

## **The Cost of Automating Elections**

**By Roberto Verzola**

One of the major considerations in shifting from manual to automated elections is cost. Aside from the electronic voting and counting machine themselves, automated election costs include operating and maintenance (O&M) costs, additional costs for personnel, additional capital costs not covered by the machine costs, and miscellaneous unforeseen costs.

### **Machine costs**

*Direct-Recording Electronic (DRE) voting machines.* Also called touch-screens, although some involve buttons or keypads for input, voters enter their choices directly on these machines rather than on paper ballots, and their choices are recorded directly on electronic media. There are two general types: the small-screen DREs and the full-face DREs, Small screens mean voters have to scroll up or down and possibly left or right to choose a race or even to see the complete list of candidates per race. Full-face DREs can present an entire ballot on a single display.

Studies and media reports put the cost of DRE machines with small screens at US\$3,000-3,500 per unit.<sup>1</sup> For its September 2002 primary elections, Miami-Dade county of Florida spent US\$24.5 million for 7,200 touch-screens (\$3,403 per machine).<sup>2</sup> Santa Clara county of California bought 5,000 units of theirs for US\$20 million (\$4,000 per machine).<sup>3</sup> Maryland's 19,000 DREs cost US\$3,551 per machine.

The full-face DRE machines, on the other hand, cost around US\$6,000-7,000 per unit.<sup>4</sup> A voting system design proposed for New York would have cost US\$60 million for 7,000 machines<sup>5</sup> or \$7,500 per machine. Research by the Budget Review Office of Suffolk county in New York found DRE machine prices ranging from US\$4,000 to \$12,000 “depending upon the extent to which the machine is

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<sup>1</sup> Farhad Manjoo, “The Case for Electronic Voting”, *Wired News*, Nov. 14, 2000.  
<http://www.wired.com/politics/law/news/2000/11/40141>

<sup>2</sup> Jason Leopold, “Electronic voting minus paper trails makes it easy to rig elections”, *Online Journal*, Sept. 4, 2003.  
<http://www.onlinejournal.com/evoting/090403Leopold/090403leopold.html>

<sup>3</sup> Leopold, see above.

<sup>4</sup> Manjoo, see above.

<sup>5</sup> Earl Lane, “Election debacle highlights debate on new voting systems”, *Newsday*, Dec. 14, 2000.  
[http://www.wheresthepaper.org/Newsday12\\_2000ElectionDebate.htm](http://www.wheresthepaper.org/Newsday12_2000ElectionDebate.htm)

outfitted for full face ballot and handicapped accessibility.”<sup>6</sup> The prices, the county report said, were subject to volume discounts.

In 2004, Ireland imported DRE voting machines from the Netherlands costing €4,500-5,000 (US\$7,050-7,833) each.<sup>7</sup> In 2007, the French Internet Rights Forum puts the cost of an electronic voting machine (touch-screen) in France at €4,400 (US\$6,893).<sup>8</sup>

It should be noted that DREs with no voter-verified paper audit trail (VVPAT) have already been decertified in several U.S. states as well as abandoned in countries like the Netherlands. DREs without VVPAT, like the machines used in India, are therefore best considered obsolete. Adding printers to DREs adds US\$500-\$1,000 to their cost,<sup>9</sup> as well as to their complexity. It also adds new points of failure (no ink, no paper, paper jammed, etc.).

*Optical Scanners.* These are based on a very different technology from the touch-screens. Optical scanners are basically electronic counting machines. Votes are cast on paper ballots, usually by marking specified areas on the ballot to indicate their choices. The ballots are then fed to the machines for optical scanning of the voters’ choices.

One report puts the cost of optical scanners in the range US\$4,000<sup>10</sup> - 6,000.<sup>11</sup> The New York county research cited earlier found scanners ranging from US\$5,000 to \$8,000.<sup>12</sup> The British Electoral Commission, however, was quoted much higher scanner prices: from £6,000 (US\$11,700) to £28,000 (US\$54,600) per unit.<sup>13</sup> Where legal requirements mandate accessibility to the handicapped, optical scanning may also require additional ballot markers (around US\$5,000 – 7,000 per unit).<sup>14</sup> A North Carolina study of voting systems estimates US\$10,000 for one optical scanner and one ballot marker,

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<sup>6</sup> Gail Vizzini, “Overview of Cost Factors Associated with Electronic Voting Machines and HAVA Compliance”, July 26, 2006. <http://www.co.suffolk.ny.us/legis/bro/Reports/2006/Voting%20Machines.pdf>

<sup>7</sup> Joe McCarthy, “Electronic Voting in Ireland: Summary of Costs”, June 5, 2004. <http://evoting.cs.may.ie/Documents/CostofElectronicvotingAsOfMay.pdf>

<sup>8</sup> Peter Sayer, “French e-voting study highlights hidden costs”, *IDG News Service*, Dec. 20, 2007. <http://www.cio.com.au/index.php/id;995730411>

<sup>9</sup> Chris Gaither, “Tallying the Woes of Electronic Balloting”, *Los Angeles Times*, Sep. 24, 2004. See <http://www.commondreams.org/headlines04/0924-23.htm>

<sup>10</sup> Kim Zetter, “The Cost of E-Voting”, *Wired Blog Network*, Apr. 4, 2008. <http://blog.wired.com/27bstroke6/2008/04/the-cost-of-e-v.html>

<sup>11</sup> Manjoo, see above.

<sup>12</sup> Vizzini, see above.

<sup>13</sup> The Electoral Commission, “Key issues and conclusions: May 2007 electoral pilot schemes”, Aug. 2007. [http://www.electoralcommission.org.uk/files/dms/Keyfindingsandrecommendationssummarypaper\\_27191-20111\\_E\\_N\\_S\\_W\\_.pdf](http://www.electoralcommission.org.uk/files/dms/Keyfindingsandrecommendationssummarypaper_27191-20111_E_N_S_W_.pdf)

<sup>14</sup> The Electoral Commission, see above.

which can serve one precinct.<sup>15</sup>

On the whole, optical scanners turn out cheaper than DRE machines because one scanner can service many more voters than one DRE machine. In the U.S., for instance, one optical scanner, possibly supplemented by one ballot scanner for the handicapped, is usually enough for one precinct. On the other hand, 5 to 10 touch screens may be needed per precinct. Another study, assuming three minutes for each voter to complete casting his/her vote, estimates that “a precinct needs 18 touch-screens to equal an optical scanner’s rate of 360 votes an hour.” A North Carolina study estimates that one optical scanner will do the work of 20 touch screens.<sup>16</sup> It is possible that optical scanners are somewhat under-utilized in smaller precincts, explaining the lower end of the capacity comparison between DREs and optical scanners.

A detailed 2008 cost analysis of Maryland’s electronic voting system notes that shifting from touch-screens to optical scanners reduces equipment cost by 80%.<sup>17</sup> This means that for the same capacity, the capital cost of DRE technology is four times more than optical scanning technology. A similar cost analysis for North Carolina estimates DRE technology to be 3.2 times more expensive than optical scanning (US\$145 million vs. \$45 million).<sup>18</sup>

The useful life of these machines is often put at 15-20 years, over which the capital costs can be amortized. However, automated election technologies are still rapidly changing. New algorithms, technologies, and architectures are being announced regularly. This means that today’s machines may only be good for one or two elections, before their weaknesses are discovered and corrected in newer machines. This accelerated obsolescence increase depreciation costs. New and stricter requirements for better security, auditability and transparency may also increase machine costs further.

In addition to these one-time costs for purchasing the electronic voting/counting machines, automating elections also incurs additional recurring costs, as well as increases personnel expenses, operating and maintenance costs, and other existing costs. To facilitate comparability, these additional costs are expressed as much as possible as a percentage of the original purchase cost of the electronic voting/counting machines.

## **Operating and Maintenance (O&M) costs**

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<sup>15</sup> Joyce McCloy, “Operating Cost Comparison for Different Types of Voting Systems”, May 19, 2008.  
<http://www.ncvoter.net/affordable.html>

<sup>16</sup> McCloy, see above.

<sup>17</sup> Save Our Votes, “Cost Analysis of Maryland’s Electronic Voting System”, February 2008, p. 6.  
<http://www.saveourvotes.org/legislation/packet/08-costs-mdvotingsystem.pdf>

<sup>18</sup> McCloy, see above.

O&M costs show greater variability reflecting local conditions and the wide range of legal requirements per country as well as within countries. These costs involve maintaining, repairing, storing, transporting and programming the machines.

Maryland's O&M cost, involving 19,000 machines, averages US\$10.7 million per year over the period 2006-2008, or \$563 per machine.<sup>19</sup> Over the period 2003-2009 (as contracted), the state's O&M cost per year ranged from a minimum of 1.4% (on the first year) of the total capital cost, to a maximum of 19.8% (2007) of the capital cost. Over the seven-period, the O&M cost reached 79% of the capital cost, or an average of 11.3% per year. About 82% of this O&M cost went directly to Diebold (now Premier), the company that supplied the machines. Cuyahoga County in Ohio spent for machine repairs in the 2006 U.S. elections the equivalent of 1.1% of the voting machines' capital cost.<sup>20</sup>

Just for the personnel operating the machines, India spent about the same amount in one election as the cost of the machines themselves (US\$225 million).<sup>21</sup>

The Maryland study also looked at the costs of counties as they shifted from optical scan to DRE systems. With DREs, their average operating costs per voter went up from US\$1.02 to \$2.84, which puts optical scanning O&M cost at around 36% of DRE O&M costs. Another study by the North Carolina Coalition for Verified Voting showed that touch-screens cost 30-40% more to operate than optical scanners (i.e., optical scanning O&M is around 75% as much as DRE O&M cost). Although these studies do not make clear why scanners should cost less to operate and maintain than DREs, there are at least two possible reasons why this is so: 1) DREs are operated by voters themselves who may not be familiar with the machines, while scanners are used by presumably trained operators; 2) 10-20 DREs must be operated and maintained for every one optical scanner.

## **Unforeseen costs**

The expenses for automating elections have generally been underestimated. Unforeseen expenses raise the cost upwards, sometimes considerably. Original claims that electronic voting will save money because less paper and labor would be used are now hardly believable.

Among the unforeseen costs associated with electronic voting are the following:

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<sup>19</sup> See above, p. 3

<sup>20</sup> Computed by the author from Joe Guillen and Mark Rollenhagen, "Paper ballots, not electronic voting, urged in Cuyahoga county", Dec. 14, 2007. See [http://blog.cleveland.com/metro/2007/12/paper\\_ballots\\_not\\_electronic\\_v.html](http://blog.cleveland.com/metro/2007/12/paper_ballots_not_electronic_v.html).

<sup>21</sup> Indian Embassy, see above.

*Additional components and supplies not included in the basic machine.* These could include optional accessories, software, ballot printing fees, audio preparation fees (for deaf voters), etc.<sup>22</sup> For instance, memory cards are sometimes charged separately from the machines themselves. A study in Cuyahoga County in Ohio showed that touch-screen machines worth US\$17.03 million needed memory cards worth an additional US\$1.05 million, raising machine costs by 6.2%.<sup>23</sup> “Miscellaneous voting machine supplies added another 3.2%. A similar study in Sarasota county in Florida found that they needed to spend over a three-year period around 39% of the original machine costs for additional capital outlays.<sup>24</sup> In 2004 alone, Ireland had to spend another 4.7% of its machine costs just for storage batteries, and another 5% for ancillaries like cases, trolleys, tables, etc.<sup>25</sup> In the U.S., new regulations may require existing DREs to be retrofitted with printers for voter-verified paper audit trails, adding to the cost.

*Machine upgrades.* When Ireland upgraded their ESI 1 machines to ESI 2, they had to pay another €2,393,<sup>26</sup> an additional expense of 53% on top of the €4,508 cost of the older machine.

*Storage costs.* Ireland spends €800,000 per annum, or 1.8% of the machine purchase cost, just to store its unused voting machines. McCarthy’s analysis for Ireland projects storage costs to go as high as 4.7% per annum of the original machine costs.<sup>27</sup>

*Insurance costs.* Ireland paid in 2004 0.68% of the machine purchase costs to insure the voting machines; an additional insurance expense of 0.61% per annum is projected throughout the life of the machines.<sup>28</sup> In Cuyahoga County of Ohio, poll worker training amounted to 4.7% of total machine costs.<sup>29</sup>

*Training costs.* In Ireland, training costs were equivalent to 1.2% of the machine purchase costs.

*Public education.* Because of the novelty of electronic voting, the public has to be educated about their use, involving additional cost. McCarthy’s study for Ireland estimates that an additional 6% of the machine cost (half of the publicity budget) were actually spent for public education. India spent the equivalent of 9.8% of its machine’s costs for publicity.<sup>30</sup>

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<sup>22</sup> Vizzini, see above, p.5.

<sup>23</sup> Computed by the author from Guillen and Rollenhagen, see above.

<sup>24</sup> Myerson, see above, p.3

<sup>25</sup> Computed by the author from McCarthy, see above.

<sup>26</sup> McCarthy, see above.

<sup>27</sup> Computed by the author from McCarthy, see above.

<sup>28</sup> Computed by the author from McCarthy, see above

<sup>29</sup> Computed by the author from Guillen and Rollenhagen, see above.

<sup>30</sup> Embassy of India, see above.

*Additional personnel expenses.* Automating elections tends to require additional highly-skilled personnel for new tasks associated with the voting/counting machines. Cuyahoga County of Ohio, for instance, spent an additional 2.4% over its total voting machine cost of US\$17.03M for technical support in the 2006 elections.<sup>31</sup>

*Project failures.* When automation projects fail, the costs are usually written off. After its 2000 election problems with punch card technology, the U.S. spent around US\$3.5 billion under its Help America Vote Act (HAVA) on new voting technologies, including touch-screens. After purchasing touch-screens, many counties have realized that they made a wrong decision, and are now contemplating a return to optical scanners, facing a bleak prospect of writing off their investments on touch-screens. In 2004, the Philippines spent P1.3 billion (around US\$24 million) for 1,600 “automated counting machines” (optical scanners), or around \$15,046 per machine which were never used because the purchase contract was declared null and void by the Supreme Court due to corruption. Today, the country continues to pay for the storage costs of the idle machines.

## **Total costs**

In terms of total costs, Maryland now (2008) spends “ten times as much as it did seven years ago.”<sup>32</sup>

In Ireland, the total expenses for electronic voting reached £53.3 million as of May 2004. This includes pilot testing in 2002 and countryside implementation in 2003 plus additional equipment ordered in January 2004 as well as subsequent expenses for storage costs, new batteries, training, insurance and publicity.

In India, the total expenses of the Election Commission for the May 2008 elections has been estimated at Rs 55 billion (US\$1.2 billion), which is around Rs 75 per registered voter or Rs 125 per voter who actually voted. Around 20% of the total costs went to electronic voting machines and polling booths, another 20% to the salaries of election personnel, and 1.82% to voters’ education.<sup>33</sup>

In Scotland, the cost of the 2007 automated elections reached £40 million (US\$78 million),<sup>34</sup> or about US\$19.22 per ballot cast, This is much higher (235%) than the £17 million spent in 2003. Around

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<sup>31</sup> Computer by the author from Guillen and Rollenhagen, see above.

<sup>32</sup> See above, p. 2

<sup>33</sup> Embassy of India, “Indian elections to cost Rs 100 billion”, *India Digest*, May 19, 2008.  
[http://www.indianembassy.org/i\\_digest/2004/may/india\\_elections.htm](http://www.indianembassy.org/i_digest/2004/may/india_elections.htm)

<sup>34</sup> Eddie Barnes, “£40m cost of Scottish election fiasco revealed”, *Scotland on Sunday*, May 11, 2008.  
<http://scotlandonsunday.scotsman.com/politics/40m-cost-of-Scottish-.3976689.jp>

£9 million of the total cost (22.5%) went to the private company which provided the counting machines, and an additional £3.5 million (8.75%) were incurred in introducing the system to the electorate.<sup>35</sup> The difference is that the 2003 elections went without a hitch, while the 2007 elections, which involved electronic voting, have been called a “fiasco”. The chaotic introduction of the new system saw nearly 150,000 ballots rejected by the machines. The BBC reported 142,000 ballots rejected (3.5% of the 4,059,000 ballots cast).<sup>36</sup>

A voter’s study in Sarasota county in Florida provides some indicative figures about the relative increases in costs after adopting touch-screens. After purchasing US\$4.7 million worth of DREs, the county found its total expenses going up by \$1.1 million per year, averaged over a three-year period,<sup>37</sup> an amount that is around 23.6% of the initial purchase. These additional costs were distributed as follows: 49% for additional personnel expenses; 38% for additional operating expenses; and 13% for additional outlay of capital, on top of the DRE machines.

The Sarasota study concludes that “there would have been real savings if the Sarasota County Commissioners had decided to throw away the DREs in April 2004 and spent \$600,000 to buy Optical Scanners for the entire county as SAVE has suggested to the commissioners.”<sup>38</sup>

## Conclusion

Small-screen DRE machines cost around \$3,000-\$4000. Full-face DREs may cost twice or more. Printing capability may further add to these costs. Optical scanner prices lie between the small-screen and the full-face DREs. However, because they have 10-20 times the capacity of DREs, DRE capital costs may be four or more times that of optical scanning. O&M costs per annum for DREs average around 11% of the total capital cost of the machines. Optical scanning O&M costs are around 36-77% of DRE O&M costs. In addition to these costs, other capital and recurring costs often arise which are unforeseen by election planners and which, added together and accumulated over the years, can add up to a big sum. These costs include additional machine components, upgrades, storage, insurance, training, public education, and additional personnel expenses. When projects fail or are abandoned, as they did in countries like the Philippines, a huge waste of public funds results.

In the meantime, the potential for improving manual methods have not been fully explored. The proposal to apply double-entry accounting in election tallies,<sup>39</sup> for instance, promises to breathe new life

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<sup>35</sup> See above.

<sup>36</sup> “Rejected votes more than thought”, BBC News, May 9, 2007. <http://news.bbc.co.uk/1/hi/scotland/6637387.stm>

<sup>37</sup> Rosemarie Myerson, “Comparison of Operating Costs”, Feb. 8, 2005. <http://verifiedvoting.org/downloads/myerson.pdf>

<sup>38</sup> Myerson, see above, p.2

<sup>39</sup> Roberto Verzola, “Double-entry accounting can improve both manual and automated elections”, May 28, 2008.

into manual methods through the use of a well-tested, time-proven, and low-cost system for detecting and locating clerical errors in tabulations of numbers.

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