A woman in a floral shirt is looking at a document on a table. In the background, there is an automated election system with a screen and a slot. Another person is partially visible, also looking at the document. The scene is set in a room with a green wall.

UNDERSTANDING THE AUTOMATED ELECTION SYSTEM

| GUS LAGMAN

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October 2017

This monograph has been adapted from a series of six articles that I wrote for a daily newspaper. It is intended as a lay guide to understanding the Automated Election System (AES). Although generally little understood, if at all, because of its technical complexities, and despite some obvious defects — obvious, that is, to the initiated — the system was used all the same in the last three elections. The hope is that, through this monograph, voters will understand enough about AES in order for them to make informed judgments about it and, even more important, government officials, especially those with the authority to take action on the AES issue, will not only understand AES better but also see the urgent need to rectify the errors and shortcomings revealed in its implementations.

FOREWORD

In a democracy, elections determine who the national and local leaders will be; it is important, therefore, that election results reflect the true will of the people. Unfortunately, it has not always been the case in some areas: time and again, fraud has attended the counting and/or canvassing of votes.

To ensure correct counts, as well as speed up the counting and canvassing, automating the election process was thought to be the solution. Forthwith, a law (R.A. 8436, as amended by R.A. 9369) was passed in December 1997, and the Commission on Elections (COMELEC) started implementing an automated system in the 2010 elections and used it again in the succeeding ones — 2013 and 2016. Sadly, it seems that the old manual system was not analyzed well enough to assist the decision-making on the type of automated system to adopt, so we ended up using a system many IT practitioners believe unsuitable. According to them, fraud at the hands of “techies” could be accomplished even more easily — also by automation.

When elections were still manual, voters watched as their own votes were counted in their own precincts, and therefore, they generally caught fraud as it occurred. Precinct-counting is the first step in the process of counting and consolidating votes and, when that step was automated, the transparency was completely lost; the tally board on which each vote, when called, was recorded in full view of voters, disappeared; the counting happened invisibly inside machines; and possibly, so did fraud. Rigging the results via the machine’s software could be done by a small group of insider technical people — either from the election administrator, that is COMELEC, or from the AES vendor/service provider, or from both — and nobody would be the wiser.

As for canvassing — the last stage in the electoral process — our experience with automated elections revealed a lack of system controls and, again, transparency features. The voting public had no convenient enough way of validating the canvassing for themselves, of finding out if fraud had been committed at that stage.

These system design shortcomings should definitely be corrected.

To serve as a guide in the discussion, two passages from the automation law are reproduced here to acquaint the reader with its purposes and focus.

Republic Act No. 9369 January 23, 2007

AN ACT AMENDING REPUBLIC ACT NO. 8436, ENTITLED “AN ACT AUTHORIZING THE COMMISSION ON ELECTIONS TO USE AN AUTOMATED ELECTION SYSTEM IN THE MAY 11, 1998 NATIONAL OR LOCAL ELECTIONS AND IN SUBSEQUENT NATIONAL AND LOCAL ELECTORAL EXERCISES, TO ENCOURAGE TRANSPARENCY, CREDIBILITY, FAIRNESS AND ACCURACY OF ELECTIONS, AMENDING FOR THE PURPOSE BATAS PAM[B]ANSA BLG. 881, AS AME[N]DED, REPUBLIC ACT NO. 7166 AND OTHER RELATED ELECTIONS LAWS, PROVIDING FUNDS THEREFOR AND FOR OTHER PURPOSES”

SECTION 1. *Section 1 of Republic Act No. 8436 is hereby amended to read as follows:*

“SECTION 1. Decla[ra]tion of Policy. - It is policy of the State to ensure free, orderly, honest, peaceful, credible and informed elections, plebiscites, referenda, recall and other similar electoral exercises by improving on the election process and adopting systems, which shall involved (sic) the use of an automated election system that will ensure the secrecy and sanctity of the ballot and all election, consolidation and transmission documents [i]n order that the process shall be transparent and credible and that the results shall be fast, accurate and reflective of the genuine will of the people.

“The State recognizes the mandate and authority of the Commission to prescribe adoption and use of the most suitable technology of demonstrated capability taking into account the situation prevailing in the area and the funds available for the purpose.”

These clearly show that the chief concerns of the law are transparency, credibility, and accuracy. As only they should be.



ACKNOWLEDGEMENTS

Since the Batasan Elections of 1984, I have had countless discussions with former COMELEC Chairman Christian Monsod – from short exchanges of ideas, to Namfrel official meetings that at times lasted for several hours (he was an active Namfrel official in the 1980s). Often, I would take home thoughts that helped mold my overall knowledge of elections, including the most suitable way of automating it. I sincerely thank him for that.

An IT colleague, Lito Averia, provided me with much-needed research information about the existing election laws (despite his not being a lawyer), as well as, some ideas about the system and graphics that I incorporated in this monograph.

I would also like to thank Namfrel, its Secretary General, Eric Alvia, and his staff, for most of the graphics and overall look of this monograph. My profuse thanks as well for the logistics assistance and funding for the initial printing cost.

I recently read in a book that every writer must have an editor, and I'm just so glad that I've known one for many years. Vergel Santos was editing a book and several news articles when I approached him, but he graciously spent some of his valuable time editing this paper.

I sent Rex Drilon, a management consultant, who also happens to be a regular golfmate a very early version and he gave me some ideas on how to re-format this monograph for easier reading.

The ten nationwide electoral exercises, from 1984 to 2007, in which Namfrel ran parallel counts (referred to as Operation Quick Count, or OQC, in the 1980s), were obviously where I gained much of my experience in automated elections. All ten parallel counts were computer-assisted. I would like to mention and thank my IT colleagues who volunteered and worked for many days and sleepless nights with me in managing those efforts: Ed Castaneda, Didi Manarang, Bobby Mauricio, Ann Gatmaytan, Vic and Ito Gruet, Ed dela Rosa, Bach Cuyugan, Jun Palpal-latoc, JR Contreras, Jade Deinla, Mari-cor Akol, Lito Averia (again), Ching Romualdo, Ed Favila, Rufy Tolentino (deceased). I could not have worked with a better team.

I would like to end this section as I started – by thanking yet another former COMELEC Chairman, Ramon Felipe. Being a believer of the transparent manual precinct-counting, he encouraged me, through email exchanges, to continue writing about it. In the 1980s, he successfully ran four completely manual elections.



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ACRONYMS USED

COMELEC	Commission on Elections
CAC	COMELEC Advisory Council
DOST	Department of Science and Technology
ASTI	Applied Science and Technology Institute
NAMFREL	National Citizens Movement for Free Elections
PPCRV	Parish Pastoral Council for Responsible Voting
ARMM	Autonomous Region in Muslim Mindanao
ER	Election Returns
BEI	Board of Election Inspectors
CCS	Consolidation and Canvassing System
NLE	National and Local Elections
C/MBOC	City/Municipal Board of Canvassers
SOV	Statement of Votes
COC	Certificate of Canvass
PBOC	Provincial Board of Canvassers
PSOV	Provincial Statement of Votes
PCOC	Provincial Certificate of Canvass
NBOC	National Board of Canvassers
NSOV	National Statement of Votes
NCOC	National Certificate of Canvass
OAV	Overseas Absentee Voter/Voting
DRE	Direct Recording Electronic (System)
OMR	Optical Mark Recognition
PCOS	Precinct Count Optical Scan
CCOS	Central Count Optical Scan
IV	Internet Voting
PMS	Pure Manual System
AES/ETA	Automated Election System with Enhanced Transparency and Accuracy

INTRODUCTION

Even as we are still more than one year away from the 2019 elections, it is not too early to start planning for it. Since there are questions regarding the appropriateness of the automated system used in the last three elections, the first step should probably be made toward determining if that system is truly the most suitable one for us. Many observers, IT practitioners mostly, have commented that the system used in 2010, 2013, and 2016 — i.e., Smartmatic’s Precinct Count Optical Scan, or PCOS (renamed Vote Counting Machine, or VCM, in 2016) — though fast, did not meet the required accuracy level, was definitely not transparent, and was very vulnerable to tampering by an insider. All these have been proved true.

***On accuracy:** No mock election results from 2009 up to the present have ever attained the required accuracy level of 99.995%, as stipulated in the bidding specifications. Neither was that level attained in all the Random Manual Audits (RMA) performed after each of the past three elections. These facts are all verifiable.*

***On transparency:** When precinct-counting is automated, transparency is lost. Nobody gets to witness the counting because it is performed by the machine and its software. The software could have “bugs”, as uncovered in the experience of many countries, including the United States; or it could contain malware (malicious software) that will naturally produce erroneous results due to manipulation. If any problems bug the very first step of the election counting/consolidation process, the rest of the process naturally becomes questionable.*

***On the vulnerability to tampering by an insider:** During the 2008 ARMM elections, Smartmatic — the service and machine provider — was able to modify the results in several precincts in Wao, Lanao del Sur — from Manila, hundreds of miles away! During the 2010 National and Local Elections (NLE), Smartmatic was able to modify the software to “correct” the total count of voters which, early in the process, reached 250 million! During the 2013 midterm*

elections, Smartmatic was able to modify the senatorial results more than once. Within the first hour after the closing of the polls, PPCRV's unofficial senatorial tally showed at least 12,000,000 votes counted, whereas Namfrel's own showed fewer than 1,000,000, based on election returns received through the transparency server. During the 2016 NLE, Smartmatic was able to modify some candidate's names, changing the "?" to "ñ". All these changes, done while count was still running, prove that an insider can modify any information in the databases, including, presumably, even the results. Again, the facts here are all verifiable.

The COMELEC could have avoided these system defects in all the past three elections had it performed a more thorough project analysis and cost/benefits study before deciding what system and technology to use. This due diligence was a must, if only for the billions of pesos of public funds the undertaking would cost. In fact, the automation of the last three elections have thus far cost the country more than thirty billion pesos (Php 30 billion)!

After the 2010 elections, the Chairman of the COMELEC Advisory Council (CAC) said in his post-election report that COMELEC should not use PCOS again. The Chairman of the Committee on Suffrage and Electoral Reforms in the Lower House at the time, said in his report that if the loopholes in the PCOS are not plugged, "a reversion to manual elections with heightened vigilance by organizations like PPCRV and NAMFREL would probably yield more credible and accurate results."

Why Smartmatic continued to win the contracts is something IT-savvy people fail to understand. Private companies would have given them the boot long ago.

If nothing is done about all this for the next elections, the same doubts would be cast on the system's reliability and the same wasteful spending would occur.

This monograph will present to the readers the study that should have been undertaken before the decision to procure the system was made. It will present certain aspects of elections in relation to the options that may be taken as to the "most suitable" automated system for us, as required by law. Specifically, this monograph will discuss the old manual system, its shortcomings, the automated system implemented in 2010, 2013, and 2016, its shortcomings, and the recommended systems solution.

PART 1
THE MANUAL
ELECTIONS OF OLD

1 THE MANUAL ELECTIONS OF OLD

To facilitate the design process of an automated election system, it is pretty standard to start by analyzing the country's present (or past) election system. This means 1) reviewing the old, purely manual, system; 2) identifying its defects, problems, and pitfalls; 3) scanning the environment for applicable automation election tools currently available; 4) determining the pros and cons of each, then choosing the best option; and, finally, 5) designing and formulating a workable system.

The purely manual election system — meaning, no automated component whatsoever — that the country used from our very first election in the 1940s up to 2007 followed a very simple procedure; for one thing, it required zero training of voters. Common sense and the ability to read and write were almost all one needed to possess. Anyone who could not read and write or had a physical disability was allowed to be assisted by a close relative. Even the Board of Election Inspectors (BEI) hardly needed any training; most of them only received written instructions that would come with the usual election paraphernalia distributed to them a few days before the elections.

The election process consists of four stages: 1) the casting of votes, 2) vote-counting at the precincts, 3) the transport of the ballots and results of counting, referred to as Election Returns (ERs), from the precincts to the canvassing centers, and 4) the three-level canvassing — city/municipal, provincial, and national consolidation of votes.

A BEI group mans each precinct. It is composed of three teachers, one assigned as chairman, the other two as poll clerks. Approximately 200 voters (the maximum is 250) are registered in each precinct. When this system was last used, in 2007, there were approximately 215,000 precincts nationwide, therefore the same number of BEIs.

Here's how the system worked:

Precinct voting and counting

The voting period starts at 7:00 a.m. and closed at 3:00 p.m. The BEI, however, starts working as early as 5:00 a.m., preparing the classroom and the election materials, including that used in verifying whether a voter is duly registered in the proper precinct. As many as 15-20 voters, or as many as can be comfortably accommodated inside the classroom, are usually allowed to vote simultaneously. Voters caught by the 3 p.m. deadline waiting in line up to 30 meters out are still allowed to cast their ballots.

After a brief rest following the close of the voting period, the BEI members start counting the votes, but not until after they have undertaken the following sequence of preparations, and done so in the full view of the watchers: the voting-precinct layout has been rearranged so that the watchers are afforded an unhampered view of the reading of the ballots and the recording of the votes; the ballots have been taken out of the box and laid on the table still folded as they were cast; each ballot has been unfolded and arranged in piles of ten ballots each; and the empty ballot box has been set aside, again, in open view.

The preliminaries done, the BEI chairman starts taking from each pile one ballot at a time and reading aloud the candidates' names written on it. One of the other BEI members records the votes as they are called into the ERs using "taras" (or sticks), while the third member records them into Tally Boards taped or stapled to the walls of the classroom precinct. Both the ERs and the Tally Boards carry the preprinted list of all candidates, from national president down to the city/municipal councilor. Because of the numerous elective positions and candidates contesting each of them, the number of ER sheets and Tally Board sheets come to more than a dozen each.

When all the votes have been read and recorded, the BEI adds up the votes for each candidate in both the ERs and the Tally Boards — the double recording is intended for easy cross-checking. The BEI completes the Minutes of the proceedings, signs the necessary forms, then packs the documents for transport to the city/municipal canvassing center. On that trip of common destination, precinct BEIs in the same polling center (usually, a school) normally take jeepneys together. It is in fact safer for them to wait for each other to finish the counting and travel together — in many cases, the counting goes into dawn.

Copies of ERs are distributed to various parties and accredited citizens' arms in accordance with law and COMELEC resolutions.

City/Municipal canvassing

In deciding the winners for **mayor**, **vice-mayor**, and **councilor** in the city or municipal elections, the votes garnered by each candidate in all the precincts are consolidated. This process is referred to as city/municipal canvassing, and this first level of consolidation is performed by the City/Municipal Board of Canvassers (C/MBOC), of which there are approximately 1,700 including cities that have each more than one district.

This Board is composed of the Election Officer, or a representative of the Commission, as Chairman; the Municipal Treasurer, as Vice-Chairman; and the District School Supervisor, or in his absence, the most senior principal of the school district, as Member.

The Board normally waits for enough number of ERs to arrive before it starts canvassing so that its work is not, or only slightly, interrupted; interruptions are usually caused by the late arrival of ERs.

Aside from the city/municipal positions, the votes of the candidates for national, provincial, and district positions are canvassed, too, to prepare them for further consolidation at the next two levels of canvassing. All forms are signed by all members of the C/MBOC.



Two forms are accomplished at each level of canvassing:

1) The Statement of Votes (SOV), into which the total votes garnered by the candidates from each precinct is entered. The precinct numbers are recorded at the top of the columns. The columns in the form are filled up as ERs arrive from the precincts. When all the precinct votes have been recorded into the SOV, totals by candidate are computed and recorded in figures and in words under the TOTALS columns of the multi-page form.

NAMES OF CANDIDATES	PRECINCT NO. _____	PRECINCT NO. _____	PRECINCT NO. _____	TOTAL	
				FIGURES	WORDS

2) The Certificate of Canvass (COC), is a summary of the SOV. The total votes per candidate appearing under the TOTALS columns of the SOV (figures and words) are entered into the COC, opposite their corresponding candidates' names.

Based on the COC, the candidates for mayor, vice-mayor, and councilor garnering the highest votes are proclaimed winners. The COC is then transported to the Provincial Board of Canvassers (PBOC) for further consolidation.

Copies of COCs are distributed to various parties and accredited citizens' arms in accordance with law and COMELEC resolutions.

Provincial canvassing

As in city/municipal canvassing, in deciding the winners for **governor, vice-governor, member of the provincial board, and district congressman**, the votes garnered by each of the candidates for those positions in all cities and municipalities in each province are consolidated. This process is referred to as provincial canvassing, and this second level of consolidation is performed by the PBOC, of which there are approximately 150, including multi-district chartered cities. (There may be some procedural variations in the case of multi-district provinces and chartered cities.)

The PBOC is composed of the Provincial Election Supervisor, or a lawyer of the Commission, as Chairman; the Provincial Prosecutor, as Vice-Chairman; and the District School Superintendent, as Member-Secretary.

At this level of canvassing, an SOV (provincial version) is accomplished to facilitate the consolidation, except that this time the columns represent the votes in the

COCs coming from all C/MBOCs in the province, not in ERs, as in the case of the city and municipal precincts. Totals per candidate are computed and recorded in figures and in words under the TOTALS columns. A Provincial Certificate of Canvass (PCOC), a summary of the provincial SOV, is prepared. All forms are signed by all members of the PBOC.

Aside from the provincial positions, the votes of the candidates for national positions are canvassed as well, to prepare them for further consolidation at the third and last level of canvassing.

Based on the PCOC, the candidates for governor, vice-governor, member of the provincial board and district congressman garnering the highest votes are proclaimed winners. The PCOC is transported to the National Board of Canvassers (NBOC) for the third and final consolidation of votes for national candidates.

National canvassing

In deciding the winners for **president, vice-president, senator, and Party-list**, the votes for each of the candidates for those positions in all provinces and chartered cities (as appearing in the PCOCs) are consolidated. This process is referred to as national canvassing and this third and final level of consolidation is performed by the NBOC.

The NBOC is split into two groups of canvassers. The first is a joint Congressional committee composed of representatives coming from both Houses of Congress; it canvasses the positions of president and vice-president. The second is the Commission on Elections (COMELEC) itself; it canvasses the positions of senator and party list.

In each of the two groups of canvassers, an SOV (national version) is again accomplished to facilitate the consolidation, except that this time the columns take the votes in the PCOCs coming from all provinces and chartered cities in the country. Totals by candidate would be computed and recorded in figures and in words under the TOTALS columns. A National Certificate of Canvass (NCOC), a summary of the national SOV, is prepared. All forms are signed by all members of the NBOC.

After the NCOCs are completed, the winning national candidates are proclaimed, at which point the election period ends.

This pure manual system is what the Philippines used in all elections from 1946 to 2007.

PART 2

PROBLEMS IN THE "PURE MANUAL SYSTEM"

2 PROBLEMS IN THE "PURE MANUAL SYSTEM"

To be sure, there were serious problems with the pure manual system, too, as previously hinted at, the biggest being the many weeks it took to complete the process and proclaim the election winners; in the last three decades, proclamation normally took more than twenty days. Once, it even took forty-two days!

The Philippines has a unique and fundamental disadvantage in its election process: the voters elect the President, Vice-President, Senators, and Party-List representative directly, thus the consolidation of votes goes all the way to the national level, a process that can take weeks.

It was not a major problem before 1972, when martial law was declared, because the number of registered voters, even at its highest, were less than a fourth of what it is today. And not only has the number of voters grown with the population since, the lowering of the voting age from 21 to 18 has swelled it further. Following are some historical figures that show the growth of the country's voting population (on the left are selected election dates, and on the right the corresponding registered voters):

Apr. 23, 1946	2,898,604	1st election ever; Manuel Roxas became president
Nov. 10, 1953	5,603,231	Ramon Magsaysay became president
Nov. 9, 1965	9,962,345	Ferdinand Marcos became president
Nov. 8, 1971	11,661,909	Last election before Martial Law
May 14, 1984	24,822,438	Batasang Pambansa Elections
Feb. 7, 1986	26,278,744	Snap Elections; Corazon Aquino became president
May 11, 1992	32,141,079	1st Synchronized Elections
May 14, 2007	45,028,197	Last election using the pure manual system
May 09, 2016	54,363,844	Most recent elections; automated, using PCOS

New precincts had to be opened in order to accommodate the ever-growing number of voters. The vote-counting time at the precinct level remained the same, because the number of voters per precinct also remained the same. But the canvassing — indeed the whole election process — took longer and longer.

To illustrate: let's say there were one million voters and 5,000 precincts each taking 200 voters, and assume that it took the precincts an average of eight hours to count the votes manually and produce the ERs. If the number of voters increased by half a million, and the number of precincts was increased by another 2,500, it would still take just eight hours to count all the votes in all the precincts.

On the other hand, the increase in the number of precincts by another 2,500 will proportionately increase the canvassing time at the C/MBOCs by 50% as there would still be only one Board of Canvassers doing the consolidation.

Other reasons slowed the process, to be sure. Before 1992, local elections used to be run separately from national elections. In each election, there were fewer positions/candidate names in the ballot that needed to be counted and canvassed. But since the national and local elections were synchronized, there has been an increase in the number of positions and names on the ballot and, therefore, an increase, too, in the number of votes to be counted and canvassed. Counting at the precincts and the eventual canvassing therefore took a much longer time.

And then, there was also the inclusion of the Party-List candidates. Averaging about a hundred candidates in every election, counting and canvassing became even more cumbersome.

The protracted election process itself caused even more serious problems. Big-time cheating became easier simply because the cheats had more time. Thus, "*dag-dag-bawas*" (literally, add-subtract) came into being. This occurred at the canvassing levels, particularly, at the City/Municipal and Provincial canvassing.

The teachers, who composed the BEI, were put at risk as they would end up going home in the early hours of the following morning. By that time, they would have put in almost 24 hours of back-breaking work, having been up since 5:00 a.m., or even earlier, on Election Day.

During the transport of the ballot boxes and the ERs from the precincts to the C/MBOC, some of the boxes were hijacked and stuffed with fake ballots, or replaced with prefilled boxes. Or, simply destroyed.

There were reports that the BEI Chairman would sometimes intentionally mis-read the ballots to favor certain candidates. This problem, however, was substantially reduced when political party watchers were allowed to position themselves behind the BEI as it conducted the count.

Still, because of the sheer magnitude of the whole operation, problems were bound to arise and, when they did, they had proved very difficult to solve. That's how automation came into favor as an "end-all and be-all" solution, and the general public tends to believe that the promise has been reasonably met.

Alas! those in the know believe otherwise.



PART 3

THE AUTOMATED ELECTION SYSTEM USED IN 2010, 2013, AND 2016

3 THE AUTOMATED ELECTION SYSTEM USED IN 2010, 2013, AND 2016

The technology recommended by the COMELEC Advisory Council (CAC) in 2008, for the 2010 elections, was Optical Mark Recognition, or OMR, and the bidding conducted in mid-2009 (for the 2010 elections) allowed only for that technology, barring non-OMR prescriptions, some of which are known today to be the much better ones. Smartmatic's Precinct Count Optical Scan (PCOS), a variant of OMR, won the contract in 2009 amid controversies in the very conduct of the bidding.

And Smartmatic's PCOS won again in 2013 and 2016.

In the PCOS system, the names of all the candidates on all levels — from president down to municipal councilor and also for ARMM governor and assemblyman — are preprinted on the ballots. Voters make their choices by marking the ovals opposite their candidates' names.

Each voter then brings his/her ballot to the PCOS machine and feeds it into a machine that then reads the markings on the ballot and stores them in its memory. The ballot itself, now marked "read", falls into the ballot box.

At the end of the voting period, the BEI presses a key in the machine, thus starting the counting of the markings equivalent to the votes; the computed totals for each candidate are stored.

Eight (8) copies of the Election Returns are printed and checked for any visible defect. If there is none, the BEI presses another key to electronically transmit the ER data to the server (computer) at the City/Municipal Board of Canvassers, to a COMELEC central server, and to a transparency server. The dominant party, dominant opposition, citizens' arms, and media (represented by the Kapisanan ng Brodkaster ng Pilipinas, or KBP), get their copy of the results from the transparency server.

After the transmission, PCOS then prints an additional twenty-two (22) copies of the ER, for distribution to the representatives of the political parties in the city/municipality. All printed copies are signed by the members of the BEI before distribution. These 30 printed copies of the ER, and where they should go, are a requirement of R.A. 8436, as amended.

Upon receipt of a precinct ER, the C/MBOC server stores the data and, when all the precincts have reported their ERs, it canvasses and consolidates all the votes reported, then prints the Statement of Votes and the Certificate of Canvass for the city/municipality. If the C/MBOC finds no visible defects in the two reports, the soft copy of the COC is electronically transmitted to the server of the Provincial Board of Canvassers.

Based on the COC, the candidates for mayor, vice-mayor, and councilors garnering the highest votes are proclaimed winners.

Upon receiving a COC from a C/MBOC, the PBOC server stores the data and, when all the C/MBOCs have reported their COCs, it canvasses and consolidates all the votes reported, then prints the Statement of Votes and Certificate of Canvass for the province. If the PBOC finds no visible defects in the two reports, then the soft copy of the PCOC is electronically transmitted to the server of the National Board of Canvassers (NBOC).

Based on the PCOC, the candidates for governor, vice-governor, members of the provincial board, and congressman garnering the highest votes are proclaimed winners.

Upon receiving a COC from a PBOC, the NBOC server stores the data, and when all the PBOCs have reported their COCs, it canvasses and consolidates all the votes reported, then prints the National Statement of Votes and Certificate of Canvass. Congress, however, has modified these procedures, as they have done in the past three automated elections. The NBOC members opted instead to manually read the votes garnered by each presidential and vice-presidential candidate in each printed COC, **as they are received from the PBOCs**, canvass and consolidate them manually, then post the results on a whiteboard. This modification has, of course, made the final consolidation more transparent, as it is done in front of the public present in Congress, and the TV cameras.

After the two NCOCs are completed by Congress and the COMELEC, and after the signing of all the documents, the winning national candidates are proclaimed, thus ending the election period. The whole process, from Election Day to the proclamation of the winners, took approximately 2-3 weeks, in the past three automated elections.

PART 4
PROBLEMS
ENCOUNTERED IN THE
AES USED IN 2010, 2013,
AND 2016

4 PROBLEMS ENCOUNTERED IN THE AES USED IN 2010, 2013, AND 2016

While the objective of speed was somehow attained, there were questions regarding the accuracy of the results and the absence of transparency.

IT practitioners were not happy about the implementation of automated elections in those three election years because the Smartmatic solution was far from suitable as an automated election system, and they know it to be non-compliant with some law provisions, as well as some bidding specifications.

First of all, in the case of OMR (like DRE), nobody gets to witness what's happening — it all happens inside a machine, a black box, with software doing the counting, an invisible process in itself. In effect, the voters are being asked to put their virtually blind trust in both the system and the implementers – i.e., the COMELEC and the service/machine provider. To ask as much of voters in countries with no history of election cheating may be reasonable — but in the Philippines?!

A little public relations campaign launched by either or both the implementers and the service/machine provider can easily camouflage the defects of the system. That, plus the voting public's fascination with automation, made acceptance of the system an almost natural consequence.

But people who are IT-savvy know better; they are unimpressed. Those who have experience in systems design and implementation of big projects are even more disappointed. And rightly so.

If this very first step in the counting/consolidation process is not transparent to the voting public, this step, and all succeeding ones, simply cannot be trusted. It is for this reason that the source code review and the random manual audit are made requirements by the automation law (R. A. 8436, as amended). These safeguards by themselves, however, will not ensure 100% accuracy of the results. Far from it.

The experience in the past three elections, using PCOS, revealed several points of non-compliance by the system and by the service provider. Consider these failures to meet bidding specifications:

1. PCOS did not meet the required accuracy level of 99.995%
2. PCOS did not recognize check marks and X-marks as votes
3. Only ovals marked at least 25% were recognized as votes (this could have disenfranchised many votes)

And these cases of non-compliance with election laws:

4. Unsatisfactory implementation of “source code review”
5. Non-compliance with the digital signature requirement of the law
6. No Voter Verifiable Paper Audit Trail (VVPAT); VVPAT was implemented in 2016 but lacked the markings — date of the elections, date and time stamp of VVPAT, and the clustered precinct number
7. Existence of an Intermediary Server, revealed only after the elections
8. Varying time stamps on ERs in 2010
9. Unsecured communication port

Even the compensating controls recommended by the international certification body, SysTest Lab, was not complied with.

Why COMELEC has not filed any case against Smartmatic for any, or all, of the abovementioned failures and shortcomings (Smartmatic would usually argue that COMELEC allowed them the non-compliance) and, worse, why it kept on awarding Smartmatic more billion-peso contracts for the same undertaking — all very serious anomalies — are extremely puzzling.

PART 5
THE AES/ETA
ALTERNATIVE AND
HOW IT WORKS

5 THE AES/ETA ALTERNATIVE AND HOW IT WORKS

The apparent reason for the unsatisfactory and costly implementation of the country's election automation was the failure of the COMELEC to correctly analyze the precinct-level counting and canvassing time line. In the following chart, it can easily be seen that automating the precinct-level counting, which only cut down the processing time by 5-12 hours, but cost the country approximately P10 billion in each election exercise, was such a revolting waste of valuable resources. The truly substantial time savings were the result of automating the canvassing, which only cost the country some P300 million per election.

Worse, transparency of the election process was lost when precinct-counting was automated.

MANUAL ELECTIONS PRECINCT-COUNT AND CANVASSING TIMELINE



- PCOS AUTOMATED THE PRECINCT-COUNTING (THUS SAVING 5-12 HOURS) : COST = ₱ 10 BILLION
- PC SERVERS, LAPTOPS AUTOMATED THE CANVASSING (THUS, SAVING OVER 40 DAYS) : COST = ₱ 300 MILLION
- SINCE 2008, THE OBVIOUS APPROACH OF AUTOMATING ONLY THE CANVASSING, TRANSMITTING THE ERs ELECTRONICALLY, WHILE KEEPING PRECINCT-COUNTING MANUAL, HAS BEEN RECOMMENDED TO THE COMELEC, BUT THE RECOMMENDATION HAS REMAINED UNHEEDED.

Had the CAC and the COMELEC gone through the above simple analysis, they would most likely have found that the better solution would be to allow the precinct-level counting to be conducted manually, to look for a way of electronically transmitting the results, or ERs, to the C/MBOC, and to automate the three-level consolidation and canvassing of the results.

Such a solution, enhanced by other features, could be the most suitable, most appropriate system for Philippine elections. There are, however, quite a few COMELEC officials and politicians who have publicly expressed their distrust of manual counting at the precinct level. Some politicians even claim that they witnessed how they were cheated on that level.

It is understandable that they don't realize, much less appreciate, that to be able to witness cheating is an argument for manual counting and, for that matter, AES/ETA (discussed in detail later in this paper); it is proof of transparency and would provide them with a basis for filing a protest. Especially now that cellphone cameras are ubiquitous, photographs and videos could be taken and affidavits from other witnesses could be secured and used in the case.

Besides, it is not that simple to win by cheating. A candidate must be able to alter the results in more than one precinct since precinct-level counts are still small. One needs to employ a lot of people for cheating. (Much of the cheating is done at the canvassing level where the numbers are bigger).

On the other hand, *when precinct-counting is automated, cheating can be hidden from the public eye and will only need one person, or a few technical people, to execute.* And it can be done as easily across all levels — municipal, provincial, and national. The losing candidate, meanwhile, is left with no solid basis for filing a protest. Certainly, a major disadvantage. Stories have been told about strong candidates who lost, but could only guess what happened, because they did not witness the cheating, if indeed, they were cheated.

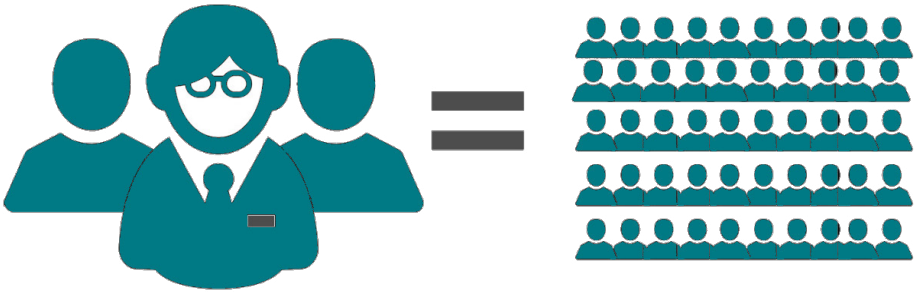
A good election system — and this is becoming the worldwide standard — must have transparency in precinct-level counting, especially because the results at this stage provide the control counts for the subsequent stages.

Following is a detailed discussion of a solution — Automated Election System with Enhanced Transparency and Accuracy (AES/ETA): Precinct-level counting is manual, while transmission of ERs is electronic, and city/municipal, provincial, and national canvassing are automated. *This system approach is more accurate, more transparent, less costly, and less vulnerable to cheating, yet will only take a few hours longer than the fastest election technologies currently available.*

How does it work?

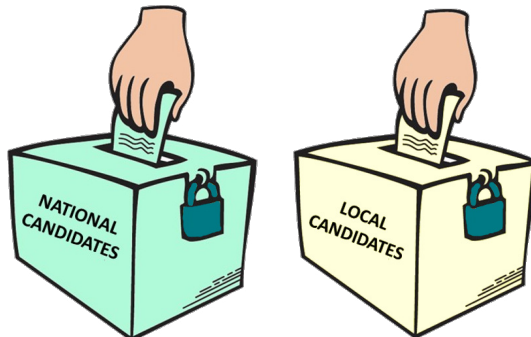
Precinct-level voting and counting

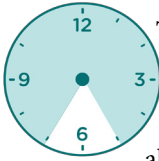
The BEIs man a clustered precinct each. A BEI is composed of three teachers, one assigned as Chairman, the other two as poll clerks (it is preferred that one poll clerk be familiar with the basic operations of a computer). Approximately 250 voters (a maximum of 300) are accommodated in each clustered precinct. (Small geographically proximate precincts may be clustered; the big ones need not.) Some 150,000-200,000 such precincts are opened — still less than the total number used in 2007.



The election process still consists of four stages: 1) the voting period; 2) the vote-counting at the precincts, manual and laptop-assisted; 3) the electronic transmission of the results of counting, or ERs, from the precincts to the canvassing centers; and 4) the three-level automated canvassing — municipal, provincial, and national consolidation of votes.

Two ballots, of different colors, are used — one for the national positions (president, vice-president, senator, and Party-list) and another for the local (congressman, governor, vice-governor, member of the provincial board, mayor, vice-mayor, and councilor). Accordingly, two ballot boxes, preferably of the same colors as the corresponding ballots, would be used.





The voting period starts at 7:00 a.m. and closes at 5:00 p.m. From 15 to 20 voters, or as many as can be comfortably accommodated inside the classroom, are allowed to vote simultaneously. When the 5:00 p.m. closing time comes, all voters in line within up to 30 meters long, are still allowed to vote. (Since the number of voters per precinct is nearly equal that when elections were manual, COMELEC may consider adopting the old 7:00 a.m. – 3:00 p.m. voting period.)

After a brief rest, the BEI starts counting the votes. (So as not to tire the BEI too much, the COMELEC may opt to field a second set of teachers, or government employees, to take over the precinct-level counting.) The national ballots are counted first; the local ballots are next.

Certain steps are followed for the vote-counting process. First, the BEI Members take the ballots out of the box and arrange them on a table in piles of 10 ballots each, and begin counting. The Chairman takes and reads out the votes, one ballot at a time, one pile at a time. As each vote is read out, one of the two other BEI members records it into the ER forms, using “taras” (or sticks), while **the third member records it into a laptop (or tablet).**

For added transparency, a projector is attached to the laptop (or tablet) and simultaneously displays the vote on a big screen for all to see. The big screen takes the place of the Tally Board, an innovation that saves time from the old manual count.). Optionally, for further transparency, a camera, mounted on a table-top device, focuses on the ballot that is being read and also projected onto the screen.

In both the manual and laptop counts, cumulative totals are taken for every 10 ballots, and the count in the ER forms is compared with that in the laptop. For any errors, a review should be able to trace them from the last 10 ballots read.

Every five piles (of 10 ballots each) that have matched, the BEI member manning the laptop prints three copies of the count from those piles: one copy is posted at the door of the precinct for anyone who wishes to look, another is posted inside the precinct for the watchers, and the third is kept by the BEI. This BEI member would also electronically transmit the partial counts to a media server/website, for broadcasting to the public. (Note: Funding for the communications expenses should be resolved beforehand.) If there were to be 150,000 precincts reporting 50 ballots periodically, each report could carry an increment of some 7.5 million ballots. In reality, the precincts would not be able to complete processing each five piles at the same time, so the increments would actually be smaller, but these would be shown in a continuous stream.

When all the votes have been read, counted, and recorded, the BEI adds up the total votes garnered by each national candidate, then posts the results in the ER forms. If the figures match those on the laptop, then eight copies of the report are printed from the laptop and signed by the BEI. The soft copy of the results (ERs) is also digitally-signed and electronically transmitted from the laptop to the server at the City/Municipal Board of Canvassers (C/MBOC) and to a website accessible to media and the public. An additional 22 copies of the national ERs are then printed and signed.

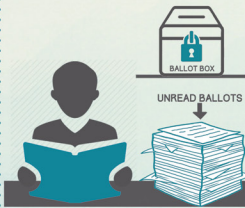
After completing the national count, the BEI proceeds with the local count, following exactly the same procedure as in the former's case.

After the eight copies of the local report have been printed and signed, the soft copy of the results is digitally-signed and transmitted to the server at the C/MBOC. After the transmission, another twenty-two copies of the report are printed and signed.

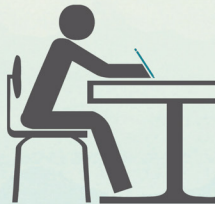
The printed copies of both the national and local ERs are distributed to the accredited political parties, but it **would greatly help these parties if soft copies** (CD, or USB, or other similar storage devices) **were also distributed to them.** (Their use will be explained later in this paper.)

When the counting of both national and local ballots is done, the BEI completes the Minutes of the proceedings, signs all the forms, then packs the documents for transport to the city/municipal treasurer and board of canvassers.

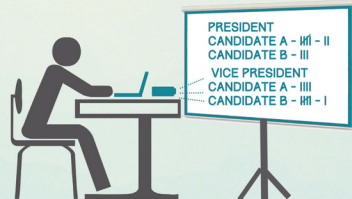
VOTE RECORDING AND COUNTING ARE SIMULTANEOUSLY DONE MANUALLY AND WITH THE AID OF A COMPUTER. PROGRESS OF VOTE RECORDING AND COUNTING IS DISPLAYED ON SCREEN.



BEI CHAIRMAN PICKS A PILE OF BALLOTS AND READS EACH BALLOT IN THE PILE. THE COMPLETED PILE IS SECURED AND SET ASIDE. HE THEN PROCEEDS TO THE NEXT PILE OF BALLOTS.



BEI MEMBER 1 RECORDS VOTES MANUALLY.



BEI MEMBER 2 RECORDS VOTES WITH THE AID OF A COMPUTER.

City/Municipal canvassing

In order to determine the winning candidates for **mayor, vice-mayor, and councilor** in each city or municipality, the votes electronically-transmitted from the precincts to the city or municipality are consolidated. This is what is referred to as city/municipal canvassing, and this first level of consolidation is done by the C/MBOC server. The results of the consolidation are digitally-signed, then printed and manually-signed by the C/MBOC.

Aside from the city/municipal positions, the votes of the candidates for national, provincial, and district positions are also canvassed to prepare them for further consolidation at the next two levels of canvassing.

Two reports are printed at the end of each level of canvassing:

- 1) The Statement of Votes (SOV). The total votes garnered by the candidates from each precinct are displayed by the C/MBOC server as they are received. The precinct numbers are recorded and displayed at the top of the columns. The columns are filled up as ERs arrive from the precincts. The totals for every candidate may also be displayed every time a column is added. When all the precinct votes have been recorded into the SOV chart, the totals for every candidate are computed by the server and recorded in figures and in words under the TOTALS columns of the chart.
- 2) The Certificate of Canvass (COC) — a summary of the SOV. The total votes per candidate appearing under the TOTALS columns of the SOV (figures and words) are entered into the COC, opposite their corresponding candidate names.

The soft copies of the SOV and of the COC are then digitally-signed and electronically transmitted to the Provincial Board of Canvassers (PBOC) for further consolidation, and to a website for public access. *Using a simple computer program, political parties can download these SOVs and compare the precinct data with the CD data they have collected at the precincts. They can also consolidate the data from all the CDs collected so that they can compare the totals with the C/MBOC totals.*

This is a very significant step for political parties to take. It provides a check that, in the past, they could only do manually (or by the cumbersome encoding of data from all ERs). This step affords them two things: 1) they will know if the precinct results (ERs) have been tampered with during the electronic transmission; and 2) they can conveniently validate the accuracy of the canvassing at all levels — all the way to national

canvassing. ***This, in combination with the transparent manual counting of the votes at the precincts, will prevent massive election cheating.***

Based on the COC, the candidates for mayor, vice-mayor, and councilor garnering the highest votes are proclaimed winners.

Provincial canvassing

As in city/municipal canvassing, in order to determine the winning candidates for ***governor, vice-governor, member of the provincial board, and district congressman***, the votes garnered by each of the candidates for those positions and electronically-transmitted by all cities and municipalities in each province, are consolidated. This is what is referred to as provincial canvassing, and this second level of consolidation is done by the PBOC server. (There can be some procedural variations for multi-district provinces and chartered cities.)

At this level of canvassing, an SOV chart (provincial version) is displayed and used to facilitate the consolidation, except that this time the columns represent the votes in the COCs coming from all C/MBOCs in the province, rather than in ERs from precincts in a city/municipality. Totals by candidate are computed by the PBOC server and recorded in figures and in words under the TOTALS columns of the chart. A Provincial Certificate of Canvass (PCOC), a summary of the Provincial SOV, is digitally signed, then printed, and manually-signed by the PBOC.

Aside from the provincial positions, the votes of the candidates for national positions are also canvassed, thus prepared for further consolidation at the third and final level of canvassing.

The soft copies of the PSOV and of the PCOC are digitally-signed and electronically-transmitted to the National Board of Canvassers (NBOC) for further consolidation and to a website open to public access. ***Again, using a simple computer program, political parties can download these PSOVs and compare the city/municipal data with the control totals they have themselves computed and stored, a step facilitated by the availability of CD data.***

Based on the PCOC, the candidates for governor, vice-governor, member of the provincial board and district congressman garnering the highest votes are proclaimed winners.

National canvassing

To determine the winners for **president, vice-president, senator, and Party-list**, the votes garnered by each of the candidates for those positions and electronically transmitted by all provinces and chartered cities (as appearing in the PCOCs), are consolidated. This is what is referred to as national canvassing, and this third and final level of consolidation is done by the National Board of Canvassers (NBOC) servers.

The NBOC is split into two groups of canvassers. The first, a joint Congressional committee composed of representatives coming from both Houses of Congress, canvasses for the positions of president and vice-president, while the second, the Commission on Elections (COMELEC), canvasses for the positions of senator and Party-list.

At this level of canvassing, an SOV chart (national version) is displayed and used to facilitate the consolidation, except that this time the columns represent the votes in the PCOCs coming from all PBOCs and chartered cities. Totals by candidate are computed and recorded in figures and in words under the TOTALS columns of the chart. A National Certificate of Canvass (NCOC), a summary of the National SOV, is digitally-signed, then printed and manually-signed.

Congress (NBOC) may, however, opt again to manually read the votes garnered by each presidential and vice-presidential candidate in each printed COC, *as they are received from the PBOCs*; canvass and consolidate them manually, then post the results on a whiteboard. Done in front of the public present in Congress, and the TV cameras, this modification makes for greater transparency.

After the NCOCs are completed, the winning national candidates are proclaimed, thus ending the election period.

The Consolidation and Canvassing System (CCS) used on the three levels of canvassing is actually the same no matter which election technology is chosen. This is the reason why in the United States, for example, each county can procure its own choice of machine, or even decide to count the ballots manually, so long as they transmit the results for consolidation in a common format.

This approach of allowing each municipality, or province, to choose its own system can also be adopted in the Philippines and is least problematic in AES/ETA because only ordinary PCs, laptops and servers need be procured: they can be bought from suppliers in any big city, thus reducing the logistics concerns of the COMELEC; technical help has also become available almost everywhere.

COMELEC may opt to contract out the project management by region, or groups of regions, to local System Integrators, of which there are many in the country. COMELEC can also undertake the development of the CCS and the front-end software. Or it could contract those out as well.

Actually, COMELEC, in 2011, already developed a CCS in-house, with the assistance of systems analysts seconded to the project by the Department of Science and Technology – Applied Science and Technology Institute (DOST-ASTI), at a cost of approximately P600,000. However, the Commission Chairman then refused to use it. Instead, the Commission used the CCS from Smartmatic that had been acquired years earlier at a cost of approximately P50 million and had to be modified anyway. The CCS developed by COMELEC may have remained a suitable system, although a thorough review and testing is suggested.

Considering the amount spent to develop the CCS — even though it had not gone through “stress testing” when it was stopped — all the software needed for AES-ETA should not cost too much; it can also be subcontracted out. A project team may be formed with DOST-ASTI involvement. ***The electorate can then look forward to an ideal automated system for Philippine elections, completely developed by Filipinos.***

The equipment for AES/ETA to be deployed in the 150,000 to 200,000 precincts would probably cost less than P5 billion (for laptops, servers, printers, projectors). If tablets were used instead of laptops, the total cost would probably be less than P4 billion. Considering the large volume to be purchased, a huge discount could be expected. Even if COMELEC allocates a few hundred million pesos for the subcontracted project management and additional allowances for the BEI members for longer working hours, the cost would still be much lower than the average of Php10 billion spent in each of the last three automated elections.

In AES/ETA the laptops (or tablets) and projectors make up a big percentage of this cost, but these could be donated to public schools through the Department of Education or sold to public schoolteachers at a discount after each election. A new set can be acquired every three years. Thus, storage and maintenance expenses are eliminated. Besides, putting these machines in storage for three years is not advisable.



***With AES/ETA, the results of Philippine elections
become truly reflective of the people’s will.***

COMELEC should go through this kind of exercise before making decisions on what technology to use – especially if such decisions meant having to import foreign technology. Unless there are logical arguments supporting the other election technologies, it is easy to conclude that, truly, the “most suitable” choice for Philippine elections is the Filipino-developed AES/ETA.

The Philippines is not the only country that has experienced automating its elections and then discovering that precinct-level counting, to be transparent, must be manually done. Following are examples, picked up from the Internet, of countries that have returned to manual elections after trying automated ones.



According to the Hill website, a good number of US states abandoned electronic voting machines, ensuring that most voters cast their ballots by hand on Election Day.



*In Germany, political scientist Joachim Wiesner and his physicist son Ulrich Wiesner complained that push-button voting was not transparent because the voter could not see what actually happened to his vote inside the computer and was required to place “blind faith” in the technology. In addition, the two plaintiffs argued that the results were open to manipulation. **The German Supreme Court eventually ruled the voting machines unconstitutional.***



Ireland bought voting machines from the Dutch company Nedap for about €40 million. The machines were tried in three constituencies for the 2002 Irish general election and a referendum on the Treaty of Nice. On 23 April 2009, the Minister for the Environment John Gormley announced that the electronic voting system was to be scrapped due to cost and public dissatisfaction.



In The Netherlands, in 2008, e-voting was suspended after 20 years of use when activists showed that the systems could, under certain circumstances, endanger the secrecy of the vote. An official commission found that the Ministry of the Interior and Kingdom Relations, which was responsible for organizing elections, was lacking in-house expertise, causing too much dependence on vendors and certification agencies. Voters had to switch back to pen and paper.

Many of those that dropped electronic voting used DRE systems. However, the same reason may apply for dropping OMR voting machines.

Sources in the know say that as many as 18 of the 30 or so countries that tried automated elections have gone back to manual. Lack of transparency was the common reason.

These countries must have realized that it is just not right that, for the sake of one virtue, others are sacrificed — *where, for speed, for instance, accuracy and transparency are sacrificed*. An ideal system is one in which automation and technology enhance most of, if not all, the virtues of the previous system.

There may be other ideas and new inventions worth incorporating into a system in order to speed up the election process and also make it more transparent and accurate. In that concept, the AES/ETA is precisely suitable.

How to proceed from here

COMELEC may think the AES/ETA approach too complicated; it is in fact a very simple system, and also one that can be improved continuously as new devices and technologies become available. Here is a suggested course of action:

- 1) Determine if the system is workable; gather a group of experienced systems analysts and computer programmers from within the organization and from the DOST-ASTI. Allow the proponent to present and discuss the AES/ETA solution with the group. The solution is being offered free of charge.
- 2) The group should determine not only the feasibility of the solution, but also the length of time that will be required in developing the system and the cost of both its development and its implementation.
- 3) If the group finds the system to be the most suitable and the cost to be acceptable, then the Commission, in consultation with the CAC, should plan for the next steps.
- 4) A project development team should be organized and a budget formulated and approved. The budget should include the cost of a nationwide information campaign, time and motion studies, mock elections, assistance to organizations that will try out the system, and other activities that will help ensure the success of its implementation.



A final word: Especially in large-scale, ultra-sensitive projects costing billions of pesos of public money, it is a must that a thorough process of evaluating the options and choosing the “most suitable” solution be undertaken; to not do so will be a great disservice to the Filipino people.

ANNEX 1

TYPES OF AUTOMATED ELECTION SYSTEMS

The automated elections of 2010, 2013, and 2016 used what is referred to as Optical Mark Recognition (OMR) System. Many found its performance satisfactory, but they were generally not IT-savvy. And even those who might have had some IT experience did not have domain knowledge — meaning, not very familiar with Philippine elections.

But this is getting ahead of the objective. Let us backtrack a bit and discuss the various automated election technologies available and still in use in some countries today.

Direct Recording Electronic (DRE) System: This technology is also referred to as the “touch screen” system. The voter submits his/her choices from among the candidates whose names (and also, oftentimes, photographs) appear on a computer monitor. A printed output indicating the choices may or may not be part of the machine’s features. (The US Election Assistance Commission, since not too long ago, has required that a printout of the voter’s choices be generated in the event that a manual recount becomes necessary.)

At the end of the voting period, once the BEI Chairman depresses a button in the DRE unit/s, the system closes the voting, counts the votes, and prints the results. It then electronically transmits the soft copy of the results to the C/MBOC.

Advantages:

- All four stages of the election process (voting, counting, transmission, and canvassing) are automated
- An instantaneous tally of the votes at the precinct level is generated
- Theoretically, the BEI has less work
- Since the results are transmitted electronically, ballot box snatching is prevented

Disadvantages:

- **Not transparent:** Voters may not trust a count they did not see
- Manipulation of results is easy for technical people inside
- Because voting is done in front of the machine, it is slow and may require 5-6 units per precinct (total of approximately 750,000 - 900,000 units, assuming 150,000 precincts)
- Logistics is a nightmare (750,000 units to be delivered to 150,000 locations)
- With such a huge number of units, the transmission failure rates are high
- The cost is prohibitive, estimated at P60 billion or more
- BEI and voter training is a staggering undertaking

- The number of technical support people may run in the hundreds of thousands
- Maintenance and storage of machines after each election are a major concern — costs and availability of warehouses are chief factors

Optical Mark Recognition (OMR) System: PCOS falls under this type. Voters indicate their choices through preprinted ballots, simply by shading the spaces (or ovals) opposite the names of their chosen candidates. The ballots are then fed into the OMR unit by the voters themselves, one at a time. Printed outputs indicating the voters' choices, for verification purposes, may or may not be part of the machine's features.

At the end of the voting period, the BEI Chairman depresses a button in the OMR unit, and that automatically closes the voting, counts the votes garnered by each candidate, and prints the results. It will then electronically transmit the soft copy of the results to the C/MBOC.

Advantages:

- Instantaneous tally of votes at the precinct level
- Since ballots are preprinted, voters simply mark choices; no need to write names
- Less work for the BEI
- Less cost than DRE (approximately, P10 billion)
- BEI and voter training minimal, relative to DRE
- No ballot box snatching, since the results are transmitted electronically

Disadvantages:

- **Not transparent:** voters may not trust the counting they did not see
- Manipulation of results is easy for technical people inside
- Because of the “shading threshold”, disenfranchisement becomes a real issue (“ex. 25% threshold” means that, if an oval is shaded less than 25%, the vote will not be counted)
- The machine is sensitive to external marks and smudges
- Difficult to fairly resolve overmarked ballots (ex. 13 ovals marked for senators)
- Easy to illegally shade ovals in undermarked ballots; or illegally shade more ovals than allowed in order to invalidate the vote
- Maintenance and storage of machines after each election are a major concern, though not as much as with DREs

Internet Voting (IV): A voter logs in to the election administrator's website, identifies him/herself and authenticates his/her legitimacy through a password. He/She then downloads the ballot, indicates his/her choices, digitally signs the ballot, and uploads it back to the designated website.

COMELEC's lament over the past elections is that the turnout of OAVs (Overseas Absentee Voters) has always been very low. That problem can be solved by Internet voting. Especially in the Middle East, where Filipino OAVs work and reside many miles away from the embassy, this voting system is convenient.

There is one major disadvantage in this AES, however, that makes it inappropriate for use in-country (not overseas), and that is, **ballot secrecy cannot be monitored**. COMELEC will not know if a voter is making his/her choices of candidates under duress. And the votes are traceable to the voter, unless an elaborate system of keeping them secret is employed. This disadvantage hardly applies to OAV voting because voters in that case are only allowed to vote for national candidates — candidates would not risk influencing voters illegally because these voters are too few, too far away, and too spread out to bother with.

Advantages:

- Very convenient for the voter as he/she can vote from any place where he/she has access to a computer or smart phone (even from home)
- Computer-equipped precincts, if used in-country (not recommended), are only needed for those voters who have no access to a computer or smart phone
- All four stages of the election process (voting, counting, transmission, and canvassing) are automated
- Instantaneous tally of votes
- No ballot box snatching, since the votes and results are transmitted electronically
- Since only PCs and servers are used, they can be purchased in any big city; therefore, less logistics concerns
- No warehousing and equipment maintenance necessary as all purchased machines can be donated to schools after each election; a new set can be purchased every three years

Disadvantages:

- Ballot secrecy cannot be monitored
- Not transparent:** voters may not trust the counting they did not see
- Manipulation of results is easy for technical people inside

If used in-country (again, not recommended) and if precincts have to be set up for voters who have no access to computers:

- Because voting is done in front of the machine, it may therefore require 5-6 units per precinct (total of approximately 375,000-450,000 units, assuming half of the voters have access to computers and therefore only 75,000 precincts will be needed)
- Training of BEI and voters with no computer experience is difficult
- Number of technical support people may run in the tens of thousands

Automated Election System with Enhanced Transparency and Accuracy (AES/ETA): Voters signify their choices by writing down the names of their candidates in ordinary ballots. After the voting period, the ballots are counted manually. The results of the counting are converted into machine-readable form (encoding of manually-counted results, or the strongly recommended lap-top-counting, side-by-side with manual-counting).

This will be followed by the printing of the Election Returns, comparison of the manual and computer-printed results (that will ensure accuracy), and the electronic transmission of the ERs to the C/MBOC. Henceforth, the automated canvassing proceeds similarly as in the DRE and OMR systems. (It is only in the precinct-voting, precinct-counting, and to a certain extent, the electronic transmission that the election technologies differ. The canvassing process is the same in all cases.)

Advantages:

- All steps of the election process are transparent to the voting public; precinct tallying is done under the watchful eyes of the voter
- Accuracy of the counting is high — after all, manual counts are the basis of accuracy; two counts run simultaneously, totals compared periodically, thus ensuring accuracy
- Cost is much less than DRE and OMR (approximately P 5 billion, maybe less); even the ballots cost much less
- Very minimal BEI training and no voter training at all are necessary
- Vulnerability to cheating is very low (only retail cheating, if at all)
- Software uses open source — can be reviewed by anybody interested
- Since only PCs and servers will be used, they can be purchased in any big city; therefore, less logistics concerns
- No warehousing and equipment maintenance necessary; all the machines can be donated to schools after each election, or sold to public school teachers at a discount; a new set can be purchased every three years
- No ballot box snatching — the results are transmitted electronically

Disadvantages:

- Precinct tallying will be 5-12 hours longer than DRE or OMR

There are of course other technologies that are available in the market, but most of them may be categorized under the above four.

ANNEX 2

COMPARATIVE ANALYSIS OF THE DIFFERENT ELECTION TECHNOLOGIES

Shortly before the 2013 elections, a group of Filipino IT practitioners, all sufficiently knowledgeable about election systems, did a cost/benefit study of what could be a “most suitable” automated system for the Philippines. Included in the study were the Direct Recording Electronic System (DRE), Optical Mark Recognition system (OMR) (specifically, PCOS), Central Count Optical Scan (CCOS), the AES with Enhanced Transparency and Accuracy (AES/ETA), and the Pure Manual System (PMS). Internet Voting (IV) was not part of that study, but was a late addition to this paper. The major criteria used in the comparison were transparency, accuracy, vulnerability to cheating, cost, speed, auditability and verifiability, training and staffing requirements, and machine reliability.

As expected, AES/ETA, came out far, far ahead of the other technologies. Small wonder therefore that **it, or a close variation of it, is the most popular election system worldwide.**

To review the descriptions of each of the abovementioned systems:

1. DRE, sometimes referred to as the “touch screen system” — the voter indicates his/her choices by tapping the names and/or photographs of the candidates that appear on a computer monitor.
2. OMR, under which falls PCOS, or Precinct Count Optical Scan — voters make their choices simply by shading the spaces opposite the names of the candidates on preprinted ballots.
3. CCOS is the same as PCOS, except that the uncounted ballots are brought to a central counting center where they are fed into a high-speed OMR machine for counting and printing by precinct.
4. In AES/ETA, voters write down the names of their chosen candidates in ordinary ballots. After the voting period, the ballots are counted manually; at the same time, tallying is done using a laptop. Henceforth, the automated canvassing proceeds similarly as in the DRE and OMR systems.
5. In IV, voters can cast their ballots directly using their own computers, laptops, or smart phones. Others can go to designated precincts equipped with laptops.

6. All voters are, of course, familiar with the pure manual system (PMS) in which no machines, except perhaps, calculators, are used.

Following is the result of the analysis, using a scale of 1 to 5, where 5 is the most favorable:

	DRE	OMR (PCOS)	CCOS	AES/ETA	INTERNET VOTING	PMS
TRANSPARENCY	1	2	2	5	1	3
ACCURACY	4	4	4	5	4	3
VULNERABILITY TO TAMPERING	2	2	2	5	2	3
COST	1	3	4	4	4	5
SPEED	5	5	4	4	5	1
AUDITABILITY	3	3	3	4	2	4
TRAINING/STAFF	2	3	3	4	3	5
MACHINE RELIABILITY	3	3	3	4	4	5
TOTAL	21	25	25	35	25	29

For this study, the above criteria were given equal weights. If the more major ones (the first six) were, however, to be given higher weights, the margin of AES/ETA over the others would be even wider.

Some notes regarding the above analysis:

Transparency: It is lost in any system that automates precinct counting. OMR and CCOS are slightly better than DRE because they, at least, have paper ballots. AES/ETA features manual precinct-level counting, therefore completely transparent. With PMS, while precinct-level counting is transparent, the canvassing, being also manual, takes too long for watchers to endure till the end.

Accuracy: As experienced even in the United States, automated counting has been found to have many inaccuracies, because of software bugs, internal tampering, loose system controls, and other similar shortcomings. In addition, OMR has threshold problems. Disenfranchisement occurs when ovals are improperly marked. AES/ETA is a “5” because, precisely, manual counting is the basis of accuracy. While PMS uses manual precinct-level counting, it also uses manual canvassing, so vulnerable to cheating because of the long process.

Vulnerabilities: DRE, OMR, CCOS, and IV all feature automated precinct-level counting. Cheating can easily be programmed into these systems. Unsuspecting election administrators, have no way of detecting it.

Cost: AES/ETA only uses PCs and laptops and is, therefore, less expensive than the other automated options. These machines can be passed on to the Department of Education after each election; thus the cost is shared. Huge additional savings come from the elimination of warehousing and repair requirements

Speed: CCOS is slower than DRE and OMR because the filled-up ballots are physically transported to the city/municipal centers for counting (thus also exposing them to substitutions). AES/ETA, which features manual precinct-level counting, is slower by an average of about eight hours, maybe less.

Auditability: In case of protests, AES/ETA's and PMS' Election Returns are a second "trusted" document, having been produced through precinct-level counting witnessed by the public. They can therefore be used as bases for such protests.

Staffing: It's easier to find staff more familiar with PCs and laptops than those familiar with automated election systems. PCs are also more reliable as machines, and repair facilities for them are everywhere. With the pure manual system, on the other hand, no additional staffing and training are necessary.

ABOUT THE AUTHOR

Gus Lagman started his IT practice at IBM in 1962. He left IBM after 6 1/2 years to become an IT entrepreneur. He founded or co-founded more than a dozen IT companies, among which were Dataprep Philippines, Inc., Systems Standards, Inc., and STI College, where he was chairman for the first 17 years.

Gus is a Certified Computing Professional (CCP), having been awarded the designation by the Institute for Certification of Computing Professionals, which is based in Illinois, USA. He was president of the Philippine Computer Society (4 terms), the IT Association of the Philippines (4 terms), the IT Foundation of the Philippines, and the South East Asia Regional Computer Confederation.

Gus joined the National Citizens Movement for Free Elections (Namfrel) as a volunteer in 1983 and was a member of its National Council from 1992 until 2007. As head of its Systems Committee, he managed the automated implementation of Namfrel's parallel counts from 1984 to 2007 (ten national elections). From May 2011 to May 2012, he was one of seven Commissioners of the Philippines' Commission on Elections.