Buying or Leasing of Election Machines by COMELEC

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1. Introduction

Background

In 2010, the Philippines held its first Automated national elections. Initially, there were numerous concerns from different sectors of society regarding the effectiveness of an automated election system. But upon completion of the election process, it was observed that the May 2010 automated election system was a success, especially in terms of reducing the amount of time spent on canvassing and counting of votes. From the average of two months, the amount of time was brought down to just a little over two weeks.

Despite this noticeable improvement, and several declarations of the success of the country's first automated elections, a number of studies (DLSU, CenPeg) and anecdotal pieces of evidence from news reports were able to document some lapses and areas for improvement. This research paper aims to consolidate and identify these areas to help assess the viability of using the same system in the succeeding national elections, the next one being in 2013.

The Automated Election system (AES) adopted by the Commission on Elections (COMELEC) is composed of three interdependent subsystems, namely: the election management system (EMS), Precinct Count Optical Scan (PCOS), and the counting/consolidating system (CCS). To implement the AES, the COMELEC received a funding of 11.3 Billion Pesos. From this amount, about 7.2 Billion were expenditures in favour of SMARTMATIC-TIM, the automated election service provider contracted by the COMELEC. Other additional obligations amounted to 0.11 Billion Pesos, thereby providing COMELEC with about 3.975 Billion pesos balance as of Dec. 31, 2009 (COA 2009). With the conclusion and completion of the 2010 elections, it is time for the government to review their expenditure relative to the experience of other countries.

According to Article 4, Section 4.3 of the contract between COMELEC and SMARTMATIC-TIM, the COMELEC has the option to purchase the set of goods (listed as Annex L in the contract) provided by SMARTMATIC-TIM. The total cost of these goods is about 2.1 Billion Pesos. This research paper aims to evaluate whether it's better for COMELEC to just lease the equipment for future elections or purchase them as stated in one of the contract options.

Rationale

As with any project undertaking, it is important to conduct a review of the project in order to evaluate whether the objectives were met on the one hand. On the other hand, the project review should also evaluate the efficiency of the project implementation for the achievement of the said objectives.

Note that this report will serve as one of the inputs in the evaluation of the election process. To accomplish this, the paper will look at the automated election experiences of different countries and comparing the Philippine case to these other cases. Using the appropriate methodology, this

report will also attempt to provide an economic basis for the choice between purchasing the PCOS machines or just leasing them from SMARTMATIC-TIM. It should be emphasized that economic analysis will be limited to the choice between purchasing and leasing of the election counting machines. It will not cover the entirety of the election process.

Purchasing and leasing each have their own benefits and costs. For instance, leasing passes the burden of obsolescence to the leasing company. Another benefit of leasing is that it is not a burden to cash flows as no large capital outlay is necessary. However, in the long run, leasing equipment always tends to be more expensive than purchasing equipment. Purchasing is always cheaper but the COMELEC would have to contend with issues of storage and maintenance. Thus, there is a need to conduct this study to properly evaluate and quantify the stream of costs of each option.

Objectives

The objectives of this study are as follows:

i. To Review the international experience in the automation of elections and the costs incurred and compare the Philippine experience to these other international cases.
ii. To analyze the feasibility of buying versus leasing election counting machines based on the 2010 elections and other recent automated elections.
iii. To review the procurement and management of the leasing of election counting machine is being practices by COMELEC and recommend improvements needed;

To meet these objectives, review of available literature and data sources has been conducted. The rest of the paper is outlined as follows. The next section provides a background on the different forms of voting technology. This is followed by a discussion of the experience of a number of countries and states in the US. A review of the Philippine experience is presented next followed by a section summarizing the findings based on the literature review and analysis.

4. Literature review

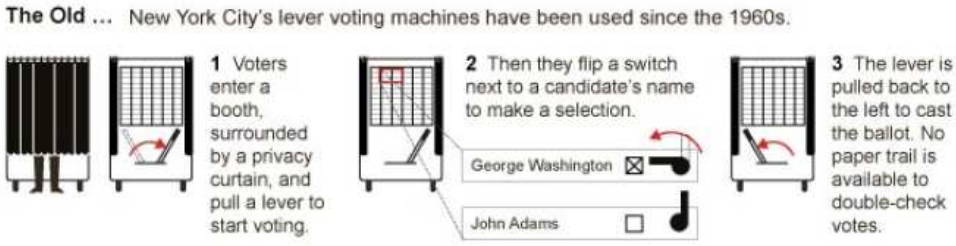
4.1 Voting Machines

Generally, automated election systems can be classified into 5: Lever, Punch cards, Optical Scanners, Direct Recording Electronic, and Electronic Distance Voting Systems. Before the discussion on the different experiences of other countries/states in terms of the implementation of an automated election system, a brief discussion on the general characteristics of each election system will be provided in the succeeding paragraphs.

Lever Voting Machines. The use of lever voting machines has been one of the oldest automated election systems. The Myers Automatic Booth developed in 1892 was the first version of the lever voting machines officially used during an election. [1] Lever voting machines have been in use in New York City since the 1960s and were only changed after the passage of the Help America Vote Act of 2002.

[1] http://www.glencoe.com/sec/socialstudies/btt/election_day/history.shtml

Figure 1 illustrates how the voting will be conducted in the system. As the name implies, the lever system involves the pulling of a lever to indicate the start and end of the voting. Pulling the lever at the start of the voting also closes the privacy curtain to ensure the secrecy and security of the vote. The procedure for voting is done by flipping the switch/pulling the lever next to a candidates' name. The casting of the vote is done by putting the lever back to its original position which opens the privacy curtain and resets the switches/levers to their original positions ready for the next voter.



Source: Chen , 2010

Figure 1. Voting through Lever Voting Machines

The machine has a mechanism for counting the votes that is also initiated once the lever has been brought back to its original position. A counter wheel within the machine turns one-tenth of a full rotation for each of the associated switches. As the counter wheel tallies and completes a full rotation for an associated switch, it drives a different counter (tens) one-tenth of a rotation. The "tens" counter similarly drives a "hundreds" counter. If all mechanical connections are fully operational during the voting period, and the counters are initially set to zero, the position of each counter at the close of the polls indicates the number of votes cast on the lever that drives it. Once the voting has closed, the machine produces a paper record of the vote tallies. Sometimes, bi-partisan teams of poll workers would also be involved in the production of the permanent paper record.[2]

One of the benefits of the lever system is that it can prevent the voter from making multiple votes or more choices than permitted. This system has a mechanism of interlocking switches that would prevent a switch from being flipped for a given position once the number of votes for that position has been cast. Unfortunately, the production of these machines has been stopped in 1982, and this has prevented the replacement or repair of the current machines that were used.

In the Presidential elections of 2000 in the United States of America, there were several experiences in a number of states that have resulted in the call for changing the system. Some of the issues that were raised about the lever machines include:

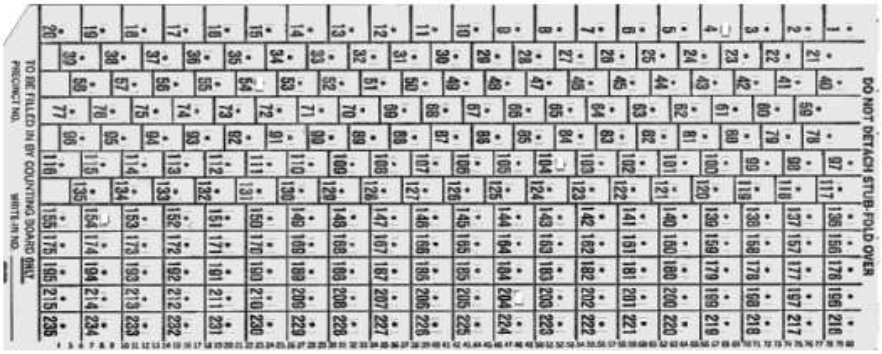
1. Lack of paper trail (individual record of each voter's vote) to allow transparency
2. Because of the age of some of the machines, they breakdown resulting to long lines during elections
3. Inadequate maintenance has resulted in a significant number of votes not being counted because of the jamming of the counter wheels.

[2] Bellis, M. The History of Voting Machines. Available online at: http://inventors.about.com/library/weekly/aa111300b.htm

Punch cards. The Punch card system was not originally devised for elections. They were initially utilized for the tabulation of vital statistics and census taking. The first time this system was adopted for electoral use was in 1960 by Joseph P. Harris and William Rouverol of the University of California at Berkeley. Building upon the current technology at that time (the Port-A-Punch by IBM), the two professors formed their own company and marketed their products which were initially used in Fulton and DeKalb Counties in Georgia. Several counties in Oregon and California followed suit. Eventually, the company was bought by IBM in 1965 which further developed and marketed punch cards as a voting technology. [3]

The technology employs a punch card (Figure 1) and a small clipboard-sized device for recording votes (Figure 2). The procedure for voting is done by the voter first inserting the card into the vote recording machine. The machine covers the entire face of the card except for one column of perforation of the punch card. The covering is actually a book whose pages consist of the ballot labels (i.e. the names of the candidates for the given positions). Voting would entail removing the chad and punching a hole in the location opposite the candidates' name. A hole beside the name of the candidate indicates a vote for that candidate.

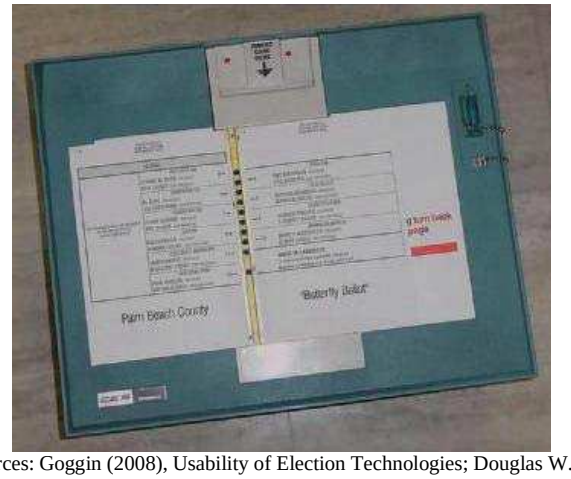
After voting, the voter may place punch cards in a sealed ballot box. "The ballot box is then taken from the polling place to the elections office at the close of voting where the cards are inspected for damage and then stacked for insertion into the card reader for counting."[4] In other areas (e.g. Los Angeles California), the ballot is fed into a computer vote tabulating device at the precinct.

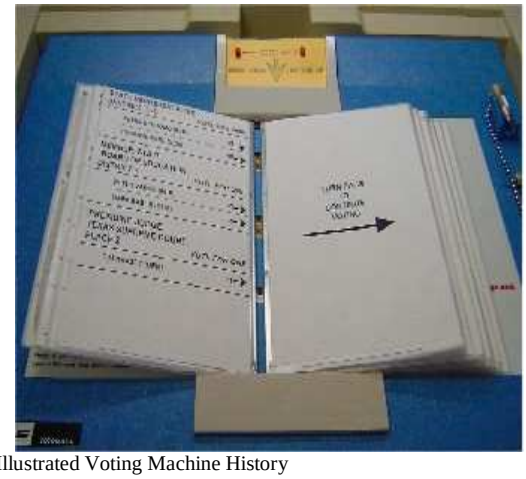


Source: Douglas W. Jones Illustrated Voting Machine History

Figure 1. Punched cards for Votomatic Voting machines

[3] Jones, D.W. Illustrated Voting Machine History Available online at http://www.cs.uiowa.edu/~jones/voting/pictures/
[4] League of Women Voters of Washington Education Fund, available online at , accessed on .





Sources: Goggin (2008), Usability of Election Technologies; Douglas W. Jones Illustrated Voting Machine History

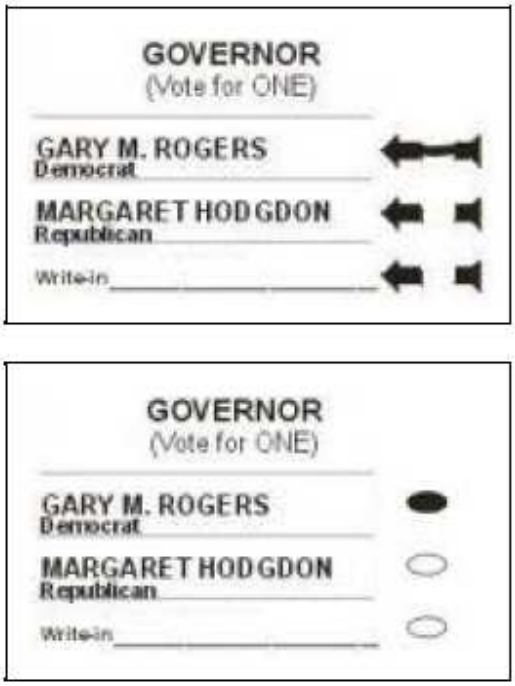
Figure 2. Voting Machines for Punch Cards

One of the major limitations of this system is that it does not warn the voters of possible mistakes such as over-voting (i.e. voting for more than the allowable number of candidates given a certain position). Another limitation is that certain votes may not be accurately counted by the system because of incomplete punches. Incomplete punches are caused by voter error (lack of awareness of how to vote) or malfunctioning of equipment (broken punching stylus). An additional limitation of the system is that the punch card itself does not contain the candidates' names. This may result to some confusion and difficulty for people who are not used to this kind of voting system.

Optical Scan. Optical scanners (also known as Mark-Sense[5]) were first adopted for elections in Kern City, California in 1962. The initial technology was based on standardized testing machines which sense electrical conductivity of the graphite pencil marks on test papers. The machines used in Kern City were developed by Norden Division of United Aircraft and the city of Los Angeles.[6] The more recent technology (SAES-1800) is now capable of reading any type of markings (full or partial shadings).[7]

The technology makes use of a paper ballot (thus, it is often referred to as a paper-based system) on which the voter would indicate their vote by filling the indicated space beside the candidate or connecting the ends of an arrow (Figure 3). After voting, the ballot is inserted into an optical scanner which tabulates the marks on the ballots. The recent technology programmed in optical scanners allows for the insertion of the ballots in any orientation and the scanning of both sides of the ballot.

[5] History of Voting Machines, Election Day, BTT, Social Studies, Glencoe available at: http://www.glencoe.com/sec/socialstudies/btt/election_day/history.shtml
[6] Douglas W. Jones Illustrated Voting Machine History available at: http://www.cs.uiowa.edu/~jones/voting/pictures/
[7] http://www.smartmatic.com/solutions/electoral-solutions/view/article/counting-devices/



Source: Theisen, E. (2007) Overview of Types of Election Equipment. Available online at: www.votersunite.org/info/TypesOfElecEquip.pdf

Figure 3. Different ways of voting using different ballots

There are two main types of scanners (Figure 4): Precinct scanners and central count scanners. Table 1 presents the characteristics of the different types of scanners.

Table 1. Characteristics of PCOS and CCOS

Characteristics	Precinct Scanner	Central count scanner
Use	On-site voting	On-site voting; Absentee voting
Location	Situated at the precinct, the voter feeds the completed ballot themselves into the machine.	Situated at a designated central election office, the completed ballots are collected at the precinct and election personnel feed the ballots into the machine.
Ballot management	• Dropped into the ballot box under the scanner • Some systems allow for ballots with errors to be corrected by the voters	The scanner separates ballots with errors or write-ins by outputting them to a special tray for personnel to examine.
Storage and Transmission of results	The scanner stores the results electronically on a memory card to be read by the central	The results are transmitted to the central computer normally via cable.

	computer at the elections office and/or the scanner transmits the results to the central office via modem.	
Cost	About $6,000 per machine	About $70,000 per machine
Capacity	Up to 3000 voters	Unlimited
Source: Theisen, E. (2007) Overview of Types of Election Equipment. Available online at: www.votersunite.org/info/TypesOfElecEquip.pdf		

Precinct Count Optical Scanners

Central Count Optical Scanners

Sources: Theisen, E. (2007) Overview of Types of Election Equipment. Available online at: www.votersunite.org/info/TypesOfElecEquip.pdf ;Douglas W. Jones Illustrated Voting Machine History available at: http://www.cs.uiowa.edu/~jones/voting/pictures/

Figure 4. Images of PCOS and CCOS

The different types of optical scanners are not necessarily independent (i.e. only one type is used in a given election). A number of US states (Maryland, New Jersey, Illinois) and even the Philippine elections in May 2010 used both types of optical scanners. Statistics for the United States indicate that during the 2006 mid-term elections, about 48.2 percent of the registered voters used optical scan paper ballot systems[8]

Direct Recording Electronic (DRE) Machines. Another voting machine popular in the US is the Direct Recording Electronic (DRE) Voting Machine. The first commercial DRE machine used in actual elections was the Video Voter developed by McKay, Ziebold, Kirby et al. It was during the 1975 elections in Streamwood and Woodstock, Illinois that the DRE voting machine was used.[9]

The voting procedure on DREs begins with the election workers providing the voter an access pass (password or access card) which the voter will enter into the machine in order to have access to the "ballot" or the screen that contains the choices for the election.[10] The voter casts his/her vote on these computerized machines by pushing a button or touching an area of a screen where the options/candidates for the positions are presented much like making a choice on an

[8] Goggin, S.N. (2008) "Usability of Election technologies: effects of political motivation and instruction use" The Rice Cultivator. Vol. 1, 2008, pp30-45.
[9] Douglas W. Jones Illustrated Voting Machine History available at: http://www.cs.uiowa.edu/~jones/voting/pictures/
[10] Theisen, E. (2007) Overview of Types of Election Equipment. Available online at: www.votersunite.org/info/TypesOfElecEquip.pdf ;

ATM machine. The voter's choices are then recorded electronically (i.e. there is no paper ballot that records the choices of the voter.)

For most DRE machines, the results are recorded in two places: an on-board data storage device embedded in the machine and a removable data storage device. These systems are equipped with a printer feature for printing out the results. Bellis (undated) likens the technology to an "electronic implementation of the old mechanical lever systems"[11] This is because similar to the lever machines, there is no ballot and the possible choices are displayed by the machine. To address the weakness of having no paper ballot, more recent types of DRE machines now have a built-in Voter-Verified Paper Audit Trail printer which prints each voter's choice before the vote is recorded electronically.

DRE machines vary by the type of controls. There are three types of controls: touch screen system, push button system and dial and button system. Table 2 presents characteristics of the different types. Among the three types, the most expensive is the push button type. However, it may be the most voter-friendly because it would not require any type of navigation as the ballot is displayed in totality. The touch screen and the dial and button system almost have the same cost and have the same screen size (about 15 inches).

Table 2. Types of Direct Recording Electronic Voting Machines by Type of Control

Type of Control:	**Touch-screen**	**Push button**	**Dial and button System**
Characteristic	The interface on which the voter makes his/her vote is the screen.	Because the entire ballot is presented in one screen, there is no navigation necessary. The voter indicates his/her vote through buttons beside the name of the candidate	The voter navigates across the screen through a special dial and pushes buttons to make a selection.
Cost of one unit of machine with VVPAT printer	$4000	$11000	$3500
Voters served	200	300	200
Example			

Sources: Theisen, E. (2007) Overview of Types of Election Equipment. Available online at: www.votersunite.org/info/TypesOfElecEquip.pdf

[11] Bellis (undated) The History of Voting Machines - History of the Voting System Standards Program. Available online at http://inventors.about.com/library/weekly/aa111300b.htm

Electronic Distance or Remote Voting System. The first 4 automated election systems discussed requires the voter to be physically present in the polling station. Recently, a number of countries in European Union (Estonia, Netherlands) have attempted to conduct an election where voters can cast their votes via the internet. This is an example of Electronic Distance or Remote Voting System.

In this type of technology, the casting of the vote is not done in polling stations but in designated public or private sites like homes, schools or even shopping malls. It may be considered the most convenient type of voting technology since it allows users to cast their vote using a generic form of technology.

Originally conceived in the United States, the technology was developed as a means for US personnel outside of the country to cast their votes from embassies, homes or even offices. There are two types Remote voting systems may be attended or unattended. Attended voting systems require the voter to go to a polling station to cast the vote. Election officials in charge of the polling stations would then validate the identity of the voter and then assign him/her to a computer wherein he/she can cast his/her vote. Unattended voting systems allow the voter to vote from virtually anywhere. Depending on the type of technology used by the system, the voter may be given the chance to use the telephone, internet or even Short messaging system (SMS) to cast his/her vote.

According to one of the research studies on the experience of Estonia in using Electronic Distance Voting, one benefit of using this technology is that it may limit the incentive for vote buying. Because voters may vote anytime during a given period, monitoring voters have become more expensive and difficult, thereby increasing the cost of buying a vote.

Still, despite this benefit, security issues are the main criticism regarding electronic distance voting. Because public internet lines are used to transmit the votes, there is a chance that the integrity of the vote may be compromised.

Other voting technology include the Open Election System which has been proposed as an alternative to the optical scanners and Automated Election system that was used in the 2010 May Elections (Box 1).

4.2Cases

In the past years, several states in the United States of America, as well as several member countries in the European Union have used different automated election systems during their electoral process. The following section reviews the experiences of these countries, and it would focus mainly on the type of technology that was utilized, and if available, certain aspects of the cost of the utilized automated election system. The technical aspects of the different automation equipment/system will not be discussed because limitations in technical expertise would prohibit the appropriate evaluation on these aspects.

Box 1. The Open Election System

An election system that was being proposed for the use in the 2010 May elections was the Open Election System. According to the presentation of Gus Lagman, one of the major advantages of the Open Election system is that it addresses the transparency issue that is being raised against the other election systems. The other elections systems do not make public ALL the steps available to the public so that anyone can make their own calculations/tabulations. In terms of cost, the system is said to be just about 40 percent of the budget of implementing the AES system for the 2010 elections.

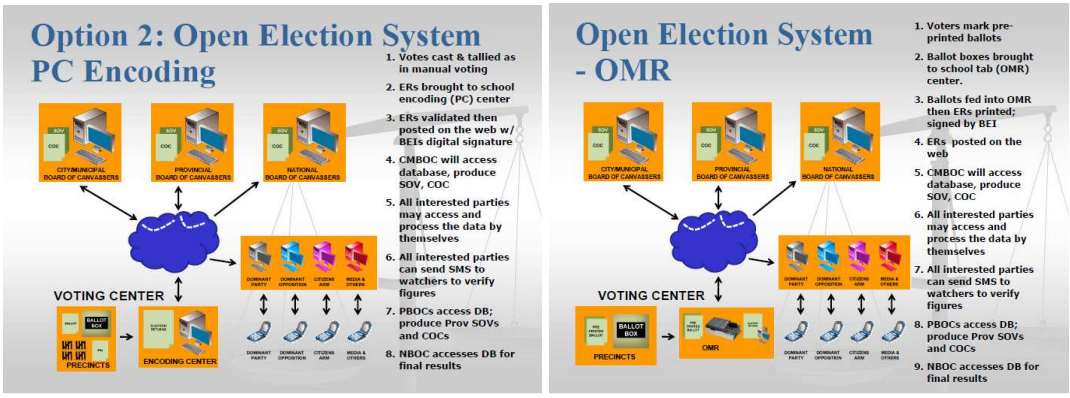


Figure 1. Diagram of Proposed Open Election Systems for implementation

The criticism that was being raised to the OES was that it entails individual encoding of the ballots manually which may make the system more prone to cheating. Chairman Melo in an interview also commented that the manual encoding of the ballots violates the provision of the automation law (RA 9369) that says all procedures must be automated.

Sources:

Calalo, Arlie (2009), Manual Voting Against the Law. Manila Standard Today.
Lagman, Gus (undated), Automation of Elections. Available online at:
http://www.scribd.com/doc/17736871/OES-Presentation-by-Gus-Lagman

Automated Elections in different U.S. States

The following section looks at the automated election systems used by different states, and how they have transitioned from one automated system to another. It identifies the system they currently use and what are the factors that influenced this choice. It also discusses the reasons behind the shift, and the cost implications that come with the changing of automated systems.

Maryland. Maryland is one of the states that has consistently published online studies regarding the cost of elections. There have been numerous studies on the cost of machineries and switching from one technology to another. An evaluation of the cost of elections in Maryland has shown that adopting the DRE voting technology has resulted to about 10 times higher spending on elections from 1997 to 2008. The maintenance and operating cost of the 19,000 touch screen voting machines has been estimated to be about 10.7 million dollars per year from 2006-2008.

From the years 2003 to 2009, the total cost of the DRE voting system is about 95 Million dollars, 1.8 percent of which goes to warehousing while 2.5 percent goes to transportation costs. Support services contribute about 10 percent to total cost of the system. Transportation cost, warehousing and support services comprise total services (Figure 5).

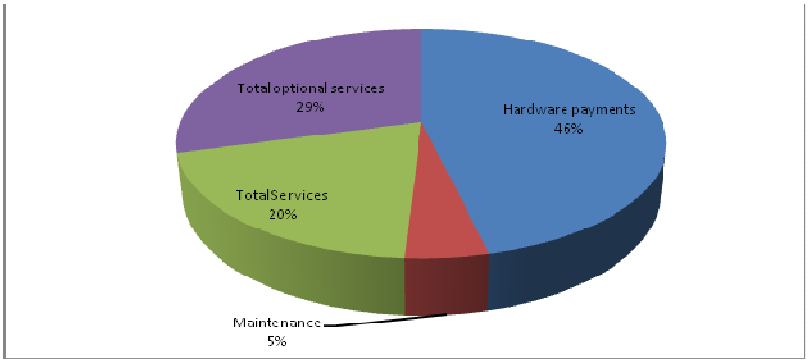


Figure 5. Cost Structure of Maryland's DRE Voting System

The recommendation of the study was to switch to optical scan technology because it would entail savings of as much as 50 percent.

Virginia. For Virginia, two general types of election equipment are being used: the Direct Recording Electronic (DRE) and Optical Scanning Equipment. Two types of DREs are used in Virginia, Full-ballot screen and small touch screen. The full-ballot screen shows the complete ballot without the need for scrolling. The voter just needs to indicate his/her choice by touching the screen near the candidate's name. Small touch screens have smaller screens and the voter needs to scroll through a number of screens in order to go through the entire ballot. The procedure for voting requires that a button/screen space be pushed to indicate that the preferred candidate.

While information on the cost of conducting elections in Virginia is not available, procedures regarding the purchasing of the election equipment and systems are made public. State Law in Virginia allows for the acquisition of voting machines by purchase, lease, lease purchase or others for all the localities provided that the machines or the voting systems have been approved or certified by the State Board of Elections (SBE). The guidelines for certification of election equipment/system identified three levels of testing that the systems have to undergo:

1. Qualification testing which aims to show that the voting system complies with the requirements of its own design specification and with the requirements of the SBE. The testing of hardware and software may be conducted by an Independent Testing Authority.
2. Certification testing: Certification testing focuses more on checking whether the system meets all the requirements of the Code of Virginia which does not necessarily require comprehensive testing of the system hardware and software. The systems testing of hardware and software should have been completed in the qualification testing.
3. Acceptance testing is conducted by the locality to check whether their needs are met. This is done as part of the procurement process for the voting system.[12]

Los Angeles, California[13]. The Los Angeles County is the largest voting district in the United States. In the November 2000 General elections, more than 2.7 million constituents (of the 4.0 million voters) have casted their votes in the entire county. It has been recognized that with this large amount of voters, the county needs to review the currently available systems being used in California and assess whether the currently implemented system in Los Angeles is the most applicable.[14] Since 1968, the county of Los Angeles has used the Votomatic punch card system which has 312 numbered voting positions on the ballot card. This is because they have purchased the Votomatic devices in 1968 and have thoroughly maintained and upgraded the machines for more than 30 years. In 1997, the 36 ballot card readers in the inventory of the county were replaced at the cost of 500,000 US dollars. The precinct workers and voters have become very familiar to the system owing to the fact that it has been implemented for more than 30 years. The accuracy of the system has been evaluated to be more than satisfactory.

Although approved for other counties in California, Los Angeles County has identified the following limitations of the optical scan machines resulting to its non-adoption. The voting technology was demonstrated in the Hall of Administration of the county last February 1997. One of the considerations for the non-adoption of the system is the fact that it is primarily used by small and mid-sized counties (under 500,000 registered voters). Another consideration was the high cost of the hardware and software purchase which would be approximately 40 million US dollars. Optical scan ballots are also more expensive than punch card ballots (about 10 times more expensive).

New York. New York was one of the last states to replace their lever voting machines. Current state law requires that all lever voting machines be replaced with precinct-based optical scanners. In one of the studies that have tried to estimate the cost of replacing the cost of lever voting machines, it was seen that the total cost of purchasing 2,227 units of the DS200 scanner would be about 17.2 Million US dollars (Table 3). The per unit cost of each scanner would be about 7744 US Dollars.

[12] GREBook, "20 Voting Equipment". Available online at http://www2.sbe.virginia.gov/GRDocs/VERIS/GR-EB-Manual/
[13] The discussion draws heavily from McCormack, C. B. (2001). Voting System comparisons/evaluation of touch screen pilot project/recommendations for the future.
[14] In the entire state of California, there are three voting systems that are certified for use. These are the punch card, optical scan and direct recording systems.

Table 3. Cost of Purchasing DS200 Scanners

	# of Scanners	Cost per Scanner	Total Cost
Bronx	277	$7,744	$2,145,088
Kings	527	$7,744	$4,081,088
New York	451	$7,744	$3,492,544
Queens	424	$7,744	$3,283,456
Richmond	115	$7,744	$890,560
Spare units	358	$7,744	$2,772,352
Training units	75	$7,744	$580,800
NYC Total	2,227		$17,245,888

Florida[15]. The impetus for Florida to improve its election system came during the 2000 Presidential elections between George W. Bush and Al Gore. Difficulties in the system of voting have been brought to light like the "hanging chads" and "butterfly ballots". Because of this, the state of Florida has invested about 24 million US dollars to purchase voting machines that would replace the old ones.

Florida's experience somehow brings to light the difficulty of purchasing election equipment. Sometime between 2004 to 2006, about 15 counties became the first to spend 90 million US dollars to purchase Direct Recording Electronic Voting machines (touch screen machines) but later these same countries decided to throw out the system because of the lack of paper trails. In 2007, more resources were spent in equipment as 23 million dollars were spent on acquiring optical scanners that are capable of producing paper trails.

Ohio. Before the implementation of the Help America Vote Act, most of the counties in Ohio used punch card voting systems. The HAVA allowed the use of voting machines in the state as long as these machines have met the applicable federal standards and have been approved for use in Ohio by the Board of Voting Machine Examiners.

The secretary of state, in turn, worked with each county's board of elections (BOE) to purchase an approved system — either a direct recording electronic (DRE) or an optical scan system manufactured by Diebold (now Premier Elections Solutions), Hart InterCivic, or Election Systems and Software (ES&S) – that best-suited each particular county.

For about half of the counties in Ohio, the new voting systems were used in the 2005 November general elections. The rest of the states were able to use them in the 2006 primary elections. [16]

Lankaster County, Nebraska. During the 2004 elections in Nebraska, the Lankaster County used Optical Scanners. The county experienced the Optical scanners double counting the ballots. The provider of the machines expressed that the double of reading of the ballots came as a surprise as the machines were tested prior to the elections and the results showed that the machines were functioning properly. Unfortunately, the incident was not isolated because the double-counting

[15] Election Reform in Florida, available at: http://www.collinscenter.org/page/voting_cost
[16] Brunner, J. (2007) Project EVEREST (Evaluation & Validation of Election-Related Equipment, Standards, & Testing) Risk Assessment Study of Ohio Voting Systems. Executive Report. Colombus, Ohio

happened not only to a handful of optical scanners but almost all the scanners encountered such problems.[17]

Bernalillo County, New Mexico. Similar to the experience of Nebraska, the Bernalillo County New Mexico had some precincts reporting more votes for president than the total number of ballots in the precinct. For instance, Precinct 558 reported 178 early voting ballots and a total of 319 votes for president; indicating a total of 141 phantom votes. Precinct 512 reported 166 ballots cast in the precinct but 318 votes registered for president. [18]

The ACE Project[19] has also conducted a survey of a number of countries that have also implemented some form of automated elections using different types of machines. For each of these countries, the results of the automation have been different.

Looking at the experience of the different U.S. States, the shift of automated election systems mostly resulted in the use of the Optical Scanning system, as seen in the cases in Maryland, Virginia, New York, Nebraska and New Mexico. It should be noted that some states have identified problems with using this system, such as in the case of Nebraska and New Mexico, while others have rejected the use of Optical Scanners outright, such as in the case of Los Angeles.

Automated Elections in the European Union, Brazil and Australia

In selected countries in the European Union, there has been a trend in the use of internet voting and casting votes outside of the usual polling precincts. As stated in the following cases – particularly Estonia and the Netherlands – internet voting was successfully implemented.

Estonia[20]. Estonia is divided administratively into 15 counties and two cities, namely, Tallinn and Tartu. During elections to the Riigikogu (Parliament), a total of 12 electoral districts are organized to cover the entire country. Three electoral districts are within the city of Tallinn, one incorporates the city of Tartu, while the other eight districts span one to three counties. Remote internet voting in the 2007 Riigikogu election was the first countrywide use of the internet as a voting method in a parliamentary election; although internet voting should be seen as an additional voting method and voters are not obliged to use this system.

The use of internet voting was first introduced in the 2005 local elections. Despite some protests focusing mainly on the fact that the secrecy of the ballot cannot be fully ensured and that the system is not transparent since the voting process cannot be observed, the system received satisfactory reviews especially in the aspect of increasing voting coverage and turnout. It was estimated that about 2 percent of those who voted in the 2005 local elections were voters who used internet voting. In a subjective survey of internet voters and non-internet voters, it was seen

[17] Problem machines spur call for recount. Lincoln Journal Star. November 14, 2004. By Nate Jenkins. http://www.journalstar.com/articles/2004/11/14/election/doc4189b9c7f14bf764391458.txt
[18] Bernalillo County Canvass of Returns of General Election Held on November 2, 2004. State of New Mexico. http://www.sos.state.nm.us/PDF/Bernalillo.pdf
[19] Ace project (undated) available at http://www.aceproject.org
[20] The discussion draws heavily from Office of Democratic Institutions and Human Rights (2007), Republic of Estonia, Parliamentary Elections, OSCE/ODIHR Election Assessment Mission Report.

that close to 5 percent of the surveyed voters who voted using the internet responded that they would certainly not have voted if internet voting was not available.[21]

The characteristics of Estonia that allowed for the use of internet voting in the country are presented in Table 4.

Table 4. Preparations for of Estonia's Internet Voting

Aspect	Preparation
Technological materials	The cornerstone of the internet voting system in Estonia is the use of a personal identification document (ID card) which is legally accepted for identification via the internet and to sign documents digitally.
Technological equipment	The Estonian internet voting system consists of following components (see Figure___): Voter Application, Internet Web Server, Certification Server, Vote Storage Server, and the Counting Server.
Technical Infrastructure	Estonia has been the pioneer in e-governance and e-democracy. The use of digital channels for different services is steadily widening. There are 55 public Internet access points per 100,000 inhabitants and all schools are connected to the Internet.[22]
Regulations/Laws	1. The legislations (Identity Documents Act in 1999, Digital Signature Act in 2000 and 2002 Riigikogu Election Act) introduced for the 2007 Riigikogu elections provides that eligible voters with the digitally-enabled ID card may cast their ballot via internet during the advance voting period, from six to four days before Election Day 2. The 2002 Riigikogu Election Act also permits voters to change their votes during the advance voting period, either by voting again through the internet or by casting a ballot paper at a polling station. The law establishes the primacy of paper balloting. The voter can change his/her vote an unlimited number of times electronically, with the last ballot cast being the only one counted, but a vote cast by paper is final and annuls all internet votes cast by the voter.
Social	1. Nearly half of households have a computer at home and more than 4/5 of those are connected to the Internet. 2. Estonia has been leading in the provision of e-governance and e-services.

A number of requirements are necessary in order to be able to conduct a successful internet-based election. The experience of Estonia has shown that aside the necessary technological

[21] Madise, Ü and T. Martens (2006) "E-voting in Estonia 2005. The first practice of country-wide binding Internet voting in the world" International Conference on Electronic Voting 2006. August 2nd-4th, 2006, Castle Hofen, Bregenz, Austria.

[22] Ibid.

materials (digitally-enabled ID card), equipment and infrastructure, certain policies and laws have to be enacted as a foundation for internet voting.

Cost information regarding the use of the internet for the Riigikogu elections is not available although it can be surmised that the necessary investment on technological infrastructure for such an undertaking has been substantive.

Netherlands[23]. Netherlands also attempted to implement electronic distance voting beginning with a project in 1999 that explored the possibilities for remote e-voting. Similar to the objective of the US in developing electronic distance voting, the goal of project was to cater to voters living outside the country. Despite this, there was a move to also explore the possibility of using remote e-voting within the country.

Before 2004 voters living outside the country could choose to vote by mail, by proxy, or in person in a polling station within the Netherlands. Among the three, it is the option of voting by mail that is seen as problematic and time-consuming. Also, not all the votes were received in time to be counted in the elections. To address this difficult procedure, the use of e-voting technology was tested during the European parliament elections. Voters outside of the country can opt to vote via internet or telephone. Between the two options, it was internet voting that was a success while the telephone experiment was only used by a very small number of voters.

Because of these results, the government decided to abandon the telephone experiment, but to carry on with the internet voting. During the national elections in 2006 a new experiment was held with the internet voting. Again, this was a great success; out of the 34,305 registered voters from abroad 21,593 voters (63%) chose to vote via Internet in the registration period. During the elections, 19,815 voters (92%) did eventually cast their vote through the Internet. These voters were asked to fill in an online questionnaire on internet voting. 11,003 voters (65%) responded to the questionnaire. Out of these voters, 99% preferred internet voting over voting via mail. 94% wanted the government to implement internet voting permanently.

Norway. In Norway, the implementation of an electronic distance voting system has been halted after the evaluation of the 2003 pilot projects resulted to questions on the security of the system. Despite this, for the 2011 municipal and county elections, 10 municipalities have been given the option to use electronic voting. This is part of the E-vote 2011 project which aims to implement trials with electronic voting in 2011 elections.

The 10 municipalities selected are Bodø, Bremanger, Hammerfest, Mandal, Radøy, Re, Sandnes, Tynset, Vefsn and Ålesund. The voters in these municipalities have the option to cast their vote on the Internet from their homes or to vote with paper ballot in the polling stations.

The project believes that providing the electronic voting option would help in increasing the efficiency of the election work in the municipalities. If successful, The E-vote 2011-project plans to introduce the system in all municipalities in Norway in upcoming elections. As part of the project support system, the E-vote 2011-project works with the selected municipalities in the

[23]The discussion in this section draws heavily from Loeber, Leontine (2008). E-voting in Netherlands: From General Acceptance to General Doubt in Two years 3rd International Conference on Electronic Voting 2008. August 6th-9th, 2008. Castle Hofen, Bregenz, Austria.

development of the elections administrative support system, which includes the development of operating procedures in the municipalities and trainings for election officials in the municipalities.

Brazil. While the experience of Norway using distance voting system has been unsuccessful, the experience of Brazil using DRE has been different. For Brazil, the direct recording 1996, 30% of the population of Brazil voted using the Direct Recording Electronic Voting system.

Expanding the use of the DRE nationwide for the 2000 and 2002 elections required the use of more than 400,000 electronic voting machines. The use of the machines allowed the tallying of the votes electronically immediately after the polls closed. The transmission of the results to the central tallying stations was through secure diskettes or via satellite telephone to central tallying stations. Within a few hours, the results were available.

Australia. In 2000, Australia used e-voting for 8.3% of the voting population or 16559 voters in four polling places. After the 2000 elections, the Australian Capital Territory Electoral Commission recommended that remote e-voting be done only if the polling places have secure local area networks. In 2004, e-voting was to be used once more but only in four polling places indicating some form of doubt on the e-voting technology.

Using the automated election experience of the abovementioned countries in the European Union, Brazil and Australia, it can be seen that the Electronic Distance or Remote Voting system can also be an effective means of conducting polls on a national level. The only setback to this system is the high cost of investment in ensuring that the proper systems are in place before the electoral exercise can be done. As in the case of Estonia and the Netherlands, the key factor in making this successful is having a secure local area network to ensure the security of the votes as they're transmitted electronically.

Summary of the different automated election systems

Because most of the documents on election equipment are from the United States, comparability with the Philippine experience would be limited. Still, the experience of the surveyed areas have brought to light some of the benefits and criticisms in the use of the election equipment. Table 5 presents a summary.

Table 5 presents a summary of the benefits and criticisms of the type of voting technology

	Benefits	Criticisms
Levers	• Cheaper than Optical scanners or DRE	• Production has stopped and spare parts may not be available.
Punch card	• Cost is relatively cheaper than Optical scan and DRE.	• The experience of Florida has brought to light the problem of partially "punched" cards
Optical Scan	• Everyone is familiar with the use of paper ballots.	• The use of specialized paper on ballots is more expensive

	• The paper ballots may limit flying voters as 1 ballot per person is provided. • For some states, there is the option to correct for mistakes (undervoting, overvoting) • The paper ballot marked by each voter is the official record of the vote and is used in recounts. • Manual recount is possible • Less complex and cheaper to maintain that DRE.	relative to punch cards. • Issues on the type of shading may affect the voting • Some states in United States have experienced Optical Scan machines double counting some ballots.
DRE	• The voting, counting and canvassing is automated • No need to print ballots (which is the largest material expense during elections)	• Full face DRE are large and bulky s huge transportation and storage costs. • Recounts can be problematic for the DRE when the electronic and the print-out "ballots" do not match in totals. • A number of states have experienced machines showing incorrect/incomplete ballots on screen.
Electronic Distance Voting	• Increased access of voters to the voting process • The experience of Estonia has shown that internet voting is an effective way to reduce the incentive to vote buying.	• Impossibility to observe the voting process fully to ensure the fundamental rights of a free and secret vote • Internet voting does not provide for a fully transparent counting procedure.

Reviewing The Philippine experience on automation

This section presents the Philippine experience on the conduct of the automation of elections by first describing the flow of events that led to the adoption of the Automated Election System.

Sometime in March 2009, the COMELEC released the *Terms of reference* for the nationwide automation of the May 2010 national and local elections. The terms of reference actually requests for proposals on three components of automation of elections. These components are:

Component 1: Paper-Based AES.
1-A. Election Management System (EMS);
1-B. Precinct-Count Optic Scan (PCOS) System; and
1-C. Consolidation/Canvassing System (CCS);
Component 2: Provision for Electronic Transmission of Election Results using Public Telecommunications Network; and
Component 3: Overall Project Management.

Box 2. Breakdown of budget

In February 2009, the Commission on Elections presented to the Members of the House of Representatives the budget estimate for the automation of the elections.

	Cost (PhP)	Remarks
Purchase cost per unit for PCOS	145,867.50	PhP 48.62 per US$
No. of Units required	80,000	
Total Purchase cost for PCOS	11,669,400,000.00	
Cost of lease	8,168,580,000.00	70% of purchase cost
Cost of services	1,555,038,400.00	19.3% of the cost of lease
Canvassing units	200,000,000.00	Purchase of PCs and printers at PhP100,000 for each of the 2,0000 canvassing areas
Cost of ballot paper	1,000,000,000.00	PhP 20 per ballot
Transmission cost	200,000,000.00	Services only. Public telecommunications nestwork to be used
Project management cost	100,000,000.00	
Ballot box	78,170,000.00	PhP 977.13 per ballot box
Total	11,301,788,400.00	

The 145,867.50 cost per machine of PCOS is based on indicative prices submitted by prospective bidders in response to the request for information issued by the COMELEC Advisory council. Based on these documents, the average cost of one counting machine is US$3,000.

The 70% estimate is based on the percentage used during the proceurement on lease basis of the voting and counting machines deployed in the 2008 ARMM elections. The 2008 ARMM elections spent 11,197,200 PhP for 1.5 million sheets of ballots or approximately PhP 7.46 per sheet. The 2008 elections used an 8.5”x14” ballot with 24 lbs thickness to accommodate 150 names of candidates. For the 2010 elections, the paper needed to be longer and thicker to accommodate 300 names.

Source: DBM

The COMELEC also requested those interested to submit a continuity plan and a back-up plan just in case there is a major systems failure. The procedure for the submission of bids is done using the two-envelope system where each bidder submits two envelopes: the eligibility to bid envelope and the bid envelope. The bid envelope should contain the technical proposal and the financial proposal. The COMELEC Special bids and Awards committee (SBAC) was in charge of the procurement of the goods and services for automation project. The budget allocated to them by Congress through RA9525 is about PhP 11.3 billion. (See box on how the budget was estimated)

The invitation to apply for eligibility and bid was to open to all manufacturers, suppliers and distributors including those who form joint ventures. The COMELEC received 7 sealed

applications for eligibility and bids. Among the 7 was the bid by the joint venture of TIM and Smartmatic. TIM is a local company while Smartmatic is a foreign company incorporated in Barbados.

Table 6. Financial Proposal of SMARTMATIC-TIM

Item	Budget estimate (Php)	Bid (PhP)
Component 1	10,923,618,400.00	6,891, 484,742.96
• 1-A (EMS) and 1-B (PCOS)	8,220,000,000.00	4,187,876,280.00
• 1-C (CCS)	140,000,000.00	139,999,999.86
• Services and others (1-A, 1-B and 1-C)	1,563,618,400.00	1,563,618,399.00
• Ballots*	1,000,000,000.00	199,999,997.51
Component 2	200,000,000.00	199,999,997.51
Component 3	100,000,000.00	99,999,999.00
Total Amount of Bid	11,223,618,400.00	7,191,484,739.48
*Inclusive of ballot paper, printing consumables and printing services (including a maximum PhP250 Million service cost for NPO/BSP). Source: COMELEC documents submitted to DBM		

The Smartmatic-TIM bid for the undertaking of the whole automation project amounted to just about PhP 7.2 billion. This includes the delivery of 82,200 PCOS machines which is priced at about PhP 3.3 billion.

The SBAC evaluated all 7 bids and concluded that only three were eligible. Thus, only the Bid envelopes of the eligible bidders were opened and scrutinized by the SBAC. Through SBAC Resoluton No. 09-001, s-2009, the committee declared that only the bid of the Smartmatic-TIM passed the standards of the SBAC and thus was proclaimed as the single complying calculated bid (Table 7). Despite being the only complying bid, Smartmatic-TIM still had to undergo post-qualification screening and end-to-end testing of the PCOS machines. The SBAC Technical Working Group undertook the end-to-end testing of the PCOS machines from May 27-30, 2009. The team declared that the PCOS project machines passed all the criteria specified in the RFP (Table 8).

Table 7. Bidders and reasons for disqualification

Bidder	Reason for disqualification
Avante International/Canon Marketing Philippines/ **NETNODE** Technologies/DB Wizards/ Creative Point	• Failed to submit first and last page of their relevant contracts • Failed to submit certificate of acceptance of the customer Confidentiality does not excuse the non-submission of key documents that establishes

	the members' track records.
Sequoia Voting Systems/Universal Storefront Services/USSC-Sequoia Voting Solutions.	One of the members of the consortium failed to submit documents that would establish its track record
Syrex/Amalgamated Motors Philippines/Avision	SEC registration was not submitted
Gilrt Satellite Network/F.F. Cruz & Co. /Filipinas (Prefab Building) Systems	Numerous technical documents were not submitted; The consortium failed to establish the existence of a working system that had been used in a prior electoral exercise
Election Systems and Software International /AMA Group Holdings	The ES&S Consortium failed to submit documents that would show that they have a system that was indeed a working system that was used in previous electoral exercise.
Indra Sistemas/Hart Intercivic/Strategic Alliance Holdings	The consortium passed all the eligibility requirements but failed to submit a bid that would satisfy the requirement of 82,200 PCOS. Their bid was only for 57,231.
Source: Comelec Advisory Council Observations on the Conduct of Procurement by the Special Bids and Awards Committee	

Table 8. End-to-end testing Criteria

ITEM	REQUIREMENT	REMARK/DESCRIPTION
1	Does the system allow manual feeding of a ballot into the PCOS machine?	Yes. The proposed PCOS machine accepted the test ballots which were manually fed one at a time.
2	Does the system scan a ballot sheet at the speed of at least 2.75 inches per second?	Yes. A 30-inch ballot was used in this test. Scanning the 30-inch ballot took 2.7 seconds, which translated to 11.11inches per second.
3	Is the system able to capture and store in an encrypted format the digital images of the ballot for at least 2,000 ballot sides (1,000 ballots, with back to back printing)?	Yes the system captured the images of the 1,000 ballots in encrypted format. Each of the 1,000 images files contained the images of the front and back sides of the ballot, totaling to 2,000 ballot side. To verify the captured ballot images, decrypted copies of the encrypted files were also provided. The same were found to be digitized representations of the ballots cast.
4	Is the system a fully integrated single	Yes. The proposed PCOS is a fully

ITEM	REQUIREMENT	REMARK/DESCRIPTION
	device as described in item no. 4 of Component 1-B?	integrated single device, with built-in printer and built-in data communications ports (Ethernet and USB).
5	Does the system have a scanning resolution of at least 200 dpi?	Yes. A portion of a filled up marked oval was blown up using image editor software to reveal the number of dots per inch. The sample image showed 200 dpi. File properties of the decrypted image file also revealed 200 dpi.
6	Does the system scan in grayscale?	Yes. 30 shades of gray were scanned in the test PCOS machine, 20 of which were required, exceeding the required 4-bit/16 levels of gray as specified in the Bid Bulletin No. 19.
7	Does the system require authorization and authentication of all operators, such as, but not limited to, usernames and passwords, with multiple user access levels?	Yes. The system required the use of a security key with different sets of passwords/PINs for Administrator and Operator users.
8	Does the system have an electronic display?	Yes. The PCOS machine makes use of an LCD display to show information: □ if a ballot may be inserted into the machine; □ if a ballot is being processed; if a ballot is being rejected; □ on other instructions and information to the voter/operator.
9	Does the system employ error handling procedures, including, but not limited to, the use of error prompts and other related instructions?	Yes. The PCOS showed error messages on its screen whenever a ballot is rejected by the machine and gives instructions to the voter on what to do next, or when there was a ballot jam error.
10	Does the system count the voter's vote as marked on the ballot with an accuracy rating of at least 99.995%?	Yes. The two rounds of tests were conducted for this test using only valid marks/shades on the ballots. 20,000

ITEM	REQUIREMENT	REMARK/DESCRIPTION
		marks were required to complete this test, with only one (1) allowable reading error. 625 ballots with 32 marks each were used for this test. During the comparison of the PCOS-generated results with the manually prepared/predetermined results, it was found out that there were seven (7) marks which were inadvertently missed out during ballot preparation by the TWG. Although the PCOS-generated results turned out to be 100% accurate, the 20,000-mark was not met thereby requiring the test to be repeated. To prepare for other possible missed out marks,650 ballots with (20,800 marks) were used for the next round of test, which also yielded 100% accuracy.
11	Does the system detect and reject fake or spurious, and previously scanned ballots?	Yes. This test made use of one (1) photocopied ballot and one (1) "re-created" ballot. Both were rejected by the PCOS.
12	Does the system scan both sides of a ballot and in any orientation in one pass?	Yes. Four (4) ballots with valid marks were fed into the PCOS machine in the four (4) portrait orientations specified in Bid Bulletin No. 4 (either back or front, upside down or right side up), and all were accurately captured.
13	Does the system have necessary safeguards to determine the authenticity of a ballot, such as, but not limited to, the use of bar codes, holograms, color shifting ink, micro printing, to be provided on the ballot, which can be recognized by the system?	Yes. The system was able to recognize if the security features on the ballot are "missing". Aside from the test on the fake or spurious ballots (Item No. 11), three (3) test ballots with tampered bar codes and timing marks were used and were all rejected by the PCOS machine. The photocopied ballot in the test for Item No. 11 was not able to replicate the UV ink pattern on top portion of the

ITEM	REQUIREMENT	REMARK/DESCRIPTION
		ballot causing the rejection of the ballot.
14	Are the names of the candidates pre-printed on the ballot?	Yes. The Two sample test ballots of different lengths were provided: one (1) was 14 inches long while the other was 30 inches long. Both were 8.5 inches wide. The first showed 108 pre-printed candidate names for the fourteen (14) contests/positions, including two (2) survey questions on gender and age group, and a plebiscite question. The other showed 609 pre-printed candidate names, also for fourteen (14) positions including three (3) survey questions.
15	Does each side of the ballot sheet accommodate at least 300 names of candidates with a minimum font size of 10, in addition to other mandatory information required by law?	Yes. The 30-inch ballot, which was used to test Item No. 2, contained 309 names for the national positions and 300 names for local positions. The total pre-printed names on the ballot totaled 609. This type of test ballot was also used for test voting by the public, including members of the media. Arial Narrow, font size 10, was used in the printing of the candidate names.
16	Does the system recognize full shade marks on the appropriate space on the ballot opposite the name of the candidate to be voted for?	Yes. The ballots used for the accuracy test (Item No. 10), which made use of full shade marks, were also used in this test and were accurately recognized by the PCOS machine.
17	Does the system recognize partial shade marks on the appropriate space on the ballot opposite the name of the candidate to be voted for?	Yes. Four (4) test ballots were used with one (1) mark each per ballot showing the following pencil marks: □ top half shade; □ bottom half shade; □ left half shade; and □ right half shade

ITEM	REQUIREMENT	REMARK/DESCRIPTION
		These partial shade marks were all recognized by the PCOS machine
18	Does the system recognize check (□)marks on the appropriate space on the ballot opposite the name of the candidate to be voted for?	Yes. One (1) test ballot with one check (□) mark, using a pencil, was used for this test. The mark was recognized successfully.
19	Does the system recognize x marks on the appropriate space on the ballot opposite the name of the candidate to be voted for?	Yes. One (1) test ballot with one x mark, using a pencil, was used for this test. The mark was recognized successfully.
20	Does the system recognize both pencil and ink marks on the ballot?	Yes. The 1000 ballots used in the accuracy test (Item No. 10) were marked using the proposed marking pen by the bidder. A separate ballot with one (1) pencil mark was also tested. This mark was also recognized by the PCOS machine. Moreover, the tests for Items No. 17, 18 and 19 were made using pencil marks on the ballots.
21	In a simulation of a system shut down, does the system have error recovery features?	Yes. Five (5) ballots were used in this test. The power cord was pulled from the PCOS while the 3rd ballot was in the middle of the scanning procedure, such that it was left "hanging" in the ballot reader. After resumption of regular power supply, the PCOS machine was able to restart successfully with notification to the operator that there were two (2) ballots already cast in the machine. The "hanging" 3rd ballot was returned to the operator and was able to be re-fed into the PCOS machine. The marks on all five (5) were all accurately recognized.
22	Does the system have transmission	Yes. The PCOS was able to transmit to

ITEM	REQUIREMENT	REMARK/DESCRIPTION
	and consolidation/canvassing capabilities?	the CCS during the end-to-end demonstration using GLOBE prepaid Internet kit.
23	Does the system generate a backup copy of the generated reports, in a removable data storage device?	Yes. The PCOS saves a backup copy of the ERs, ballot images, statistical report and audit log into a Compact Flash (CF) Card.
24	Does the system have alternative power sources, which will enable it to fully operate for at least 12 hours?	Yes. A 12 bolt 18AH battery lead acid was used in this test. The initial test had to be repeated due to a short circuit, after seven (7) hours from start-up without ballot scanning. This was explained by TIM-Smartmatic to be caused by non-compatible wiring of the battery to the PCOS. A smaller wire than what is required was inadvertently used, likening the situation to incorrect wiring of a car battery. Two (2) COMELEC electricians were called to confirm TIM-Smartmatic's explanation. The PCOS machine was connected to regular power and started successfully. The following day, the "re-test" was completed in 12 hours and 40 minutes xxx 984 ballots were fed into the machine. The ER, as generated by the PCOS was compared with predetermined result, showed 100% accuracy.
25	Is the system capable of generating and printing reports?	Yes. The PCOS prints reports via its built-in printer which includes: 1. Initialization Report; 2. Election Returns (ER); 3. PCOS Statistical Report; 4. Audit Log.
26	Did the bidder successfully demonstrate EMS, voting counting, consolidation/canvassing and transmission?	Yes. An end-to-end demonstration of all proposed systems was presented covering: importing of election data into the EMS; creation of election configuration data for the PCOS and the CCS using EMS; creation of ballot faces using EMS; configuring the PCOS and the CCS using the EMS-

ITEM	REQUIREMENT	REMARK/DESCRIPTION
		generated election configuration file; initialization, operation, generation of reports and backup using the PCOS; electronic transmission of results to the: [1] from the PCOS to city/municipal CCS and the central server. [2] from the city/municipal CCS to the provincial CCS. [3] from the provincial CCS to the national CCS; receipt and canvass of transmitted results: [1] by the city/municipal CCS from the PCOS. [2] by the provincial CCS from the city/municipal CCS. [3] by the national CCS from the provincial CCS; receipt of the transmittal results by the central server from the PCOS.
Source: Supreme Court . Roque et al. vs. COMELEC et al. , September 10, 2009		

Thus, in Jun 9, 2009, the COMELEC authorized SBAC to issue the notice of award and to proceed to Smartmatic-TIM. On July 10, 2009, the COMELEC and Smartmatic-TIM executed a contract for the lease of goods and services under the contract amount of PhP 7,191,484,739.48.

The COMELEC Advisory Council (CAC) has indicated that the COMELEC SBAC has satisfactorily conducted the bidding process. The CAC cited the following characteristics of the SBAC bidding process as indicators of transparency:

1. The entire bidding procedure was open to observers and media prompting a comment from a disqualified bidder that the procedure was one of the most transparent government procedures in history.
2. Special procedures allowing observers to voice their observations and bidders to submit manifestations reflected the SBAC's commitment to properly conducted bidding exercise.
3. All SBAC decisions including the reasons for the disqualifications were made public[24].

The CAC also commended the SBAC for being consistent with all its decisions. Initially, the CAC found the SBAC too stringent in applying the eligibility requirements. Certain ambiguities in the bids of the documents were taken against the bidders resulting to none of the bidders being considered. Reconsiderations were applied to all bidders and no bidder received preferential treatment. The CAC believes that the SBAC can effectively defend awarding the contract to the lone bidder. The official observer's report of Dr. Arwin Serrano of the PPCRV concurs with the findings of the SBAC.

[24] Comelec Advisory Council Observations on the Conduct of Procurement by the Special Bids and Awards Committee, June 2009.

While the entire SBAC procedure seems to be satisfactory, there have been a number of criticisms regarding the conduct of the certification testing by SysTest Labs and the Technical Working Group.

Findings

Based on the foregoing review of pieces of literature, the following findings have been observed:

There is an indication that the COMELEC has used the best available technology (in terms of usability and cost) for the 2010 elections relative to DRE, Levers or Punch Cards. However, the findings of a number of studies (CenPeg, Monsod, DLSU) on the weakness of the security issues of the entire OMR should not be taken for granted.

The cost per machine in PPP (Purchasing power parity) US$ of selected states and areas is presented in Figure 6. It has to be noted that the machines being compared may not be of the same manufacturer or model type. The bars in blue pertain to optical scanners while the bars in orange pertain to direct recording electronic voting machines (DREs). Based on Figure 7, the cost per unit of the election equipment used in the 2010 May elections is lower than the cost of the optical scanners used in Maryland or New York.

Figure 6. Per Unit Cost of Election Machines

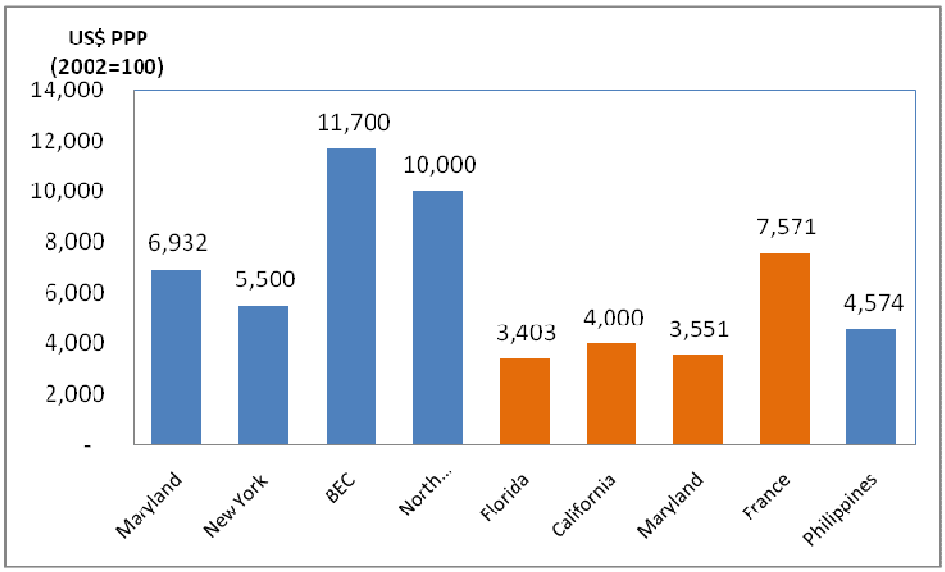
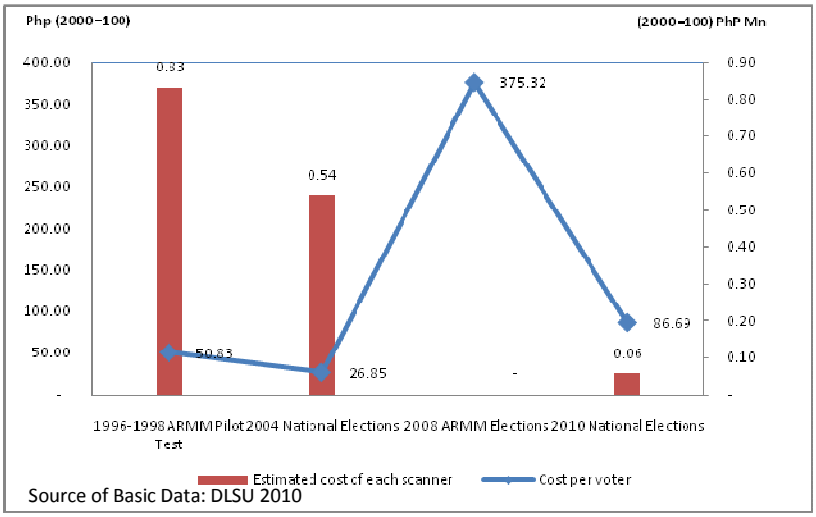


Figure 7. Automation Attempts in the Philippines



Source of Basic Data: DLSU 2010

Relative to other attempts in the country to conduct automated elections, data shows that while the cost per voter during the 2010 National elections is higher than the 2004 National Elections or the 1996-1998 ARMM pilot test, it is still below the 2008 ARMM elections that has an estimated cost of 86.69 pesos per voter (Figure 7).

However, in terms of cost per machine, the 2010 National elections registered the lowest per unit cost for the PCOS at about 60,000 pesos per machine. This is significantly higher than the 540,000 PhP in 2000 prices per unit cost of the 2004 or the 830,000 PhP in 2000 prices of the 1996-1998 ARMM pilot testing.

One possible reason for the low per unit cost of the election machines used in the 2010 elections is that the figure reflects only 70 percent of the purchase price of the machines.

Usability. The fact that the technology that was used is paper-based increases the usability of the technology. As mentioned in the earlier chapters of this paper, the use of paper ballots is one of the advantages of the optical scanning technology because the voters are used to having paper ballots.

Analysis of different types of technology has also shown that paper ballots have good usability. In an experiment looking at the usability of the different types of election equipment, it was found that the overall error rate for paper-based election systems was just over 1.5%, which is not only lower than the error rate for lever machines and punch cards, but lower than the rates found for commercial DREs. This comes at no cost in terms of efficiency or subjective usability, at least relative to punch cards and lever machines. Furthermore, with respect to effectiveness, paper ballots seem less sensitive to the effects of age, which were substantial for punch cards and lever machines. The age effects suggest differential enfranchisement of different subpopulations, which is generally considered counter to the aims of election systems. The relationship between age and efficiency for DREs is still unknown.[25]

[25] Byrne, Greene and Everett (2007)

Other issues on the AES and PCOS . Still, there are some issues that need to be resolved with the use of the PCOS machines. One of these issues it the disenfranchisement of voters attributable to the refusal of a second ballot to voters who commit errors (especially for overvoting). The review of international experience revealed that there are optical scan machines that can identify under or over voting and can alert the voters to this error. This would then allow voters to correct their errors. However, the experience for the Philippines would not allow this because while the machines would be able to detect errors, the voters cannot correct their mistake for over-voting.

Assessments of the election automation in the country observed that there were lapses in a number of areas. Studies by Cenpeg and the analysis of Monsod observed that the pilot-testing was not satisfactorily conducted. The studies also found some lapses on the supplier "who had no extensive experience in the technology and seemed to be also learning while it was being implemented."[26]

Purchasing vs. Leasing

Purchasing or leasing the voting equipment is an important concern especially since the government has spent more than 7 billion pesos for the lease of the equipment. Fail (2006) in his analysis of the Help America Vote Act and its consequences discussed the benefits of a short term lease (say 10 years) rather than outright purchase of the equipment. Fail provided the following reasons for leasing the voting equipment.

One of the major benefits of leasing is that it would allow for machinery upgrades while purchasing fixes the "version" of the equipment to the time when it was purchased. A lease contract may contain opportunities to renegotiate the machines to be used in order to update the technology. Innovations in voting technology have allowed for touch-screen voting, the use of audio devices and even internet voting. Fixing the voting technology for our country by outright purchasing automatically forgoes all these possible innovations.

Another benefit of leasing would be shifting the rick of obsolescence to the private sector who is in the best position to bear and minimize the cost of obsolescence. Because the manufacturers/vendors are the ones producing, maintaining and using the machines, letting them bear the cost of obsolescence actually gives them the incentive to produce longer-lasting and more adaptable machines. If the country purchases the voting equipment, further costs in terms of maintenance, repairs and fixing the glitches would make the ownership of the said equipment more expensive.

Leasing would also encourage competition in the voting machinery/election automation market. It may also allow Filipino companies to produce our own technology that may be suitable for the Philippine political set-up that would better address the needs of election in our country.

In terms of the actual experience in using the election machines, the CAC has expressed its apprehension in purchasing the voting equipment. The Comelec Advisory Council also said: "It was not a perfectly executed exercise by any stretch of the imagination. The preparation time was too short. Smartmatic-TIM committed numerous mistakes, some of which nearly derailed

[26] Monsod (2010) The 2010 Automated Elections – An Assessment, The Jaime V. Ongpin Foundation Lecture Series, Nov. 9, Ateneo de Manila, Rockwell, Makati City.

the entire exercise. The Comelec also made several questionable decisions that placed the integrity of the AES in jeopardy….However, after the new President was proclaimed and many of fears surrounding the election automation were put to rest…..despite all the mistakes, the AES ultimately did work….The Comelec is better off not exercising the option to purchase the PCOS machines, so it can look for an even better solution for the 2013 elections."[27]

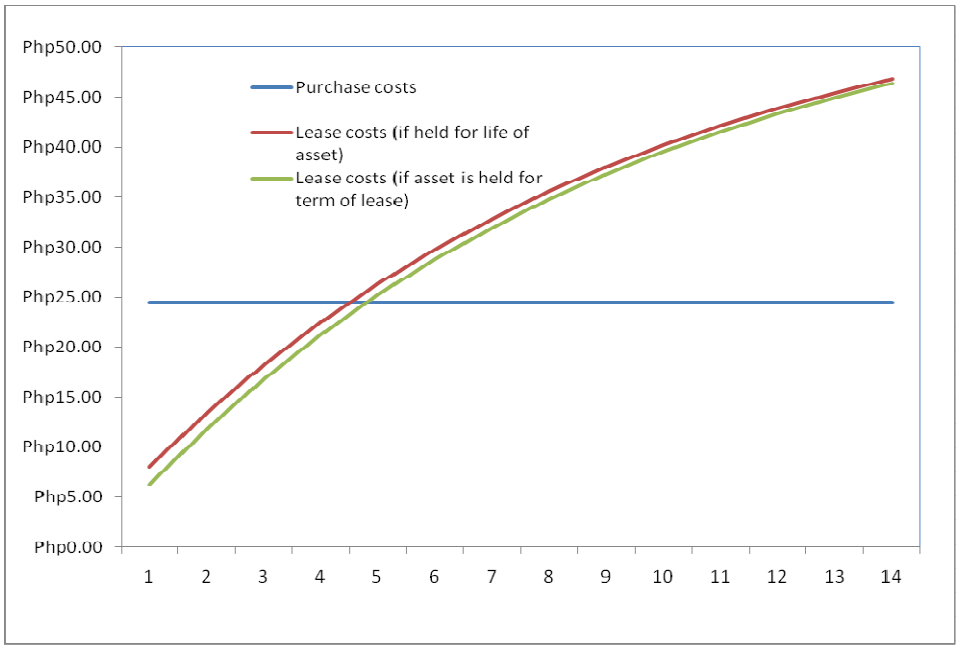
So under the assumption that leasing the election machinery would be the best option, the next question would be how long the lease has to be before it becomes more expensive to lease the asset. Using data from supporting documents submitted to DBM and certain assumptions[28] on the other costs of purchasing the equipment, it has been calculated that going beyond 4 lease payments would make leasing more expensive than purchasing (Figure 8).

The assumed costs of purchasing the equipment are presented in table 9.

Table 9. Assumed cost of purchasing the equipment

Description	Cost (PhP)	Notes
Capital Cost	23,016,000,000.00	
Warehousing cost	1,060,315,383.72	Present value of 139,000,000 for 15 years, the assumed life of the asset.
Maintenance cost	122,516,273.00	Assumed value based on an initial maintenance cost growing at 10% per annum.
	24,198,831,657.00	

[27] Ibid.
[28] Other assumptions: 12 periodic discount rate, No initial deposit, payment made after the end of the term, purchase option price at 2 billion Php; Lease payments to be made during the life of the asset total to 9 billion PhP.


Php50.00
Php45.00
Php40.00
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Php30.00
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Php20.00
Php15.00
Php10.00
Php5.00
Php0.00
1
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14
Purchase costs
Lease costs (if held for life of asset)
Lease costs (if asset is held for term of lease)

Conclusion

The objective of this research paper is to assess the recent automated election process in the Philippines and to compare the country's experience to other international cases in terms of automation. Another is to analyze the feasibility of buying election counting machines versus leasing them from the supplier.

During the recently concluded 2010 national elections, SMARTMATIC-TIM utilized the Precinct Count Optical System in conducting the polls. The voting machines belongs to the optical scanner type of voting machines similar to the ones used in several states in the U.S. – including Maryland, Virginia and New York. In the case of the Philippines, the PCOS system is effective as an entry point to automated elections because it still uses the paper ballots that the Filipino voter has grown accustomed to. Thus, this automated system uses elements that the voters are familiar with and aware of, making the transition from manual to automatic easier.

In terms of cost, while the machines and the systems may not necessarily be comparable, there seems to be an indication that the cost of leasing the PCOS machines (including all the other supplementary costs like software and services) is less than the cost that have been incurred by a number of US states and other countries.

The experiences of other countries and US states tell us that no automated system is perfect. Each system has its set of criticisms and a number of US states have documented faults in the systems and voting machines that they have used. For the Philippines, this lesson tells us that while the Philippine experience has been positive in general, we should listen to the documents presented by experts in the IT field suggesting areas for improvement. Also, issues on transparency of the voting technology have to be addressed. The proponents of the OES election system have pointed out that the automated voting technology is not transparent.

In terms of buying or leasing equipment, the latter is a more viable option given several factors. First, the shifting of technology is faster and the possibility of these machines to be outdated or obsolete is greater. Leasing the machines will pass the burden of obsolescence to the leasing company. Second, it reduces the risk of the country having to own electoral machines that do not work as anticipated or expected. An example of this can be seen in the case of Florida, where the state purchased the DREV system, only to be unused and thrown away after.

Finally, calculations using data from the 2010 elections show that leasing voting technology for 4 lease payments or less makes leasing more economical than outright purchase of the equipment.

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