. The result was demonstrated in front of ECI and the committee in 2011, and demonstrations were conducted in five different areas where political parties, media and civil society organizations (CSOs) were involved.

The first prototype was somewhat disappointing, and the two companies decided to assemble a second prototype. ECI conducted simulations in five different areas during July and August of 2012. On 19 February 2013, the second prototype was approved by the committee, who then recommended that ECI revise the election technical regulations accordingly (ECI 2018).

Figure 4. Direct recording electronic (DRE) machine with voter-verified paper audit trail (VVPAT) printer

Source: Wikimedia Commons, <https://commons.wikimedia.org/wiki/File:The_Deputy_Election_Commissioner,_Dr._Alok_Shukla_organised_a_media_preview_of_the_Electronic_Voting_Machine_%26_Voter_Verifiable_Paper_Audit_Trail_(VVPAT),_in_New_Delhi_on_June_21,_2011.jpg>, accessed 20 April 2020

The VVPAT system hardware (see Figure 4) is composed of two devices—the printer and the VVPAT Status Display Unit (VSDU). The control unit (aforementioned) and VSDU are kept by the polling station officials, while the balloting unit and VVPAT printer are installed inside the voting booth.

When a vote is cast, the VVPAT printer will generate a receipt containing the serial number, name and symbol of the selected candidate, and the VSDU will display the voting status for seven seconds to notify the voter that the machine has recorded her/his vote successfully. The voting receipt will then automatically cut and fall into a sealed VVPAT box (ECI 2018).

VVPAT is considered important because it assured voters that the e-voting machine has recorded their vote correctly. VVPAT generates confidence among election officials, participants and voters that the implementation of election technology is in accordance with free and fair election principles.

VVPAT was first implemented in the 2013 Nagaland legislative election in the electoral area of Noksen. Since May 2017, VVPAT has been implemented at all polling stations in the Lok Sabha (parliamentary) by-elections (ECI 2018).

The same DRE machines were used once again in the 2019 election held on 11 April and catering to almost 900 million voters (Suri and Gupta 2019). ECI

declared the Lok Sabha election result by matching the result from electronic vote counting with manual counting of VVPAT-generated receipts. Of 542 electoral areas, none reported any discrepancy between the electronic and manual counting results. It is important to remember that not all receipts printed by VVPAT were counted. Following protests from opposition parties the Supreme Court mandated counting of receipts generated by VVPAT in five polling stations per electoral area; previously, only one polling station per electoral area had been so counted (Nambiar 2019). Ahead of the voting, opposition parties had asked ECI to reintroduce manual voting and vote counting, or to conduct VVPAT receipt counting in 50 per cent of polling stations per electoral area. Their demand was not granted (Nambiar 2019). The opposition camp was reported to accept the election result (Biswas 2019).

There are, of course, demands from the public to return to the manual voting method. Up to 2015 there were 51 court rulings related to the implementation of e-voting. Usually, legal challenges are filed by losing candidates who maintain that the e-voting machine recorded votes incorrectly. In the 1999 Kartanaka legislative election, for example, one of the losing candidates filed a lawsuit to the High Court of Kartanaka. However, after listening to explanations provided by the experts who designed the e-voting machine, the court ruled that there is no proof that the e-voting machine is prone to manipulation. The court also ruled that e-voting is worth maintaining because it reduces election costs; speeds up the voting, counting and recapitulation process; and effectively seals off any loopholes that might be exploited in the manual voting method. In addition, the plaintiff was not able to provide convincing evidence that the e-voting machines had been tampered with (Bailey and Sharma 2015: 96–97). (For more on security of the voting system see Box 3.)

E-voting in India endures, despite many lawsuits challenging it, because there has not been any significant irrefutable proof that its use is problematic. Criticism tends to be drowned out by the support it garners popular support and a prevailing sense viewpoint that many people the benefit from it. E-voting in India successfully provides an answer to the problem of time and high cost, and the VVPAT technology has helped to allay concerns about the potential for fraud and manipulation. Government support and confidence in ECI as an independent institution responsible for improving the quality of elections have been important factors in the advance of election technology in India. Public communications and voters' education on the e-voting machine through various social media channels and the official website of ECI also play an important role in increasing public acceptance of e-voting in India.

Box 3. Security of India's online voter registration

An Indian cybersecurity expert, Srinivas Kodali, filed a petition to the Hyderabad Supreme Court on 3 November 2018. Kodali asked ECI to implement an open feature that shows the history of voters' name deletion and to give up the source code used in the online voter registration system.

The ECI, like many voters in India, did not consider cybersecurity of the DRE machines to be an important issue because the machines were not connected to the Internet. However, the public have demanded a better and more transparent online voter registration system, prompting ECI to start introducing stricter cybersecurity measures in that domain. The security of ECI's website has also been improved, not least because it is used to publish information about election results (Chopra 2018).

In preparation for the 2019 election, ECI conducted a series of protection measures to the cybersecurity of the election IT system, especially to the voter database system and office network. Cyber protection then became an important issue during the election and was included in the planning phase because ECI was well aware of the gravity of the cyber hacking threat (Chopra 2018).

The first step taken by ECI on 17 March 2019 was to issue a Cybersecurity Protocol. The protocol contains guidance on how to prevent unauthorized access to the system; duplication and modification of data; and diversion, impairment and loss of data. This protocol was made available to the public and downloadable via the ECI website. Also, ECI created an educational video on cybersecurity available via ECI's YouTube channel.

Protection of voters' data which are stored in the online voter database system became the focus of ECI's cyber protection effort because it has frequently been the target of interference. In the local parliament election in December 2017, for example, many voters complained that their name was missing from the electoral roll. Voters expressed their frustration on Twitter by tweeting the #whereismyvote hashtag. This problem had an impact on ECI's reputation, not least because the ECI had indeed deleted 2.2 million voters from the system on grounds that they had been duplicated (Thaker 2018).

The Netherlands

The experience of the Netherlands is also interesting. This country, which adopts the parliamentarian system, also implements the same election system as Indonesia, that is the open-list proportional representation system. In the Netherlands, citizens are not required to register as voters to vote. Any citizen with the voting right and registered address is allowed to come to the polling station and cast their vote. There are two groups of people that are required to

register before they can vote: homeless people with no address and Netherlands citizens who live abroad (Jansen 2012: 1). Organizing elections is the responsibility of regional government. Government at municipality level is responsible for printing ballots and counting votes, and for deciding whether voting is conducted manually or electronically. Meanwhile, responsibility for organizing elections at polling station level is assumed by government employees or volunteers who have received short courses from the government (Jansen 2012: 1).

Machine voting was first considered by the Parliament Committee for Home Affairs in October 1964. Parliament members were basically supportive of introducing technology, but had several concerns nevertheless: (a) would voters with less education be able to use the technology properly; (b) would the confidentiality principle be compromised if an electoral officer assisted a voter to use the technology inside the voting booth; (c) would the complexity of the technology mislead voters into choosing the wrong candidates; and (d) would technical error lead to incorrect electoral results? However, no political parties at the time seriously elaborated on these issues. As a result, Parliament passed the Electronic Act in 1965. Voting with technological assistance was then introduced gradually in many cities, with Amsterdam becoming the last city to adopt e-voting (Jansen 2012: 2) (see Figure 5).

Figure 5. Direct recording electronic (DRE) machine in the Netherlands

Source: Wikimedia Commons, <https://commons.wikimedia.org/wiki/File:Verkiezingen2.JPG>, accessed 20 April 2020

Criticism of voting and counting technology was first expressed by a minor party, Centrumdemocraten, who lost their seats at the 1998 parliamentary election (Jansen 2012: 2). Criticism also arose in the Parliament in response to

technical errors that occurred in the tabulation system during local elections. The media covered the debate, in which the Secretary of State asked for advice from the Election Council in regard to these problems, and expressed his concern over the monopoly held by Nederlandse Apparaten Fabriek (NEDAP) on the tabulation process (whereby NEDAP is the sole keeper of the source code). The sub-committee formed by the Ministry of Interior and Kingdom Relations (MOIKR) finally advised establishing a certification procedure for the e-recap software. However, both the Parliament and MOIKR failed to follow up on that advice (Goldsmith and Ruthrauff 2013: 265–66).

The Election Council would continue to have concerns in the following years. In March 2003, the Election Council wrote a letter to the ministry responsible for introducing the software certification, which listed errors found in the e-recapitulation software during the 2002 and 2003 elections. The Election Council also emphasized a lack of control mechanisms. This intervention again failed to produce results.

A wave of public protests began in July 2006. Rop Gonggrijp, founder of the first Internet service company in the Netherlands and well-known for his involvement in the WikiLeaks movement (Jansen 2012: 4), along with other computer experts initiated a campaign around the slogan 'We Don't Trust Voting Computers'. This was directed against the introduction of e-voting in the Amsterdam municipality election, for the very first time, in March 2006. Gonggrijp doubted the security of the hardware proposed and was disappointed that it had no auditing mechanism. He then initiated a public debate on the use of computers in electronic voting by publishing investigation result on the e-voting system (Goldsmith and Ruthrauff 2013: 266).

The 'We Don't Trust Voting Computers' campaign became a media sensation and was covered by national television. The media questioned the Netherlands' Organization for Applied Scientific Research (TNO)'s capability to test e-voting machines; it was found that TNO had only tested 1 out of 8,000 e-voting machines in a period of four years. It was also found that TNO never conducted security testing (Goldsmith and Ruthrauff 2013: 268).

The public in the Netherlands has also expressed their concern over the colour of the confirmation button of the e-voting machine. The confirmation button is red which is commonly associated with 'alert' or 'cancel' commands rather than confirmation. For some of the machines, the manufacturers have changed the red button to green (Jansen 2012: 3).

The e-voting machine manufacturers in the Netherlands accused the campaign of being a conspiracy and tried to convince the public that their products had been thoroughly tested. However, 'We Don't Trust Voting Computers' activists successfully demonstrated to the public that the memory chip of an e-voting machine could be easily substituted, and that election results were potentially open to manipulation (Goldsmith and Ruthrauff 2013: 268).

In response the Minister of MOIKR, Atzo Nicolai, made an immediate request of the Netherlands' General Intelligence and Security Service (AIVD) to perform independent testing on the e-voting machines. The results were that three of the four machines manufactured by one of the companies passed the test. One other machine manufactured by a second company was considered eligible for use, but the VSDU machines tested were considered not secure enough. Minister Nicolai recalled 1,200 VSDU machines on 30 October 2006, only three weeks before the election day. As a result, voters in several cities had to resort to manual voting, or switch to NEDAP's machine. Members of Parliament asked Nicolai to form two independent commissions to analyse the implementation of e-voting machines in the past (Goldsmith and Ruthrauff 2013: 269).

The Voting Machines Decision-making Commission produced six conclusions in their report of 16 April 2007. First, they considered that the e-voting issue had not received enough attention. Second, that MOIKR lacked sufficient technical knowledge, making them highly dependent on technology vendors. Third, that MOIKR had failed to perform effective monitoring. Fourth, that the testing and certification standard set by TNO was outdated and could not be relied upon to protect the system from modern cyber threats. Fifth, that TNO failed to act accountably and transparently by not publishing the certification and testing report, in effect blocking access for independent experts to verify the certification and testing result. Sixth, that the legal framework offered no proper regulation of electronic voting, especially regarding the necessary security requirements (Goldsmith and Ruthrauff 2013: 270–71).

Following the Voting Machines Decision-making Commission report, another was published by the Election Process Advisory Commission (on 23 September 2007) which described voting principles and linked them to various voting methods available in the Netherlands. The latter made at least two principal criticisms: first, that the government had no detailed regulation on the management and security of election equipment; and second, that the e-voting system was not verifiable and transparent enough: there was no way for a voter to know whether her/his vote had been properly saved or recorded in the system (Goldsmith and Ruthrauff 2013: 271).

The Election Process Advisory Commission concluded that the conventional voting method at polling stations should be the main voting method in the country. Every municipality should implement the same voting method and voting by paper ballot was the most recommended method. In regard to the vote counting process, the commission agreed to the use of ballot printers or ballot counter machines because both technologies produce a physical audit paper trail that can be verified by voters (Goldsmith and Ruthrauff 2013: 272).

On 23 September 2007, the Secretary of State held a press conference to announce that the government would revoke the 1997 Regulations on the Approval of Voting Machine. Not long after that, the State Court of Netherlands

issued a decision on 1 October 2007 to revoke the certification for all e-voting machines. Therefore, e-voting machines are no longer available in the country (Goldsmith and Ruthrauff 2013: 272).

The Netherlands' experience shows the importance of comprehensive legal regulations to specify the principles and requirements to be met by voting and counting technologies, and the importance of transparency in how the technology system works. Regulations should be debated and formulated by all stakeholders, including representatives from civil society. Also, no company should have a monopoly over a technology used in voting applications, especially when the producer is a private company.

1.3.2. Electronic ballot printer (EBP) in Democratic Republic of Congo

The EBP machine is similar to the DRE machine. The difference is that EBP does not save voters' input. After a voter casts her/his vote with the EBP machine, the machine will print out a token card that contains information about the voter's choice. This token card must then be inserted into a ballot box with other cards to be counted and recapitulated later, either manually or electronically.

The EBP consists of two machines, the ballot printer (that prints out the ballot that signifies a voter's choice) and the ballot scanner (to scan the ballot so that the data contained on it can be recorded). The token card generated by the EBP serves a similar function to the audit paper trail generated by DRE. Consisting of two devices, the EBP is more expensive than the DRE machine. However, the EBP ballot printer machine significantly reduces the cost of procuring ballots, especially if due to large number of candidates a large and complex ballot design is needed.

EBP technology with ballot scanning was adopted by the Congolese Electoral Commission (CENI) for use in concurrent (that is, presidential, legislative and governor) elections of 30 December 2018 in Democratic Republic of Congo (DRC).[6] With the EBP machine, voters in Congo cast their vote by inserting the ballot paper into the EBP machine. The machine then checks the QR code. If the QR code is valid, then the voter can proceed to cast their vote. The voting process starts with the presidential election, and then the parliamentary elections at national and provincial level. Voters' choices are printed into three different token cards by the internal thermal printer. The vote is stored in a database, and then the voter puts the token cards into ballot boxes. If the EBP machine shuts down due to power failure or printer error, the voter can still finish the voting process when the electricity is back on and the machine is restarted. This is possible because the machine does not record the voter's selection until the token cards are printed (Westminster Foundation for Democracy 2018: 5).

CENI has provided information and demonstrations for the public on how to use the EBP machine since March 2017, when CENI commissioners brought

home three EBP e-voting machines following their visit to South Korea. Congo Research Group (CRG) reported that, since the first demonstration event, two out of the three e-voting machines have experienced problems. This disappointing fact deterred CENI from adopting EBP technology for the 2017 governors' election, and they requested the manufacturer to improve the machines so that they could be used for the 2018 national elections (Congo Research Group 2018: 2).

In the report entitled 'Voting Machine Review of Democratic Republic of Congo in August 2018' (Westminster Foundation for Democracy 2018), it is reported that the first prototype called P1 arrived in Congo in August 2017. After some tests were conducted, CENI asked the manufacturer to develop a second prototype. P2 arrived in Congo in January 2018. Unsatisfied with P2, CENI asked for more developments until P3 was launched in February 2018. With the P3 model, the internal battery is removable, with 24 volt capacity—P2 only has 12 volt capacity. P3 is also equipped with an active scanner to read and process the election result tabulation form; an additional 1 GB of memory capacity; and an AES 256-bit encryption system for security, including SQLite database (P2 is equipped with AES 128-bit).

CENI's insistence on adopting EBP for the 2018 national and concurrent elections was based on its conviction that electronic technology would reduce fraud and manipulation, while also expediting the process of obtaining the election result and at cost savings of up to USD 100 million. The decision to adopt the technology was taken despite many people being against it, including the opposition parties and the US Government as a donor country. The reasons for opposition were varied, ranging from the fact that the EBP machines had been shown to be problematic ever since they were first demonstrated; lack of infrastructure in Congo (many remote areas are without sufficient electricity power supply); the fact that a quarter of Congo's population are illiterate; and the difficulty of ensuring the machines' production and distribution schedule would be met (International Crisis Group 2018).

It was only later that the public discovered that CENI did not have the resources and capability to conduct detailed inspection of the software, source code and database. CENI officers only had rudimentary knowledge about the machine's features based on brief descriptions provided by the manufacturer (Westminster Foundation for Democracy 2018: 3).

CRG, Acting for Transparent and Appeased Elections (AETA), Public Expenditure Observatory (ODEP) and other CSOs in Congo predicted that e-voting in the concurrent presidential, legislative and governor elections on 23 December 2018 would not be smoothly implemented. CENI only had 16 months' preparation for the adoption of e-voting. CENI had not given full demonstrations on how to vote using the e-voting machine at polling stations where there would be perhaps 300 voters. CENI could only make a rough

estimate that each voter would take approximately 1.5 to 2 minutes in the voting booth to cast their ballot using the e-voting machine (Bax and Clowes 2018).[7]

Box 4. Congolese public perceptions of the electronic ballot printer (EBP)

A survey conducted by CRG in February 2018 showed that 69 per cent of voters in Democratic Republic of Congo did not believe that CENI would be able to organize free and fair elections. Resistance against the EBP machine grew even higher after this point; 10 days before voting day (23 December 2018), the storage facility where the EBP machine was kept in the capital, Kinshasa, was burned down at 02:00 hours (Paravicini 2018). The fire rendered 80 per cent of the EBP machines unusable. As a result, CENI delayed the voting day until 30 December 2018 to procure five million printed ballots (Burke 2018).

The decision to implement e-voting was taken by CENI without due consideration of legal aspects and the constitution. CENI apparently realized the danger that might arise due to the lack of constitutional basis for the move, and so began to use the term 'EBP' to refer to what previously had been known as 'e-voting'.

Elections on 30 December went quite well; however, some were unable to vote because due to conflict and the Ebola outbreak, election activities did not reach certain areas (such as Beni, Yumbi and Butembo) (Giles 2018). Further, media organizations including Reuters, the *New York Times* and the *Sunday Times* reported some Kinshasa polling stations opened up to six hours late, causing long lines of voters. The delay was caused by damage to 7,000 EBP machines in a warehouse fire and by heavy rain. In other regions, heavy rains also caused delays in the voting process at 830 polling stations, as reported by The Catholic Bishops Conference (CENCO), one of the most widely referenced election monitoring institutions in DRC (Paravicini 2018). CENCO also reported as many as 544 out of 12,300 polling stations had defective EBP machines. In more than 100 polling stations, election observers were prohibited to monitor the voting and counting process.

Political tension rose uncontrollably when hoaxes about the election result spread through social media. The Government of DRC then decided to shut down access to the Internet access and SMS services until the election result was announced on 6 January 2019. The government also shut down the broadcasting signal of the most famous radio station in Congo, Radio France International, after it had broadcast the result as spread by the opposition camp (Reuters 2019).

The fact is that up until 6 January 2019, CENI did not publish the national vote recapitulation result (Maclean 2019). CENI announced the official result only when Felix Tshisekedi came out as the President-elect on 19 January.

Tshisekedi's victory was immediately followed with allegations of fraud from the losing side, and from experts and election observers both national and international (Burke 2019). The Southern African Development Community (SADC) urged CENI to re-run the election. Meanwhile one of the candidates, Martin Fayulu, filed an election result dispute to the Constitutional Court (Reuters 2019). Tshisekedi was finally inaugurated as President on 24 January 2019. Detailed election results were never published (Bujakera 2019).

There are important lessons that can be taken from DRC's experience with adopting EBP, which is why it is included in this Guide. Other than Kenya's Constitutional Court approving the 2018 election result as announced by CENI, the adoption of the new technology was a disappointment. The new technology was developed in too short a time frame, had no legal basis in the constitution, and was not generally accepted by the public. Implementation of election technology by the EMB was instead forced through, leading to a turbulent environment in which a mob of protesters burned down the storage facility in Kinshasa where the e-voting machines were kept (see Box 4), and as well as conflict between supporters of rival candidates.[8] This was ultimately due to uncertainty of the election result and lack of transparency from the EMB.

1.3.3. Countries with experience of Internet voting

Internet voting allows citizens to participate electorally without having to attend polling stations. Voters can cast their vote anywhere via any computer, tablet computer or smartphone, as long as this device is connected to the Internet. The election authority may also be able to provide computers and Internet access at some polling stations.

Internet voting is considered to be more inclusive of voters with disabilities and voters abroad, although it requires more high-level security and assurance of confidentiality. System development must ensure that the system is secure from any threat from hackers who want to destabilize or manipulate the election result. Internet voting should also have features to make the electoral process transparent.

Estonia

Estonia is the best example of a country that has successfully implemented Internet voting. This country, which is directly adjacent to Latvia and Russia, was the first to introduce Internet voting as 1 of the 10 voting methods in its 2005 elections (International IDEA 2011: 18). The EMB felt ready to introduce Internet voting technology because the Estonian Government had experience of using online systems to provide public services to its citizens, and the EMB itself had already digitized certain other electoral processes (Vinkel 2012: 176). In 2019, the total population of Estonia was 1,325,879 (World Population Review n.d.).

Estonia used Internet voting technology in the 2005 local elections, the 2007 parliamentary election, the 2009 European Parliament election, the 2009 local elections, the 2011 parliamentary election, the 2014 European Parliament election, the 2015 parliamentary election, and the 2017 local elections (E-Estonia 2018). Since it was first adopted, the number of voters using the Internet voting technology has increased (see Table 3). It became the most used voting method during the 2011 parliamentary election (Vinkel 2012: 176).

Table 3. Growth of Internet voting in Estonia

Election type and date	Voters participating by Internet (%)
Local (2005)	1.9
Parliamentary (2007)	5.5
European Parliament (2009)	14.7
Local (2009)	15.8
Parliamentary (2011)	24.3
European Parliament (2014)	31.3
Parliamentary (2015)	30.5

Source: E-Estonia, *Frequently asked questions i-voting*, <https://e-estonia.com/wp-content/uploads/faq-a4-v02-i-voting-1.pdf>, accessed 2018.

Priit Vinkel, a member of Estonia's Election Commission Secretariat since 2005, explains that the success of Internet voting in the country is down to three factors. First, openness and enthusiasm for e-government among the public (cultural characteristics). Second, a secure Internet voter identification system. Third, transparent monitoring of the system's compliance with election principles. These three foundations ensure that public trust in the Internet voting system is consistently high, as evidenced by the increasing rate of participation in every election (Vinkel 2012: 179).

Vinkel emphasizes the importance of electronic identification, or e-ID, as an indispensable component in Estonia's electronic public service as a whole. Since 2002, every citizen in Estonia above the age of 15 is required to have an e-ID. Issued by the government, e-ID contains a certificate and digital signature that serves as remote authentication. The certificate contains the name of the e-ID owner and a personal code, and is equipped with two key codes protected by a password set up by the user. The e-ID also contains electronic data about the owner that can be accessed by the public. Any person that misuses e-ID is liable to be punished with fines or imprisonment of up to three years (Vinkel 2012: 180–81).

Any voter who wishes to vote via Internet voting can access the website (<https://www.valimised.ee>) via computer or smartphone. Voters can login to the application by inputting their e-ID number or mobile ID. If the registration is successful, the system will display all candidates standing for election.

After the voter has selected her/his favoured candidate the system then prompts the voter to confirm their selection. If the voter chooses 'yes', the system will then ask the voter to input second PIN code as designated. If the vote has been successfully recorded, the system will prompt a notification to this effect. The system will also inform the voter that he/she may vote as many times as he/she likes, but only the last vote will be counted.

Box 5. Confidentiality in Estonia's Internet voting system

The confidentiality of voting as specified in the Estonian Constitution is construed by legislators to have two distinct sub-principles: secrecy of direct and personal voting; and anonymity during vote counting. Internet voting satisfies both of the sub-principles because it applies a 'double envelope' scheme for vote counting (Vinkel 2012: 182).

This double envelope scheme has been proven to effectively safeguard the confidentiality of voters in other countries. In this scheme, every voter is required to insert her/his ballot into an envelope. This envelope is then inserted into a bigger envelope and digitally signed. The voter is also required to write down her/his name or address on the big envelope.

The big envelope will then be delivered to a central site to be verified and confirmed so that only one vote per identity will be counted. Before the votes are counted, the voter's digital signature and personal information—as shown on the big envelope—are deleted, and the encrypted, anonymous vote—as contained in the smaller envelope—is inserted into the ballot box to be counted.

This scheme uses two types of cryptography—public key and personal key. The voting system is encrypted with a public key, while the voter's vote is encrypted with a personal key. A vote can only be counted if the public key and the personal key, which are paired to one another, are a match. The election official keeps the personal key, and on the day of the election, he/she opens the ballot box of Internet voting with both keys.

Voters in Estonia are able to revise their vote, i.e. use the Internet voting system more than once. The EMB also gives voters a free choice of whether to use the conventional voting method instead. However, this option only applies until several days before the official voting day. If a voter casts her/his vote via the Internet and, later, also participates in conventional voting on the election day,

the latter vote prevails (Vinkel 2012: 182). The EMB of Estonia upholds the principles of ballot secrecy (see Box 5) and 'one person, one vote'.

In general, the implementation of Internet voting in Estonia has been successful and welcomed by the public. However, there is always the lingering question about cybersecurity, money politics and the widespread practice of vote buying (Wigartz 2017: 6). Since 2010, there has been a surge in public demand and debate concerning the need to implement a better verification system. This prompted the Estonia National Electoral Committee (NEC) in 2011 to form an Electronic Voting Committee (EVC) to enhance this and other aspects of Internet voting implementation. Several amendments to the Elections Law were made to accommodate the implementation of the new verification system in the 2011 parliamentary election (ODIHR 2015: 1).

The EVC has no authority to make regulations, but its mandate to develop the Internet voting system has boosted confidence among the EMB, voters, and other stakeholders. For the 2015 parliamentary elections, for example, EVC trialled various Internet voting software and system documentation and configured various features including cybersecurity (ODIHR 2015: 5).

The Office for Democratic Institutions and Human Rights (ODIHR) in 2015 said that Estonia's Elections Law is still lacking comprehensive regulations on security, auditing systems, and end-to-end system verification. ODIHR conceded that EVC has been very professional and punctual in implementing Internet voting technology, albeit the body has yet to certify the Internet voting system to an independent, authoritative institution.

The technology vendor delivered the software for Internet voting on 6 January 2015. The device was then tested for five days, from 19 to 23 January. EVC then provided the server's source code and made final changes to the software on 4 February. On 10 and 13 February the Internet voting system was established at the NEC location and on 13 February the password for votes encryption and decryption was distributed to NEC members (ODIHR 2015: 5).

Box 6. Cybersecurity in Estonia's Internet voting system

Estonia is a country that takes cybersecurity policy very seriously. This is because the whole governance of Estonia relies on the Internet or cyber technology. The Estonian Government has provided online-based services since 1999, introduced electronic resident identification cards in 2001, and started implementing Internet voting in 2005. Estonia adopted its cybersecurity strategy in 2008 after an incident of cyberattack against the country in 2007 (Djafar et al. 2019: 31). This strategy was updated in 2014 (Ministry of Economic Affairs and Communications, Republic of Estonia n.d.).

Estonia nevertheless came under renewed cyberattack in April 2017 for several weeks. The hackers targeted online banking services, media platforms and government websites. During the attack, a huge wave of spam communications was sent by robot, rendering government employees unable to communicate with their colleagues via email. The civil service was virtually brought to a complete halt, and online media were unable to broadcast news (McGuinness 2017).

Based on that experience, for the national elections on 3 March 2019, the NEC decided to implement a new Internet voting system programmed by Cybernetica US. The Internet voting system is equipped with an end-to-end verification system that is regarded by IT experts as resistant to hacking (Ummelas 2017). The voting system as a whole, including other voting information, is secured by two institutions, the Information System Security (RIA) and the Computer Emergency Response Team. These were tasked with ensuring that there would be no IT system in the election process that had not undergone rigorous testing (Einmann 2017). NEC also provided secure Internet education to election participants (candidates) so that they could independently secure their technology devices and email accounts from hackers (Stokel-Walker 2019). Estonia's 2019 national election went very smoothly.

The success of Internet voting in Estonia is supported by three factors. First, high public confidence that the EMB will be able to organize elections with Internet voting technology, following the precedent of government success in implementing e-governance more widely. Second, the government has issued regulations specifying the principles and goals to be met in implementing the Internet voting technology. Third, the establishment of institutions with responsibility and capability to maintain and secure the Internet voting technology in the face of potential cyberattack (see Box 6). High public confidence in the election result was a result of the implementation of Internet voting technology with the sole purpose of serving the voters and catering to their needs.

Pakistan

Pakistan recently implemented Internet voting in its legislative elections held on 14 October 2018. However, in contrast to Estonia where the option is provided for all voters in the country, Internet voting in Pakistan is provided only for out-of-country (OOC) voters.

Preparation for Internet voting was conducted in a very short time, the Supreme Court of Pakistan having issued the decision to implement the change only in August 2018 (see Box 7). The Supreme Court then instructed six million OOC voters to register themselves as Internet voters between 1 and 17 September (Election Commission of Pakistan 2018).

Box 7. Internet voting and Pakistan's legal framework

Internet voting for overseas voters has been discussed in the Pakistani Supreme Court with various stakeholders since April 2018. The Supreme Court at first rejected Internet voting due to technical and cybersecurity reasons, and concern about compliance with Article 94 of the Election Law and Article 226 of the Constitution regarding the secrecy of the ballot.

The Supreme Court's stance was reinforced by the Internet Voting Task Force (IVTF), which also issued a report on the implications of widening Internet voting. IVTF compared Internet voting with the banking network system. According to IVTF, vote manipulation is less easily detected than banking fraud and, in another contrast, corrective measures after the fact are unavailable. This is because in the case of voting choices the transaction recording feature is not embedded; to do otherwise (i.e. record choices) would be to ignore the principle of secrecy of the vote.

Registration is done via the website <http://www.overseasvoting.gov.pk>. The procedure is as follows: first, the voter creates an account using their email address and phone number. After logging in, the system will determine the eligibility of the voter and ask them to input: their 13-digit national identity number; the issuance date of their national identity card; their passport number; and the tracking identity number of their passport. If the voter is eligible, the system will ask two questions to verify the voter's data and identity. After successful verification, the system will send a notification email to the voter's email address to confirm her/his registration as an OOC voter (Kamran 2018). Subsequently, the system will send an email with a digital Voter's Pass that can be used to vote on polling day.

On election day, after the voting process is over, the Election Commission of Pakistan (ECP) will issue the forms containing the election result using the

Reporting Portal of the Overseas Voting System and send them to the EMB at regency/municipality level. ECP is allowed to exclude the election result from Internet voting in the election result form if ECP considers the confidentiality, security and reliability of the system to have been compromised.

The Internet voting system in Pakistan is developed by ECP and the National Database and Registration Authority (NADRA). The development process costs about 95 million rupees (USD 614,000). In the 2018 election, 6,233 voters out of the 7,461 registered abroad voters participated via Internet voting (Geo News 2019).

1.3.4. E-pens in Hamburg, Germany

E-pens are ordinary pens with the addition of a small camera and microprocessor. These scan the virtual markers put down by voters on a software-produced ballot, which has a special pattern consisting of many translucent grey dots on its background. The pattern is unique for every political party and every page (Arzt-Mergemeier, Beiss and Steffens 2007).

During voting, a voter who touches the ballot with the e-pen will indicate her/his choice according to the position of the e-pen. Her/his choice will be scanned by the micro-camera, and the marked coordinate put down by the voter will be recorded by the e-pen. In regional elections in Hamburg, the recorded data are transferred through docking station and USB cables to laptops provided at the polling centre to be counted automatically later.

If any voter activates the e-pen incorrectly or uses an unregistered e-pen, the application installed in the laptop will notify the election officials. However, the application does not do this if the voter merely inputs the marking incorrectly or fails to input any marking. After the voter has returned the e-pen to the docking station, they then insert their ballot booklet in the ballot box (all of which takes place at the polling centre).

The Parliament of Hamburg proposed the implementation of the e-pen voting system in its 2008 election. This system was considered because the Parliament did not want any drastic changes amid another electoral system reform at the time (that allowed voters to vote for more than one candidate). With the e-pen, which had not yet received any approval from an authoritative institution, voters were still using traditional ballpoint and ballot, but the election result could be obtained much faster and securely (see also Box 8 on the users' perceptions of e-pens).

Later, the e-pen technology's anti-fraud credentials were certified by the Federal Office for Information Security, only for it to be replaced by the DRE voting machine. The DRE system was then declared to be unconstitutional by Germany's Constitutional Court in 2009 because it does not allow any auditing process to be performed on the election result and violates the publicity principle; Germany's Constitution mandates every electoral process to be public so that it

can be monitored by the public without requiring any special knowledge (German Federal Constitutional Court 2009).

Box 8. Users' perceptions of e-pens in Hamburg

The proposal to use e-pens for Hamburg's local parliament election in 2008 came after the e-pen technology was evaluated in the city in parallel to national elections in 2005. Of 677 voters who used the technology, 84 per cent were happy with it and expected to use e-pens again in the next elections. The other 16 per cent asked for further information, agreeing that the introduction of the technology was not preceded with proper guidance and information.

The German experience shows the importance of acknowledging that no voting and counting technology can be implemented properly if not all voters understand how to use it. Elections are a medium through which popular sovereignty is expressed. Their implementation must be easily understood by the public, so that they can participate fully in the electoral process. The best election is not the election with the latest state-of-the-art technology, but one which accommodates the people's right to vote properly, resulting in an accurate electoral result, and is trusted by the people to be a reflection of their will.

1.3.5. E-counting (with OMR) in the Philippines

OMR (optical mark recognition) is a technology to count votes/ballots. Voters cast their vote with pencil or ballpoint pen by filling in the circle on the ballot specifically designed to be read by the OMR machine, which will then scan and count the votes. Vote counting with OMR can be done at polling centres by inserting the special ballots into the machine, or by sending the ballots from multiple polling centres to the vote-counting facility to be counted together (as in the Philippines).

From a financial perspective, OMR technology is cheaper than DRE and EBP because it only requires a few scanners for each polling station. However, OMR also has special requirements, like ballots with specific thickness and design, and specific ink that can be read by the OMR machine. (These specifications may inflate the cost as compared with conventional voting methods.) In the Philippines, in order to maintain the integrity and credibility of vote counting in the 2019 by-election, ballots were equipped with special markings, barcodes, ultraviolet marking and other markings that can only be read by OMR machine (Jaymalin 2019).

There are two reasons why we include the experience of the Philippines in this Guide. First, like Indonesia, the Philippines is a republic and archipelago country with a presidential system of government, albeit with a mixed election system

(unlike Indonesia's proportional representation system). Second, much can be learned from the Philippines' extensive experience in implementing OMR technology for nine years.

The country consists of 7,000 islands and has a six-year presidential election cycle (Carter Center 2010: 9). In administering the election, the Philippines' EMB faces the recurring problem of protracted counting processes. With manual voting and counting, the election result can only be known and announced fully one month after the voting day is over (Carter Center 2010: 1). In order to expedite the counting process and to prevent vote manipulation, the Commission on Elections (Comelec) proposed the idea of adopting vote-counting technology or e-counting.

In preparation, Comelec had to study the available legal framework. The existing regulation, the Republic Law No. 9369 issued on 23 January 2007, allows Comelec to implement technology in the voting and vote-counting process. However, the norms contained in the Law are often inconsistent with the Elections Law (this latter is applicable to national and local elections, as well as executive and legislative elections).

Law 9369's Chapter 1 stipulates that any electronic election system adopted must safeguard confidentiality and accuracy of the people's votes, and the result must reflect the will of the people. Chapter 21 goes on to require that whatever method is adopted by the election authority, there still should be physical documents regarding the election result that must be published and distributed to authoritative institutions and political parties. Chapter 21 also states that the document must be distributed electronically to the Board of Canvassers within one hour after the end of voting.

In addition to legal obstacles, Comelec also had to deal with low public confidence. As the first step, with government support, an Independent Committee of Technology Assessment was formed to reassure the public that the technology adopted would be free from government intervention (International IDEA 2018: 13). Feasibility studies and trials of the technology were initiated and several pilot projects were implemented. The election authority then decided to adopt OMR and it gained considerable public support once introduced in 2010 (Carter Center 2010: 1).

However, the OMR machine in the Philippines, also known as Precinct Count Optic Scan (PCOS), is often problematic. Shortly before election day in the 2010 Elections,[9] it was found that 75,000 PCOS machines were configured incorrectly. Comelec deployed massive logistical resources to resolve the problem up to and until the very end of voting day (International IDEA 2011: 22). After the election Comelec received many protests and complaints from MPs and losing candidates/political parties (totalling 98, as compared to 73 in the 2007 elections) (Goldsmith and Ruthrauff 2013: 201).

A process of audit, by manually counting a random sample of votes, should have been done and announced on the night of polling day but was not completed to schedule. In some areas, the auditing results were unavailable for weeks after election day (Carter Center 2010: 2). The requirement stems from Law 9369 Chapter 24 which dictates that the random manual auditing must be performed on one machine per electoral area (parliamentary or regency/municipality), selected at random by the election authority. If there is a discrepancy between the manual and the electronic count, then the source of the error must be identified and manual counting of all votes must be conducted in all areas where calculation errors occurred.

Problems re-occurred in the 2013 elections. General Secretary of the National Citizen Movement for Free Elections (Namfrel), Eric Jude O. Alvia, drew attention to several weaknesses of the PCOS, one of which was inconsistencies in the results transmission. This error was resolved by implementing the technology vendor, Smartmatic, to repeat the transmission process (President of the Republic of Indonesia 2016). (For more on results transmission, see Box 9.)

Frequent problems with PCOS produce mistrust among the public. For this reason, Comelec bowed to public demand for the introduction of VVPAT technology, having previously been against it (Esmaquel 2016). Unfortunately, the PCOS machines that were purchased for EUR 120 million in 2010 (International IDEA 2011: 32) are not compatible with VVPAT technology and Comelec had to purchase new e-voting machines for the 2016 elections.

In those elections, the newly purchased PCOS machines printed a paper receipt for the voter after they successfully scanned a ballot. The voter received this VVPAT receipt and after checking it was responsible for placing it in a receptacle; failure to do so constituted an electoral violation (Carter Center 2016: 7).

Issues around OMR machines arose again in the national by-election of May 2019, although the encryption and voice recording software had been upgraded, and the election authority did conduct simulations in preparation in several areas (Macapagat 2019). Comelec increased the system's recording capacity from 800 votes to 1,000 votes per machine following the increase of voters (from 54 million in 2016 to 61 million—the number of OMR machines remained static at 92,000 units) (Esmaquel 2019). Comelec spokesperson, James Jimenez, said that around 400–600 machines were not functioning properly on polling day. That is higher than the number of malfunctioning machines in the 2016 elections (Felongco 2019).

In addition, around 1,665 memory cards, or 1.9 per cent of the total, were broken or could not be synchronized with the machine. A Comelec commissioner, Marlon Casquejo, said this could have been due to low quality standards on the part of the company that produced them (Lopez 2019). As a

result, the vote tabulation process went very slowly and the announcement of results was far behind schedule (Calonzo et al. 2019).

Comelec later stated that the problems were caused by a new regulation by which it was mandated to prioritize lowest bidding cost in technology/logistics procurement. As a result, election resources were produced by different companies, with incompatibilities between components of the system (Lopez 2019).

Box 9. Vote recapitulation in the Philippines

The votes recapitulation process in the Philippines is also known as 'canvassing'. A Board of Canvassers (BoCs) was formed to receive and collect the election results transmitted electronically from all electoral areas, and is responsible for vote recapitulation in presidential elections.

All political parties, candidates and election observers are granted access to monitor and oversee the whole process (from voting, to results transmission, to recapitulation). The EMB provides a copy of its report on the results at each polling station, also known as the canvas certificate.

The result of voting and vote counting as recorded in the OMR machine is transmitted to two different parties. First, to the BoCs. From the OMR machine, the result is transmitted through a digital memory card (protected with special code) which is delivered to the BoCs, including the printed document containing the vote-counting result. The two recorded digital results act as reserves in case the vote counting from a certain polling station cannot be transmitted via the Internet. Second, voting and vote counting is transmitted to the central server for online recapitulation (the OMR machine is connected to the Internet so that it can do so). In fact the result is transmitted to three different servers—the transparency server, central server and regency/municipality server. In areas without Internet access, the vote-counting result is delivered by election official to the vote-counting centre (Carter Center 2016: 8).

The recapitulation result at the national level is announced by Comelec. Interestingly enough, there is one election observer organization, Parish Pastoral Council for Responsible Voting (PPCRV), which conducts unofficial vote recapitulation. The public can also freely access the result from Comelec's transparency server and the printed copy of vote-counting results from every polling station. Thanks to these measures, the public has become more appreciative of Comelec because the announcement of election results has been expedited and uncertainty reduced.

The implementation of e-counting in the Philippines provides three lessons. First, an adequate legal framework is necessary to support and guide elections that employ these kinds of technology. Second, enough resources and time should be

allocated to planning and testing the new technology. The more time provided for testing the technology, the more potential errors can be identified and the better implementation will be on the election day. Error or malfunction on election day might cause voters to distrust not only the present technology, but any election technology introduced by the election authority in the future. Third, the legal framework in other laws related to voting and counting technology, such as the procurement process, security and system auditing, should be compatible with the applicable rules in the elections law. In procuring voting and counting technology, best quality should be the selection criterion, not lowest cost.

1.3.6. Other countries' experiences of electronic recapitulation (e-recap)

Scanner technology is the most commonly applied in recapitulation technology. Usually, scanner-based e-recap technology is equipped with data entry technology. This system was applied in Kenya, and in Pakistan in a slightly different version in its 2018 legislative election. The experience from both countries will be elaborated.

Kenya

Kenya is a republic with a two-chamber (bicameral) parliamentary system of government. The Kenyan Parliament numbers 350 members and the Senate 68 members. Both Parliament and Senate members are directly elected by voters in a plurality/majority with a first-past-the-post electoral system, where each district elects one seat. In presidential elections, the winning candidate is any candidate with more than 50 per cent of the votes and with at least 25 per cent of the votes in half of the total 47 regencies in the country (Kanyinga 2014: 20). According to a constitutional amendment in 2010, second-round presidential elections are allowed (Kanyinga 2014: 128).

We include Kenya in this Guide because its experience provides valuable lessons to Indonesia where adoption of e-recap technology is planned. Kenya has implemented e-recap twice: in the 2013 and the 2017 elections. However, the implementation of that technology in was poor in both. It is expected that the same mistakes will not be repeated in Indonesia.

Kenya's Independent Electoral and Boundaries Commission (IEBC) was founded in November 2011 as an independent, accountable and transparent EMB as mandated by the constitution and officiated in August 2010. It replaced the Electoral Commission of Kenya, dissolved in the same year, due to the violent course of the 2007 elections it had overseen as EMB at the time. The Constitution mandates IEBC to organize elections that conform to the free and fair principle (Kanyinga 2014: 115–16). The new EMB introduced the RTS application, an e-recap system that works by transmitting vote-counting results from polling stations to an election result monitoring centre electronically.

E-recap was publicized among voters as a technology that would ensure the transparency of the tabulation process all over the country and expedite the announcement of the election result (see Box 10). Although the Internet in small cities was not reliable enough, and the technology was not cheap, the decision to implement e-recap was welcomed by stakeholders (Halakhe 2013). This was a consequence of the bad experience during the holding of the 2007 elections, which were marked by inflated vote counts and flaws in the vote recapitulation process that led to the emergence of election-related violence that resulted in the deaths of around 1,200 people (Warner 2013).

Elections in Kenya are managed and organized at four different levels: by IEBC at national level; and by election organizers at constituency, regional, and polling station level. In the 2017 election there were 290 constituency election offices, 47 county offices and 40,883 polling stations (Carter Center 2018: 18–19).

There are three steps in Kenya's e-recap system, namely:

1. *Actions by the election offices at polling station level.* Form 34A with the vote-counting result is filled and signed by the head organizer at the polling station. An officer then scans the form and inputs the result into a mobile phone application specifically configured for this purpose. If Internet access at the polling station is poor or there is no mobile phone reception, the election officer is expected to go to a location with better reception so that this step can be successfully performed (IEBC 2018).
2. *Tabulation of numerical data at the National Tallying Centre (NTC).* The officers at the vote tabulation centre input the vote-counting results from polling stations into an Excel spreadsheet file. The result of the calculation process is then put into the electoral area tabulation result form (Form 34B) (Carter Center 2018: 25).
3. *Verification at the national vote tabulation centre*. Election officers compare and verify the scanned 32A forms against the physical documents submitted by organizers at electoral area level. Election observers are allowed to read the vote tabulation transmission results at the national tabulation centre's IT and communication control room (Carter Center 2018: 28).

Learning from mistakes made in the 2013 elections, for the 2017 elections IEBC decided to prepare data backup so that they could still conduct manual recapitulation were manipulation or technical error to occur. In 2017 every voter was given six ballots—one for the presidential election, one for the parliamentary election, one for senate election, one for governor election, one for regent election, and one for the special women's parliament election (Carter Center 2018: 14).

Box 10. Benefits of electronic recapitulation (e-recap) technology

- Increased transparency from electronic transmission of election result at polling centre.
- Display and visualization of election result at recapitulation centre.
- Election data become accessible to the media and other stakeholders in real time.

E-recap in Kenya is complemented with various mechanisms to prevent fraud and maladministration. For example, because the e-recap system relies so much on the vote-counting process at polling centres, the IEBC specifies the form for submitting results in great detail and provides Form 34A for this purpose. The vote-counting process at the polling centre itself is conducted manually. If there is any discrepancy between the uploaded form and the physical form, the physical form prevails over the digital form (Obulutsa 2017). However, RTS, which is a part of the Kenya Integrated Election Management System (KIEMS, see Box 11), is yet to be certified. IEBC has sought companies to do certification and testing, but no company has yet been willing to certify a technology system without having access to manual processes, source code, procurement checks, and other similar information (Ellena and Petrov 2018: 28).

RTS was tested in all regencies on 2 August 2017, or six days before election day on 8 August. However, IEBC published the e-recap results from some regencies only. IEBC's failure to publish all the results was considered by the Carter Center (which deployed an election observation mission to the country) to signal that the recapitulation process would be problematic in the 2017 elections more broadly (Carter Center 2018: 21).

E-recap in the election on 8 August 2017 was indeed not good enough. Observers from the Carter Center found that some of the 34A Forms had to be scanned at the vote tabulation centres because either the KIEMS was faulty or the cellular reception at polling stations was poor (Carter Center 2018: 25). IEBC was also criticized by civil organizations and presidential candidates for being slow in providing the 34A Form photos and the vote tabulation form scan results at electoral area level, although the result of the presidential election was announced by IEBC three days after election day (Carter Center 2018: 5).

The Elections Law of Kenya gives seven days after the election day for the IEBC to publish the entire vote-counting result forms, but more than a week after the election result was announced, thousands of scanned vote-counting result forms, which are supposed to be used to verify the election result, were missing from the e-recap website. IEBC had failed to transmit all of the forms to the national recapitulation data centre and was not being transparent about it. IEBC

failed to communicate properly with election stakeholders and the general public, especially in its decision to publish the presidential election result based on the vote tabulation result form at electoral area level (34B Forms) instead of the 34A Forms (Carter Center 2018: 25–30).

The situation triggered a political upheaval because the opposition camp felt cheated and alleged that the e-recap system had been manipulated. Although the IEBC allowed representatives of the election participants and independent election observers to observe both the voting and vote-counting process (at polling stations) and the vote tabulation process (at the tabulation centres), the tabulation results are required to be published at the vote tabulation centres (Carter Center 2018: 26). On 1 September 2017, the Kenyan Supreme Court issued its decision that the 2017 presidential election was unconstitutional, and that the result was invalid and illegitimate due to illicit and illegal practices during the transmission of the result (Article 86 of Kenya's Constitution states that IEBC is required to announce and publish the accurate, diversified, accountable and transparent result of presidential election). An unauthorized party was detected accessing the electronic voting system before and after polling day, and it was found that there were five million unverified votes. The numerical data from the nationwide vote tabulation results from the RTS-KIEMS were successfully transmitted to the vote calculation centre at national level. However, many of these data were lacking the 34A Form counterpart for the presidential election, as required by the Kenyan Elections Law (Carter Center 2018: 26). It was also revealed that there was a discrepancy among 34B Forms uploaded to the KIEMS from the same electoral areas. In the court proceeding, an IT expert detailed further irregularities such as empty ballots and non-existent votes (Kenyan Supreme Court 2017).

On the other hand, two out of seven Supreme Court judges gave dissenting opinions, arguing that the irregularities during the e-recap process were unintentional and honest mistakes on the part of the election committee (Kuo and Dahir 2017).

Kenya's presidential re-election was held on 26 October 2017. The election was boycotted by presidential candidate Odingga-Kalonzo Musyoka, producing a drastic reduction in voter turnout, to just 47.6 per cent (Englebert 2019). It was reported that 100 people were killed during electoral-related violence (de Freytas-Tamura 2017).

Box 11. Kenya Integrated Election Management System (KIEMS)

The revision to the Kenyan Elections Law of 2016 required the elections authority to form the Kenya Integrated Election Management System (KIEMS). KIEMS integrates electronic systems including voter identification and registration (with biometric technology), candidate registration, result transmission and e-recapitulation systems. The EMB is required to test out and evaluate KIEMS no later than 60 days before election day.

In fact, because IEBC was late in appointing its new members, the body was only able to conduct testing and limited simulation of KIEMS on 2 August 2017, six days before election day. IEBC was also only able to publish the simulation result in a limited number of regencies. A national-scale KIEMS simulation was not conducted until the re-election held on 26 October (de Freytas-Tamura 2017).

Article 39, paragraph 1, point C of the Elections Law mandates the IEBC to immediately deliver the vote-counting results from polling stations to the National Tallying Centre (Kenyan Election Law 2017). In practice, up until 17 August 2017, nine days after voting day, IEBC did not receive all of the 34A and 34B Forms manually filled by election committees (Kenyan Supreme Court 2017).

In conclusion, the controversy surrounding e-recap in Kenya's 2017 second-round presidential election was caused by three factors: (a) lack of transparency regarding the technology used in the electoral process; (b) election officials' failure to communicate adequately with the public, candidates and other stakeholders, in order to build trust in the technology and the election result; and (c) insufficient testing and trial runs of the system.

The IEBC should have published the recapitulation results from all regencies in order to gain public trust and credibility with all stakeholders that they were able to implement e-recap competently and accountably. Sufficient testing and trial runs provide better insights when evaluating the technology and can motivate well-informed choices about adoption. For any EMB, this has important time management implications, but especially if a country has to organize multiple concurrent elections as Kenya did in 2017. Also, election authorities should ensure the availability of supporting infrastructure, such as stable Internet connection that covers all electoral areas.

Pakistan

Unlike Kenya, the legislative election in Pakistan uses the mixed member system also known as the parallel system. Of 342 National Assembly members, 272 are elected using the first-past-the-post majoritarian system, while 60 female members and 10 members representing minority ethnic and religious groups are

elected under a proportional system (with a 5 per cent of vote share minimum threshold) (Ahmad 2017: 1).

Pakistan implemented e-recap to obtain faster election results. The technology adopted is very similar to that used in Kenya. The difference is that the vote-counting result form at polling stations is photographed using smartphones instead of being scanned with a scanner. The photo is then submitted to a specified mobile phone application along with the numerical data of the result. The result transmission system (RTS) will then send the data to three different servers—the election organizer's at electoral area level, the server of the ECP at province level and the central ECP server (Election Commission of Pakistan n.d.).

Before e-recap was implemented in the 2018 election, ECP conducted three pilot projects. The first was conducted in 2015 in the National Legislative Members Substitution Election at 50 polling stations in Attock PP-16 electoral area. The second pilot project was conducted on 26 October 2017 in the Legislative Members Substitution Election in Peshawar (all polling stations in the electoral area NA-4 of Peshawar). The third pilot project was held in Chakwal PP-20 electoral area in January 2018 (Election Commission of Pakistan n.d.).

Pakistan's RTS technology was developed by NADRA, the same institution that developed the Internet voting system for OOC voters implemented in the 2018 election. ECP did not provide the polling station officers with smartphone devices to transmit the vote-counting results, but instead asked polling station officers to use their own personal smartphones. During the preparation, NADRA deployed 2,800 IT experts to train 180,000 polling station officers who would be responsible to photograph and send the vote-counting result Form 45. The RTS training was conducted for 21 days, from 25 June to 15 July 2018 (Election Commission of Pakistan n.d.).

E-recap was first implemented at national scale in the election held on 25 July 2018. Votes from total registered voters numbering 105.96 million were transmitted from 85,058 polling stations to the RTS after the vote-counting process was completed. Unfortunately, as reported by online media (ProPakistani, The Express Tribune Pakistan, Geo TV and The Dawn), the RTS did not function optimally on the election day. The RTS crashed at midnight after receiving more than 170,000 transmissions of Form 45, for both the national assembly election and the local election. This led ECP to delay the announcement of the election result (Wasim 2018).

Candidates and political parties participating in the election were suspicious about RTS having crashed; opposition parties spread allegations that there had been vote manipulation. The situation was made worse by the lack of contingency planning by ECP and NADRA in the case of system malfunction. The two institutions issued different statements regarding the incident. ECP's Secretary said on the morning of 26 July that there had been a malfunction in the system and the election authority had to perform manual recapitulation. An ECP

spokesperson then stated that the system was gradually slowing down when uploading the Form 45s and performing data entry. A senior official of NADRA, meanwhile, said that there was no problem with the RTS (Wasim 2018).

Box 12. Parallel offline data entry in Pakistan

In addition to the main recapitulation system (RTS), the Electoral Commission of Pakistan also implemented its own Result Management System (RMS). While RTS is an online application, RMS is offline software installed on computers available at the election organizer's office at electoral area level and operated by trained entry data operators. When the election organizer receives the physical copy of the vote-counting results Form 45, the operators input the data into the RMS. After all data from all polling stations in the area have been stored in the system, the RMS will automatically print a Form 47 which is then either transmitted to the Electoral Commission using a fax machine or uploaded directly to its official website.

Following the incident, ECP sent a letter to the Government Cabinet Division Secretary to ask him to immediately form an investigation committee and submit an investigation report in four weeks, to give findings on system implementation capability, the RTS preparation and finalization process, the quality of training for data entry officers, and the measures taken by ECP and NADRA to address the problem. ECP also asked the Cabinet Secretary to issue recommendations (Express Tribune Pakistan 2018). Such a committee was formed, consisting of technical experts from the Telecommunications and IT Security Agency and the Telecommunications Authority of Pakistan.

There are two lessons to be learned from the implementation of e-recap in Pakistan. First, it is important to prepare contingency plans so that, in the case of emergency, the EMB can handle problems swiftly. A swift response will quell speculation and rumours regarding the electoral process that might compromise public trust. Second, implementing e-recap and manual recapitulation at the same time is a good idea, especially when the former is being introduced for the first time. Manual recapitulation or a credible offline electronic process such as RMS (see Box 12) can serve as a viable backup in the case of malfunctions in e-recap that cannot immediately be solved.

Endnotes

1. Voter verified paper audit trail (see Box 1).
2. European Parliament (2018: 8).
3. In Congo, however, while such measures were limited, in practice most voters faced no difficulty in casting their vote because candidates' photos were available.
4. The SMS method uses an application embedded in a special SIM card that is distributed to all polling stations for electronic recapitulation purposes. The polls officer then activates the SIM card by entering the verification code that was previously received separately by post, then the code is verified by the national data centre. The officer enters the results by sending an SMS.
5. The application used in the Unstructured Supplementary Service Data (USSD) method is installed on a national tabulation server, not on the SIM card as in the SMS method. With USSD technology, data filling by officers will be guided centrally (KPU 2016: 16–17).
6. Initially, the 2018 Election in Congo was set to be held on 23 December 2018. However, the election had to be delayed until 30 December because the storage facility where the EBP machines were kept was burned down by a mob of rioters. In the 2018 concurrent elections, 46 million voters had to choose among 34,900 parliamentary candidates and 21 pairs of presidential/vice-presidential candidates. The Congo national parliament contains 500 members, and provincial parliaments contain 715 members (Giles 2018).
7. Under the election law, voters have the opportunity to vote for 11 hours, starting at 06:00, ending at 17:00 (Westminster Foundation for Democracy 2018: 7).
8. According to the report *Democratic Republic of the Congo 2018 Human Rights Report*, there were 16 election-related deaths from 21 November to the election day, 30 December, (United States Bureau of Democracy, Human Rights and Labor 2018: 24).
9. There were multiple elections in the Philippines' election of 2010: the presidential election, National Senate elections, parliamentary elections, governor elections, city mayor/regent elections, and the legislative elections at provincial and regency/municipality level (Carter Center 2016: 4).

2. Voting and vote-counting technology

2.1. Global implementation principles

There are many reasons to use electronic technology in election processes: a faster process of obtaining the result; more access for voters with special needs, or those who live in harder to reach locations, such as in remote areas or abroad; and reduced procurement (logistics) costs, to name but a few. However, adoption of voting technology often leads to new and more complex problems, especially when it cannot satisfy all the principles of free and fair elections. For example, the implementation of DRE equipped with VVPAT may help the election authority to make the election process more efficient while maintaining its ability to audit the whole process, but unless implemented correctly the auditing technology may violate the principle of voter confidentiality. Implementing the most advanced technology available does not in itself create the optimal electoral process.

It should be underlined that, when a voting technology system works in clear, transparent and traceable trajectories (able to accurately capture the vote of each voter, as it must), the system is challenged to be able to protect the confidentiality of voter choices. Therefore, the principles of the application of voting technology must be detailed and fully met (see Box 13).

Box 13. Checklist of implementation principles that must be adhered to

Assessment and planning phase

- The implementation of technology starts from assessing the actual needs and the alternatives to solve an electoral issue.
- The decision to implement election technology is agreed by all stakeholders and supported by the public.
- The implementation of election technology has a legal basis in the applicable laws.
- There are regulations governing the details of e-voting, e-counting and e-recap mechanisms.
- There is a clear and detailed time frame containing the objectives to be realized in planning, procurement, pilot project and implementing phases.
- There is transparency in the planning process.
- Financial resources are available.

Procurement stage

- There exists a credible institution capable of developing election technology.
- The election technology should be ultimately controlled by the electoral management body (EMB) and not by a foreign or private vendor. Where technology is purchased or leased from an external supplier, the relationship between the EMB and the supplier must be accountable.
- The procurement of the election technology must be transparent.
- The technology system must be certified as reliable through a rigorous process of testing.

Implementation stage

- System security, cybersecurity and voter confidentiality must be guaranteed.
- There must be an auditing mechanism in place and the opportunity to re-run voting.
- The technology must not be confusing but user-friendly and inclusive for all eligible voters.
- The implementation of election technology starts from small-scale elections, such as regional elections, before being implemented in national elections.

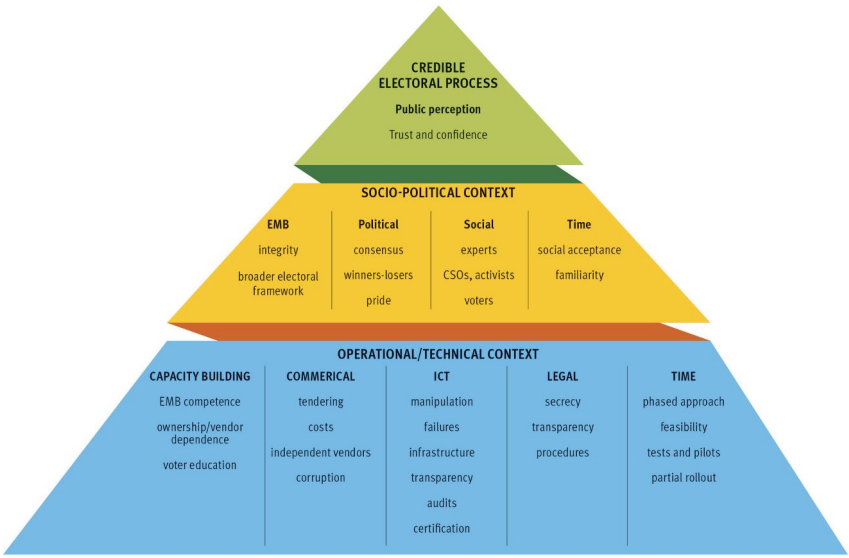
Box 13. Checklist of implementation principles that must be adhered to (cont.)

Implementation stage (cont.)

- The election authority provides public education on how the new voting and counting technology works.
- All election officials, from the national level to polling station committees, have proper understanding and knowledge of how to operate the voting and counting technology.
- The election technology should be sustainably implemented and maintained.

Learning from the experiences of other countries, public trust is the most important element in implementing voting technology. Without public trust, the result of the election might not be as legitimate as when the public fully trusts the systems in place, even if the technology is successfully introduced and without any fraud or manipulation. The keys to public trust are transparency, professionalism, and the presence of mechanisms for accountability. Figure 6 is an illustration of the trust-level pyramid.

Figure 6. The trust-level pyramid



Source: International IDEA, *Introducing Electronic Voting: Essential Considerations* (Stockholm: International IDEA, 2011), <https://www.idea.int/publications/catalogue/introducing-electronic-voting-essential-considerations>, accessed 18 December 2019.

The trust pyramid is one of the instruments that can be used to build legitimacy and trust in the implementation of electronic voting technology. Public trust can only be achieved if the operational/technical context and socio-political context are properly considered.

Operational/technical context

There are several basic components that need to be considered regarding the operational/technical context, including:

1. *Legal framework*. Whether the existing framework, either the constitution or the elections law, provides sufficient legal justification for the election authority to implement election technology; also what principles are contained in the legal framework that are relevant to this change and therefore need to be heeded.
2. *Capacity to implement the changes*. Whether the available human resources are capable and up to the formal standards required to implement the technology. The EMB must develop its institutional capacity by improving the quality—and ensuring sufficient quantity—of its IT professionals. This is achieved by making the use of technology a habit in the electoral process before the voting and vote-counting phase in order to gain public trust and developing a technology-ready working culture. Competent implementation will also itself serve to educate the public on how the technology really works.
3. *Sufficient time frames to prepare voting and counting technology*. Time is the frame of reference that binds the preparation process and the implementation process. The EMB should allocate enough time to study the technology, prepare the regulations, conduct repeated tests and educate the public about the change. It should be borne in mind that implementing voting and counting technology requires a significant amount of time. The EMB must be in a position to convince the public that the long and arduous process and the money spent will be worth the result, that is, a free and fair election.

Socio-political context

During preparatory phases, the involvement of stakeholders such as political parties, civil society, academics, experts and the general public serves as the foundation for developing a socio-political environment conducive to the success of implementing election technology. By allowing a broad spectrum of political parties and/or civil society to be involved in the testing process, an EMB is able to show its commitment to provide transparency and accountability in the

preparation process. Political parties and candidates, whose electoral victory or defeat will be determined through and with the technology, are more likely to feel suspicious of the voting and counting technology if denied such involvement. This is a further reason why it is important to allocate sufficient time for the preparation process.

After successfully fulfilling the above preconditions the public, likewise, is more likely to trust the electoral process and the result produced from it. However, if the two preconditions are not met, then the public and election participants may well dispute the election result.

2.2. Cybersecurity principles

There is no formal definition for the term 'cybersecurity'. IT experts give their own multiple definitions and there is even no convention yet on how to write the term (whether as separate words, hyphenated or not). Nevertheless, the International Telecommunication Union (ITU) defines cybersecurity as:

> ... the collection of tools, policies, security concepts, security safeguards, guidelines, risk management approaches, actions, training, best practices, assurance and technologies that can be used to protect the cyber environment and organization and user's assets.
> Organization and user's assets include connected computing devices, personnel, infrastructure, applications, services, telecommunications systems, and the totality of transmitted and/or stored information in the cyber environment.
> (International Telecommunication Union 2008)

The issue of cybersecurity gained yet further prominence following the 2016 US presidential election campaign and result, when both major parties and their supporters expressed concern over the use of Internet-enabled technology (in, variously, the vote-counting process, hacking of internal party communications, and the use of private email servers for official government correspondence).

These and other high-profile cases of hacking have led to some scepticism about election technology in European democracies. The Netherlands decided to resort to manual result recapitulation in the 2017 elections. France, after a massive cyberattack on all television stations in 2014, cancelled the implementation of Internet voting in the 2017 presidential election. Similar concern was also shared by the public and Government of Germany in its 2017 elections, having experienced an attack by hackers on MPs' computers in 2015. Germany had implemented a very similar recapitulation system to that abandoned by the Netherlands in the same year (Wolf 2017).

Cybersecurity issue is accordingly being taken more seriously at intergovernmental forums. International IDEA organized public discussion on cybersecurity in elections on 13–14 June 2017. Representatives of EMBs across Europe and the USA, as well as industry experts, public intellectuals and independent researchers attended. A follow-up event was held at the end of 2018 in the Netherlands, where participants presented their progress in implementing cybersecurity measures (Wolf 2018) and all findings have been since published (van der Staak and Wolf 2019).

According to data released by IT Governance, during the first quarter of 2019 there were more than 1.75 billion incidents of cyberattack and personal data leakage across the world. Meanwhile, Harjavec Group has calculated that by 2021 global financial losses from cybercrime will reach USD 6 trillion (Djafar et al. 2020: 2). In the context of elections, cybercrime poses at least two major threats: cyber breaches themselves; and the impacts on perceptions of the electoral process among the public. Even a minor cyber breach such as defacing an EMB's website has the potential to cause controversy and damage the legitimacy of election results (van der Staak and Wolf 2019: 15).

In Brazil, TSE cooperates with other state institutions when it comes to cybersecurity although, as in India, the DRE machines used are not connected to the Internet. In India, the electoral commission has enhanced its cybersecurity to secure the voter database and office networks. In the Philippines, cybersecurity in elections is not discussed as much as in Brazil, in spite of a massive hack and leak of biometric voter registration data in 2016. The transmission of vote-counting results is conducted with memory cards in the Philippines, and its electoral commission focuses on ensuring the ballot is machine-readable and countable.

In Estonia, cybersecurity is heavily regulated and managed. The Internet voting system in Estonia's 2019 election used the latest system, secured by the Computer Emergency Response Team (see Section 1.3.3). In Kenya, cybersecurity is a general concern. That the e-recap system used is vulnerable to hacking was evidenced in the Kenyan Supreme Court's decision to revoke the presidential election result and re-run the election (see Section 1.3.6).

The ever-increasing number of cyberattacks on electoral systems worldwide cannot be underestimated. In order to ensure security from cyberattack, a government adopting Internet-based election technology should adhere to the following principles (based on Association of Chartered Certified Accountants 2017):

- Identify cybersecurity threats periodically.
- Develop a cybersecurity system that at least poses a certain degree of difficulty on unauthorized entry to the system.

- Impose proper control mechanisms on the officers or employees that work for EMBs. Deactivate email accounts of any former officer or employee on departure from employment at an electoral institution, and block her/his access to the system. Periodically change the password to access the information system to prevent unauthorized access.
- There should be a technical procedure for firewall and Internet gateway, security configurations, control access, malware protection and patch management that must be adjusted to general standard.
- Manage data according to institutional needs. There should be a set of regulations on data assets review, data categorization and types of protection for every data category, a control mechanism on who can access certain data, and examinations on system traffics.
- There should be response scenarios for when hacking occurs. If the system was hacked, the institution should have a response scenario to determine how the attack will be identified, who will lead the response measures, how the forensic test and investigation will be conducted, and how to deal with public communication after the attack.

2.3. Election principles in Indonesia

Under Indonesia's Constitution, just as the principles of elections are recognized by the international community, implementation of elections must be carried out in accordance with six principles: direct, general, free, confidential, honest and fair (KPU n.d.). 'Direct' means that voters immediately cast their votes according to their conscience, without intermediaries, and without levels. 'General' means that all citizens who have met the minimum age requirement have the right to choose and to be elected. 'Free' means that every voter is free to make a choice according to their conscience, without any influence, pressure and coercion from anyone and in any way. 'Secret' means that voters' choices are guaranteed not to be known by anyone and in any way. 'Honest' means general elections are carried out in accordance with applicable laws and regulations. And 'fair' means all citizens who have the right to vote have the same voting rights—one vote each.

The six principles are applicable to not only the voting and vote-counting stages of an election, but all electoral stages. When deliberating on use of a certain election technology and its potential impact, the election authority should also consider and refer to the following:

1. *Fairness principle*. The use of technology in elections should provide equal access to all participants at every stage of the election. In addition to this,

the use of technology should maintain the principle of one person, one vote, by avoiding duplication of voters' data.

2. *Honesty principle*. The use of technology should minimize the risk of fraud or manipulation. The use of technology in vote recapitulation, for example, should be aimed at fulfilling this principle by preventing the practice of illicitly inflating votes. The use of open data technology should be aimed at enhancing openness and transparency.
3. *Confidentiality principle*. The use of technology should maintain voters' confidentiality, especially in the voter registration process and during the voting and vote counting. The use of technology can make the voter registration mechanism more efficient and accurate by avoiding data duplication. However, the same confidentiality standard should be applied at voter registration, voting and vote-counting stages. If the use of technology (e.g. biometrics) reveals the personal identity of voters and their vote in the election, then the use of technology is instead detrimental to the election process. Sometimes the manual voting procedure like the one implemented in Indonesia is more reliable in upholding the confidentiality principle.
4. *Directness principle*. The use of technology should ideally make the election process simpler for voters and other election participants.

It is important for the use of technology to comply with the existing legal framework and the constitution (including, but not restricted to, the election principles) as the fundamental principle in running an election. In Indonesia, the results of political party registration through electoral technology (a system called Sipol, see Section 4.1.2) were countered by the Election Supervisory Agency (or Badan Pengawas Pemilu Umum, Bawaslu) because the Election Law did not mention the possibility of using technology at political party registration stage.

Box 14. Legal framework for utilizing election technology in Indonesia

The constitution and legislation regarding elections in Indonesia do not specifically regulate the use of electoral technology. However, Constitutional Court Decision No. 147/PUU-VII/2009 states that Article 88 of Law No.32/2004 about Regional Government is constitutionally contingent with Article 28 C paragraph (1) and paragraph (2) of the 1945 Constitution. In this case, the term 'vote' in Article 88 of Law 32/2004 can be interpreted using conventional methods or using election technology through e-voting with the following cumulative conditions:

1. Not violating 'direct, public, free, confidential, honest and fair' principles.
2. Readiness in terms of technology, financing, human resources and software, community readiness in the area concerned, and other requirements needed.

The legal framework of a country, both the constitution and the election law, must be reviewed in order to identify the regulatory space for the use of election technology. The existing legal framework usually does not specifically mention or regulate matters of electoral technology (see Box 14), but contains more fundamental election principles. The latter must then be given interpretation in order to guide the adoption of technology. In simple terms, the use of technology must strengthen the principles and values of elections.

If Indonesia is going to implement voting technology, the EMB needs to review the various terms used in the elections, such as 'ballot box', 'vote-counting process', 'damaged and empty votes', 'election fraud', and so on. A review of this kind ensures that the implementation solution is consistent with its purpose, especially as regards the intentions contained in relevant legislation (International IDEA 2011: 25).

3. How to make a decision on voting technology

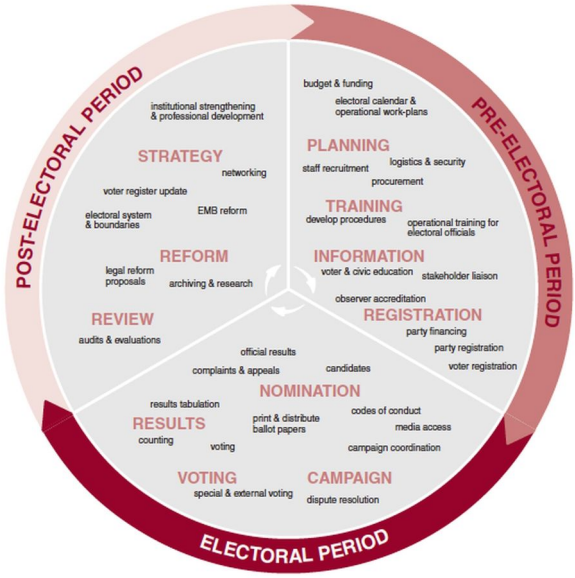
3.1. Identifying the problems

Before deciding to implement voting and counting technology there are two questions that must be answered by all stakeholders, including the EMB:

1. What is the goal of implementing the (voting and counting) technology?
2. How will the technology resolve issues and get closer to the desired goal?

The implementation of technology could make a democracy either stronger or more vulnerable. In general, we can assume that there is no perfect electronic voting system because the available system is always in the state of being developed (International IDEA 2011: 11). Therefore, there is also no ideal voting and counting technology (or system) that is relevant and suitable to specific needs. It is therefore important to identify all the problems that we want to address by using the election technology before deciding what type of election technology to adopt.

Figure 7. The electoral cycle



Source: Ace Project, Electoral cycle: What is the electoral cycle?, <http://aceproject.org/electoral-advice/electoral-assistance/electoral-cycle>, accessed 12 May 2020.

Understanding the election cycle (see Figure 7) is the easiest way to map and identify the election problems at hand. International IDEA categorizes the election cycle into three phases: pre-electoral period, electoral period and post-electoral period. This categorization makes it easier for EMBs, government and other election stakeholders to identify the most urgent problems that need to be solved right away.

Pre-electoral period

This phase mainly consists of preparation activities. Roughly speaking, there are four types of crucial problems that might occur during this phase, problems related to budgeting; logistics procurement; voter registration; and electoral participant registration. Problems regarding the management of voters' and logistics data are one of the most recurrent themes in the pre-electoral period. One of these is lack of transparency in budgeting and preparation processes.

Electoral period

This is considered the main phase of the three, because voting and vote counting are done during this period. However, there are four problems that may arise

during this phase, problems related to candidacies; campaigns; voting; and vote counting. Also, the election process during this phase is often plagued with problems relating to high procurement costs (logistical resources such as ballots) and the arduous process of vote recapitulation.

Post-electoral period

This phase mainly consists of evaluating and reviewing the previous two. During this period, the election authority and election participants can conduct specific reviews on certain electoral stages (drawing on observations throughout stages, see Table 4) and formulate strategic measures to prevent and resolve any problem related to that electoral stage in the future (see Table 5). (This Guide is a contribution to Indonesia's post-electoral phase in particular.) It is always advisable to listen to the complaints of voters and the wider general public, and map all of the problems in the election process.

Table 4. Questions for post-electoral reviews

Question	Checklist		List of problems
Are there problems in the election preparation phase?	Yes	No	-..... -..... -.....
Are there problems during the election process?	Yes	No	-..... -..... -.....
Are there problems during the post-election phase?	Yes	No	-..... -..... -.....

3.2. Finding possible solutions

After identifying and mapping the problems, we can then find the best possible solutions for the problems at hand. If the election authority or legislators are considering election technology as the solution, first and foremost they need to make sure that the decision is supported by the public and other electoral stakeholders. There are, however, cases where EMBs do not think that election technology is the best solution in their country context.

Political actors may be against electronic voting for various reasons, either in principle—because they have genuine cybersecurity or other technical concerns, or do not trust that the system will be implemented with independence from other political actors—or for strategic and tactical reasons, fearing that the new electoral system might be an advantage for their opponents (electorally, and/or because introducing the reform could itself confer prestige) (International IDEA

2011: 19). Therefore, the involvement of public and election participants is very important in deciding on solutions. Learning from the experience of other countries can be a good way to consider the benefits, costs and risks of implementing a certain election technology. As shown in Chapter 1.3, it is important to deliberate on specific performance indicators including user-friendliness/accessibility, security, cost and sustainability.

Table 5. Identifying solutions (a multi-stakeholder task)

Technology type/sub-type*	Advantages	Disadvantages	Indicators**	High	Low
E-voting (DRE, EBP, e-pens, Internet voting, etc.) **E-counting** (OMR/OCR) **E-recapitulation** **Open data**			Usability		
			Cost		
			Security		
			Accessibility		
			Voter confidentiality		
			Vulnerability to misuse and/or manipulation		

*State the choice of technology.
**To be developed in consultation with various stakeholders.

3.3. Legal prerequisites

Any country that decides to implement e-voting, e-counting or e-recap should check whether they have a comprehensive set of regulations, which include the constitution, elections law, laws on the implementation of e-government or cybersecurity, or other relevant regulations on the implementation of technology. However, the elections law should play the major role in supporting the implementation of voting and counting technology. If the existing regulations do not mention implementation of election technology explicitly, then the regulations need to be revised. Implementation of voting and counting technology, or its cancellation, may have significant consequences if it occurs in a legal vacuum.

The legal framework should not merely use the phrase 'technology implementation', but should specify the rules of technology implementation in the electoral process in detail, and ensure the preservation of the aforementioned fundamental election principles (security, transparency and vote confidentiality) which may form the basis of substantive indicators to be satisfied.

In general, there are nine aspects that may be used as a set of guidance in devising a legal framework for technology implementation in elections (Goldsmith and Ruthrauff 2013: 110):

1. *The physical aspect of the electoral digitization process*. Digitized voting and counting processes will be very different from manual ones. For example, with e-voting, physical ballots and equipment to mark them will be no longer needed. The election committee will also no longer need to prepare physical ballot boxes for the recapitulation process at every administrative level.
2. *The transparency dimension*. Regulations must be in place governing who will be given access to the election technology system during the electoral process, including access to warehouses where digital equipment is stored. However, the procedures should also be designed to allow third parties, such as election observers, to oversee the system. Transparency measures should be clearly defined in the laws so that observers and political party representatives understand the procedure and their access privileges.
3. *Technology trials and certification*. The election authority must ensure that the technology to be implemented has undergone a certified testing process. The election laws should clearly identify all institutions with the authority to provide certifications, determine the certification period, and set the standards and requirements for certification, including their consequences. In this regard, if the result of the certification shows that the technology satisfies the applicable standards, especially the universal election principles of freedom, fairness and confidentiality, then the election authority should be allowed to take the technology to the next phase of the election. If not, then the election authority should try out other technology options.
4. *Auditing mechanism*. The election laws should specify the scale and type of auditing mechanism (e.g. result auditing, internal log auditing and auditing on access to technology storage) to be applied to the election technology. Auditing is necessary for ensuring that the technology functions properly.
5. *The status of audited voting result cf. electronic result*. If there is a discrepancy between the auditing result and the result generated by the electronic technology, the election laws must provide a way to resolve this and initiate consultations, inclusive of all stakeholders, on alternative technologies.

6. *Data security and storage*. Regulation of election data storage and integrity needs to be provided in the legal framework, including regulations on the time period and deletion procedure for electronic data. These provisions should be in accordance with the existing data protection law.
7. *Voter identification*. If voter identification or authentication processes are an integral part of the electronic voting technology, then the election laws need to specify the rules on using voters' biometric data in electronic identity documents, and any other data that can be read by the device/system. It is important to protect the confidentiality of votes by concealing the connection between a voter's identity and her/his vote in the election (confidentiality principle).
8. *Access to source code*. Election laws should determine whether the source code is to be open source or not. This provision will complement the access privileges granted to stakeholders.
9. *Law enforcement*. Each type of election technology will give rise to certain types of problems: e.g. those associated with e-recap are different from the ones that occur in a manual recapitulation process. If in the latter inflation of the vote might occur through the involvement of corrupt election officials/committees at a certain administrative level; such frauds will not occur in e-recap. However, vote inflation might instead occur through cyberattack/hijacking of the system, or system errors. Therefore, election laws, in governing the law enforcement scenarios attendant on introducing technology, must include what types of evidence can be presented in legal proceedings, should the election result be challenged.

3.4. Procurement

Election technology procurement is an important part of the process because it affects the legitimacy of the technology and the elections in which it is used. The procurement process can be divided into three different stages—selection of vendors, choosing a vendor and the procurement itself.

3.4.1. Selection of vendors

The EMB is required to make a list of system specifications that must be fulfilled by vendor. The system requirements may refer to the problem identification process (see Section 3.1) and the agreed indicators it has set out (Section 3.2), especially relating to the advantages and weaknesses of the technology. Selection of vendors should follow a specified, detailed mechanism, and should be comprehensively logged and reported upon. The entire tendering process must be transparent and competitive.

Box 15. Technology specifications

Comprehensive technology specifications would include the following 13 elements (Goldsmith and Ruthrauff 2013).

1. *Type of technology*. The EMB should be able to identify which type of voting or counting technology that they need, or combination thereof.
2. *Scale*. The number of devices needed often affects vendors' ability to deliver them on time. Determining the shipping destination(s) beforehand is also important. The vendor should be provided with information regarding the total amount of voters based on gender and age, and the total number of voters with disabilities.
3. *Time frames*. The EMB should inform the vendor about the time frames available for producing and shipping the devices, so that the vendor will be able to synchronize these with the electoral cycle deadlines.
4. *Voter authentication*. If the EMB decides to digitize the whole voting–counting–recapitulation process, then it should inform vendors of what type of voter authentication method is preferred, whether fingerprint or QR scan method.
5. *Auditing mechanism*. The requirements for a mechanism to audit the system should be specified in detail.
6. *Election result transmission*. The facility that will be used to transmit the election result from the e-voting and e-counting machine to the vote recapitulation system on the national level should be described and specified in detail.
7. *Environmental conditions and power supply*. It is important that the EMB describes the environmental conditions of the shipping destination location(s); this enables the vendor to make necessary modifications, e.g. extra dust-proofing of the hardware.
8. *Electoral system*. It is preferable if the EMB is able to inform the vendor about the likely future election system (reforms) as well as the one currently used (e.g. in Indonesia's case, five ballots are needed for concurrent elections) so that the vendor can ensure that the system provided will be able to satisfy future as well as present needs.
9. *Accessibility*. The EMB should explain their expectation of how the implementation of election technology will not hamper voters with disabilities from participating, and specify appropriate adjustments to the user-interface design (e.g. sound feature for deaf voters).
10. *Security*. The EMB should specify the requirements for system security in detail.
11. *Access to source code*. The EMB should inform its vendor whether or not they will need to share the technology source code with external parties for auditing purposes.

Box 15. Technology specifications (cont.)

12. *Additional service*. It is preferable if the EMB informs its vendor whether or not any additional services are required, e.g. training workshops for their staff on operating the technology.
13. *Terms of use*. The EMB should specify when and for how long they expect to use the election technology provided by the vendor, taking into account auxiliary supplies (inks, batteries and data storage devices).

The selection process of the proposals submitted by vendors should be based on the specifications and standards that have been set out by the EMB (see Box 15). Demonstrating the efficacy of the technological device by vendors should be mandatory, in order to test the specification of the system. The EMB should also invite all stakeholders to the demonstration process including election monitoring agencies, election experts, civil society representatives, women's and disabilities groups, and political parties.

Mandatory demonstration of the technology by the supplier should be seen as a way to assess not only its user-friendliness but also a wider range of quality indicators. The Council of Europe lists six types of system tests that must be conducted by EMBs:

1. *Performance test*. This test is conducted to determine the speed and the effectiveness of computers, networks and software integrity. A quantitative test in a laboratory measures computers' response times in processing millions of instructions per second; a qualitative test measures the reliability, scalability and interoperability of a computer. Performance tests are usually conducted concurrently with durability tests.
2. *Durability test*. Durability tests demonstrate the stability of a system. The test is conducted by giving instructions with an intensity above normal operational capacity.
3. *Security test*. This test is conducted to determine the system integrity in protecting data and other features' functionality. There are six basic elements that must be fulfilled in testing a system's security, namely confidentiality, integrity, authentication, authorization, availability and non-rejection.

4. *Implementation test.* Implementation tests are necessary to evaluate the technology equipment by letting end-users operate it. Indispensable, first-hand feedback on the quality of the system is thus provided.
5. *Checking the source code*. Systematic checks on a computer's source code are conducted for two reasons. First, to detect and fix any errors overlooked during the initial development phase. Second, to improve the quality of software and developers' general understanding of the system.
6. *Certification and auditing*. Certification is generally defined as technical evaluation by experts who are not involved in the technology's development and production. Certification is necessary, especially if a technology is going to be used for the first time. In providing certification, the technology provider is adhering to the transparency principle by allowing an external party to assess the integrity of the product. Certified technology also provides stronger assurance in regards to security because it is produced according to defined parameters, and therefore helps develop public trust (Barrat et al. 2015: 7).

The independence of institutions that provide certification should also be proven (Barrat et al. 2015: 6). Auditing, no less than certification, is also necessary and mandatory. The purpose of the auditing process is to examine the accuracy of results generated by the technology in every critical phase. Random allocation of the auditing process may be provided for in law to ensure that the whole system functions properly (Barrat et al. 2015: 16).

Auditing processes must be conducted transparently: the auditor should be mandated to publish the auditing scope, sampling method and auditing mechanism. Any good auditing process will verify the integrity, security and accountability of the system.

3.4.2. Choosing a vendor

The EMB—along with other stakeholders—decides which vendor has the most suitable system according to the specifications. It is important to choose the vendor that provides the best quality technology system for voting, counting and recapitulating.

After deciding the winner of the tender process, the EMB should immediately prepare a working contract. The content of the contract should be published, so that other stakeholders too can monitor whether the winning vendor has performed its contractual duties. A working calendar should contain targets that must be completed by the winning vendor and the EMB should ideally allow the public to monitor this.

It is important that the EMB includes agreed terms on who should own the intellectual property rights of the technology system to be implemented, and which parties are responsible for repairing the system in the case of failures.

3.4.3. Procurement of technology

In this, the third stage, progress should be published periodically in the interest of maintaining public trust, and according to a specified schedule e.g. monthly or bimonthly. The shipping and distribution process should also be properly scheduled to prevent any delay and to ensure that electoral personnel receive sufficient and timely training in using the equipment.

The government and EMB may reconsider outright purchase of election technology if the country has a long electoral cycle, e.g. once every five years. In such cases and where budgets are limited, consideration should be given to renting the election technology instead.

3.5. Implementation

Implementation is the most crucial phase but cannot be initiated unless the previous ones have been carried out comprehensively, and to a high standard. Moreover, proceeding to implementation is conditional on positive results of testing and other inputs to the decision. In other words, implementation is the ultimate process and the most decisive.

During implementation, there are several lessons learned that should be kept in mind:

1. *Time.* No voting technology is an instant solution and it will take time before the public feel the benefits. Usually, it takes several electoral cycles without any major technical error or political controversy, also involving significant voter education, before the public can be fully convinced of these benefits (International IDEA 2011: 20). Realistic expectations should be brought to bear during the problem identification process; the benefits from implementing technology will not be reaped in just one election.
2. *Capacity building and human resources.* Voting and counting technology should never be considered as a purely technical solution, isolated from other issues of capacity and competence on the part of the election organizer (International IDEA 2011: 21). The public, especially voters and political parties, will resist the implementation of e-voting technology if they know that the EMB lack the capacity to do so successfully. Trainings and workshops by experts and the vendor itself are the best solution to specific skills and knowledge gaps.

3. *Voter education.* Voter education must be initiated immediately after an EMB decides to implement election technology. In this context, the purpose is to raise public awareness of the new electoral procedure and technology. This can be done by providing trainings not only for voters, but also for the media, political parties, election participants and CSOs (Barrat et al. 2015: 17). Voter education is a good opportunity for the EMB to explain the motivations for adopting the technology and to gain public trust in the process.
4. *Technology trials*. It is important to conduct trial runs in limited areas of a country before mass roll-out of the voting technology. This can be done in, for example, a single constituency during legislative elections, or a local election (see Box 16). If e-recap is to be introduced in place of manual methods, for example, it is not recommended to apply the change wholesale. It is best to still run manual counting and recapitulation in parallel with trial runs of e-recap. The election results from the systems can then be compared to test the accuracy of e-recap machines. After successive trials in several locations, e-recap can then gradually replace the old system.

To reiterate, EMBs should conduct a trial run first before using the election technology in large-scale elections, especially in the case of e-voting. But this can also precede limited local/constituency pilots. There are three main purposes for conducting trial runs of this kind:

1. The EMB learns the strengths and weaknesses of the election technology to be implemented, including any potential problems that might arise later. Therefore, it can devise a plan for mitigating the risk of errors in the full-scale implementation of the technology.
2. Voters have the chance to experience and scrutinize the systems and devices that they will use in the election.
3. The EMB can measure its own preparedness and internal capacity to implement the system. If a trial run leads the EMB to conclude that they still lack the necessary capacity, they may consider starting small and implementing gradually in limited areas, before taking it to national scale.

Box 16. E-voting implementation stages, Brazil

E-voting in Brazil was launched after passing nine stages:

1. Information dissemination and voter education for voters and wider general public (since 1986).
2. Technical capacity development for election staff and committees, and digitization of election results.
3. Software and hardware development, with help from local experts.
4. Trial runs and testing in several locations.
5. Final decision from the EMB on the type of technology.
6. Quality control and other testing in various cities (1996).
7. E-voting authorized for local elections (1996).
8. Post-election review and plans for system refinements.
9. Full launch preparations of the e-voting system for the 2002 elections.

Source: International IDEA, *Introducing Electronic Voting: Essential Considerations* (Stockholm: International IDEA, 2011) <https://www.idea.int/publications/catalogue/introducing-electronic-voting-essential-considerations>, accessed 18 December 2019.

3.6. Evaluation

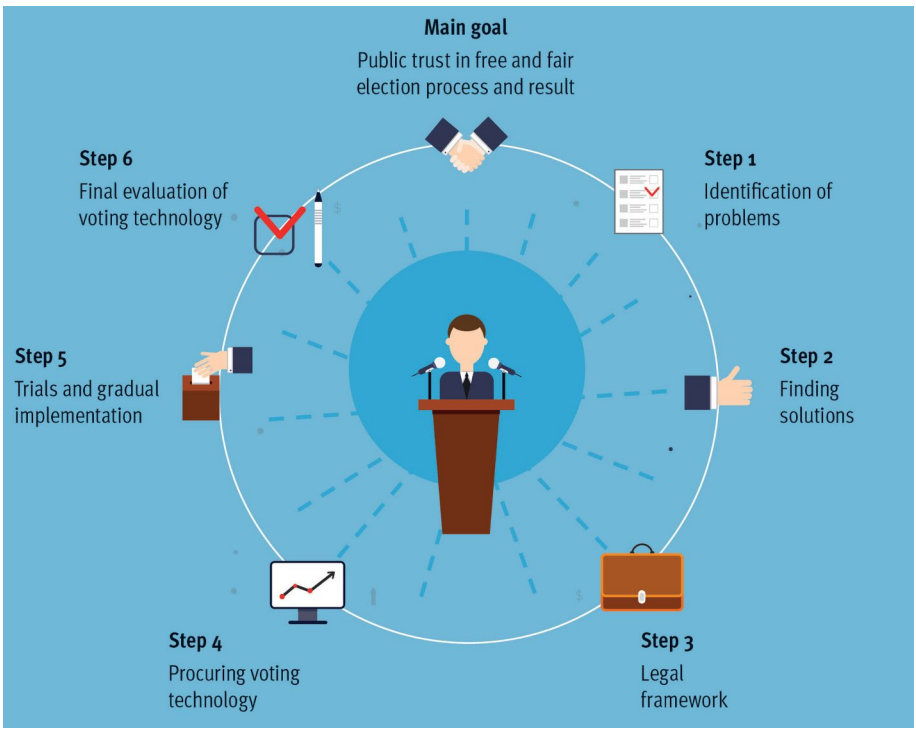
Comprehensive evaluation of the election technology must be conducted at every electoral phase—pre-electoral, electoral and post-electoral. By this point, the purpose of evaluation is ideally to find any problems regarding implementation of the technology, in the hope of finding ways to further refine its deployment. But evaluating the implementation of election technology also serves to revisit three fundamental questions:

1. Is the election technology able to solve the specific problem(s) it was designed to, according to the problem identification process conducted during the planning phase?
2. Is the implemented election technology reducing the the problem(s)/ effects thereof, or instead exacerbating them?

3. Is the use of the election technology increasing public confidence in the election process?

These questions should be discussed and elaborated during the evaluation process in order to improve the implementation of the election technology in the future, and indeed to help the EMB decide whether to continue using the technology or replace it altogether. Seeking potential upgrades to election technologies is not a one-off but a cyclical process (see Figure 8); whatever the final result of an evaluation, the EMB will then enter a new cycle of problem identification, selecting solutions and, very likely, procuring and implementing an alternative or next-generation technology system. As regards methods of evaluation, these may include focus group discussion with stakeholders on behalf of the EMB and opinion polls to get a better picture of how implementation of the election technology has been received by the public. An important general principle is that evaluation on election technology should be conducted by involving all parties that have a stake in the election, from government and the EMB itself to political parties, CSOs, election experts and voters.

Figure 8. Evaluating voting technology



4. Indonesia's experiences with election technology

The use of election technology in Indonesia is not entirely novel. Since the 1999 elections, Indonesia has been using electronic technology to tabulate the election result at national level. There has been large-scale use of technology in electoral processes since the 2004 election. Although up until the national elections in 2019, Indonesia had never used e-voting, other election technology had become integral to almost every stage of election management. In general, the main purpose of implementing election technology in Indonesia has been to increase transparency and accountability in the electoral process, and in turn to increase public trust and legitimacy in the election result. The chairperson of KPU believes that the use of technology in electoral process will improve the quality and integrity of the election (Lee, Samino and Udi Prayudi 2017: 107).

To date, the use of election technology in Indonesia can be classified into three types: the use of technology in election processes, the use of recapitulation technology, and the use of technology during voting and vote counting. However, according to the applicable laws and regulations, recapitulation of election results is conducted manually and tiered. As such, the purpose of recapitulation technology has been to improve transparency and control of election result information only. The same also applies to voting and vote-counting technology that is now proposed to be used in elections in Indonesia.

4.1. Use of technology in electoral stages

Election technology in Indonesia is implemented to facilitate the electoral process and to assist KPU's organizational needs, for example coordination and communication between staff at different levels and locations. There were at least

six types of election technology implemented in Indonesia in the 2014 elections (see Sections 4.1.1–4.1.5, and concerning e-recap, 4.2.4).

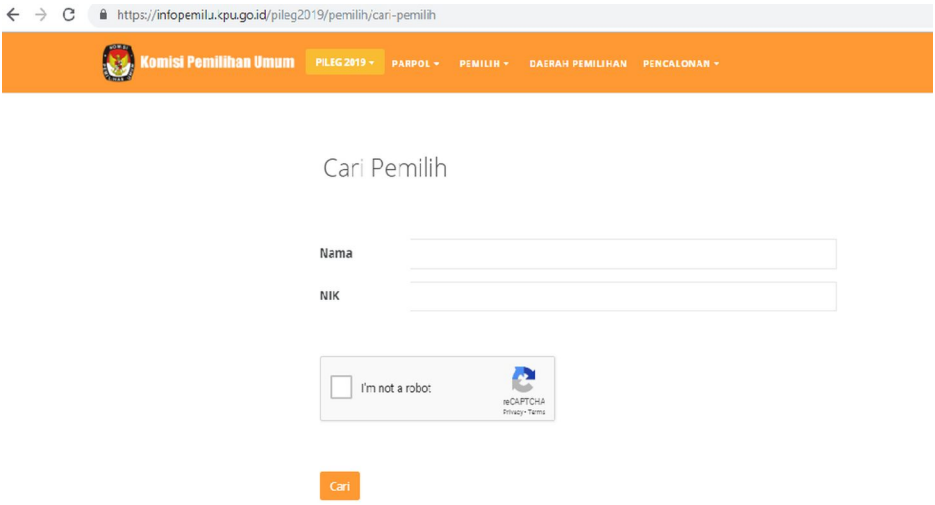
4.1.1. IT for voter registration

In the voter registration process IT is used to tabulate lists of names of citizens who are eligible to vote (i.e. have reached the age of 17 or have been married). Other than making voter registration easier, the use of technology for data tabulation is also useful to improve the accuracy of the electoral roll. KPU developed its Voter Data Information System (Sidalih, see Figures 9 and 10) during its 2007–2012 mandate. The lack of consolidated voter data in the 2009 elections prompted KPU to further develop the Sidalih. In that election, KPU processed more than 80,000 spreadsheet files with a computer application that was not integrated with a centralized database, rendering the updating of voter data unmanageable (Prakarsa Pendaftaran KPU 2012 [Engineering the KPU Registration in 2012]; Lee, Samino and Udi Prayudi 2017: 112). As a result, KPU branches at province and regency/municipality level had their own version of voter data in different data formats and on different platforms.

Sidalih was developed to resolve this issue by creating a centralized, accurate, integrated and updated database. KPU cooperated with numerous institutions to develop the system, including: the Agency for the Assessment and Application of Technology (BPPT), the Ministry of Home Affairs, various CSOs, universities and delegations from KPU at province level, all of which were represented on the initiative's steering committee (Lee, Samino and Udi Prayudi 2017: 113). Sidalih has two main functions:

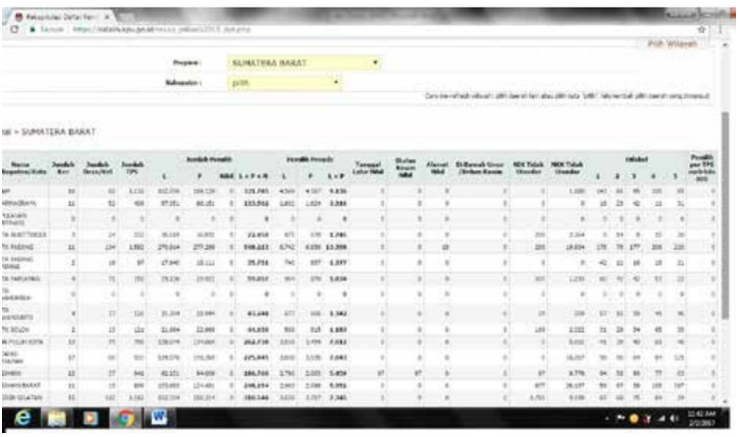
1. It is used by the officers at polling stations and KPU member bodies to update voters' data through a CRUDE (create, read, update and delete) system. Other than facilitating the data collection process, Sidalih is also helpful in allocating voters to the appropriate polling station.
2. Sidalih automatically publishes voters' data online so every voter can check for themselves whether he/she has been registered or not. Sidalih also allows KPU to monitor progress of the voter data from the entire region centrally, to see if there are any errors such as duplicate entries or incomplete voter data (Lee, Samino and Udi Prayudi 2017: 114).

Figure 9. Indonesia's Voter Data Information System (Sidalih)—login



Source: General Elections Commission of Indonesia (KPU), Cari Pemilih, <https://infopemilu.kpu.go.id/pileg2019/pemilih/cari-pemilih>, accessed 5 May 2020.

Figure 10. Indonesia's Voter Data Information System (Sidalih)—monitor display from the account of Indonesia's Electoral Commission (KPU)



Source: A. Lee, P. Samino, and K. Udi Prayudi (eds), *Inovasi Pemilu: Mengatasi Tantangan, Memanfaatkan Peluang* [Election innovations: overcoming challenges, leveraging opportunities] (Jakarta: KPU, 2017).

In the 2019 concurrent elections, Sidalih was crucial for every voter to check their registration status because a new regulation mandated all voters to own

electronic resident identification cards (e-KTP) as a requirement to register. Four months before election day there were still many residents who had not conducted the procedure to obtain their e-KTP. As of 31 December 2018, 97.8 per cent (or 188.4 million residents) had obtained their e-KTP while the other 2.2 per cent (or 4.2 million people) had not (Ayu 2019).

Apart from benefiting voters, Sidalih has also been used by election participants and CSOs to check the accuracy of the electoral roll, which has historically been a recurrent problem. In the concurrent elections of 2019 several political parties, such as the Justice and Prosperity Party (PKS) and Grand Indonesia Movement (Gerindra)—both were supporting Prabowo Subianto-Sandiaga Shalahuddin Uno for President and Vice-President, respectively—as well as Bawaslu and several CSOs lodged protests against the official electoral roll released by KPU (the latter included the Association for Elections and Democracy (Perludem), Centre for Election Access of Citizens with Disabilities (PPUA Penca) Indonesia, Indigenous Peoples' Alliance (AMAN), and Migrant Care). One of the main issues at that time was the high number of duplicated voters. KPU updated their electoral roll three times (16 September, 15 November and 15 December 2018) after first publishing the electoral roll (known as DPT) on 5 September 2018. The first DPT listed just under 187.8 million voters (The Jakarta Post 2018); the last update—which was called Improved DPT No. III— listed just under 192.9 million (Andayani 2019).

4.1.2. IT for political party registration

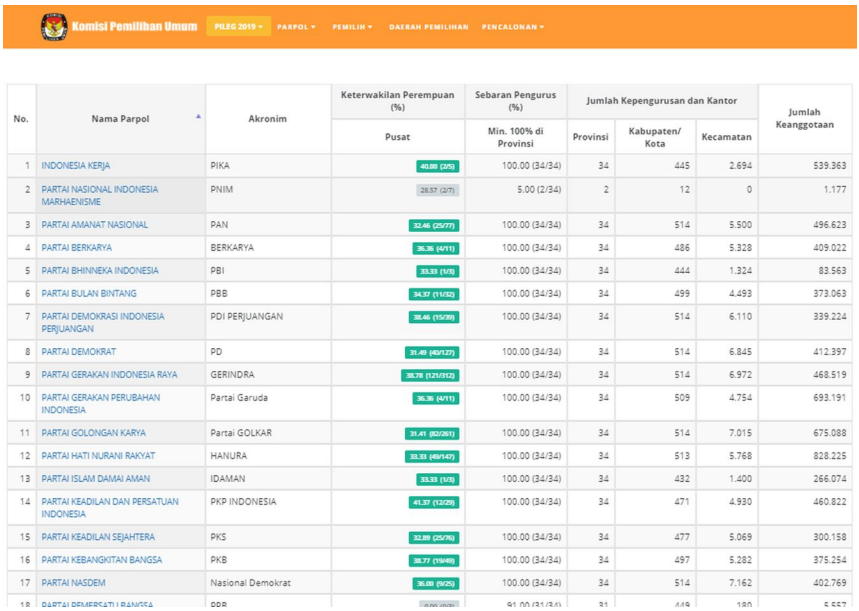
Sipol (see Figure 11) is an online system used to facilitate the registration and verification process for political parties that wish to participate in an election. There are two main purposes of the implementation of Sipol: (a) Sipol is useful for political parties to simplify the process of filling the membership data form at central, province, regency/municipality and neighbourhood level, as required by the Elections Law in order to participate in elections; and (b) for KPU, Sipol is very helpful in facilitating the verification process of the membership data submitted by political parties, as Sipol only receives submission forms in a standardized format (Lee, Samino and Udi Prayudi 2017: 109).

Similar to the development of Sidalih, KPU cooperated with BPPT and several other institutions to develop Sipol. With Sipol, the public can view the details of political parties' administration offices, the total members and officers at each branch, and the total number of female representatives (Article 173 paragraph (2) letter e of the Election Law No. 7/2017 specifies that women must occupy a minimum of 30 per cent of positions at the central level). With Sipol, transparency and public participation in the political party verification process were expected to increase.

In the 2019 concurrent elections, there were nine political parties that failed the verification process according to Sipol, and which protested this result. Sipol

was the main subject of dispute in Bawaslu. Many political parties complained that Sipol often crashed, causing data to be deleted or replaced, and it was difficult to access. Bawaslu ruled that Sipol cannot be used to determine whether a political party passes the verification test or not because the implementation of Sipol is not specified in the Elections Law. Bawaslu also found KPU to have committed an administrative violation because, according to the witnesses brought to the judicial hearing, the mandatory use of Sipol renders the political party registration process difficult and hence violates the user's right to participate in an election.

Figure 11. Political Party Registration System (Sipol)


Komisi Pemilihan Umum PILEG 2019 PARPOL PEMILIH DAERAH PEMILIHAN PENCALONAN

No.	Nama Parpol	Akronim	Keterwakilan Perempuan (%)	Sebaran Pengurus (%)	Jumlah Kepengurusan dan Kantor			Jumlah Keanggotaan
			Pusat	Min. 100% di Provinsi	Provinsi	Kabupaten/ Kota	Kecamatan	
1	INDONESIA KERJA	PIKA	40.00 (2/5)	100.00 (34/34)	34	445	2.694	539.363
2	PARTAI NASIONAL INDONESIA MARHAENISME	PNIM	28.57 (2/7)	5.00 (2/34)	2	12	0	1.177
3	PARTAI AMANAT NASIONAL	PAN	32.46 (25/77)	100.00 (34/34)	34	514	5.500	496.623
4	PARTAI BERKARYA	BERKARYA	36.36 (4/11)	100.00 (34/34)	34	486	5.328	409.022
5	PARTAI BHINNEKA INDONESIA	PBI	33.33 (1/3)	100.00 (34/34)	34	444	1.324	83.563
6	PARTAI BULAN BINTANG	PBB	34.37 (11/32)	100.00 (34/34)	34	499	4.493	373.063
7	PARTAI DEMOKRASI INDONESIA PERJUANGAN	PDI PERJUANGAN	38.46 (15/39)	100.00 (34/34)	34	514	6.110	339.224
8	PARTAI DEMOKRAT	PD	31.49 (40/127)	100.00 (34/34)	34	514	6.845	412.397
9	PARTAI GERAKAN INDONESIA RAYA	GERINDRA	38.78 (121/312)	100.00 (34/34)	34	514	6.972	468.519
10	PARTAI GERAKAN PERUBAHAN INDONESIA	Partai Garuda	36.36 (4/11)	100.00 (34/34)	34	509	4.754	693.191
11	PARTAI GOLONGAN KARYA	Partai GOLKAR	31.41 (82/261)	100.00 (34/34)	34	514	7.015	675.088
12	PARTAI HATI NURANI RAKYAT	HANURA	33.33 (49/147)	100.00 (34/34)	34	513	5.768	828.225
13	PARTAI ISLAM DAMAI AMAN	IDAMAN	33.33 (1/3)	100.00 (34/34)	34	432	1.400	266.074
14	PARTAI KEADILAN DAN PERSATUAN INDONESIA	PKP INDONESIA	41.37 (12/29)	100.00 (34/34)	34	471	4.930	460.822
15	PARTAI KEADILAN SEJAHTERA	PKS	32.89 (25/76)	100.00 (34/34)	34	477	5.069	300.158
16	PARTAI KEBANGKITAN BANGSA	PKB	38.77 (19/49)	100.00 (34/34)	34	497	5.282	375.254
17	PARTAI NASDEM	Nasional Demokrat	36.00 (9/25)	100.00 (34/34)	34	514	7.162	402.769
18	PARTAI PEMERSATU BANGSA	PPB		91.00 (31/34)	31	449	180	5.557

Source: General Elections Commission of Indonesia (KPU), Rekapitulasi Partai, <https://infopemilu.kpu.go.id/pileg2019/verpol/parpol>, accessed 5 May 2020.

4.1.3. IT for candidate registration

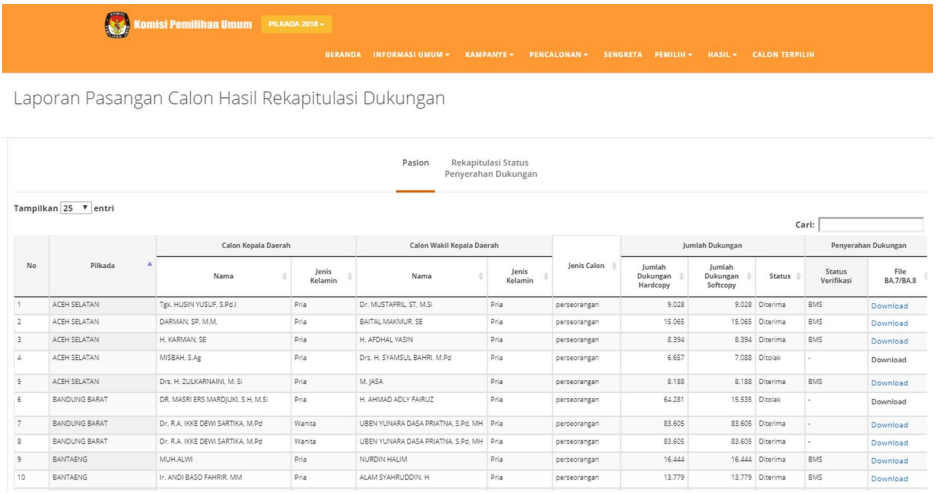
Indonesia's candidacy information system (Silon) works in a similar way to Sipol, but is exclusively used for individuals to register as candidates for local/regional elections. This system was first developed for the 2015 concurrent local elections. Silon has been implemented with three main purposes:

1. To facilitate the candidate registration process in local elections and also to facilitate the verification process of candidates' submission forms, both for candidates who are party members and for independent candidates.

Depending on districts and their population the thresholds for registration vary. For any candidate from a political party, she/he is required to have at least 20 per cent to 25 per cent of parliamentary nominations (from members duly elected from the previous election). An independent candidate is required to gain at least 6.5 per cent to 10 per cent of public support from the total population of their respective region as proven by copies of the citizens' identity card. The Silon technology makes it easier for the election authority to conduct verification on the validity of the public support, its compliance to the applicable rules, and to check whether there is any data error, such as duplicate entries.

2. With Silon, voters can easily view detailed information about the candidates, including their political party affiliation and the amount of public support that any independent candidate has received (see Figure 12). Voters can also look up candidates' curriculum vitae, visions and missions, and the policies/programmes that they propose as electoral candidates.

Figure 12. Recapitulation of candidate nominations (2018 local elections)



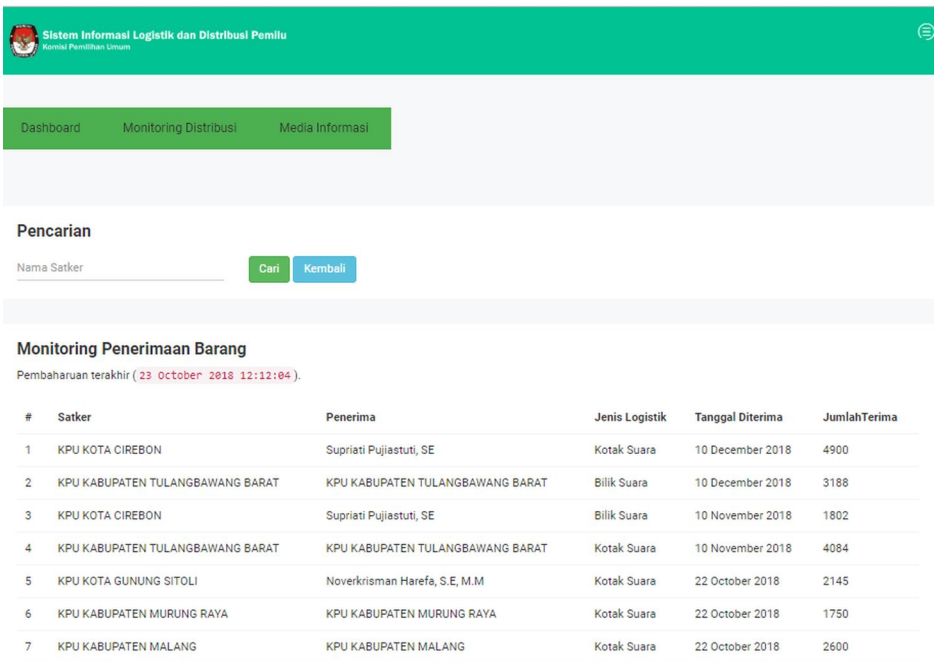
No	Pilkada	Calon Kepala Daerah		Calon Wakil Kepala Daerah		Jenis Calon	Jumlah Dukungan			Penyerahan Dukungan	
		Nama	Jenis Kelamin	Nama	Jenis Kelamin		Jumlah Dukungan Hardcopy	Jumlah Dukungan Softcopy	Status	Status Verifikasi	File BA.7/BA.8
1	ACEH SELATAN	Tgk. HUSIN YUSUF, S.Pd.I	Pria	Dr. MUSTAFRIL, ST, M.SI	Pria	perseorangan	9.028	9.028	Diterima	BMS	Download
2	ACEH SELATAN	DARMAN, SP, M.M.	Pria	BAITAL MAKMUR, SE	Pria	perseorangan	15.065	15.065	Diterima	BMS	Download
3	ACEH SELATAN	H. KARMAN, SE	Pria	H. AFDHAL YASIN	Pria	perseorangan	8.394	8.394	Diterima	BMS	Download
4	ACEH SELATAN	MISBAH, S.Ag	Pria	Drs. H. SYAMSUL BAHRI, M.Pd	Pria	perseorangan	6.657	7.088	Ditolak	-	Download
5	ACEH SELATAN	Drs. H. ZULKARNAINI, M. Si	Pria	M. JASA	Pria	perseorangan	8.188	8.188	Diterima	BMS	Download
6	BANDUNG BARAT	DR. MASRI ERS MARDJUKI, S.H, M.Si	Pria	H. AHMAD ADLY FAIRUZ	Pria	perseorangan	64.281	15.535	Ditolak	-	Download
7	BANDUNG BARAT	Dr. R.A. IKKE DEWI SARTIKA, M.Pd	Wanita	UBEN YUNARA DASA PRIATNA, S.Pd, MH	Pria	perseorangan	83.605	83.605	Diterima	-	Download
8	BANDUNG BARAT	Dr. R.A. IKKE DEWI SARTIKA, M.Pd	Wanita	UBEN YUNARA DASA PRIATNA, S.Pd, MH	Pria	perseorangan	83.605	83.605	Diterima	-	Download
9	BANTAENG	MUH.ALWI	Pria	NURDIN HALIM	Pria	perseorangan	16.444	16.444	Diterima	BMS	Download
10	BANTAENG	Ir. ANDI BASO FAHRIR, MM	Pria	ALAM SYAHRUDDIN, H	Pria	perseorangan	13.779	13.779	Diterima	BMS	Download

Source: General Elections Commission of Indonesia (KPU), Silon system. Recapitulation results can be accessed from <https://infopemilu.kpu.go.id/pilkada2018/paslon/hasilRekapitulasiDukungan>, accesssed 14 May 2020.

4.1.4. IT for election logistics

In order to better monitor and supervise the procurement of elections logistics, KPU has developed a logistics information system, Silog (Lee, Samino and Udi Prayudi 2017: 127). With Silog, KPU branches at regency/municipality level, which are responsible for distributing elections logistics (such as ballots, voting booths, inks, administrative forms), can easily and sustainably process information regarding that distribution. At the same time, the central KPU can check whether elections logistics have been properly distributed by its subsidiaries. Two types of information can be accessed through Silog: first, whether the elections logistics have been dispatched (dispatch); second, whether the logistics have been received by the election officers at destination (reception, see Figures 13 and 14). The Silog web portal was developed by KPU in cooperation with a team of specialists from the Bandung Institute of Technology and Partnership for Governance Reform.

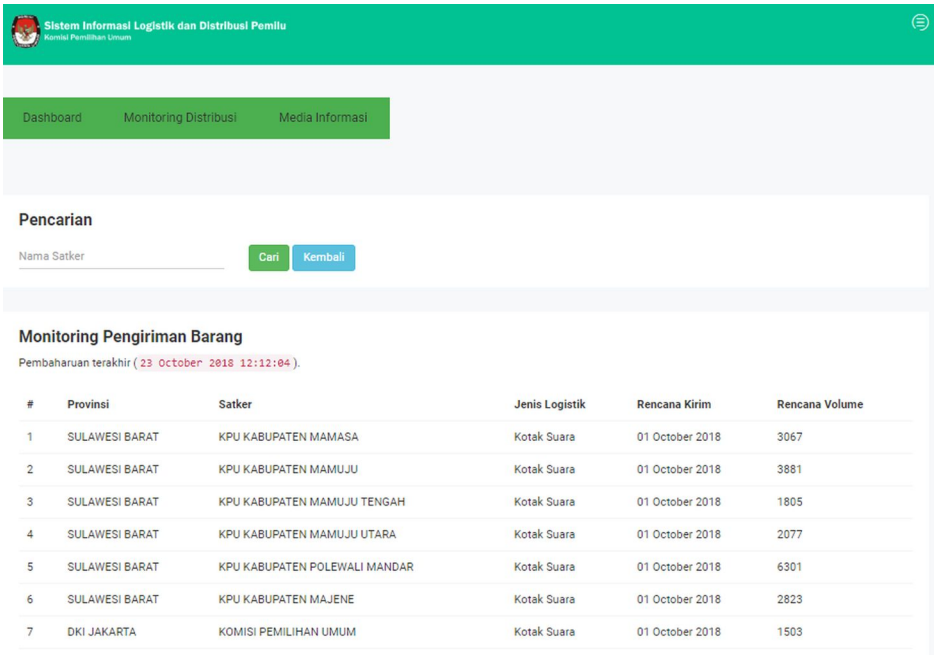
Figure 13. Receipt of goods (election logistics) display



#	Satker	Penerima	Jenis Logistik	Tanggal Diterima	JumlahTerima
1	KPU KOTA CIREBON	Supriati Pujiastuti, SE	Kotak Suara	10 December 2018	4900
2	KPU KABUPATEN TULANGBAWANG BARAT	KPU KABUPATEN TULANGBAWANG BARAT	Bilik Suara	10 December 2018	3188
3	KPU KOTA CIREBON	Supriati Pujiastuti, SE	Bilik Suara	10 November 2018	1802
4	KPU KABUPATEN TULANGBAWANG BARAT	KPU KABUPATEN TULANGBAWANG BARAT	Kotak Suara	10 November 2018	4084
5	KPU KOTA GUNUNG SITOLI	Noverkrisman Harefa, S.E, M.M	Kotak Suara	22 October 2018	2145
6	KPU KABUPATEN MURUNG RAYA	KPU KABUPATEN MURUNG RAYA	Kotak Suara	22 October 2018	1750
7	KPU KABUPATEN MALANG	KPU KABUPATEN MALANG	Kotak Suara	22 October 2018	2600

Source: General Elections Commission of Indonesia (KPU), <http://www.silog.kpu.go.id>.

Figure 14. Delivery of goods (election logistics) display



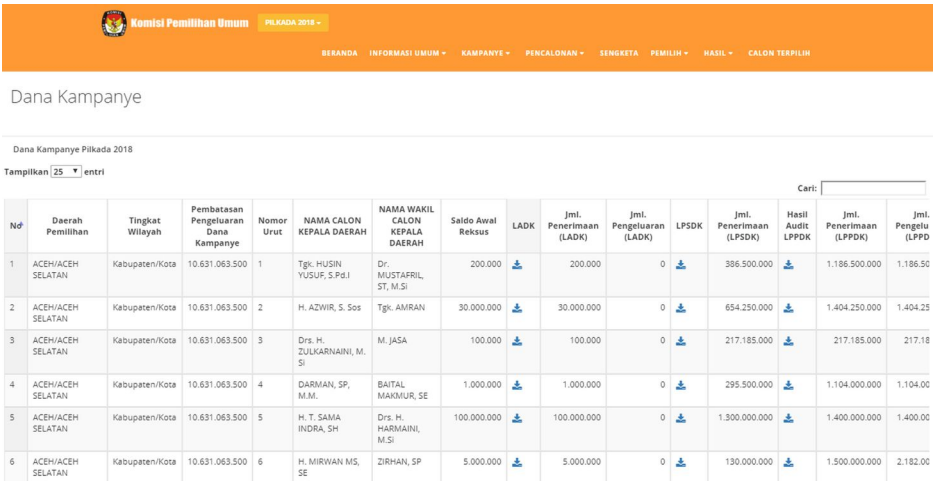
#	Provinsi	Satker	Jenis Logistik	Rencana Kirim	Rencana Volume
1	SULAWESI BARAT	KPU KABUPATEN MAMASA	Kotak Suara	01 October 2018	3067
2	SULAWESI BARAT	KPU KABUPATEN MAMUJU	Kotak Suara	01 October 2018	3881
3	SULAWESI BARAT	KPU KABUPATEN MAMUJU TENGAH	Kotak Suara	01 October 2018	1805
4	SULAWESI BARAT	KPU KABUPATEN MAMUJU UTARA	Kotak Suara	01 October 2018	2077
5	SULAWESI BARAT	KPU KABUPATEN POLEWALI MANDAR	Kotak Suara	01 October 2018	6301
6	SULAWESI BARAT	KPU KABUPATEN MAJENE	Kotak Suara	01 October 2018	2823
7	DKI JAKARTA	KOMISI PEMILIHAN UMUM	Kotak Suara	01 October 2018	1503

Source: General Elections Commission of Indonesia (KPU), <http://www.silog.kpu.go.id>.

4.1.5. IT for campaign funds reporting

In order to increase transparency and accountability, KPU has developed an information web portal, Sidakam, that contains financial statements of political parties' or candidates' campaign funds. The web portal contains the Initial Financial Statement of Campaign Funds with detailed information of funding sources, either individual donors or business entities, including the amount of funds given. It also contains detailed information on campaign expenses and auditing reports on candidates'/parties' campaign income and expenditure statements (see Figure 15).

Figure 15. Campaign income and expenditure display (2019 local elections)



No	Daerah Pemilihan	Tingkat Wilayah	Pembatasan Pengeluaran Dana Kampanye	Nomor Urut	NAMA CALON KEPALA DAERAH	NAMA WAKIL CALON KEPALA DAERAH	Saldo Awal Reksus	LADK	Jml. Penerimaan (LADK)	Jml. Pengeluaran (LADK)	LPSDK	Jml. Penerimaan (LPSDK)	Hasil Audit LPPDK	Jml. Penerimaan (LPPDK)	Jml. Pengelu (LPPD
1	ACEH/ACEH SELATAN	Kabupaten/Kota	10.631.063.500	1	Tgk. HUSIN YUSUF, S.Pd.I	Dr. MUSTAFRIL, ST, M.Si	200.000		200.000	0		386.500.000		1.186.500.000	1.186.50
2	ACEH/ACEH SELATAN	Kabupaten/Kota	10.631.063.500	2	H. AZWIR, S. Sos	Tgk. AMRAN	30.000.000		30.000.000	0		654.250.000		1.404.250.000	1.404.25
3	ACEH/ACEH SELATAN	Kabupaten/Kota	10.631.063.500	3	Drs. H. ZULKARNAINI, M. Si	M. JASA	100.000		100.000	0		217.185.000		217.185.000	217.18
4	ACEH/ACEH SELATAN	Kabupaten/Kota	10.631.063.500	4	DARMAN, SP, M.M.	BAITAL MAKMUR, SE	1.000.000		1.000.000	0		295.500.000		1.104.000.000	1.104.00
5	ACEH/ACEH SELATAN	Kabupaten/Kota	10.631.063.500	5	H. T. SAMA INDRA, SH	Drs. H. HARMAINI, M.Si	100.000.000		100.000.000	0		1.300.000.000		1.400.000.000	1.400.00
6	ACEH/ACEH SELATAN	Kabupaten/Kota	10.631.063.500	6	H. MIRWAN MS, SE	ZIRHAN, SP	5.000.000		5.000.000	0		130.000.000		1.500.000.000	2.182.00

Source: General Elections Commission of Indonesia (KPU), Silon system, <https://infopemilu.kpu.go.id/pilkada2018/dana-kampanye>, accessed 19 October 2019.

Ultimately, the entire technology used by KPU is just a means to create a more transparent and accountable election process. In order to be more compliant with the spirit of election open data initiatives (Carlon and Wolf 2017: 9), Indonesia's KPU is striving to gain more independence and increase public trust in the election process through election data transparency and accountability.

By making the election process more transparent, KPU is able to increase participation in the political process by enabling the public to access, process and disseminate elections data. For example, Perludem, a Jakarta-based CSO, initiated a 'hackathon' (hacking marathon) competition by using the open data on electoral candidates as contained in the Silon. In the hackathon competition, thousands of IT developers competed against each other to create the best smartphone application to convey information about electoral candidates and elections in general to users.

4.2. Electronic recapitulation in national and local elections (1999–2019)

KPU's IT feasibility study (2016) points out that recapitulation technology has been used in Indonesia since its 1999 elections. As mentioned, it is used informally because the existing rules and regulations only cover the implementation of a manual and tiered recapitulation process. Therefore, electronic recapitulation (e-recap) technology is used to tabulate election result

data and publish them for public access. The following sections describe the e-recap technology used in Indonesian elections from 1999 to 2014, based on KPU's own study by its ICT Implementation Team (KPU 2016), and more recently in the 2019 elections.

4.2.1. The 1999 elections

Following the fall of the authoritarian regime of Suharto (1967–1998), the 1999 elections became the first transitional election held in the newly democratic political system. Election technology was finally introduced in that election, having been done manually since 1955.

The election result was entered into a computer system by committees at regency/municipality level. The data entry was then transmitted to KPU by two methods: first, by utilizing the communication network belonging to Bank Rakyat Indonesia and Bank National Indonesia; second, using VSAT satellite and network channel rented from Telkom. The computerized system used by KPU was known as the Integrated Hajj Communication System (Siskohat). The main issue with the system was that data transmission often had to wait for times of day when data traffic was less busy so that data from the BNI and BRI's network could be transmitted smoothly.

4.2.2. The 2004 elections

Election result data entry in the 2004 elections at district level was conducted with a special form called C1-IT and directly transmitted to KPU's data centre. Virtual private networks (VPNs) were used to directly connect the computer at district level with the KPU server. In practice, there were three stages in entering and processing the election result data:

1. *District level*. KPU deployed staff as operators who were responsible for inputting the election result data at each polling station in all sub-districts.
2. *Connection with KPU's server*. The operator staff at district level were responsible for directly performing data entry via VPN directly connected with the KPU server, and no later than four days after the committee received the complete result of vote counting from polling stations in their respective district. However, because not all districts had adequate Internet connection, especially those in remote areas, some districts still delivered their vote-counting result manually.
3. *Processing and publishing of results by KPU*. KPU intended to process the data inputted by direct connection with district level within an estimated two weeks after voting day, and to directly publish the national tabulation centre's result via KPU's website.

The IT used in the 2004 elections was equipped with a security system in four parts—data processing, uninterrupted power supply, communication and location security.

In the event, the KPU website used to publish the recapitulation result was hacked and defaced, resulting in the alteration of political parties' logos and falsification of the votes acquired by each. Despite being based on the same raw data, the result of the recapitulation process for the presidential election differed by 0.26 per cent from the manual recapitulation result.

4.2.3. The 2009 elections

E-recap technology was used once again in 2009, but with different IT, namely an ICR system that functions as the scanner for the vote-counting result forms at polling stations (C1 Forms). KPU's Regulation Number 2 of 2009 was the formal legal basis for the implementation of this technology. In general, the implementation of ICR technology serves four main purposes:

- expediting the vote-counting process;
- obtaining more accurate data tabulation;
- producing authentic and secure electronic copies of election result documents; and
- boosting transparency and allowing direct public monitoring (KPU 2016).

ICR works similarly to the technology used in the 2004 elections, where a polling station officer is responsible for filling the C1-IT Form to be scanned with the scanner device available in KPU at regency/municipality level. The scanned result is then transmitted to the KPU data centre to be published. Initially, KPU's target was to recapitulate the election results online no later than 15 days after voting day, so that the public could be swiftly appraised of the election result. However, up until the designated date, only 13 per cent of total vote counts nationwide had been transmitted to KPU's data centre. The explanation offered for the delay was twofold: a lack of training provided to polling station officers, and failures by the ICR to properly scan the C1-IT Form.

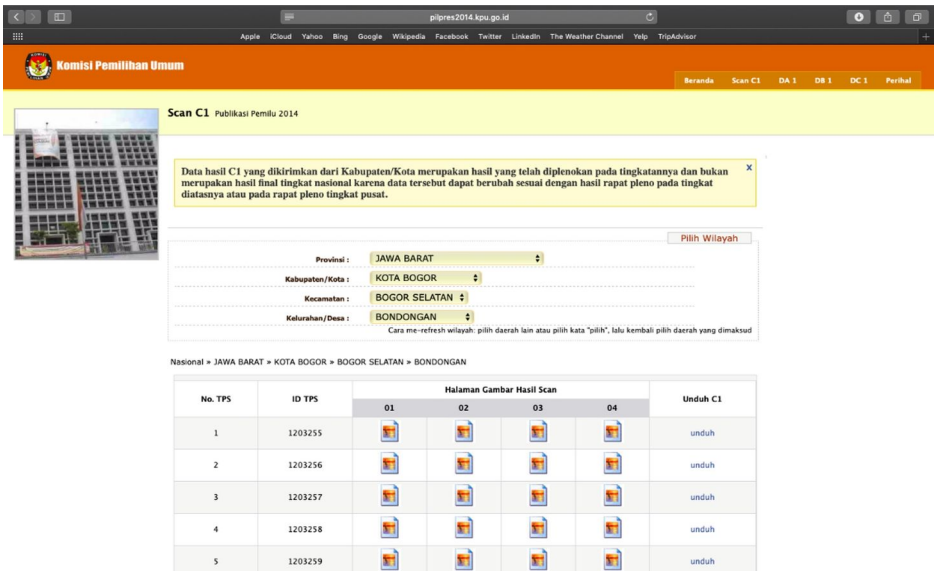
4.2.4. The 2014 elections

The recapitulation technology used in the 2014 elections was similar to the one used in the 2009 elections and with the same purpose of promoting transparency and public participation in overseeing the process. However, the ICR technology and the C1-IT Form are longer used. Instead a C1 Form is immediately scanned and the scanned result is then uploaded to KPU's website for the public to access. In the presidential election, in addition to scanning the C1 Form KPU used e-

recap and Excel applications. Specifically, the three elements used by KPU in the 2014 elections to facilitate the recapitulation process are as follows:

1. *C1 scan*. KPU branches at regency/municipality level were asked to perform scans of the C1 Form (that contains the vote-counting result from polling stations) by utilizing a scanner device with a speed of 20–30 pages per minute and Internet connection complying with minimum speed requirements. The number of scanners and officers to operate them was adjusted to the number of polling stations in each regency/municipality and in turn, the size of each province. The C1 Form scanning results from every polling station are open to the public for download (from <http://www.pilpres2014.kpu.go.id>, see Figure 16).

Figure 16. C1 Form scan result in the 2014 presidential election



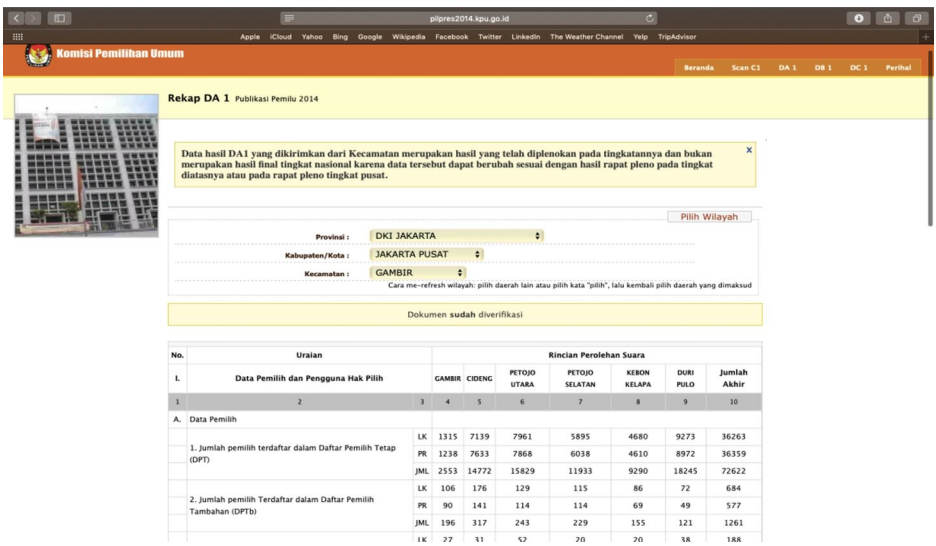
Source: General Elections Commission of Indonesia (KPU), Scan C1, <https://pilpres2014.kpu.go.id/c1.php>, accessed 12 May 2020.

2. *E-recap*. This is an offline application designed by KPU for the vote-counting recapitulation process as a mean of ensuring the accuracy of C1 Form content as filled by election officers at polling stations. This application was not made for public use but to be used by election officers at regency/municipality level while they scan the C1 Form, and can only be accessed by KPU. Prior to scanning and publishing the scan result,

election officers first conduct data checking. Then, the election officers copy the data contained in the C1 Form into the e-recap application. This application is directly integrated with KPU's data centre.

3. *Microsoft Excel application*. The soft copy of recapitulation documents from district level (DA1 Forms), recapitulation documents from regency/municipality level (DB1 Forms) and recapitulation documents from province level (DC1 Forms) are stored in Excel format (see Figure 17). This application was developed with two main purposes: first, to be used in the recapitulation result plenary meeting by KPU branches at regency/municipality and provincial level; second, to provide for publication of results in the public information portal https://pilpres2014.kpu.go.id.

Figure 17. Recapitulation results using Excel (2014)



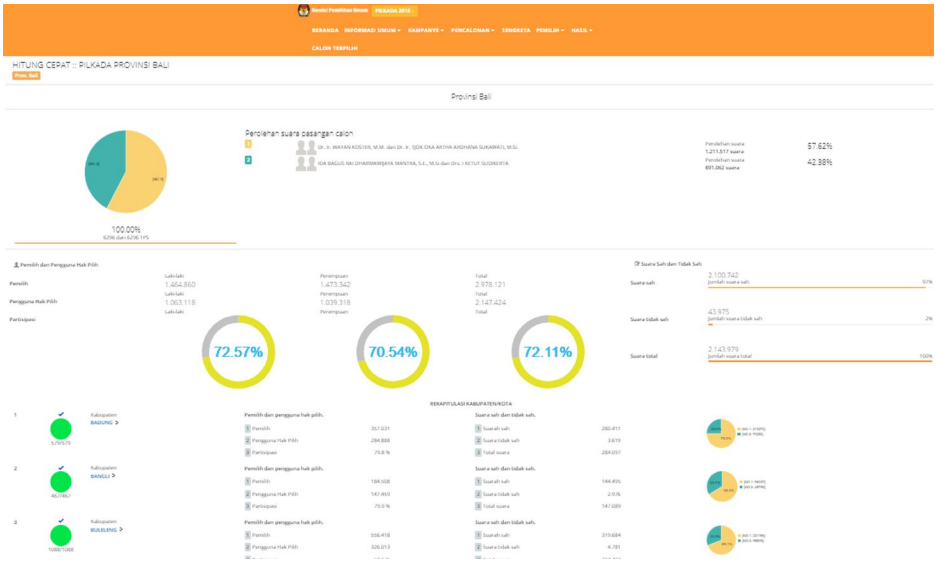
No.	Uraian		Rincian Perolehan Suara							
I.	Data Pemilih dan Pengguna Hak Pilih		GAMBIR	CIDENG	PETOJO UTARA	PETOJO SELATAN	KEBON KELAPA	DURI PULO	Jumlah Akhir
1	2	3	4	5	6	7	8	9	10
A.	Data Pemilih								
	1. Jumlah pemilih terdaftar dalam Daftar Pemilih Tetap (DPT)	LK	1315	7139	7961	5895	4680	9273	36263
		PR	1238	7633	7868	6038	4610	8972	36359
		JML	2553	14772	15829	11933	9290	18245	72622
	2. Jumlah pemilih Terdaftar dalam Daftar Pemilih Tambahan (DPTb)	LK	106	176	129	115	86	72	684
		PR	90	141	114	114	69	49	577
		JML	196	317	243	229	155	121	1261
		LK	27	31	52	20	20	38	188

Source: General Elections Commission of Indonesia (KPU), <https://www.pilpres2014.kpu.go.id>, accessed 10 October 2019.

4.2.5. The 2014 local elections

The e-recap technologies used in the 2014 local elections were the same as in the 2014 elections overall, namely—C1 scanners, e-recap and Excel. These three were also implemented in the concurrent local elections of 2015, 2017 and 2018, the results of which were published on the infopemilu.kpu.go.id website (see Figure 18). However, when used in the 2018 concurrent elections, the site was hacked, prompting KPU to temporarily shut down the site.[1]

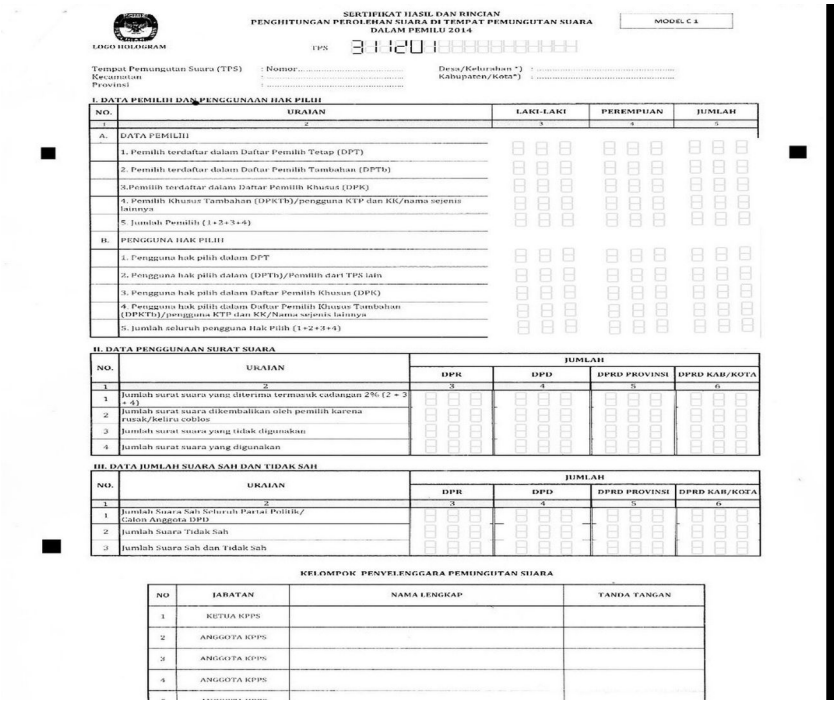
Figure 18. Electronic recapitulation, 2017 local elections



Source: General Elections Commission of Indonesia (KPU), HITUNG CEPAT :: PILKADA PROVINSI BALI, <https://infopemilu.kpu.go.id/pilkada2018/hasil/cepat/t1/bali>, accessed 10 October 2019.

Seven segment technology was tried for the first time at several polling stations during the 2017 Jakarta local election. This technology is similar to ICR, being used to read numbers on the seven segment C1 Form (see Figure 19). A computer automatically counts the numbers put in the seven segment C1 Form by election officers at polling stations manually, according to the designated pattern. After that, the seven segment C1 Form is scanned and will generate two documents—the picture of the scanning result and numbers in text format for recapitulation purposes.

Figure 19. An example of a seven segment C1 Form



SERTIFIKAT HASIL DAN RINCIAN
PENGHITUNGAN PEROLEHAN SUARA DI TEMPAT PEMUNGUTAN SUARA
DALAM PEMILU 2014

MODEL C 1

LOGO HOLOGRAM

TPS 3 1 1 2 0 1

Tempat Pemungutan Suara (TPS) : Nomor:
Kecamatan :
Provinsi :
Desa/Kelurahan *) :
Kabupaten/Kota*) :

I. DATA PEMILIH DAN PENGGUNAAN HAK PILIH

NO.	URAIAN	LAKI-LAKI	PEREMPUAN	JUMLAH
1	2	3	4	5
A.	DATA PEMILIH			
	1. Pemilih terdaftar dalam Daftar Pemilih Tetap (DPT)			
	2. Pemilih terdaftar dalam Daftar Pemilih Tambahan (DPTb)			
	3.Pemilih terdaftar dalam Daftar Pemilih Khusus (DPK)			
	4. Pemilih Khusus Tambahan (DPKTb)/pengguna KTP dan KK/nama sejenis lainnya			
	5. Jumlah Pemilih (1+3+3+4)			
B.	PENGGUNA HAK PILIH			
	1. Pengguna hak pilih dalam DPT			
	2. Pengguna hak pilih dalam (DPTb)/Pemilih dari TPS lain			
	3. Pengguna hak pilih dalam Daftar Pemilih Khusus (DPK)			
	4. Pengguna hak pilih dalam Daftar Pemilih Khusus Tambahan (DPKTb)/pengguna KTP dan KK/Nama sejenis lainnya			
	5. Jumlah seluruh pengguna Hak Pilih (1+2+3+4)			

II. DATA PENGGUNAAN SURAT SUARA

NO.	URAIAN	JUMLAH			
		DPR	DPD	DPRD PROVINSI	DPRD KAB/KOTA
1	2	3	4	5	6
1	Jumlah surat suara yang diterima termasuk cadangan 2% (2 + 3 + 4)				
2	Jumlah surat suara dikembalikan oleh pemilih karena rusak/keliru coblos				
3	Jumlah surat suara yang tidak digunakan				
4	Jumlah surat suara yang digunakan				

III. DATA JUMLAH SUARA SAH DAN TIDAK SAH

NO.	URAIAN	JUMLAH			
		DPR	DPD	DPRD PROVINSI	DPRD KAB/KOTA
1	2	3	4	5	6
1	Jumlah Suara Sah Seluruh Partai Politik/ Calon Anggota DPD				
2	Jumlah Suara Tidak Sah				
3	Jumlah Suara Sah dan Tidak Sah				

KELOMPOK PENYELENGGARA PEMUNGUTAN SUARA

NO	JABATAN	NAMA LENGKAP	TANDA TANGAN
1	KETUA KPPS		
2	ANGGOTA KPPS		
3	ANGGOTA KPPS		
4	ANGGOTA KPPS		

Source: KPU (General Elections Commission of Indonesia), ICT Implementation Research Team [Tim Kajian Penerapan Teknologi Infomasi dan Komunikasi Pemilu dan Pilkada], *Kajian Penerapan Teknologi Pemilu dan Pilkada: Proses Pemungutan, Penghitungan, dan Rekapitulasi Suara* [Study on Elections and Election Technology Application: Voting, Counting and Vote Recapitulation Processes] (Kalarta: KPU, 2016: 107).

4.2.6. The 2019 elections

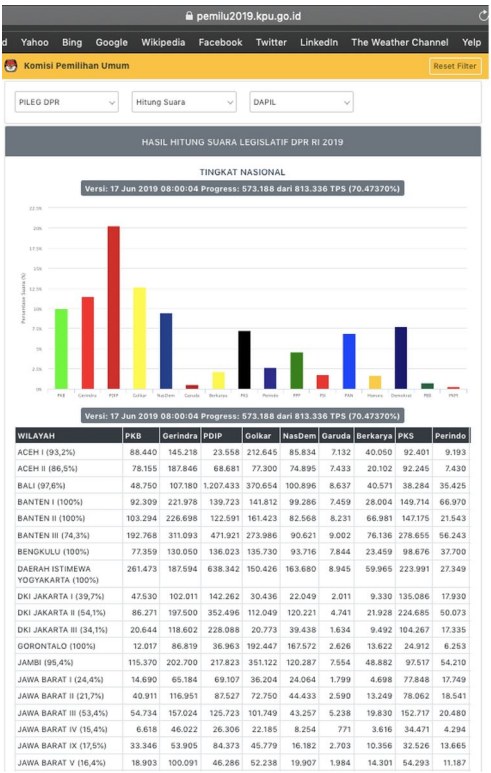
In the first concurrent election held in 2019, KPU once again implemented e-recap technology (or Situng). The Situng portal was used to publish the vote-counting results from polling stations, and vote recapitulation result at district, regency/municipality, province and national levels. Public participation in overseeing the vote counting and recapitulation results was thus facilitated and encouraged.

As in preceding years, the system was based on C1 Form scanners, e-recap and Excel to tabulate recapitulation forms, and once again the recapitulation result as published (see Figure 20) is not the official result of election, but only an informal count result by KPU according to the vote-counting results from polling stations.

The implementation of e-recap in the 2019 elections was mildly disputed because of an error in data input that led to an allegation of fraud and

manipulation. The input error occurred when a KPU election officer at a regency/municipality branch mistakenly entered the wrong votes result in to the system, diverging from what was written on the C1 Form. In fact, data input error does not affect the official (manual and tiered) recapitulation process in any way. Therefore, the official data on the election result certificate at that polling station or on the C1 Form was still valid. After being informed of the mistake, KPU immediately rectified it. KPU also provided access for the public to file reports on any mistake in data input. According to data published by KPU on its Instagram account in May 2019, there were 271 data input mistakes from the total of 700,238 election results from polling stations uploaded to Situng portal. KPU officers found 191 mistakes when conducting data monitoring, and 80 mistakes were found thanks to the reports submitted by the public.

Figure 20. Display of 2019 electronic recapitulation results in Situng



WILAYAH	PKB	Gerindra	PDIP	Golkar	NasDem	Garuda	Berkarya	PKS	Perindo
ACEH I (93,2%)	88.440	145.218	23.558	212.645	85.834	7.132	40.050	92.401	9.193
ACEH II (86,5%)	78.155	187.846	68.681	77.300	74.895	7.433	20.102	92.245	7.430
BALI (97,6%)	48.750	107.180	1.207.433	370.654	100.896	8.637	40.571	38.284	35.425
BANTEN I (100%)	92.309	221.978	139.723	141.812	99.286	7.459	28.004	149.714	66.970
BANTEN II (100%)	103.294	226.698	122.591	161.423	82.568	8.231	66.981	147.175	21.543
BANTEN III (74,3%)	192.768	311.093	471.921	273.986	90.621	9.002	76.136	278.655	56.243
BENGKULU (100%)	77.359	130.050	136.023	135.730	93.716	7.844	23.459	98.676	37.700
DAERAH ISTIMEWA YOGYAKARTA (100%)	261.473	187.594	638.342	150.426	163.680	8.945	59.965	223.991	27.349
DKI JAKARTA I (39,7%)	47.530	102.011	142.262	30.436	22.049	2.011	9.330	135.086	17.930
DKI JAKARTA II (54,1%)	86.271	197.500	352.496	112.049	120.221	4.741	21.928	224.685	50.073
DKI JAKARTA III (34,1%)	20.644	118.602	228.088	20.773	39.438	1.634	9.492	104.267	17.335
GORONTALO (100%)	12.017	86.819	36.963	192.447	167.572	2.626	13.622	24.912	6.253
JAMBI (95,4%)	115.370	202.700	217.823	351.122	120.287	7.554	48.882	97.517	54.210
JAWA BARAT I (24,4%)	14.690	65.184	69.107	36.204	24.064	1.799	4.698	77.848	17.749
JAWA BARAT II (21,7%)	40.911	116.951	87.527	72.750	44.433	2.590	13.249	78.062	18.541
JAWA BARAT III (53,4%)	54.734	157.024	125.723	101.749	43.257	5.238	19.830	152.717	20.480
JAWA BARAT IV (15,4%)	6.618	46.022	26.306	22.185	8.254	771	3.616	34.471	4.294
JAWA BARAT IX (17,5%)	33.346	53.905	84.373	45.779	16.182	2.703	10.356	32.526	13.665
JAWA BARAT V (16,4%)	18.903	100.091	46.286	52.238	19.907	1.984	14.301	54.293	11.187

Source: General Elections Commission of Indonesia (KPU), HASIL HITUNG SUARA PEMILU PRESIDEN & WAKIL PRESIDEN RI 2019, <https://pemilu2019.kpu.go.id/#/ppwp/hitung-suara/>, accessed 5 May 2020.

However, even after the manual recapitulation process was completed, KPU was not able to upload and enter all of the recapitulation data. As a result, the portal did not show 100 per cent of the vote-counting results from all over Indonesia.

Many organizations, such as the Network for Democracy and Electoral Integrity (Netgrit), expressed their disappointment that KPU decided not to continue its experiment with introducing seven segments to the C1 Form in the 2019 elections. The reason behind its discontinuation, according to the head of the Technical and Public Relations Division of KPU, Nur Syarifah, was that the 2019 elections were complex and KPU did not want to cause upheaval; he pointed out that in local elections there are not too many candidates in the race, but in the 2019 elections there were thousands of candidates.

Civil organizations such as Perludem and Netgrit consider e-racapitulation in 2019 to have been a failure. The process was sluggish and many of the scan results of C1 Forms could not be accessed by the public. Many problems related to e-recap are believed by many people to reflect systemic fraud in the 2019 elections.

4.2.7. Oversight recapitulation

In order to maximize its capacity as the Election Supervisory Agency and to facilitate its activities, Bawaslu created the Election Monitoring System (Siwaslu). Use of this technology had two main purposes: (a) to optimize data and information presentation and to facilitate decision-making processes by the elections overseer in order to improve their performance; and (b) to satisfy the needs of reporting process and information services in the process of monitoring the 2019 elections (Bawaslu 2019).

Siwaslu is a mobile phone application used by election monitoring officers at polling stations, and overseers at sub-district, district, regency/municipality, and province levels. The overseer who uses this application is responsible for inputting vote counting and recapitulation results data, including uploading the recapitulation forms at every administrative level. The data collected by Bawaslu are used for comparison, to minimize mistakes or frauds in the recapitulation process.

4.3. Electronic recapitulation by civil society

4.3.1. The Kawal Pemilu Jaga Suara Initiative

Kawal Pemilu (<http://www.kawalpemilu.org>) was not initiated by KPU but by five private citizens, among them Ainun Najib, Ruli Achdiat Santabrata, Felix Halim and Andrian Kurniady. The idea of creating Kawal Pemilu was proposed as a response to the worrying political situation that engulfed the 2014 election. At that time, polling institutions and think tanks were divided and published different results. Some pollsters announced that Joko Widodo and Jusuf Kalla

were the election winners, while others declared for Prabowo Subianto and Hatta Rajasa. Ainun Najib and friends saw that they could do something to soothe the political tension.

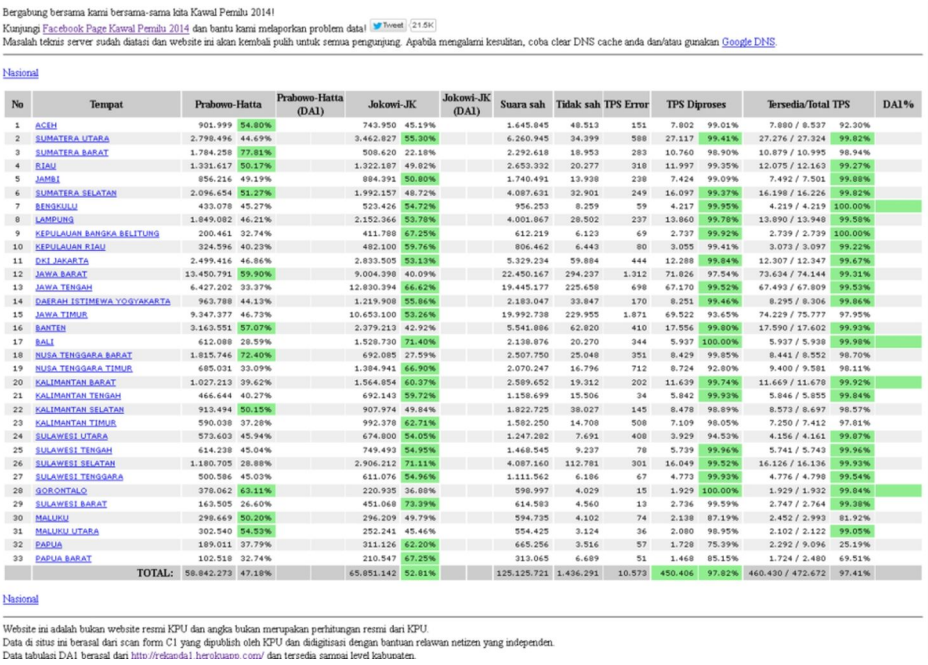
Kawal Pemilu utilizes open data technology, where data are freely accessible by anyone, freely reused and freely distributed by practically anyone. This application publishes the C1 Form data that contain the vote-counting result at polling stations; DA1 data that contain the plenary meeting result at district level; DB1 Form data that contain plenary meeting results at regency/municipality level; and DC1 Form data that contain the plenary meeting result at province level. Kawal Pemilu is also equipped with a feature for reporting data errors.

Kawal Pemilu invites all members of society to volunteer for digitizing electoral data through a crowdsourcing method. The invitation was so eagerly accepted that within just six days, volunteers had successfully uploaded 97 per cent of the electoral data published on KPU's website. Kompas.id reported that Kawal Pemilu's website was visited by more than three million visitors after the media began reporting this application.

Kawal Pemilu was greeted with enthusiasm by many in Indonesia, including members of KPU itself as the election authority. Kawal Pemilu made the 2014 presidential election result (see Figure 21) more legitimate because the application prevented allegations of vote manipulation, and dubious claims of victory by losing candidates. Kawal Pemilu also made all voters, both domestic and abroad, more involved in the presidential election; unlike KPU's website that sets a limitation on how many people can visit it in a certain period of time, kawalpemilu.org does not set such a limitation.

Kawal Pemilu was used again in the 2019 concurrent elections. CSOs such as Netgrit, the People's Voter Education Network (JPPR), Perludem, the Independent Committee for Election Observations (KIPP), Seven Three Forum (Fortuga) and Indonesia Democracy Network, collaborated with Kawal Pemilu to initiate the Jaga Suara 2019 (Watch Over Votes 2019) movement. This movement was initiated by Netgrit with five purposes in mind: (a) to oversee the voting and vote-counting process in the 2019 elections, especially the presidential election and national legislative election; (b) to protect people's votes from manipulation, improving public trust in the electoral process and result; (c) to increase public participation in election monitoring activity; (d) to promote the use of e-recap technology; and (e) to report any mistake or fraud in election data (Salabi 2019).

Figure 21. Kawal Pemilu website, close of the 2014 presidential election



Bergabung bersama kami bersama-sama kita Kawal Pemilu 2014!
Kunjungi Facebook Page Kawal Pemilu 2014 dan bantu kami melaporkan problem data! Tweet 21.5K
Masalah teknis server sudah diatasi dan website ini akan kembali pulih untuk semua pengunjung. Apabila mengalami kesulitan, coba clear DNS cache anda dan/atau gunakan Google DNS.

Nasional

No	Tempat	Prabowo-Hatta		Prabowo-Hatta (DA1)	Jokowi-JK		Jokowi-JK (DA1)	Suara sah	Tidak sah	TPS Error	TPS Diproses		Tersedia/Total TPS		DA1%
1	ACEH	901.999	54.80%		743.950	45.19%		1.645.845	48.513	151	7.802	99.01%	7.880 / 8.537	92.30%	
2	SUMATERA UTARA	2.798.496	44.69%		3.462.827	55.30%		6.260.945	34.399	588	27.117	99.41%	27.276 / 27.324	99.82%	
3	SUMATERA BARAT	1.784.258	77.81%		508.620	22.18%		2.292.618	18.953	283	10.760	98.90%	10.879 / 10.995	98.94%	
4	RIAU	1.331.617	50.17%		1.322.187	49.82%		2.653.332	20.277	318	11.997	99.35%	12.075 / 12.163	99.27%	
5	JAMBI	856.216	49.19%		884.391	50.80%		1.740.491	13.938	238	7.424	99.09%	7.492 / 7.501	99.88%	
6	SUMATERA SELATAN	2.096.654	51.27%		1.992.157	48.72%		4.087.631	32.901	249	16.097	99.37%	16.198 / 16.226	99.82%	
7	BENGKULU	433.078	45.27%		523.426	54.72%		956.253	8.259	59	4.217	99.95%	4.219 / 4.219	100.00%	
8	LAMPUNG	1.849.082	46.21%		2.152.366	53.78%		4.001.867	28.502	237	13.860	99.78%	13.890 / 13.948	99.58%	
9	KEPULAUAN BANGKA BELITUNG	200.461	32.74%		411.788	67.25%		612.219	6.123	69	2.737	99.92%	2.739 / 2.739	100.00%	
10	KEPULAUAN RIAU	324.596	40.23%		482.100	59.76%		806.462	6.443	80	3.055	99.41%	3.073 / 3.097	99.22%	
11	DKI JAKARTA	2.499.416	46.86%		2.833.505	53.13%		5.329.234	59.884	444	12.288	99.84%	12.307 / 12.347	99.67%	
12	JAWA BARAT	13.450.791	59.90%		9.004.398	40.09%		22.450.167	294.237	1.312	71.826	97.54%	73.634 / 74.144	99.31%	
13	JAWA TENGAH	6.427.202	33.37%		12.830.394	66.62%		19.445.177	225.658	698	67.170	99.52%	67.493 / 67.809	99.53%	
14	DAERAH ISTIMEWA YOGYAKARTA	963.788	44.13%		1.219.908	55.86%		2.183.047	33.847	170	8.251	99.46%	8.295 / 8.306	99.86%	
15	JAWA TIMUR	9.347.377	46.73%		10.653.100	53.26%		19.992.738	229.955	1.871	69.522	93.65%	74.229 / 75.777	97.95%	
16	BANTEN	3.163.551	57.07%		2.379.213	42.92%		5.541.886	62.820	410	17.556	99.80%	17.590 / 17.602	99.93%	
17	BALI	612.088	28.59%		1.528.730	71.40%		2.138.876	20.270	344	5.937	100.00%	5.937 / 5.938	99.98%	
18	NUSA TENGGARA BARAT	1.815.746	72.40%		692.085	27.59%		2.507.750	25.048	351	8.429	99.85%	8.441 / 8.552	98.70%	
19	NUSA TENGGARA TIMUR	685.031	33.09%		1.384.941	66.90%		2.070.247	16.796	712	8.724	92.80%	9.400 / 9.581	98.11%	
20	KALIMANTAN BARAT	1.027.213	39.62%		1.564.854	60.37%		2.589.652	19.312	202	11.639	99.74%	11.669 / 11.678	99.92%	
21	KALIMANTAN TENGAH	466.644	40.27%		692.143	59.72%		1.158.699	15.506	34	5.842	99.93%	5.846 / 5.855	99.84%	
22	KALIMANTAN SELATAN	913.494	50.15%		907.974	49.84%		1.822.725	38.027	145	8.478	98.89%	8.573 / 8.697	98.57%	
23	KALIMANTAN TIMUR	590.038	37.28%		992.378	62.71%		1.582.250	14.708	508	7.109	98.05%	7.250 / 7.412	97.81%	
24	SULAWESI UTARA	573.603	45.94%		674.800	54.05%		1.247.282	7.691	408	3.929	94.53%	4.156 / 4.161	99.87%	
25	SULAWESI TENGAH	614.238	45.04%		749.493	54.95%		1.468.545	9.237	78	5.739	99.96%	5.741 / 5.743	99.96%	
26	SULAWESI SELATAN	1.180.705	28.88%		2.906.212	71.11%		4.087.160	112.781	301	16.049	99.52%	16.126 / 16.136	99.93%	
27	SULAWESI TENGGARA	500.586	45.03%		611.076	54.96%		1.111.562	6.186	67	4.773	99.93%	4.776 / 4.798	99.54%	
28	GORONTALO	378.062	63.11%		220.935	36.88%		598.997	4.029	15	1.929	100.00%	1.929 / 1.932	99.84%	
29	SULAWESI BARAT	163.505	26.60%		451.069	73.39%		614.583	4.560	13	2.736	99.59%	2.747 / 2.764	99.38%	
30	MALUKU	298.669	50.20%		296.209	49.79%		594.735	4.102	74	2.138	87.19%	2.452 / 2.993	81.92%	
31	MALUKU UTARA	302.540	54.53%		252.241	45.46%		554.425	3.124	36	2.080	98.95%	2.102 / 2.122	99.05%	
32	PAPUA	189.011	37.79%		311.126	62.20%		665.256	3.516	57	1.728	75.39%	2.292 / 9.096	25.19%	
33	PAPUA BARAT	102.518	32.74%		210.547	67.25%		313.065	6.689	51	1.468	85.15%	1.724 / 2.480	69.51%	
	TOTAL:	58.842.273	47.18%		65.851.142	52.81%		125.125.721	1.436.291	10.573	450.406	97.82%	460.430 / 472.672	97.41%	

Nasional

Website ini adalah bukan website resmi KPU dan angka bukan merupakan perhitungan resmi dari KPU.
Data di situs ini berasal dari scan form C1 yang dipublish oleh KPU dan didigitisasi dengan bantuan relawan netizen yang independen.
Data tabulasi DA1 berasal dari http://rekanda1.herokuapp.com/ dan tersedia samnai level kabupaten.

Source: Kawal Pemilu, Hasil Tabulasi Data Kawal Pemilu 2019, <http://www.kawalpemilu.org>, accessed 10 October 2019.

The IT team of Jaga Suara introduced some improvements over Kawal Pemilu 2014: the system interface was simplified; the system was tweaked to be able to collect scanned C1 Form data results from KPU's website automatically, and verify the validity of votes and data types; and the system now automatically displays data changes daily. The IT team also used two websites, one to publish vote tabulation results in every electoral area for the public (https://kawalpemilu.org), and the other (https://upload.kawalpemilu.org/) to be used as the working platform for Jaga Suara 2019 volunteers. The latter could only be accessed by volunteers and used to upload the copies of C1 Forms from polling stations (Netgrit 2018).

As a first step, the Jaga Suara team established a cooperation with Facebook Indonesia to verify volunteers' identity. Jaga Suara's team also received support from Google Indonesia in the form of free cloud storage to store the C1 Form data collected by volunteers. In total, 92,254 volunteers joined the Jaga Suara 2019 movement.

Jaga Suara divided volunteers into four groups (Netgrit 2018):

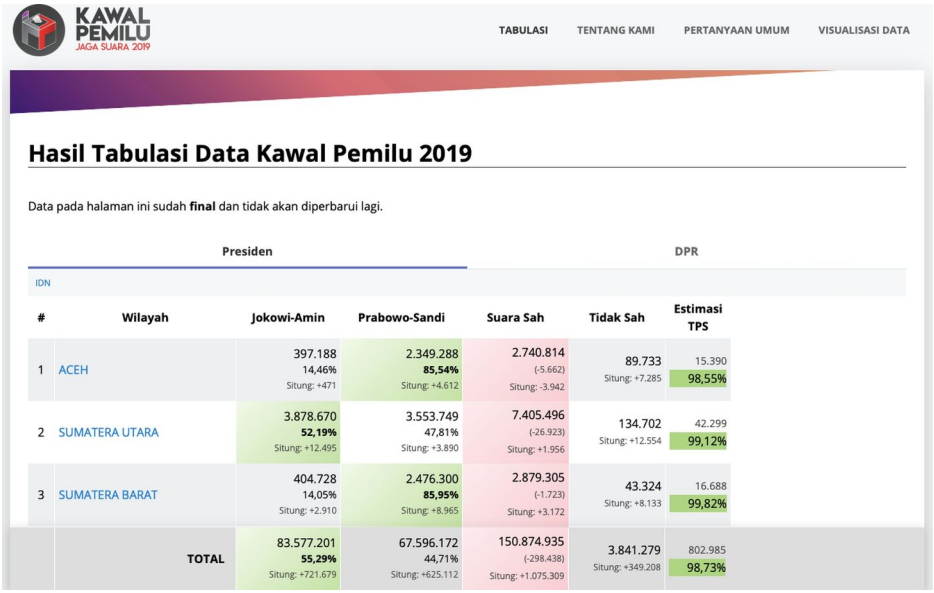
1. *Administrators (admins)*. Admins were volunteers with the highest level of authority because they were authorized to promote/demote other volunteers. Admins were also empowered to block or dismiss any volunteer who has tampered with election data. Admins were authorized to input data, upload photos and edit data input by moderators, and were allowed to see reports of data input mistakes. Only admins were able to change data input. In total, there were 67 admins.
2. *Moderators*. Moderators were granted permissions to upload C1 Form photos and input the scanned data of C1 Forms to be translated into numbers in the system. Moderators' duties were to identifying the type of forms to be uploaded, and to analyse the total number of valid votes, invalid votes and the voter turnout. Moderators were included in a Facebook group called 'Moderator Kawal Pemilu-Jaga Suara 2019'. There were 854 moderators in total.
3. *Referral volunteers*. As well as uploading C1 Form photos, volunteers of this type were able to invite their friends or colleagues to become volunteers. There were 40,000 referral volunteers.
4. *Regular volunteers*. Regular volunteers were only able to upload C1 Form photos that they obtained from their local polling stations and report any mistakes in vote counting. There were 60,000 regular volunteers in total. The recruitment period for volunteers was December 2018 to 17 April 2019.

C1 Form data were not only drawn from KPU's website (as in 2014); in fact the primary data used were the C1 Form photos taken by volunteers at polling stations, which were then verified by other volunteers assigned by the Jaga Suara team. C1 Form photos from Bawaslu's Siwaslu and copies of scanned C1s from KPU's e-recapitulation were used only when there was no volunteer available at the polling station. Each volunteer was able to upload more than one C1 Form photo from local polling stations, as they were allowed to observe more than one polling station in their area. Over 1.8 million C1 Form photos had been uploaded to Kawal Pemilu by 11 June 2019.

According to Kawal Pemilu's tabulation result of 2 July 2019, the total vote for presidential and vice-presidential candidates Joko Widodo and Ma'ruf Amin was 83,512,677 (or 55.29 per cent), while the total vote for candidates Prabowo Subianto and Sandiaga Uno was 67,545,154 (or 44.71 per cent). These figures are different from the ones published on KPU's system, where the totals were 84,249,982 (or 55.27 per cent|) and 68,189,053 (or 44.73 per cent), respectively.

On 29 May 2019, after receiving data from 777,332 polling stations (95.1 per cent), the Jaga Suara 2019 team published a report on all the discrepancies and errors in the data that they had received. The team found mistakes made by election officers in regard to total votes, mistakes when copying vote counts, and mistakes when transferring vote counts from original C1 Forms to copies. In regard to mistakes in total vote counts, there are many instances where the total vote for candidates was different from the official total vote, both on original C1 Forms and on copies. In regard to mistakes when copying data, there are instances where the total votes for candidates on C1 Form originals was different from the total votes on copies, and likewise for total invalid votes. Finally, as regards mistakes when copying vote counts, the total votes for candidates on original C1 Forms were different from the total as recorded on copies. According to Netgrit, there were in total 26,479 C1 Forms with data discrepancies between the original C1 Form and C1 Form copies (Netgrit).

Figure 22. Kawal Pemilu Jaga Suara



Source: Kawal Pemilu, Hasil Tabulasi Data Kawal Pemilu 2019, <https://kawalpemilu.org/#pilpres:0>, accessed 8 May 2020.

Kawal Pemilu was able to identify discrepancies among C1 Forms because the system is equipped with an automatic discrepancy detection feature. Such a feature was absent from KPU's e-recap system in 2019.

The value of Kawal Pemilu as a control variable alongside the manual recapitulation process conducted by KPU has been recognized by its use for that

purpose, informally, by the Constitutional Court of Indonesia (MK). Although MK judges did not formally include Kawal Pemilu (as authoritative) in their consideration when making decisions, IT expert Marsudi Wahyu Kusworo said that the fact that there is only a slight difference between the recapitulation results generated by these two systems shows that the election result is credible. Kawal Pemilu as organized by the Jaga Suara 2019 movement has successfully improved public trust in the election result—albeit a minority of people still consider Jaga Suara 2019 as biased towards candidate Joko Widodo and Ma'ruf Amin.

4.3.2. Recapitulation experiments with blockchain

Academic and political expert from the University of Indonesia, Effendi Ghazali, started an initiative to experiment with blockchain technology for vote recapitulation in the 2019 elections. Ghazali partnered with a technology service provider which created a programme to be used by volunteers at polling stations to upload original C1 Forms into the system. Volunteers were required to register their email addresses and smartphone numbers (Ghazali 2019).

Total vote data from original C1 Forms are saved into a specific layer, and if the uploaded original C1 Form was altered, the alteration is recorded by the system and it can only occur in different layer. Recapitulation with blockchain relies on Internet connection. In remote areas with poor Internet connection, volunteers might need to travel to an area with better Internet connection after taking photos of original C1 Forms to upload them. According to Ghazali, the experiment was discontinued due to a lack of volunteers and therefore a low sample of votes.

4.4. E-voting trials

Although Indonesia does not use e-voting, the Indonesian Government has conducted many trials of the technology in village elections throughout the country, using an e-voting machine developed by BPPT. Ever since it was first tried during a village-level election in Jembrana, Bali, in 2010, this e-voting machine has been equipped with a VVPAT printer (see Section 1.3.1, Box 1). It was then tried in seven other village elections in Boyolali, Musi Rawas, Empat Lawang, Boalemo, Banyuasin, and Bogor Regency, and in the regent election of Bantaeng in 2013 (Darmawan and Nurhandjati 2016: 6–7).

During a trial in a village election in Babakan Village, Bogor Regency (12 March 2017), a four-stage process for casting of votes was observed, namely:

1. *Obtaining token card; e-verification*. The voter verifies her/his electronic resident identification card (e-KTP) and obtains a token card to be inserted into the e-voting machine (stage 2). The e-verification machine is

used to verify the voter's identity in order to include only valid voters and avoid any voter casting her/his vote more than once.

2. *In the voting booth*. The voter enters the voting booth and inserts her/his token card into the e-voting machine. To cast her/his vote, the voter then only needs to touch the candidate photo on the display screen according to her/his respective choice, until the system prompts a confirmation question of yes or no. The voter chooses 'yes' to confirm her/his selection.
3. *VVPAT*. After casting their vote the voter receives an audit paper printed out by the e-voting machine, to be inserted into a sealed audit paper box outside the voting booth, which serves as physical verification in case of a disputed election result. Therefore, the audit paper box is not allowed to be opened.
4. The voter is required to dip a finger into an ink container as proof of having participated in the election (Salabi 2017).

In practice, the e-voting procedure faced many problems. Some voters inputted their vote twice causing the system to experience technical error, some voters said that they did not choose the confirmatory 'yes' option after casting their vote, and some devices lost power (Salabi 2017).

According to a report published by Tempo.co, an e-voting machine developed by BPPT and PT Industri Telekomunikasi Indonesia since 2013 was implemented in several village elections in Agam Regency (West Sumatera), Banyuasin (South Sumatera) and Bantaeng (South Sulawesi). The price of a set of e-voting equipment is 40 million rupiah or around USD 3,000 (Siswadi 2017). One e-voting set consists of five pieces of equipment:

- a computer to display the list of voters;
- electronic resident identification card (e-KTP) reader to validate voter's identity;
- smart card for voters as key access to use the e-voting machine;
- touchscreen monitor for voters to cast their vote; and
- thermal printer to print out receipt of the voter's vote that also contains a digital code.

E-voting is widely discussed in Indonesia. For example, when the election law was being drafted, the Special Committee on the Draft Election Law visited Mexico and Germany to study e-voting. Furthermore, the speaker of the House

of Representatives suggested that the elections be held with e-voting in order to avoid the duplication of identity cards in the electoral process.

However, others still question the relevance of e-voting in the Indonesian context. For Hadar Nafis Gumay, former KPU RI member, successful implementation of village head elections with e-voting should not be interpreted as a green light to implement it nationally. His assessment is that the move would be appropriate once trials have been conducted successfully in at least in one third of Indonesia's provinces (Salabi 2017).

CSOs have also broadly taken the same view and rejected e-voting for Indonesian elections. Perludem mentioned three reasons that e-voting is inappropriate in Indonesia.

1. *Implementing e-voting technology might be counterproductive* and create new problems. In fact, many countries have reverted to manual voting methods after implementing e-voting because it barely satisfies free and fair election principles (Germany and the Netherlands are two examples).
2. *Existing methods are successful*. So far, the voting and vote-counting practices at polling stations have been successful and conducted transparently, with every member of society allowed to monitor the process.
3. *E-voting would not target the gaps*. The problem with the voting and vote-counting process in Indonesia lies in the tiered recapitulation process (which consumes more time than necessary and is prone to many kinds of manipulation) not in the voting and vote-counting process itself.

4.5. Indonesia's electoral/cybersecurity context

KPU's cybersecurity and IT systems began to be seriously questioned during the 2018 local elections when the recapitulation system (Situng) that displays the quick count result was hacked on the election day, 27 June. The hacking of Situng made Indonesian political parties, election activists, election observers and the general public even more worried and vocal about the reliability of KPU's Sipol. At that time, many political parties complained that due to Sipol's technical errors they could not access it to register themselves and participate in the election. Because of this, nine political parties took legal action at Bawaslu against KPU for administrative neglect.

Not long after that, another problem occurred in relation to KPU's IT system. KPU's Sidalih—which keeps more than 109 million voters' data—was unable to optimally delete redundant data, and it was found that data operators in many areas faced difficulty in accessing the Sidalih website. In response, several CSOs,

including Perludem, KIPP, Indonesia's Voters' Committee (TePI) and JPPR, urged KPU to audit their system and increase its IT server capacity.

Sidalih is not known to have been hacked, but this remains a possibility. In the trial over the disputed result of the 2019 presidential election, KPU did not explain the problem with Sidalih. In fact, Sidalih became one of the arguments alleged by candidate Prabowo-Sandi, that vote manipulation stemmed from the problematic Final Voters' List.

Returning to the hacking of Situng, it was later found that the perpetrator was a 14-year-old. For Setiadi Yazid, a cybersecurity expert from the University of Indonesia, the details of the hacking only served to prove that KPU's cybersecurity was poor.

The hacking on 27 June 2018 was the first ever in the history of Indonesian elections. In the 2014 elections, when Situng was first implemented, no one was able to hack the system.

One of the newest CSOs, Netgrit—established in 2018 by four ex-members of KPU—started a public debate about cybersecurity on 6 December 2018. Netgrit, in cooperation with International IDEA and the Ministry of Communication and Informatics, organized a public discussion titled 'Cyber Security Challenges in the 2019 Elections'. Several recommendations for Indonesia's EMB emerged from the discussion, among them: to educate voters and the general public through media coverage on the importance of cybersecurity; and to encourage an exchange on new topics that had not previously been discussed by policymakers in Indonesia.

To date, KPU has taken several measures in order to ensure the security of its IT system, and Situng in particular: (a) an IT Enhancement Acceleration programme was implemented to expedite the completion of KPU's IT master plan; (b) 21 new servers were added for smoother access; (c) a new ecosystem was established for Situng, to ensure that the system is resistant to any malware or hacking attack; and (d) an Election IT Security Task Force was set up as a hub for various stakeholders including the State Cryptography and Cyber Agency (BSSN), Ministry of Communication and Informatics, and Cyber Crime Department of the National Police (Netgrit 2018: 5).

Many IT and cybersecurity experts believe these measures are insufficient. Denny Hermawan, a lecturer from the Faculty of Computer Science, University of Indonesia, suggests that KPU should isolate Situng's system, servers and networks from the public networks. In addition, Denny Hermawan also recommends that KPU obtain ISO 27001 certification as a matter of urgency, expand its IT personnel, and delegate its main tasks into three divisions—prevention, handling and auditing of cybersecurity incidents (Netgrit 2018: 21–22).

Indonesia's 2019 election was a concurrent election that combined the presidential election, national legislative election, provincial legislative election,

regency/municipality-level election and senate members election in a single day for the first time. Five elections in a single day, not to mention that the election covers a vast number of electoral areas and a voter population of nearly 193 million, is certainly not an easy task for the EMBs. Publishing a quick count result on Situng is a standard feature since the 2014 election. KPU is expected to be able to provide an inclusive and credible information service to the public.

Since the 2017 local elections, the Indonesian public has been very polarized into two different political groups. This situation is exacerbated by the widespread deployment of hoaxes and fake news by political elites as campaign tactics. Many predicted that the 2019 elections would be the culmination of 'battle' between the two groups. Such conditions made it all the more important that KPU's whole IT system, especially Situng, should not fail—and so delegitimize the voting and vote-counting process in the eyes of the public—but instead answer to the socio-political challenges of the country.

In order to cater to the needs of a quick count result in the 2019 election (on Situng), KPU held a series of meetings with election participants, government ministries and other relevant institutions. The first was held on 18 January 2019 at KPU headquarters. In the meeting, it was revealed that the Election IT Security Task Force had not been properly integrated with other structures. Situng was discussed with election participants without having first been checked by BSSN, the State Intelligence Agency (Badan Intelejen Negara, BIN), the Ministry of Communication and Informatics, and the Cyber Crime Division of the National Police as the main stakeholders.

The Police's Director of Anti-Cyber Crime, Albertus Rachmat Wibowo, said in the meeting that KPU should coordinate with the Election IT Security Task Force to conduct risk mitigation measures and investigations of the whole system. The security of Situng was indeed much discussed, besides issues of its inclusivity, with election participants requesting access to see how the system works. The opposition camp even requested that a system audit should be conducted by independent, third-party experts or organizations. Netgrit proposed that KPU should conduct a trial run of Situng so that all election participants and the public could see how Situng actually works.

Some of the recommendations were put into action: KPU conducted two trial runs of Situng; system audit was conducted by BPPT; and a double security system was implemented. However, the notion that the quick count result from Situng was fraudulent was spread by the campaign team of one of the presidential candidates and his supporters. They requested that KPU stop using Situng because it failed to meet the ISO 27001 standard.

Perludem's Executive Director, Titi Anggraini, challenged this demand to shut down Situng. Anggraini argued that the demand arose because of data input mistakes in several polling stations by election officials, not because of a cyberattack that altered the result of vote recapitulation. KPU Chairperson Arief

Budiman admitted that during the 2019 elections, KPU's website had experienced many cyberattacks from both inside and outside the country. However, according to Budiman, the enhanced cybersecurity system prepared by BSSN and the Cyber Crime Division of the National Police was able to fend off the attacks (Ristianto 2019).

As mentioned, in the 2019 election the problem was the slow upload process of C1 Form copies, which was ostensibly due to high demand for access to the Situng server. The technical guidance to polling station working committee officers is not optimal; the C1 Form copies intended for uploaded into Situng are not filled in but are entered into the ballot box. As a result, uploading a C1 Form copy as the basis for e-recap must wait for the opening of the ballot box at the sub-district level (Idroos 2019). Another problem was that a large number of C1 Form documents uploaded into Situng could not be downloaded by the public.

These problems with Situng were presented by the campaign team of the losing candidate Prabowo Subianto-Sandiaga Shalahuddin Uno as an argument during the hearing of the presidential election result dispute at the MK. The fact that KPU ignored the data input mistakes was presented by the losing candidate as an example of an organized, systematic and massive fraud on behalf of the EMB.

Endnotes

1. Learn more about this incident: <https://nasional.kompas.com/read/2018/07/02/15533781/diserang-hacker-kpu-tutup-laman-rekapitulasi-hasil-pilkada-2018>.

5. Conclusions and recommendations

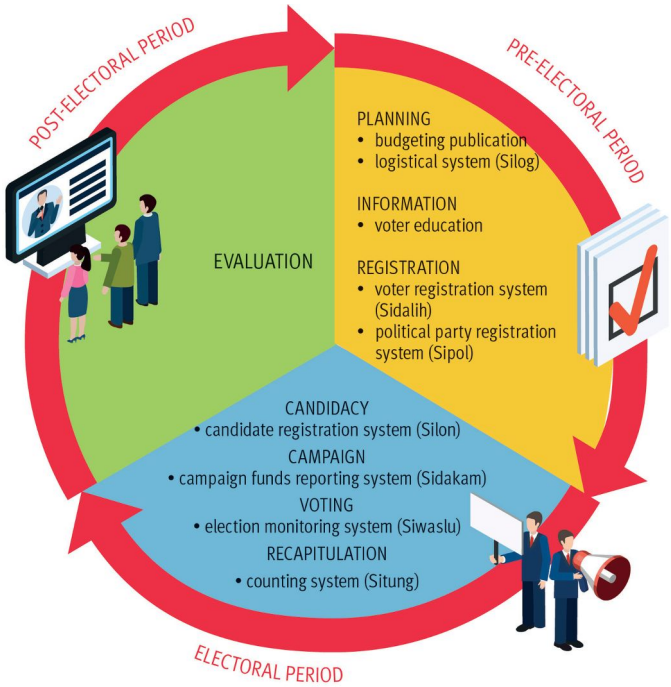
There is no ideal, perfect voting and counting technology: only technology that is appropriate to specific needs and which can improve the quality of an election. There needs to be awareness of this on the part of all election stakeholders, starting from the EMB, election participants, government and other interested parties, especially in Indonesia, where many stakeholders have expressed their desire to implement voting and counting technology. At the time of writing and especially after the 2019 concurrent elections, this intention is increasingly widespread. KPU has also made plans to continue implementing e-recap in the 2020 concurrent regional elections. This raises an important question: how much consideration have stakeholders paid to the procedures, findings and potential lessons contained in Chapters 3 and 4 of this Guide when making the proposal?

Almost all stages in the Indonesian electoral process involve a certain degree of election technology (see Figure 23). The EMB implements essentially two types: (a) technology that is used during the electoral period; and (b) technology that is used in the pre-electoral period (see also Section 3.1). The budgeting, logistics, voter registration and political party registration systems are categorized as technologies belonging to the latter. Candidate registration, campaign funds reporting, election monitoring, and vote-counting systems are categorized as technologies of the electoral period itself.

It is important to note that both categories of election technology are used only to improve transparency and public access to the electoral process. In this sense, technology is not the decisive factor in the electoral process. For example, the vote counting system (Situng) is a medium used by KPU to publish election results and hence improve the transparency and legitimacy of the result. However, to decide the election result, the applicable elections law stipulates that the vote recapitulation process shall be conducted manually at every electoral area level, starting from polling stations and moving to district, regency/municipality,

province and national levels. Therefore, Situng is considered as an informal e-recap system implemented by KPU to store election data and to publish those data in real time.

Figure 23. Election technologies implemented by Indonesia's Electoral Commission (KPU) and the Election Supervisory Agency (Bawaslu)



If we consider all the stages in adopting voting and counting technology, the very first step is to identify all the problems we want to solve. The first question we have to answer is: what are the problems with the manual recapitulation method that require the introduction of the e-recap method in its place?

Until 2019 and ever since the 1955 election, voting, vote counting and vote recapitulation were conducted manually, from polling station to the national level. Voters come to polling stations to cast their vote by marking the ballot with their choice (by poking the ballot with a nail or another pointed object). Manual recapitulation is considered the most democratic stage in the whole electoral process in Indonesia because its oversight often involves direct participation from the public. There is an interesting election custom in Indonesia where the people come to polling stations not only to cast their vote, but also to watch the vote-counting process after the finish of polling at 13:00. During the counting process, the polling station officers will count the votes by opening the ballots and

showing them to the election observers and all the people that are gathered up at the polling station. The whole event is usually very rousing and helps the election authority to minimize the probability of vote-counting manipulation.

This custom, however, does not proceed to vote recapitulation at the next level (district, regency/municipality, province or the national level). Problems often occur during vote recapitulation at district level where the election officers sum up the vote-counting results from all the polling stations located in the district. There are two main problems that often occur during the vote recapitulation process: (a) accidental mistakes by election officers when writing down the vote counts result during the recapitulation process; and (b) the possibility of vote manipulation involving election officer(s) in favour of one of the candidates.

Amid the increasing demand for e-voting after the 2014 elections, KPU decided to form a special team to study the feasibility of implementing e-voting.[1] The Election IT Study Team, made up of experts, was responsible for producing a report on the potential advantages and disadvantages in the three crucial stages of Indonesian elections, also based on analysis of the strengths and weaknesses of the status quo (see Table 6).

Table 6. Expert group's expectations of e-voting

Voting stage	• The voting process is esteemed by the international community. • High social interaction. • A unique and rousing political occasion that happens every five years. • Problems (misplaced ballots, voter registration errors, availability of logistics, vote manipulation by polling station officers).
Vote-counting stage	• Done relatively smoothly and successfully. There is a democratic spirit apparent in the vote-counting process. • Recurring problems: mistakes in filling the recapitulation form, slow and arduous vote-counting process especially in legislative elections. • A stage for social interaction and public political education. • Tolerance of differences.
Recapitulation stage	• A relatively long process. • Causing conflict or political tension between candidates' supporters. • Possibility of vote manipulation/frauds.

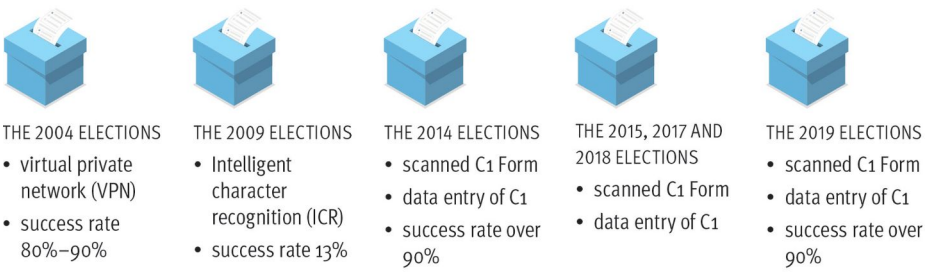
Source: Samino, P., 'Kajian IT KPU: Pemanfaatan IT dalam Pemungutan, Penghitungan, dan Rekapitulasi Suara' [The Use of IT in Voting, Votes-counting, and Votes Recapitulation], Presentation material for public discussion 'Indonesia needs e-recap, not e-voting', Jakarta, 14 March 2017.

One of the most notable conclusions from the Election IT Study Team is that there is no significant problem with the current voting and vote-counting process

at polling station level. The group concluded that e-voting is not the right solution and that implementation of e-recap is preferable. In addition to the possibility of vote manipulation and counting error, there is a more serious problem in the manual recapitulation process: it takes a very long time to be completed (up to 30 days). In its report, the feasibility study team lists five potential benefits of implementing e-recap technology (KPU 2016: 93):

- E-recap may shorten the vote recapitulation process, so that the public can know the election result faster. This may avert political tensions caused by the delayed announcement of election results.
- E-recap helps election officers to recapitulate the vote-counting results from polling stations faster and more accurately, preventing counting errors that are caused by negligence/carelessness and fatigue of officers.
- The e-recap machine works without any consideration whatsoever to the emotions and interests of the parties involved, making its generated results more trustworthy.
- From a technical point of view e-recap is the easiest technology to implement as compared with e-voting and e-counting. Therefore, it is simply appropriate to implement e-recap first, i.e. starting from the simplest, moving up to greater complexity (the law of technological advancement).
- E-recap technology can be designed and produced domestically.

Figure 24. History of electronic recapitulation (e-recap) in Indonesia



As discussed, KPU has been already using e-recap, albeit informally, to tabulate and publish election data for five elections up to and including 2019 (see Figure 24). The Election IT Study Team goes on to provide: (a) recommendations on what types of technology KPU should develop for the pre-electoral period and the electoral period; and (b) an election IT development 'road map' for KPU (see Table 7).

Table 7. IT Development Roadmap for KPU

No.	Work programme	2016				2017				2018	
		I	II	III	IV	I	II	III	IV	I	II
1.	E-recap application development										
2.	Integrating the e-recap application with Sidalih and other applications										
3.	Optimizing the KPU web portal										
4.	Integrating the KPU web portal with the e-recap application										
5.	Testing the e-recap application in village and district elections										
6.	Optimizing the e-recap application										
7.	Testing the e-recap application at municipality level										
8.	Testing the e-recap application at regency level										

Source: KPU (General Elections Commission of Indonesia), ICT Implementation Research Team [Tim Kajian Penerapan Teknologi Infomasi dan Komunikasi Pemilu dan Pilkada], *Kajian Penerapan Teknologi Pemilu dan Pilkada: Proses Pemungutan, Penghitungan, dan Rekapitulasi Suara* [Study on Elections and Election Technology Application: Voting, Counting and Vote Recapitulation Processes] (Kalarta: KPU, 2016: 122).

The report indicates that Indonesia's EMB has completed two of the strategic stages prior to adopting voting and counting technology—problem identification and finding solutions. Therefore, from the analysis offered in this Guide, there is one remaining stage—a study of the existing legal frameworks.

The Constitutional Court has ruled that the EMB is allowed to adopt voting and counting technology as long as the technology does not violate the principle of free and fair elections. However, at the more technical level, such as in the electoral laws, no specific regulation related to voting and counting technology can be found. Law No. 10/2016 on Head of Regional Elections (an amended version of law No. 1/2015) contains several articles that mention and permit the use of technology, such as the following:

- Article 85 paragraph (2): The voting procedure as referred to in paragraph (1) point b shall be administered by taking into account the preparedness of the Regional Administration Office in regard to availability of infrastructure and public acceptance of the efficiency and simplicity principle.
- Chapter XIV, Vote counting, First Part: Vote counting at Polling Stations, Article 98 Paragraph (3): Regarding electronic voting procedure, the vote-counting process shall be done manually and/or electronically.
- Chapter XIV, Vote counting, Fifth Part: Monitoring and Penalty in Vote counting and Vote Recapitulation, Article 111 paragraph (1): The mechanism for manual vote counting and vote recapitulation and/or electronic vote-counting shall be regulated in the KPU Regulations.

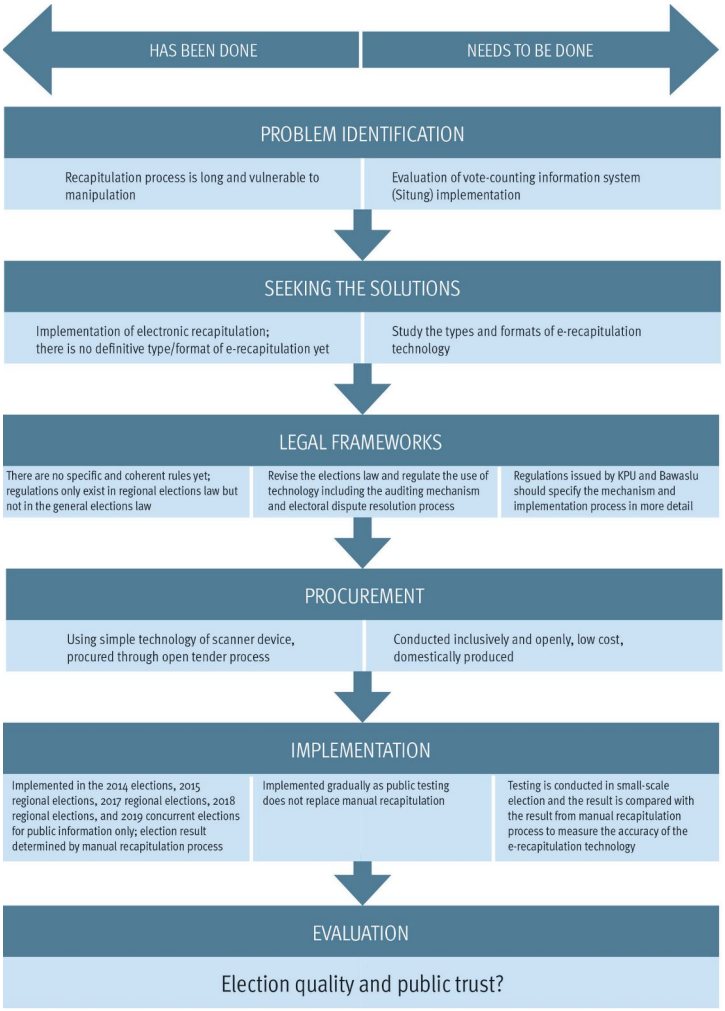
As we can see, many of these regulations are about e-voting implementation procedure instead of e-recap. In addition, they regulate the implementation of technology only in voting and vote-counting stages. Meanwhile, there is still no regulation whatsoever in the regional elections law regarding the result determination stage and post-electoral dispute resolution process. As a consequence, there is a legal vacuum that could lead to the general public distrusting and questioning the legitimacy of the election result.

Moreover, despite the fact that KPU has conducted several tests, the general public still think of e-recap technology merely as a tool to publish the election result, not as a replacement for the manual recapitulation procedure, and the public still have no idea how the vote-counting system (Situng) works. Although, if we look at the concurrent elections of 2019, the public seem to think that the vote-counting process is equal to the official vote recapitulation process. So that they think the election result was determined by the vote-counting system, not by the manual recapitulation process. Consequently, the public in general are more concerned about the vote counting process, and they immediately think that there must be something amiss when election officers make counting mistakes or other simple errors. The general public, then, have questioned the credibility and the accuracy of the vote-counting system developed by KPU as a part of its open data initiatives.

It is clear that there are two things that need to be considered by KPU before they proceed to the procurement and implementation stages of the technology: (a) the legal frameworks that will regulate the use of election technology; and (b) public trust in the technology to be implemented. It remains for KPU to deal with these two problems by deliberating, preparing and testing the technology with the involvement of all stakeholders in order to develop an efficient and

effective voting and counting technology to improve the quality of the election (see Figure 25).

Figure 25. Next steps: a technology adoption scheme for Indonesia



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Annex

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Heroik M. Pratama is a political researcher at the Association for Election and Democracy (Perludem) Indonesia. He graduated from the Department of Politics and Governance at the University of Gadjah Mada in 2014 and is currently undertaking a postgraduate degree in political science at the University of Indonesia. Pratama has a strong interest in issues relating to elections, political parties and democracy. In 2019 he was an international observer for Thailand's election with the Asian Network for Free Elections (ANFREL). He has written several publications on electoral issues and his latest publication is *The Dynamics of Fulfilling Campaign Finance for Women Legislative Candidates on 2019 Simultaneous Election: Case Study DKI Jakarta II Electoral Constituency* and *Redesigning Simultaneous Electoral System*. He also writes articles for journals and newspapers in Indonesia.

Nurul Amalia graduated from the University of Indonesia in 2015. During her studies in history she took an interest in political history and wrote her thesis on the underground media during the Indonesia New Order.

She became involved in electoral issues when she joined rumahpemilu.org as a journalist. Rumahpemilu.org is a media advocacy for electoral issues, organized by Perludem. Amalia writes frequently around the themes of election technology, women's politics, oligarchy and the politics of marginal groups. In 2017 she received the Best Opinion award from Indonesia's Election Supervisory Body for her special coverage 'Bawaslu Decides KPU Makes Administrative Violations, These Are Arguments and Some Notes'.

Amalia is now doing research work for Perludem. Her second book with Perludem is 2019 *Concurrent Election Evaluation: From Electoral System to Management*.

About International IDEA

The International Institute for Democracy and Electoral Assistance (International IDEA) is an intergovernmental organization with the mission to advance democracy worldwide, as a universal human aspiration and enabler of sustainable development. We do this by supporting the building, strengthening and safeguarding of democratic political institutions and processes at all levels. Our vision is a world in which democratic processes, actors and institutions are inclusive and accountable and deliver sustainable development to all.

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About Perludem

Perkumpulan untuk Pemilu dan Demokrasi (Association for Election and Democracy) is an independent non-profit organization and one of the leading non-governmental organizations in Indonesia. Perludem was establish in 2005 by former members of the Indonesia Election Oversight Committee (Panwaslu) which focuses on election and democracy.

Perludem's scope of activities is divided into three areas: (a) assessment, such as conducting research into election-related issues; (b) training of electoral

stakeholders to improve understanding of elections; and (c) monitoring the electoral process to ensure it is in accordance with the existing election regulations.

Perludem actively publishes books, journals and articles related to electoral issues. Perludem's vision is 'Manifestation of a democratic country and elections that promote freedom of the people and uphold the sovereignty of the people'.

<http://perludem.org>

Elections and technology are inseparable in today's world. Technology is regarded as a technical instrument to attain certain electoral goals such as efficiency and effectiveness, as well as to ensure a high-quality process and integrity of results. However, in practice, the proposition of adopting technology in elections is often not accompanied by deep thinking and adequate preparations. Consequently, the use of technology often becomes a paradox: the intention being to solve a problem, but new problems are created instead.

Based on this observation, this Guide has been written to provide a tool for election administrators or nations which, like Indonesia, are considering the use of technology in elections. In Indonesia, technology has been widely used since the 2014 general elections, especially to meet open data principles in elections. Despite this, the general elections of 1999, 2004, 2009 and 2014, and various regional elections, have used electoral technology for only two main objectives—data tabulation and transparency of the electoral process.

At the time of writing, e-voting and e-recapitulation are being discussed for implementation in Indonesia's future elections. As well as providing step-by-step guidance and points of consideration for various decision-makers, this Guide also features various types of voting technology that exist to date, accompanied by the experiences of several countries in using them. The Guide describes the various types of electoral technology that have been used in Indonesia, capturing their track records and the lessons learned—lessons that may be useful to other countries—demonstrating that voting technology does not need to be limited to e-voting.

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