ELECTION SCIENCE INSTITUTE | Improving the American Election Process

DRE Analysis for May 2006 Primary
Cuyahoga County, Ohio

August 2006

Document and Contact Information

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About ESI

Election Science Institute is a non-partisan, non-profit election science organization, which seeks to improve the election process using rigorous science-based approaches done in collaboration with the nation's foremost election science experts.

Our strategy is to bring county election officials and citizens together with expert researchers, engineers and leading technologies to create model election systems that are auditable and transparent. By embedding scientifically-based best practices into local election systems, our democratic ideals are well-served.

Legal Information

August 15, 2006

Commissioner Jimmy Dimora, President
Commissioner Peter Lawson Jones
Commissioner Timothy F. Hagan
Cuyahoga County Administration Building
1219 Ontario Street, 4th Floor
Cleveland, Ohio 44113

SUBJECT: ANALYSIS OF MAY 2006 PRIMARY ELECTION
CUYAHOGA COUNTY, OHIO

Dear Commissioners:

Enclosed is the analysis of the May 2006 Primary in Cuyahoga County prepared by Election Science Institute. On behalf of the researchers and many others who worked on this report, thank you for your willingness to let us behind the scenes to conduct a thorough review of how the new election system is performing in the early stages of use.

Your openness will certainly result in elections that are ultimately more accurate for the voters of Cuyahoga County. Indeed, the lessons learned through this analysis will be useful to election boards around Ohio and throughout the country. This project is an important step to restoring confidence in the outcome of our elections.

Key findings and recommendations are outlined in the Executive Summary; a detailed account of the research is found in each of the seven sections of the report, with each section corresponding to the research commissioned by Cuyahoga County. As you know, voting machines are only a component within the larger election system. Any assessment of an election system must include an evaluation of administrative procedures, pre-election programming and testing of the voting machines, voter and booth worker interaction, and counting and auditing procedures. We would like to underscore that our findings are based on research of the entire election system. Although the new touch screen election system is vastly different from its predecessor, it is still the case that an election can only be as successful and reliable as the human administration of all the components of the election system.

Also on behalf of the ESI team, I believe it is important to say directly to you that the current election system appears to provide some of its promised benefits at potentially great cost; namely, that the election system, in its entirety, exhibits shortcomings with extremely serious consequences, especially in the event of a close election. These shortcomings merit your urgent attention. Relying on this system in its present state should be viewed as a calculated risk in which the outcome may be an acceptable election, but there is a heightened risk of unacceptable cost.

While the challenges facing Cuyahoga County's election system are considerable—time, resources, and the will to do the difficult work that is needed—ESI remains confident that the most significant constraint for election system improvement is the will to achieve meaningful improvement in the election system. With the cooperation of the voting system vendor, public officials, the public and the media, the serious issues uncovered during this investigation can be addressed employing widely used management science methods and process improvement techniques.

As I mentioned when I stood before you in late April, prior to the Primary Election, meaningful improvements can be achieved but are not likely be complete before the November 2006 or November 2008 general elections.

ESI stands ready to assist you. We are committed to working with you and your community in whatever way necessary to provide the most accurate and transparent elections possible and helping voters understand that an improvement program is in place and its goals will be achieved.

Thank you once more for the opportunity to work with you, and thank you for your leadership.

Sincerely,
ELECTION SCIENCE INSTITUTE

Steven Hertzberg
Project Director

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Executive Summary

Background

Following the 2004 General Election in Ohio, Cuyahoga County adopted a new voting system using the Diebold touch-screen voting system. The new system complies with both the new federal election technology standards established under the Help America Vote Act of 2002 (HAVA) and with recently enacted Ohio legislation that requires voting systems to produce a paper ballot that can be verified by the voter. Under Ohio law, this paper ballot (Voter Verified Paper Audit Trail (VVPAT) serves as the official ballot in the event of recount or contested election.

The May 2006 Primary, the first major election using the new system, presented an opportunity to assess the new system's benefits and weaknesses. The Cuyahoga County Board of Commissioners decided that an independent scientific analysis of the Primary election would give elections officials objective feedback on the accuracy, reliability and usability of the new voting system.

In April 2006, the Cuyahoga County Commissioners engaged Election Science Institute (ESI) to study all aspects of the new system during the Primary Election. Voting devices are only a small part of an election system: any thorough assessment of a voting system must include an evaluation of the administrative procedures, pre-election programming and testing of the machines, voter and booth worker interaction, and counting and auditing procedures. Although the touch screen systems are vastly different from optical scan and punch card, it still holds true that an election will be only as successful and reliable as the human administration of all system components.

The project was an important step toward making Ohio a model for sound, transparent implementation of new election technology.

The Scientists

ESI assembled a highly qualified interdisciplinary team of researchers with national credentials and began research immediately.

The team of statisticians, systems engineers, computer scientists and political scientists was able to use the Cuyahoga County Primary Election of May 2006 as a real-time laboratory to examine both the performance of the new Diebold VVPAT-enabled system in an actual election and the administrative procedures involved in deploying the new system.

To conduct a comprehensive and multi-dimensional assessment of the new system, the ESI team carried out an array of discrete, independent projects, each focusing on a different component.

- An exit poll of voters on Election Day was conducted by researchers from the Center for the Study of Elections and Democracy (CSED) and Edison Mitofsky, Inc. The survey asked voters about their experience and their confidence in the new system.
- A survey of booth workers was conducted by experts from The Pollworker Institute, Promark Research, and CSED. The survey probed booth workers about their experience and their opinions about strengths and weaknesses of the new system.
- A review and analysis of Election Day incidents reported by booth workers and command center staff fielding booth worker calls was conducted by scientists from the California Institute of Technology and the University of Utah Public Policy Center.
- A manual count of the VVPAT paper ballots carried out by elections officials from around Ohio and the country, along with statisticians and engineers, endeavored to reconcile the number of actual paper ballots with the results report printed on the VVPAT tape. The manual count project provided an indication of how difficult a formal complete recount would be, if required.
- An analysis of voter wait times and voting machine allocation by systems engineers from Ohio State University and Sagata Ltd. assessed how many voting machines would be required, and what other measures would be needed, to bring delays at polling places down to acceptable levels.
- A comparison of the paper ballot results, the results recorded on the machine memory, official results, and other reports was conducted by social and political scientists, including a principal investigator for the Election Assistance Commission Vote Count and Recount Project,
- A detailed threat analysis conducted by a systems engineer (a senior member of the American Society for Quality), an operations engineer and election officials assessed both the likelihood of particular threats and a standard for the proper functioning of the system.

Summary of Key Findings

Key Finding: After three months of exhaustive research, empirical evidence supports the key definitive finding: The machines' four sources of vote totals – VVPAT individual ballots, VVPAT summary, election archive, and memory cards – did not agree with one another.

The current election system appears to provide some of its promised benefits at potentially great cost; namely, that the election system, in its entirety, exhibits shortcomings with extremely serious consequences, especially in the event of a close election. These shortcomings merit urgent attention. Relying on this system in its present state should be viewed as a calculated risk in which the outcome may be an acceptable election, but there is a heightened risk of unacceptable cost.

The ESI team arrived at this conclusion only after completing the seven projects described above. This conclusion is supported not only by the findings themselves but also by the difficulty encountered in conducting the projects.

Key findings from each of the research projects are summarized below. Duplicate findings in most cases serve as confirmation of that finding. In some instances, however, the findings from two projects may appear inconsistent for one or more reasons.[1]

Election Day Voter Exit Poll Survey

Key Finding: The vast majority of voters surveyed were pleased with their experience with the new system, liked touch screen voting and had confidence that their votes would be recorded correctly.

ESI conducted exit poll interviews with voters from a statistically significant number of polling places on Election Day. The project had two distinct goals: First, it measured the attitudes of voters towards the voting experience and especially their reactions to new voting technology and processes. This study assessed the voting experience from the voters' perspective by surveying them immediately after they left the polling place. Second, it provided an assessment of the conditions voters encountered at the polling place, including the length of the lines, the characteristics of the booth workers, and the organization of the polling place.

- Most voters (about 90% of those surveyed) liked the new system and had confidence their votes would be recorded correctly, although 10% did have problems.
- The vast majority of voters liked touch screen voting.
- More than 95% of older voters and nearly 90% of African-American voters found the new system easier to use than the previous punch card system, although some older voters and African-American voters expressed slightly more concern with the new voting equipment and indicated they had more difficulties with the new machines in general.

Post Election Survey of Booth Workers and Election Day Technicians

Key Finding: Improved training, both practical and procedural, is likely to minimize incidents experienced on Election Day.

To gain perspective on the election system from Election Day workers, ESI spoke with and surveyed Booth Workers and Election Day Technicians shortly after Election Day. Our focus was to understand: (i) how well the new Diebold DRE voting system met voters' needs on Election Day; (ii) if the new Diebold DREs and Optical Scan voting machines functioned as specified on Election Day; (iii) the quantity and types of problems in the field on Election Day; (iv) the ability of the election system to cope with Election Day problems; (v) the capacity to mitigate Election Day problems in a timely manner; (vi) and the adequacy of the training received by Election Day workers to address Election Day challenges.

[1] For example, the percentage of booth workers who reported experiencing problems opening or closing the machines does not correspond to the percentage of incident reports involving opening or closing the voting machine. One reason for this apparent discrepancy: the booth worker survey focused primarily on operation of the voting machines but the incidents reports covered all problems. Another reason: while the Presiding Judge of the precinct would report the incident only once, every booth worker, if asked, might report the same incident.

- About one-third of booth workers said they had difficulty setting up the machines and 45% said they had difficulty "closing out" the machines at the end of the day. Specifically, 38% had some difficulty with the printers and/or paper spools.
- 41% of booth workers noticed differences between how they learned to use the machines in training and how the machines operated on election day. A large majority (74%) of that group thought the training and actual procedures were either "a lot different" or "somewhat different" from one another.
- 51% disagreed that the training provided them with enough information to do their job well; 57% disagreed that they had enough hands-on practice with the voting machines.
- 53% of election workers also expressed concern that training on election law and administrative procedures was inadequate.
- About half of the booth workers attempted to call the command center on election day; 35% of those callers were able to speak to someone on the first try.

Polling Place Incident Report Analysis

Key Finding: Incident reports were widespread but concentrated, with 9% of precincts reporting 10 or more incidents. The most commonly reported incidents were voter registration issues (30.1%), election administration issues (22.6%), problems related to voting machines (16.2%) and issues involving booth workers (9.1%).

Booth workers are required to report all polling place "incidents" that might have an impact on the results such as anomalies in the voter check-in process, problems with the voting machine, fleeing voters and other events. ESI reviewed and analyzed both the incident reports provided by booth workers and the log kept by Command Center staff fielding calls from booth workers.

- 88.7% of all precincts reported at least one incident. However, certain precincts had a very high number of incidents. 9% of precincts reported having ten or more incidents and five precincts reported 20 or more incidents.
- Almost one-third (30.1%) of all incidents involved voter registration issues, such as incorrect addresses, misspelled names, or inconsistent signatures.
- 22.6% of reported incidents related to election administration, such as not being able to reach the Board of Elections by telephone, issues with training, steps in the process being skipped (such as not having voters sign the poll book when polls were busy), and lack of supplies.
- 16.2% of incidents involved problems with all voting equipment (i.e. the voting machines, the printing devices, or the ballot access cards and encoder devices).
- 9.1% percent of incidents involved the booth workers, usually a worker not showing up. When the relationship between booth worker incidents and other reported incidents was examined more closely, there was a correlation found between the two—for example, a higher rate of machine failure, encoder or access card problems, or printer, administrative, supply, voter, and seal incidents. Such a correspondence strongly suggests that not having a full complement of booth workers at a precinct can lead to other problems at that polling place.

- 8.4% of incidents were voting machine-only-related; more than half of the time because of machine failure. Almost 40% of the time the incident was a machine failure that resulted in the machine being shut down. One-quarter of the incidents were related to memory cards.
- A total of 4.2% of incidents were related to seals on the voting machines, printer canisters, and the bags in which materials were to be returned to the election offices; a small number overall, but problematic if chain of custody becomes an issue.
- Printing incidents were only 3.9% of the total reported, but they have the potential to be pernicious because the paper printout is the official ballot, according to Ohio law.
- Encoders and access cards accounted for 3.9 % of incidents reported. Although complete card failures are less than one percent of all reported incidents, they could produce significant problems in polling places depending on their severity and how workers and election judges respond to cards that become stuck in machines, do not work, or come out of a machine[2].
- Ballot handling incidents were 4% of the total. Reported incidents included voters being sent away because the ballot could not be encoded, failure to have a voter complete the information on a provisional ballot, or voters being given the wrong access card or ballot.

Optimal Voting Machine Allocation Analysis

Key Finding: New strategies for voting machine allocation are needed to minimize voter wait time and distribute it equally across all locations.

Cuyahoga County is currently facing a decision whether to purchase additional voting machines, which is a significant expenditure, To help Cuyahoga County evaluate the need for these additional machines, ESI analyzed current machine allocation.

- Current machine allocation indicates that a potentially perilous strategy is in place. The simulation model shows that even a moderate increase in turnout will likely cause certain polling locations to be overwhelmed unnecessarily.
- Permitting voters to use any machine in a polling location or vote center greatly reduces waiting time.
- Ballots are different lengths based on local issues; that variability causes long waits and might contribute to the appearance of unequal treatment.

[2] ESI has become aware of encoder battery failure within other jurisdictions utilizing the same equipment. Election officials are advised to check the battery strength prior to each election.

Manual Count of Paper Ballots

Key Finding: VVPAT's were missing, missing information and the tally of the individual ballots did not always match the VVPAT summary printed at the end of Election Day.

In order to validate the accuracy of Election Day vote tabulations by the Cuyahoga County BOE Diebold voting system, ESI conducted a manual count of the VVPAT paper ballots. Using a recount fixture that allowed for viewing the tapes without handling them, a team of election officials, booth workers and students tallied the votes for governor on each tape. The paper ballot tallies were initially compared to the results report printed on the VVPAT tapes. When the count did not match the count provided by the results report, the paper ballots were recounted.

- 85% of the VVPAT Ballots and VVPAT Summaries reconciled after the primary manual count, where approximately 15% required a secondary count
- 1.4% of the VVPAT cartridges exhibited missing ballots.
- 16.9 % of VVPAT tapes showed a discrepancy of 1 - 5 votes between the tally of ballots and the results report; 2.1 % showed a discrepancy of over 25 votes.
- During the manual recount, team members discovered 40 VVPAT tapes (9.66%) that were either destroyed, blank, illegible, missing, taped together or otherwise compromised.
- Identifying information on the VVPAT tape such as precinct information and machine identification was inconsistent, as were the summary reports printed at the end of the day. 2.8% of the VVPATs were missing machine ID numbers; 5.4% did not identify the precinct, increasing the difficulty of a meaningful audit and raising questions about the integrity of the vote count.
- VVAPTs showed evidence of booth workers using trial and error to print reports and start up or close down the machines; workers apparently attempted to overcome printer problems by shutting down machines, removing and replacing cards, and restarting machines.
- 72% of the labels identifying cannisters containing the VVPAT tapes were missing information. 46% of the canister labels were blank.
- Booth workers frequently failed to sign the tapes. Such failures in chain of custody also increase the risk of a legal challenge.

Comparing the Count

Key Finding: Discrepancies were found across vote counts stored on different mediums across the election system.

ESI conducted an exhaustive analysis of regular voted ballots from onboard machine memory compared to manual counts of paper ballots, official results, and other interim and election reports. The comparisons revealed a wide range of discrepancies. Some discrepancies may also reflect ESI's errors in processing.

- A lack of inventory controls and gaps in the chain of custody of mission critical assets, such as DRE memory cards, DRE units, and VVPAT cartridges, resulted in a significant amount of missing data. Because of the missing data, ESI is unable to give a definitive opinion of the accuracy of the Diebold TSX system.
- Due to limits in the data, software computational abnormality contributing to the count inaccuracies cannot be ruled out. Computational abnormality could be the result of a failure to adequately test the voting equipment before the election or to manage the various databases appropriately.
- In multi-precinct polling places, voters could vote on machines located in other precincts. Accordingly, ballots from a number of precincts appeared on the same VVPAT tape. VVPAT ballots, however, lack a header identifying the precinct. Without this information, it is not possible to conduct a precinct-level tally of the VVPAT ballots.
- While discrepancies between the VVPAT summaries and VVPAT ballots themselves were relatively small, discrepancies between paper record and the electronic record were considerably larger and more pervasive. For the most part the discrepancies can be characterized as the DRE memory cards and Election Archives registering more votes than were produced by the VVPAT summaries or by hand counts of the VVPAT ballots.
- These conclusions are based on the data ESI was able to obtain from the May 2 election; however, data could not be retrieved for 13 VVPAT summaries, 87 VVPAT cartridges, 53 election archives and 3 DRE memory cards, which were used to tablulate the official vote count.

Election System Functional Threat Analysis

Key Finding: The current election system, if left unchanged, contains significant threats to inventory control of mission critical election assets, error-free vote tabulation, and tabulation transparency. One likely result is diminished public confidence in a close election.

In consultation with a number of experienced election officials, ESI developed a functional threat analysis intended to help guide Cuyahoga in planning for November and beyond. Significant threats include:

- To the extent that the legal ballot is the VVPAT record, operating thousands of voting machines on Election Day offers many opportunities for DRE printer errors to have profound effects on the manual count. Consider that each machine has a printer and potentially multiple rolls of paper. Paper records of votes (the official records) may be lost without voters' awareness because of paper jams, paper not being loaded properly, ink issues, and other problems.
- Lack of a standardized proven manual count process is likely to result in recount error and inefficiency. With no proven VVPAT manual count process or counting aids in place, the BOE may produce inaccurate or unexplainable results that might be witnessed directly by the media, election law attorneys and activist groups and are likely to impact opinion about the fairness and accuracy of an election.
- Too few working DREs in a specific vote center result in long lines and people not staying to vote. High turnouts, long ballots and (to a lesser extent) machine breakdowns make the chance of at least one vote center with very long lines a virtual certainty. With a sensible allocation, it still can be impossible to predict which center will have the incidents.

- Inconsistent DRE programming can cause glitches in electronic count. Any issue that leads to unreliable consolidation of data is serious because thousands of votes could be lost or shifted by accident in the electronic count.
- Inconsistent DRE closedown procedures affect the manual count. Variability in how machines are closed down at the polling place on Election Day could lead to unreliable paper records, which would prevent a reliable manual count.
- The lack of memory card security can cause incidents. Considering that the memory cards used are fairly standard and the encryption efforts are questionable, straightforward issues with card security (lost, stolen, or substituted) are conceivable.
- Effective database management is crucial. Without direct observation of the data consolidation and electronic counting process and/or interviews with relevant personnel, ESI can only speculate about causes and issues in data management. Moreover, checks and balances of the data consolidation process can be designed to improve detectability.

Summary of Key Recommendations

Prepare a multi-year election improvement plan, with specific performance goals for each statewide election.

- **Following a more thorough analysis of the election and research provided by ESI, refine and develop the functional threat analysis to determine priorities for the 2006 General Election and beyond.** The functional threat analysis can assist the Cuyahoga election officials in determining the priorities for the General Election and afterwards.
- **Extensive new booth worker training, expert procedural oversight and a procedural overhaul are recommended to address the risks to transparency posed by the new equipment and changing election requirements**. Booth worker training should focus on proper recording of information and handling of seals and locks, the treatment of equipment memory cards and the handling of printers providing a voting paper trail. Other issues relate to the voter registration file and appropriate ballot styles for voters. These and other challenges pose threats to a reliable voting process, as described in depth in the full report. It would be beneficial to examine the processes, procedures, and training related to the many issues examined and threats identified.
- The vast majority of precincts had few incidents reported, but certain precincts had a very high number of incidents reported. **It is recommended that precincts with many incident reports be subjected to a thorough audit.**

Revise booth worker training to address documented errors in opening and closing of the DRE voting devices and printout of the VVPAT ballots.

- Most booth workers liked the new system, but about one-third had difficulties operating the new equipment. Difficulties were most frequently reported with opening and closing procedures. Booth worker concerns about the quality and amount of training surfaced in response to several survey questions. **Booth worker proficiency required for smooth operation of the new system requires substantially improved training.**
- The training process used in the May primary election should be thoroughly reviewed to reduce the threat of malfunctions in future elections. **Include hands-on testing involving VVPAT printer machines and failure resolution in training. Use test rating results for allocation of workers such that at least one highly rated worker is at every location.**
- Inconsistencies in training and instructional ambiguities resulted in substantial differences between precincts in what identification voters were asked to show. **To ensure uniform implementation of new ID requirements, the instructions to booth workers must be clear and consistent in booth worker materials and training.**

Modify election processes to address documented problems in the chain of custody of mission critical election assets: memory cards, VVPAT Cartridges, and DRE voting devices. Develop, test and implement appropriate inventory control procedures.

- In order to be able to reconstruct the events of , the procedures for opening and closing machines and processing voters must be consistent. The data gathered by ESI in the course of the manual recount suggested a lack of consistency, which hindered auditibility. This inconsistency is especially prominent in how booth workers complied or failed to comply with established policies. **ESI recommends that the BOE take strong measures to improve consistent application of policies and procedures associated with the creating and handling of memory cards and VVPATs.**

Work with voting system vendor to establish procedures that will ensure audibility of the election process, specifically to allow for a reliable comparison of the paper ballot and electronic count.

- **The BOE should work with the voting system vendor immediately to develop a machine-level auditing capability** that will make it simple and transparent to compare electronic and paper ballot data, and to thus identify the specific anomalies associated with specific machines.
- The attempt to count VVPAT ballot revealed multiple problems with the DRE printers. The VVPAT printer, whether resulting from human or machine error, will likely continue to present a significant liability in the elections process. And because the printer is necessary to create the official ballot, such a risk is deeply problematic. Some of these issues can be mitigated with improved booth worker training and greater familiarity with the machine on the part of the booth worker. **ESI strongly recommends that the Board of Elections develop contingency strategies to ensure that printer issues don not prevent a manual count of paper ballots.**

Develop accounting procedures and report formats that will allow for a thorough post-election audit.

- The myriad difficulties ESI encountered and the extensive effort required to reconcile the paper ballot count and the electronic record make it difficult to forecast a reasonable limit on the levels of time and effort required for a comprehensive, thorough post-election audit. **The BOE needs to determine what information must be collected on Election Night and in the post-Election period and work backwards to develop the procedures necessary to ensure that information will be consistent and available.**

Develop and practice a meaningful manual recount process.

- The "recount fixture" should be developed and further refined for extensive use in a count of the VVPAT ballots. **To ensure the audit process works prior to the November General Election, ESI recommends that the BOE conduct a practice audit.**

In order to mitigate the probability of long wait times across many vote centers, the current approach for allocating voting machines on should be replaced with the SAG Method utilized by ESI in this report.

- More machines, alone, will not reduce waiting time to vote. In some instances, there are significant differences in ballot length between precincts, and it will take those voters longer to comprehend the ballot and cast their votes. **By conducting voting tests in a wide variety of districts before the election, machines could be allocated more precisely.**
- Ideally, it would be desirable to have machines on stand-by for speedy allocation to polling locations where long lines develop.

Biographies of the Study Team Members

Project Director

Steven Hertzberg, ESI's founder, is an Aerospace Engineer who spent his early career working as a civilian within the US Department of Defense. However, Steven successfully transitioned into a serial entrepreneur, participating in successful ventures in the automotive accessories, industrial food equipment, information technology, television and direct marketing industries. Mr. Hertzberg formed ESI shortly after the 2000 Presidential election in an effort to develop his concept of the Public Service Intermediary (PSI).

Project Team

Theodore T. Allen is an associate professor of industrial and systems engineering at the Ohio State University in Columbus. He received his PhD in industrial and operations engineering at the University of Michigan in Ann Arbor. He is a senior member of the American Society for Quality and an associate editor of the Journal of Manufacturing Systems. He has over 30 refereed publications related to design of experiments and six sigma systems improvement including a Springer textbook. Also, he is a partner in Sagata Ltd., whose work on elections is supported by the Election Science Institute.

R. Michael Alvarez, professor, Caltech, is one of the principal investigators for the Caltech/MIT Voting Technology Project, and is regarded as an international expert on elections, voter behavior, election administration, voting technology and political methodology. He has published three books and scores of peer-reviewed articles on these subjects, and is currently working on a new book on the electronic voting controversy (with Thad E. Hall).

Mikhail Bernshteyn is a founding partner of Sagata Ltd., which is a software and consulting company. He is also the director of its Canadian branch in Montreal. He received his PhD in industrial and systems engineering at the Ohio State University. He has published several articles in top tier journals in applied statistics and continues multidisciplinary research applying operations research and statistics.

Howard B. Christensen, PhD (statistics), accepted appointment as Asst. Prof. at Brigham Young University in 1967 and did a sabbatical at the Statistical Research Division, Bureau of the Census, 1974-1975. He has taught sampling courses at BYU from 1967 to present and developed and modified the sampling design for the Utah Colleges Exit Poll, a statewide exit poll in Utah. This sample survey has been conducted every even year since 1982. He also developed an off-year exit poll for Salt Lake City Mayor's race, 2003 and for a Utah Primary in 2006. He has consulted on numerous other sample survey projects. His research interests have been survey sampling, nonparametrics, and statistical education, and he has written two introductory statistics books published by Houghton Mifflin, and Saunders/Harcourt Brace Jovanovich.

Thad E. Hall, assistant professor, University of Utah, is the principal investigator for the Election Assistance Commission's Vote Count and Recount Project. He has written several reports, articles, and a book on election administration and voting technology.

William Hertzberg of Intellectual Property Development (IPD) Consultancy designed and developed the Manual Count fixture that was utilized to handle the VVPAT. IPD Consultancy is a small product commercialization consultancy which specializes in facilitating the "Product Program" from ideation through market acceptance. IPD researches, plans, and implements both the technical development and market development process for consumer and industrial products. Services include such work scopes as technology/market assessments, product planning documentation, product presentation documentation, and sourcing prospective licensees or joint-venture partnerships and affiliation. IPD offers consulting services to operating companies as well as individual inventors.

Jonathan N. Katz, professor, Caltech, is a principal investigator for the Caltech/MIT Voting Technology Project, and is a recognized expert in the areas of electoral behavior and political methodology. He has published widely on these topics in the academic literature, and is a much-sought expert for questions about redistricting, election administration, and electoral law.

D. Roderick Kiewiet, professor, Caltech, has written four books on elections, congress and public policy, and authored numerous articles on voting behavior, congressional elections, legislative politics, Russian politics, ethnic politics in California, state and local government, public school finance, and American political history.

Joe Lenski is co-founder and Executive Vice President of Edison Media Research. With Edison Media Research, Joe oversees hundreds of media research projects each year in the United States, Canada, Europe and the Middle East. Under his supervision Edison Media Research currently conducts all exit polls and election projections in the United States for the six major news organizations - ABC, CBS, CNN, Fox, NBC and the Associated Press. Joe's experience with political exit polling began with the CBS Election & Survey Unit for the 1988 U.S. Presidential election and includes being involved in every major exit poll conducted in the United States in the last 18 years as well as organizing an extensive exit poll of 125 parliamentary districts in the Azerbaijan election in 2005. Joe is also a member of the Executive Council of the New York Chapter of the American Association of Public Opinion Research

Corrie Lynn, ESI's Project Coordinator, has been involved in the independent public relations, marketing and training industry for over 11 years. She has produced a wide range of media, automotive, sales training and consumer programs across the US.

Warren Mitofsky, Mitofsky International's president, started and directed Voter Research & Surveys from 1990 to 1993, which was the election consortium of the four major television networks, ABC, CBS, CNN and NBC. It is now known as Voter News Service (VNS).From 1967 to 1990, Mitofsky was executive director of the CBS News election and survey unit, and was an executive producer of its election night broadcasts. He conducted the first exit polls for CBS in 1967, and developed the projection and analysis system used successfully by CBS and Voter News Service. He started the CBS News/New York Times Poll in 1975 and directed it for CBS for its first 15 years.

Quin Monson is Assistant Professor of Political Science and Assistant Director of the Center for the Study of Elections and Democracy at Brigham Young University. His PhD is from Ohio State University. His research and teaching are in public opinion; campaigns, elections, and voting behavior; survey research methods; and religion and politics. He co-directs the Utah Colleges Exit Poll with Kelly Patterson. He is the co-editor of Dancing Without Partners: How Candidates, Parties, and Interest Groups Interact in the Presidential Campaign (Rowman and Littlefield, 2007), Electing Congress: New Rules for an Old Game (Prentice Hall, 2007), and The Last Hurrah? Soft Money and Issue Advocacy in the 2002 Congressional Elections (Brookings Institution Press, 2004). His research has also appeared in Political Research Quarterly, Political Analysis, Presidential Studies Quarterly, and the Journal for the Scientific Study of Religion.

Kelly Patterson is associate professor of political Science at Brigham Young University. He is director of the Center for the Study of Elections and Democracy. He teaches and does research on campaigns and elections.

Douglas A Samuelson D.Sc has over 30 years of experience in statistics, operations research, regulation and enforcement, litigation support, and decision and policy analysis. He has been a Federal policy analyst, a successful high-tech inventor, entrepreneur and executive, and a university faculty member. Currently he is President of InfoLogix, Inc., a research and consulting firm in Annandale, Virginia. He has a D.Sc. in operations research from The George Washington University.

Gary Smith has been the Chairman Board of Elections/Director in Forsyth County, Georgia since 2002. Gary has been instrumental in implementing the Diebold DRE voting system across Georgia, and now has 3 years of experience with the system. Gary is also a member of the Georgia Elections Task Force and the HAVA State Planning Committee, and resides on the Georgia Election Officials Association Legislative Committee and is an Executive Board member of the Voter Registrars Association of Georgia. Mr. Smith led the manual count operations.

Tracy Warren, of The Pollworker Institute, has more than 15 years of experience in public policy, with a focus on good government, campaigns and elections and constitutional issues. She was Director for the Constitution Project's Election Reform Initiative, housed at Georgetown University, and currently serves as Executive Director for The Pollworker Institute, a nonpartisan, non-profit organization dedicated to improving booth worker recruitment, training and retention. Since 2002, Warren has worked as a consultant on election reform and implementation of the Help America Vote Act for the U.S. Election Assistance Commission, the International Foundation for Election Systems, the Pew Charitable Trusts and the District of Columbia, among others. Her articles on election issues have appeared in Campaigns and Elections, Elections Today and The National Voter.

Dan Williams is an instructor of Statistics at Brigham Young University and operates DEW-It Research, a statistical consulting and questionnaire design firm, where he consult with various survey research companies, data collection companies, educational entities, and other organizations to design research projects, write survey instruments, design samples, and organize and analyze collected data.

Section I

Election Day Voter Exit Poll Survey

Project Team

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Overview

ESI interviewed Cuyahoga County voters on Election Day, immediately after they departed their polling places. The project's goals were:

1. measure the attitudes of voters towards the voting experience and especially their reactions to new voting technology and processes;

2. provide an assessment of the conditions voters encounter at the polling place, including the length of the lines, the characteristics of the booth workers, and the organization of the polling place.

Key Findings

For most voters there was little or no difficulty using the new touch screen voting equipment, but 10% did have difficulties. The vast majority liked touch screen voting. They had confidence their votes would be correctly recorded. They found it relatively easy to use. And when they needed assistance they got it. Older voters and African-American voters expressed slightly more concern with the voting equipment and indicated they had more difficulties with the machines in general. Nevertheless, over 95% of older voters and nearly 90% of African-American voters found the system easier to use than the previous punch card system.

Observations

Several additional sources of information exist that give more detailed observations of Election Day findings, including observations of exit poll interviewers and exit poll supervisors. This anecdotal information is not addressed within this draft of Initial Exit Poll Findings. The findings herein are an attempt to quantify issues related to the voter experience.

Relevance Of Data

The data reflect voters' attitudes towards voting on Election Day -- their responses were collected immediately upon exiting the polling location. These data do not reflect the performance of internal processes of the election system. Please note that due to rounding error, percentages in the following tables do not always equal 100%.

The Voting Experience

Question A: Voter's Gender

Table 1: Voter's Gender

			TOTAL	Gender			Ethnicity			Which primary did you vote in today?			
				Male	Female	Refused	Non African-American	African-American	Refused	Democratic Primary	Republican Primary	Local issue only	NA
TOTAL	No. of respondents		2,597	1,171	1,364	61	1,897	558	141	1,822	634	104	36
Sex	Male	Col %	45%	100%			48%	37%	44%	42%	54%	40%	63%
	Female	Col %	53%		100%		50%	61%	47%	56%	43%	59%	37%
	Refused	Col %	2%			100%	2%	2%	10%	2%	3%	2%	

Question B: What age group do you belong?

Table 2: Age Group

		TOTAL	Gender			Ethnicity			Which primary did you vote in today?			
			Male	Female	Refused	Non African-American	African-American	Refused	Democratic Primary	Republican Primary	Local issue only	NA
TOTAL	No. of respondents	2,597	1,171	1,364	61	1,897	558	141	1,822	634	104	36
Age	18-24	5%	5%	5%	2%	5%	5%	6%	5%	5%	9%	1%
	25-34	8%	7%	9%	3%	8%	9%	1%	8%	6%	15%	9%
	35-44	16%	17%	17%	2%	17%	17%	11%	16%	17%	23%	4%
	45-54	25%	26%	25%	2%	25%	25%	21%	25%	26%	19%	25%
	55-64	20%	19%	20%	15%	20%	19%	17%	20%	20%	21%	19%
	65+	25%	25%	23%	60%	24%	23%	41%	25%	24%	14%	37%
	Refused	1%	1%	1%	16%	1%	3%	3%	1%	1%		6%

Touch Screen Vs. Punch Cards

When asked to compare the new touch screen voting to their experience with punch card system, 92% said the touch screen voting was better. Only 8% said it was worse. Those who said the system was worse were more likely to be male, older or African-American. However, among all three sub-groups, approximately 90% still found the new system preferable to the punch cards. There were no differences for voters in Cleveland vs. the suburbs, or morning or afternoon voters. And it did not matter which primary they voted in.

Table 3: Touch Screen vs. Punch Cards

			TOTAL	Gender			Ethnicity			Which primary did you vote in today?			
				Male	Female	Refused	Non African-American	African-American	Refused	DEM Primary	REP Primary	Local issue only	NA
TOTAL	No. of respondents		2,432	1,097	1,284	51	1,796	517	118	1,691	609	99	33
How would you compare the touch screen voting system to the punch card system that had been used previously at your polling place?	Touch screen is Much Better	Col %	69%	63%	73%	77%	71%	66%	52%	69%	68%	78%	57%
	Touch screen is Somewhat Better	Col %	23%	26%	20%	19%	22%	23%	27%	23%	25%	15%	15%
	Touch screen is Somewhat Worse	Col %	5%	7%	3%	3%	4%	5%	16%	4%	5%	2%	17%
	Touch screen is Much Worse	Col %	3%	3%	3%		2%	3%	5%	3%	1%	4%	9%
	Did not use touch screen voting system	Col %	0%	0%	0%		0%	0%	0%	0%	0%		
	Have never used punch card system	Col %	1%	2%	1%		1%	2%		1%	1%	1%	2%

Ease Of Use

Most voters (95%) had an easy time using the new voting equipment. African-Americans expressed slightly more difficulty using the machines. Nevertheless, 90% of African-Americans found the system easy to use. Difficulty increased slightly with age of the voter. Of those ages 55 to 64, 6% had some difficulty. This rose to 7% for those 65 or older.

Table 4: Rate ease of use of Touch screen voting system

			TOTAL	Gender			Ethnicity			Which primary did you vote in today?			
				Male	Female	Refused	Non African-American	African-American	Refused	Democratic Primary	Republican Primary	Local issue only	NA
TOTAL	No. of respondents		2,447	1,103	1,292	51	1,804	522	121	1,697	614	101	34
How would you rate the ease of use of the touch screen voting system?	Extremely Easy	Col %	73%	69%	77%	82%	77%	64%	55%	73%	75%	84%	58%
	Somewhat Easy	Col %	22%	25%	19%	18%	20%	26%	34%	22%	21%	12%	24%
	Somewhat Difficult	Col %	4%	5%	2%		2%	7%	5%	4%	3%	3%	3%
	Extremely Difficult	Col %	1%	1%	1%		0%	2%	4%	1%	1%	1%	6%
	Did not use touch screen voting system	Col %	0%	0%	0%		0%	0%	3%	0%			9%

Challenges With Voting

Voters were asked if they had problems using the touch screen voting system. 10% of them said they did. Those having the most problems were African-Americans (19%), those ages 65 or older (16%) and Cleveland voters (13%), which was more than in the suburbs. Only one-third of voters asked for assistance and fully 96% of those who asked received help. Only 4% say they did not.

Polling place workers tried to be helpful by offering assistance before a voter tried to vote (not shown). 73% were offered help beforehand and one-third of the voters said they needed this assistance. The offer of assistance was higher for African-American voters and older voters. 83% of African-Americans were offered assistance, as were 79% of those 65 or older.

Table 5: Any problems using the touch screen voting system?

			TOTAL	Age							Ethnicity			Location	
				18-24	25-34	35-44	45-54	55-64	65+	Ref.	Non African-Amer.	African-Amer.	Ref.	Cleveland	Outside Cleveland
TOTAL		No. of respondents	2,450	119	189	406	615	492	606	22	1,816	515	120	680	1,771
Did you have any problems using the touch screen voting system?	Yes	Col %	10%	8%	9%	9%	7%	10%	16%	28%	8%	19%	17%	13%	9%
	No	Col %	90%	92%	91%	91%	93%	90%	84%	72%	92%	81%	83%	87%	91%

Voter Confidence

There was great confidence among voters that their vote would be correctly recorded by the new Diebold voting machines. Fully 94% felt this way. There was only slight variation among various groups of voters who were not confident their vote would not be correctly counted. African-Americans (7%) were slightly more likely than other voters (5%) to feel this way. Morning voters (7%) were slightly more likely than afternoon voters (5%) to say this. There were no differences between men and women or among age groups, or whether voters were from Cleveland or the suburbs.

Table 6: How confident are you that your vote today will be recorded correctly?

			TOTAL	Gender			Ethnicity			Time of Interview	
				Male	Female	Refused	Non African-American	African-American	Refused	Morning	Afternoon
TOTAL		No. of respondents	2,572	1,158	1,358	56	1,888	548	136	1,260	1,312
How confident are you that your vote today will be recorded correctly?	Very Confident	Col %	61%	60%	62%	81%	65%	53%	44%	60%	62%
	Somewhat Confident	Col %	33%	33%	33%	15%	30%	40%	40%	33%	32%
	Not Very Confident	Col %	4%	5%	3%	5%	3%	4%	12%	4%	4%
	Not Confident At All	Col %	2%	2%	2%		2%	3%	3%	3%	1%
	Was not able to vote	Col %	0%	0%	0%		0%		1%	0%	0%

Finding Their Polling Place

Only a few voters (4%) had trouble finding their polling places. No group had more trouble than any other.

Table 7: Any trouble finding your polling place?

			TOTAL	Gender			Age							Ethnicity		
				Male	Female	Refused	18-24	25-34	35-44	45-54	55-64	65+	Refused	Non African-American	African-American	Refused
TOTAL	No of respondent		2,580	1,168	1,355	57	125	202	428	645	515	640	26	1,894	551	136
Did you have any trouble finding your polling place today?	Yes	Col %	4%	3%	4%	9%	3%	3%	4%	4%	2%	4%	12%	3%	3%	16%
	No	Col %	96%	97%	96%	91%	97%	97%	96%	96%	98%	96%	88%	97%	97%	84%

Previous Voting

Most voters (96%) had voted previously in Cuyahoga County. Only 2% were first time voters and another 2% voted previously outside the county. The first time voters in this election were brought out mostly by the local issues on the ballot. 12% of the voters who said they only voted for local issues were voting for the first time.

Table 8: Where and when did you last vote?

			TOTAL	Gender			Age							Ethnicity		
				Male	Female	Refused	18-24	25-34	35-44	45-54	55-64	65+	Ref.	Non African-Amer.	African-Amer.	Ref.
TOTAL	No. of respondents		2,543	1,148	1,342	52	125	199	422	642	510	623	23	1,877	534	132
Before today's election, where and when had you last voted?	Cuyahoga County	Col %	96%	96%	96%	98%	70%	91%	95%	97%	99%	99%	93%	96%	94%	99%
	Not in Cuyahoga County	Col %	2%	2%	2%		1%	4%	3%	2%	0%	1%	7%	2%	3%	
	This is my first time voting	Col %	2%	3%	2%	2%	29%	5%	1%	0%	0%	0%		2%	3%	1%

Voter Identification

21% of the voters were asked for some form of identification at the polling place. Younger voters were asked more often. 32% of those under age 35 were questioned, as were 31% of African-Americans, but only 18% of non African-Americans. Identification was requested more in Cleveland (35%) than in the suburbs (16%). The most popular form of identification used by those asked was a driver's license (71%). Only 1% showed a utility bill. 21% used some other form of identification. The identification offered was accepted in almost all cases (96%). No group was turned down more than any other.

Table 9: Asked for Identification?

			TOTAL	Age							Ethnicity			Location	
				18-24	25-34	35-44	45-54	55-64	65+	Refused	Non African-American	African-American	Refused	Cleveland	Outside Cleveland
TOTAL	No. Of Respondents		2,509	123	202	422	636	498	601	27	1,894	558	57	717	1,793
Were you asked to present any identification when you went to vote today?	Yes	Col %	21%	36%	29%	20%	21%	16%	21%	25%	18%	31%	34%	35%	16%
	No	Col %	79%	64%	71%	80%	79%	84%	79%	75%	82%	69%	66%	65%	84%

Table 10: Type of Identification Request

			TOTAL	Gender			Ethnicity			Which primary did you vote in today?			
				Male	Female	Refused	Non African-American	African-American	Refused	Democratic Primary	Republican Primary	Local issue only	NA
TOTAL	No. of respondents		535	254	265	16	344	171	20	392	115	16	13
What form of identification did you provide?	Drivers license	Col %	71%	73%	70%	76%	69%	78%	63%	73%	67%	82%	46%
	Utility bill	Col %	1%	3%			2%			1%	1%	7%	
	Other	Col %	20%	17%	24%	19%	22%	17%	18%	19%	27%	5%	17%
	Refused	Col %	7%	8%	6%	4%	7%	6%	19%	7%	4%	6%	37%

Provisional Ballots

Fewer than 5% of voters claimed they used provisional ballots. There was a higher share among those who voted in the Democratic (5%) primaries than the Republican (3%). Only 2% of those who voted only for local issues used provisional ballots.

Table 11: Provisional Ballots

			TOTAL	Sex			Ethnicity			Which primary did you vote in today?			
				Male	Female	Refused	Non African-American	African-American	Refused	Democratic Primary	Republican Primary	Local issue only	NA
TOTAL	No of respondents		2,586	1,168	1,361	57	1,894	556	136	1,812	634	104	36
Did you vote today using a provisional paper ballot?	Yes	Col %	4%	5%	4%	9%	4%	5%	11%	5%	3%	2%	4%
	No	Col %	96%	95%	96%	91%	96%	95%	89%	95%	97%	98%	96%

Methods Statement

ESI recruited the services of Edison Media Research and Mitofsky International as well as the Center for the Study of Elections and Democracy (CSED) at Brigham Young University to assist in the conduct of the exit survey. The exit poll was conducted at a scientific sample of 50 polling places among 2,597 voters. Each interviewer was instructed to approach all voters exiting the polling place after they had voted.

The polling places are a stratified probability sample of Cuyahoga County. Within each polling place an interviewer approached every voter as he or she exited the polling place. An average of 52 voters completed a questionnaire at each sample polling place.

All samples are approximations. A measure of the approximation is called the sampling error. Sampling error is affected by the design of the sample, the characteristic being measured and the number of people who have the characteristic. If a characteristic is found in roughly the same proportions in all precincts the sampling error will be lower. If the characteristic is concentrated in a few precincts the sampling error will be larger. Gender would be a good example of a characteristic with a lower sampling error. Characteristics for minority racial groups will have larger sampling errors.

For this exit poll the table below lists typical sampling errors for given size subgroups for a 95% confidence interval. A typical sampling error for a result based on the full sample is +/- 3 percentage points. The values in the table should be added and subtracted from the characteristic's percentage in order to construct an interval. 95% of the intervals created this way will contain the value that would be obtained if all voters were interviewed using the same procedures. Other factors, including non-response, are likely to increase the total error.

Error Due to Sampling

All sampling methodologies, including this exit poll, produce results that have the potential for "sampling error." There are other potential sources of error due to voter non-response or non-comprehension of survey questions, etc. The "sampling error" can be calculated based upon the number of voters in that specific sub-group interviewed.

Table 12: Calculating error due to sampling

Sample Size	100	101-200	201-500	501-950	951-2350	2351-5250
Percent of Voters with Characteristic	Number of Voters in Base of Percentage (+/-%)					
5% or 95%	9	6	4	3	2	2
15% or 85%	14	10	7	5	3	2
25% or 75%	17	12	8	6	4	3
50%	20	14	10	7	5	3

For example, 49% of women said they needed help when they were offered it by a polling place worker. There were a total of 1,298 women voters in the exit poll. A sample size of 1,298 is between 951 and 2,350 in the table below. The 49% who said they needed help is closest to 50% in the table below. The intersection of the column with 1,298 and the row closest to 49% shows an error due to sampling of +/- 5 percentage points. Repeated exit polls would produce a result 95% of the time between 49% +/- 5%, or 44% to 54%.

Comparison to Unofficial Vote

The exit poll appears to be a reasonable estimate of all voters casting votes at polling locations in Cuyahoga County on May 2, 2006. The results from our exit poll, which do not include absentee votes, and the unofficial vote without the absentee votes posted by the Board of Elections on its web site, are all relatively close to each other.

Cuyahoga County Vote – May 2, 2006

Table 13: Democratic Governor

Democratic Governor	Exit Poll	Vote Count	Difference
Strickland	71.3%	71.9%	-0.6%
Flannery	28.7%	28.1%	0.6%

Table 14: Republican Governor

Republican Governor	Exit Poll	Vote Count	Difference
Petro	52.7%	56.3%	-3.6%
Blackwell	47.3%	43.7%	3.6%

Table 15: Democratic Senate

Democratic Senate	Exit Poll	Vote Count	Difference
Brown	91.0%	86.1%	4.9%
Keiser	9.0%	13.9%	-4.9%

Table 16: Republican Senate

Republican Senate	Exit Poll	Vote Count	Difference
DeWine	76.3%	80.7%	-4.4%
Pierce	13.6%	10.6%	3.0%
Smith	10.1%	8.7%	1.4%

The estimates are affected by the sample size, the overall response rate of 49% and that the "how voted" questions were at the end of our survey and not at the beginning as is usually done for elections. About 25% of those who filled out the questionnaires chose not to tell us for whom they had voted.

The 49% response rate in Cuyahoga County on Tuesday compares to the 44% response rate for the exit poll in the State of Ohio in November 2004 and the 53% response rate for the national exit poll that year.

Section 2

Post Election Survey of Booth workers & Election Day Technicians

Project Team

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Overview

To gain additional perspective on the election system, ESI surveyed Booth Workers and Election Day Technicians shortly after Election Day. Our focus was to understand: (i) how well the new Diebold DRE voting system met voters' needs on Election Day; (ii) how the new Diebold DREs and Optical Scan voting machines functioned as specified on Election Day; (iii) what types of difficulties occurred in the field on Election Day; (iv) how booth workers coped with Election Day issues; (iv) what capacity the booth workers possessed to mitigate election-day issues in a timely manner; (v) and how their training prepared them to address election-day challenges.

General Approach

ESI interviewed by telephone a random sample of Booth Workers (booth workers, judges, and presiding judges) and Election Day Technicians in order to collect data on the performance of the election system from the perspective of the booth worker. Specifically:

- ESI collaborated with the Cuyahoga BOE to produce post-election survey questionnaires specifically designed for Cuyahoga County Election Day Technicians and Booth Workers.
- ESI sent letters to all Election Day Technicians and Booth Workers, who were scheduled to work during the May 2nd election, notifying them that they may receive a survey telephone call.
- ESI then telephoned and conducted interviews with 527 Election Day Technicians and Booth Workers.

Methodology

A full list of approximately 5,800 election workers was obtained from the County. The list was divided by random assignment into 11 replicates of just over 500 each. The first two replicates were selected for participation in the survey. Prior to calling the election workers, the County sent an advance letter alerting potential survey respondents to the project and requesting their cooperation.

The questionnaire was developed after consultation with personnel at the Board of Elections, a review of County training materials, consultation of other booth worker surveys, and based on observations while conducting exit polling on Election Day.

A pilot survey was conducted on May 19 to test the questionnaire on a small number of booth workers. Some minor changes were made to the questionnaire as a result of the pilot. The survey was conducted from Tuesday May 23rd until Saturday May 29th. A total of 527 interviews were completed for a response rate (the proportion of eligible respondents participating) of 54% and a cooperation rate (the proportion of eligible respondents actually contacted that agreed to participate) of 85%. The interviews, which lasted an average of 19 minutes each, were conducted Promark Research Corporation of Houston, Texas.

The "sampling error" for each question can be calculated based on the number of respondents interviewed. For most questions asked of the entire sample of 527 the margin of sampling error is approximately plus or minus 4%. It should also be noted that there are other potential sources of error that can be caused by non-response, non-comprehension of the survey questions, or other factors.

Findings

Summary of Findings

In general, the following was found:

- The overwhelming majority of booth workers, like voters, generally approves of the new machines and has confidence in them.
- Many booth workers were recruited to work as a booth worker by another booth worker. Booth workers state that they are strongly motivated by their sense of civic responsibility and duty as well as the opportunity to work alongside friends.
- The booth workers generally expressed satisfaction with their job. Seventy-eight percent were at least "somewhat satisfied" with their experience on Election Day. Ninety-two percent of booth workers said they are likely to work again in November.
- About one third of booth workers said they had difficulty setting up the machines and 45% said they had difficulty "closing out" the machines at the end of the day. Specifically, 38% had some difficulty with the printers and/or paper spools.
- Once the machines were up and running, less than a quarter of the booth workers appear to have had many difficulties with them throughout the day.
- Forty-one percent of booth workers noticed differences between how they learned to use the machines in training and how the machines operated on Election Day. Of that 41%, a large majority (74%) thought the training and actual procedures were either "a lot different" or "somewhat different."
- 53% of election workers also expressed concern that training on election law and administrative procedures was inadequate.
- 51% disagreed that the training provided them with enough information to do their job well; 57% disagreed that they had enough hands-on practice with the voting machine.
- 63% of booth workers and judges agreed that the Election Day Technician "was able to solve technical difficulties with the touch screen machines."
- About half of the booth workers attempted to call the command center during the day on Election Day. 35% of those callers were able to speak to someone on the first try.

Issues requiring Attention

The data also suggest some areas to concentrate on for improvement including:

- The booth workers overwhelmingly saw the need for better training. Improved training will increase job satisfaction of booth workers and decrease the number of issues reported by booth workers on Election Day. Changes to training should include more hands on training and practice with the new equipment, especially regarding the procedures for setting up and closing down at the end of the day.
- Better election-day support so that issues that occur can be dealt with more quickly. The report below includes data on the type and frequency of problems, but one overarching issue that emerged in the comments from booth workers regarded the difficulty in accessing help and some lack of responsiveness up the line when problems were reported.
- Booth worker recruitment efforts that bring in new booth workers that possess a higher comfort level with computers and technology that will better facilitate the use of the touch screen voting machines as well as enough experience and maturity to handle the complexity of changing election laws and procedures.

Who are the Election-Day Workers?

This section briefly describes the demographic characteristics of the booth workers (Presiding Judges, Judges, and Booth Workers) who comprised 90% of the survey sample and the Election-Day Technicians (EDTs) who were 10% of the sample.

As displayed in the table below, election workers in Cuyahoga County are quite different from the general population in Cuyahoga County. Compared to the county as a whole, booth workers are disproportionately older women. They have a mean age of 66 and a median age of 69 while the mean and median for EDTs were both 55. The median age of the county is only 37. Only 29% of the booth workers are male and 45% of the EDTs are male while the county population is 47% male. Sixty-two percent of the booth workers are retired compared to only 35% of the EDTs. Only 20% of the booth workers are employed full or part time compared to 52% of the EDTs.

In terms of race, the booth workers approximate the county population. Sixty-seven percent of booth workers and 62% of EDTs are white, approximating the county proportion. Thirty percent of booth workers and 37% of EDTs are African American, again approximating the county proportion of 27%.

Booth workers have somewhat higher levels of education than the adult population of Cuyahoga County with 94% of the booth workers having completed at least a high school education compared to 82% of the adult population the county. About a quarter of election workers and the general population have a college degree. The EDT's in this sample have an even higher rate of high school education (100%) with nearly 40% having a college degree. EDTs are also more likely to report higher levels of family income.

Not surprisingly, most booth workers have tremendous prior experience as election workers. Only 12% have worked one or fewer elections prior to May 2nd compared to 39% of EDTs. The median number of prior elections worked was 10 for booth workers and only 2 for EDTs.

Large differences emerged between booth workers and EDTs in terms of their comfort level with computers. A minority of booth workers reported feeling "very comfortable" using a computer. Seventy-seven percent of EDTs feel very comfortable and 23% feel "somewhat comfortable"—somewhat surprising given the job description required some technical skill. Twenty-one percent of booth workers report being "not very comfortable" or "not at all comfortable" with computers.

Table 17: Booth Worker Demographics

	Cuyahoga County Population (US Census)[3]	Election Workers (includes booth workers, judges, and presiding judges)	Election Day Technicians
Median Age	37	69	55
% completed High School	81.6	93.8	100
% completed 4 or more years of college	25.1	26.7	39.7
% male	47.2	29.0	45.3
% employed	58.6	20.3	51.9
% white	67.4	67.4	61.5
% African American	27.4	30.0%	36.5%
Median number of elections worked	NA	10	2

Motivation and Recruitment

The survey makes it possible to investigate the motivations of the election workers and how they were recruited. These pieces of information can provide clues about how to recruit and train booth workers in the future.

The booth workers state that they are strongly motivated by their sense of civic responsibility and duty as well as the opportunity to work alongside friends. The survey listed ten possible reasons why they decided to be an election worker (Q8A-Q8J). Three stood out as especially important. They are:

- "I think it is my duty as a citizen" (74% very important)
- "I am the kind of person who does my share" (81% very important)
- "I can be with people I enjoy" (54% very important)

[3] http://factfinder.census.gov/servlet/SAFFFacts?_event=Search&_lang=en&_sse=on&geo_id=05000US39035&_county=Cuyahoga%20County

None of the other possible reasons included in the survey received over 40% "very important."

One potential motivator for becoming a booth worker is the pay. Booth workers are paid a modest stipend for their long hours. Overall only 38% of election workers say that "I wanted to make some extra money" is "very important" to their decision to become a booth worker. As the table below shows, election workers with lower incomes place a higher importance on the money. Fifty-two percent of election workers with total annual incomes below $20,000 said the extra money was "very important."

Q8g I wanted to make some extra money. PROMPT IF NECESSARY Please tell me if this was very important, somewhat important, not very important, or not at all important to your decision to be an election worker.

Table 18

	Q32 Which of the following income groups includes your TOTAL FAMILY INCOME in 2005 before taxes...						
	Up to $20,000	$20,000 to less than $30,000	$30,000 to less than $40,000	$40,000 to less than $50,000	$50,000 to less than $75,000	$75,000 to less than $100,000	$100,000 or more
Very important	66	30	21	10	14	2	4
	52.4%	38.5%	33.3%	21.7%	35.9%	8.3%	26.7%
Somewhat important	45	29	23	22	11	9	5
	35.7%	37.2%	36.5%	47.8%	28.2%	37.5%	33.3%
Not very important	7	12	9	7	5	8	5
	5.6%	15.4%	14.3%	15.2%	12.8%	33.3%	33.3%
Not at all important	8	7	10	7	9	5	1
	6.3%	9.0%	15.9%	15.2%	23.1%	20.8%	6.7%
Total	**126**	**78**	**63**	**46**	**39**	**24**	**15**
	100.0%	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Retirees were no more likely to be motivated by the extra money than those employed full or part time, but students and those who were unemployed or looking for work appear more motivated by the money. Nearly a majority of student workers (47%) said the extra income was "very important" and 71% of unemployed workers said the money was "very important."

The method of recruitment is another important factor in staffing elections. Thirty-seven percent of the election workers were recruited by another worker (Q11—see recoded responses in appendix). Recruitment by political party or board of election officials is named by 23%. Job postings appear to be less effective with only 7% naming an official job posting by the county and another 5% responding to an ad or report in the media. More election workers simply volunteered on their own (13%) than responded to job postings or advertisements.

However, one notable trend is that while the proportion of election workers recruited by job postings and advertising is relatively low, the table below is suggestive of the possibility of recruiting a different type of booth worker through job postings. Those workers recruited through ads and job postings appear to be different from the other election workers. The table below shows that 32% of election workers who are recruited through a job posting have full time employment and only about a third of them are retired. A much lower proportion of

those recruited by other election workers (12%) or political party officials (19%) are employed full time. In contrast, large majorities of those recruited through the political parties or other election workers are retired.

Q27 How would you describe your employment status? Are you employed full time, employed part time, looking for work, a student, a homemaker, or retired?

Table 19

	Q11 How were you first recruited as a booth worker?							
	Volunteered / pursued it on my own	BOE or political party official	Another booth worker, judge, or EDT	An ad in the local media	A teacher or professor	A job fair or official job posting by the county	A friend, family member	Other way (specify)
Employed full time	4	21	22	1	0	11	5	3
	6.3%	18.6%	12.2%	4.0%	.0%	32.4%	9.6%	18.8%
Employed part time	7	5	21	3	1	5	4	3
	11.1%	4.4%	11.6%	12.0%	16.7%	14.7%	7.7%	18.8%
Unemployed	6	7	8	2	0	5	7	0
	9.5%	6.2%	4.4%	8.0%	.0%	14.7%	13.5%	.0%
Student	1	3	3	1	3	0	2	0
	1.6%	2.7%	1.7%	4.0%	50.0%	.0%	3.8%	.0%
Homemaker	3	8	13	2	0	1	9	1
	4.8%	7.1%	7.2%	8.0%	.0%	2.9%	17.3%	6.3%
Retired	42	69	114	16	2	12	25	9
	66.7%	61.1%	63.0%	64.0%	33.3%	35.3%	48.1%	56.3%
Total	**63**	**113**	**181**	**25**	**6**	**34**	**52**	**16**
	100.0%	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Different recruitment methods can also bring booth workers with much higher comfort levels with computers. The table below shows that on average the booth workers recruited through official job postings had a much higher comfort level with computers as did the very small number recruited by a teacher.

Q29 Generally speaking, how comfortable do you feel using a computer...

Table 20

	Q11 How were you first recruited as a booth worker?							
	Volunteered / pursued it on my own	BOE or political party official	Another booth worker, judge, or EDT	An ad in the local media	A teacher or professor	A job fair or official job posting by the county	A friend, family member	Other way (specify)
Very comfortable	27	48	70	9	5	26	26	7
	45.0%	43.2%	39.5%	42.9%	83.3%	78.8%	52.0%	43.8%
Somewhat comfortable	18	41	75	7	1	6	14	8
	30.0%	36.9%	42.4%	33.3%	16.7%	18.2%	28.0%	50.0%
Not very comfortable	5	9	6	3	0	1	8	1
	8.3%	8.1%	3.4%	14.3%	.0%	3.0%	16.0%	6.3%
Not comfortable at all	10	13	26	2	0	0	2	0
	16.7%	11.7%	14.7%	9.5%	.0%	.0%	4.0%	.0%
Total	**60**	**111**	**177**	**21**	**6**	**33**	**50**	**16**
	100.0%	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

The survey also examined the kinds of problems booth workers encountered on Election Day. A more detailed analysis of these problems appears later in this report, however it is worth noting here that booth workers recruited by other booth workers or by a political or party officials all experienced problems at about the same rate. A group recruited through one method did not seem to be more susceptible to problems as a group of booth workers recruited by some other means.

Overall, the booth workers are a highly motivated group and have a strong desire to do their share out of a sense of civic duty. Monetary concerns seem to be of secondary importance to the stronger motivations of civic duty. While most booth workers are recruited by other workers or party officials, the increased technological demands of the touch screen voting equipment require more technical expertise. The small proportion of workers recruited through teachers and official job postings self-reported a much higher comfort level with computers. These methods could be explored further in an attempt to recruit a higher proportion of computer savvy election workers.

Job Satisfaction and Retention

Booth workers are a critical link in the delivery of a smooth and efficient election. It is important for the County to recruit and retain a capable and satisfied cadre of booth workers to ensure success on Election Day. When asked how likely they are to work in the November election (Q10), 92% said they are very likely or somewhat likely to work in November. However, 28% of the booth workers indicated that at some point during the training process they considered not working on Election Day (Q9). Most of these concerns can be alleviated by increasing the booth workers' comfort level with the new voting machines through better training (see below).

The workers at the polls generally expressed satisfaction with their job. Seventy-eight percent (Q3) were at least "somewhat satisfied" with their experience on Election Day. Satisfaction is important because it appears to be part of the motivation that brings workers back to work in subsequent elections. For example, in the table below, of those who were "very dissatisfied" with their job as an election worker, a majority (53%) considered not working at the polls on Election Day. The proportion who considered not working goes down as satisfaction increases until it reaches 18% of those who were "very satisfied" with their job as an election worker.

Q9 At any time during the training and recruiting process, did you consider not working at the polls on Election Day?

Table 21

	Q3 Overall, how satisfied are you with your job as an election worker in Cuyahoga County...			
	Very satisfied	Somewhat satisfied	Somewhat dissatisfied	Very dissatisfied
Yes	38	59	29	16
	18.0%	30.7%	37.2%	53.3%
No	173	133	49	14
	82.0%	69.3%	62.8%	46.7%
Total	**211**	**192**	**78**	**30**
	100.0%	**100.0%**	**100.0%**	**100.0%**

Likewise, job satisfaction appears to influence the likelihood of election workers returning to work in future elections. As shown in the table below, as job satisfaction goes from "very satisfied" to "very dissatisfied" the proportion of election workers saying they will return to work in November decreases from 88% to 47%.

Q10 How likely are you to work as a booth worker in the elections this coming November...

Table 22

	Q3 Overall, how satisfied are you with your job as an election worker in Cuyahoga County...			
	Very satisfied	Somewhat satisfied	Somewhat dissatisfied	Very dissatisfied
Very likely	189	131	36	14
	87.9%	67.9%	46.8%	46.7%
Somewhat likely	21	48	32	7
	9.8%	24.9%	41.6%	23.3%
Not very likely	4	9	7	3
	1.9%	4.7%	9.1%	10.0%
Not at all likely	1	5	2	6
	.5%	2.6%	2.6%	20.0%
Total	**215**	**193**	**77**	**30**
	100.0%	**100.0%**	**100.0%**	**100.0%**

Employment status appears to have some relationship to job satisfaction (table not shown). Discounting students (there are only 15 in the sample), retired persons were more likely to say they are dissatisfied with their experience as an election worker. Close to 27% of retirees are somewhat or very dissatisfied. Over 90% of individuals employed full time and 88% of individuals employed part time state that they are at least "somewhat satisfied" with their job as an election worker.

The analysis that follows focuses on the relationship between concerns election workers reported and their overall levels of job satisfaction. The table below shows that individuals who strongly agreed the booth worker training prepared them well for Election Day also expressed the highest job satisfaction. Almost 72% of individuals who "strongly agreed" that the training prepared them well said they were very satisfied with their job. Only 24% of election workers who "strongly disagreed" that the "training prepared them well" said they were "very satisfied."

Q3 Overall, how satisfied are you with your job as an election worker in Cuyahoga County...

Table 23

	Q16i The training prepared me well for Election Day.			
	Strongly agree	Agree	Disagree	Strongly disagree
Very satisfied	51	86	50	24
	71.8%	50.6%	28.9%	24.2%
Somewhat satisfied	17	63	77	36
	23.9%	37.1%	44.5%	36.4%
Somewhat dissatisfied	3	17	37	22
	4.2%	10.0%	21.4%	22.2%
Very dissatisfied	0	4	9	17
	.0%	2.4%	5.2%	17.2%
Total	**71**	**170**	**173**	**99**
	100.0%	**100.0%**	**100.0%**	**100.0%**

The experience on Election Day is also related to the satisfaction election workers express. A series of survey questions measured the problems the election workers experienced on Election Day (Q23a-i). Not surprisingly, election workers who experienced the fewest problems are also the most satisfied workers. Nearly 60% of workers that didn't report any problems said they were "very satisfied." The proportion of individuals reporting they are "very satisfied" drops as the number of problems increases. Only 31% of booth workers saying they experienced two or more problems said they were "very satisfied" with their job.

Q3 Overall, how satisfied are you with your job as an election worker in Cuyahoga County...

Table 24

	Count of the number of problems (Q23a – i)		
	Zero	One	Two or more
Very satisfied	89	49	80
	59.7%	43.4%	30.9%
Somewhat satisfied	46	45	103
	30.9%	39.8%	39.8%
Somewhat dissatisfied	12	15	52
	8.1%	13.3%	20.1%
Very dissatisfied	2	4	24
	1.3%	3.5%	9.3%
Total	**149**	**113**	**259**
	100.0%	**100.0%**	**100.0%**

Satisfaction with the job is important for retention of election workers and it is vital to retaining an experienced and trained cadre of election workers. The survey results indicate that the satisfaction the election workers express could be raised by making improvements to the training process and focusing on efforts to minimize problems at the polls on Election Day. In turn, these improvements would likely increase retention and reduce absenteeism on Election Day.

Training

Effective training is a key factor in satisfaction and retention. Concerns by election workers over the quality and amount of training surfaced in several survey questions and should be a major focus of the County leading into the fall election.

Of the election workers who considered not working on Election Day (Q9) the largest proportion (48%) named concerns about the training as their top reason (Q9a). As a group, the election workers are not only civic-minded, but they are also dedicated to doing their jobs well. Nearly a third of the election workers attended more than one pre-election training session (Q13) and the training materials and DVD were widely read prior to Election Day (Q14A and Q15A).

However, the election workers wanted better training and instruction before Election Day than they received. When they were asked a series of questions about the training, only a narrow majority (51%) disagreed that the training provided them with enough information to do their job well (Q16A), a majority (57%) disagreed that they had enough hands-on practice with the voting machine (Q16B), and large majorities disagreed with statements suggesting that the training sessions were too long (Q16D) or boring (Q16E).

Another significant concern is that many election workers thought that the training differed significantly from the experience they had on Election Day. When asked if they noticed differences between how they learned to use the voting machines in training and how the voting machines operated on Election Day 41% said yes (Q17). Of those that said yes, a large majority (74%) thought the training and actual procedures were either "a lot different" or "somewhat different" (Q17A). This finding suggests that training materials do not accurately or adequately represent how the machines operate and the likely scenarios for Election Day.

The need to develop new training materials and to pass along this information to a group of experienced election workers presented a series of challenges. Less than a majority (48%) of all election workers agreed that the training provided them with enough information to do their jobs well. The table below displays agreement with the statement "The training session provided me with enough information to do my job well" by age category of the booth worker. Younger election workers may have had a less difficult time because of familiarity with technology and because they did not need to learn a different set of procedures. Large majorities of the election workers in the younger age groups agreed that the training session provided them with enough information. The number drops to below a majority for every age group 65 years old and older.

Q16a The training session provided me with enough information to do my job well. PROMPT IF NECESSARY Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree? (collapsed into Agree/Disagree)

Table 25

	Election Worker Age Group							
	18–24	25–34	35–44	45– 54	55–64	65–74	75–84	85+
Agree	8	6	20	46	48	61	52	8
	66.7%	75.0%	64.5%	62.2%	52.2%	37.9%	41.3%	47.1%
Disagree	4	2	11	28	44	100	74	9
	33.3%	25.0%	35.5%	37.8%	47.8%	62.1%	58.7%	52.9%
Total	**12**	**8**	**31**	**74**	**92**	**161**	**126**	**17**
	100.0%	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

The importance of improved training is not confined solely to the use of the touch screen machines. The election workers need to know election law and how it applies in particular situations. Preparation for the use of the new machines was coupled with changes in election procedures and law. Thirty-five percent of election workers agreed that they were not sure they were doing their jobs correctly "because the laws keep changing." As the table below shows, this uncertainty is more concentrated among older election workers. As age increases, workers more readily agree that constant changes in election law decrease their ability to do their job correctly. This is presumably because they must forget old practices and learn new ones and are unable rely as much on their past experience.

Q16g Sometimes I am not sure I am doing my job correctly because the laws keep changing. PROMPT IF NECESSARY Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree? (collapsed into Agree/Disagree)

Table 26

	Election Worker Age Group							
	18–24	25–34	35–44	45–54	55–64	65–74	75–84	85+
Agree	2	3	9	23	27	52	49	7
	16.7%	37.5%	31.0%	32.9%	32.9%	33.8%	40.8%	46.7%
Disagree	10	5	20	47	55	102	71	8
	83.3%	62.5%	69.0%	67.1%	67.1%	66.2%	59.2%	53.3%
Total	**12**	**8**	**29**	**70**	**82**	**154**	**120**	**15**
	100.0%	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

The survey does contain some evidence that older election workers faced different challenges during training than younger workers. Overall, 55% of respondents either "strongly agree" or "agreed" with the statement "The training was easy to understand." As the table below shows, narrow majorities of the groups of election workers over age 65 disagreed with the statement while large majorities of younger workers agreed.

Q16h The training was easy to understand. PROMPT IF NECESSARY Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree? (collapsed into Agree/Disagree)

Table 27

	Election Worker Age Group							
	18–24	25–34	35–44	45–54	55–64	65–74	75–84	85+
Agree	10	6	24	49	59	76	54	8
	76.9%	75.0%	77.4%	66.2%	65.6%	47.8%	43.5%	47.1%
Disagree	3	2	7	25	31	83	70	9
	23.1%	25.0%	22.6%	33.8%	34.4%	52.2%	56.5%	52.9%
Total	**13**	**8**	**31**	**74**	**90**	**159**	**124**	**17**
	100.0%	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

A very similar pattern is evident in the relationship between age group and level of agreement with the statement "The training prepared me well for Election Day" (Q16i). A minority of all respondents agreed with the statement but as the table below shows, a large majority of election workers under age 55 agreed with the statement while the majority of those over 65 disagreed with the statement.

Q16i The training prepared me well for Election Day. PROMPT IF NECESSARY Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree? (collapsed into Agree/Disagree)

Table 28

	Election Worker Age Group							
	18–24	25–34	35–44	45–54	55–64	65–74	75–84	85+
Agree	10	4	19	44	45	65	48	8
	76.9%	57.1%	63.3%	59.5%	48.4%	40.1%	39.0%	47.1%
Disagree	3	3	11	30	48	97	75	9
	23.1%	42.9%	36.7%	40.5%	51.6%	59.9%	61.0%	52.9%
Total	**13**	**7**	**30**	**74**	**93**	**162**	**123**	**17**
	100.0%	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Overall, the election workers expressed some reservations about the quality of the training they received. The new machines, the changes in election law and procedures, and general perception that the training they received was inadequate created uncertainty in their minds. This is particularly true of the older election workers. Consequently, in addition to improving the overall content of the training, consideration should be given to calibrating the training so that it meets the needs of the various groups of election workers on which the election process depends. In particular, the election workers expressed a desire for more opportunities for practice with the touch screen machines. Only 42% of all election workers agreed with the statement "I was able to spend enough time doing hands-on practice with the voting machines" (Q16b). Only 16% "strongly agreed" with this statement.

At the end of the survey, respondents were given the opportunity to voice any additional concerns they had about the survey or their jobs as booth workers. Even after being on the phone with an interviewer for an average of 19 minutes, nearly one in five respondents chose to share additional comments with an interviewer. The vast majority of these comments did not address the survey content; rather, they addressed complaints about being a booth worker and offered suggestions for improvement. Most of these comments focused on the training and how ill-prepared the workers felt they were for Election Day.

Sampling of comments from election workers regarding training

> "Everything in training was a rush job. My instructor was a very good instructor, but it was difficult to keep up with the amount of workers and each individual. I think there should have been individual attention…"

> "I need more training. We need more training. All of us. I went back afterwards--most people just went one time. [Interviewer probed for additional comments] No I think that's it. The main thing is just training."

> "…the hours were long and the pay was very low and the meeting was long and hard to understand and it would've been better if we had actual hands-on practice."

"The people that did the training weren't trained enough because the three women giving training, one will tell you one thing and another will come over and tell something different, I found that a little frustrating."

"I had no hands on experience before the election. At the two sessions I attended there were not enough machines and too many people…"

"I would like to have more classes to be thorough on how to work the machines well on Election Day. Basically, have a class where they could answer the question that I may have on working the machines, instead of guessing my own answers."

"The trainings were poorly executed and the instructors were poor. They stunk. That caused a lot of problems that occurred there. I knew what [I] was doing but we lost a lot of older people."

"I wish they [had] show[ed] us more how to zero out the machines. I wish they [had] sent someone that knew more about the machines. I [knew] more than the trainer. The problem I had was the zero machines--they should have [spent] more time on the zero [machines]."

"…Most of the workers I worked with didn't have a thorough understanding of the process."

"People were confused on setting up the machines. There wasn't enough training."

Election-Day Experience

Overall, Cuyahoga County booth workers gave high marks to the new voting machines, confirming positive evaluation of voters in the exit poll results. An extremely high proportion of the booth workers (87%) and voters (94%) expressed confidence that votes in the May 2nd primary were recorded correctly. The booth workers and voters also gave comparably high ratings when comparing the new touch screen voting machines to the punch card system with 90% and 92% of booth workers and voters rating the new system as much better or somewhat better.

Table 29: Rating the new voting system

Question	Booth workers	Voters (exit poll)
How confident are you that votes in the May 2nd primary were recorded correctly? (booth worker Q6) How confident are you that your vote today will be recorded correctly? (exit poll question G) % very confident or somewhat confident	87%	94%
How would you compare the touch screen voting system to the punch card system that had been used previously at your polling place? (booth worker Q7 and exit poll question J) % much better or somewhat better	90%	92%

The booth workers received positive feedback about the new touch screen machines from voters, with 94% of booth workers agreeing with the statement that "Generally speaking, voters were satisfied with the touch screen voting machines" (Q18D) and 92% of booth workers agreeing with the statement that "Most voters had no problems using the touch screen voting machines" (Q18F). These findings confirm the widespread public satisfaction and ease of use expressed by voters in the exit poll conducted by ESI.

Most of the problems experienced by booth workers on Election Day occurred at the beginning and end of the day. A majority said that there were problems setting up the machines (Q18A) and shutting them down (Q18B). Asked later in the survey about their own experience, about a third of booth workers said they had difficulty setting up the machines (Q23A) and 45% said they had difficulty "closing out" the machines at the end of the day (Q23I). Specifically, the printers and paper spools (Q23C, Q23D, and Q23E) appear to have caused some difficulty.

The setting up and closing out of the machines in the May primary required skills that election workers did not need in prior elections. It is quite possible that individuals who possess skills and experience with computers encounter fewer difficulties completing such tasks. As shown in the table below, the individuals who do not feel "comfortable at all" are most likely to agree that there are setup problems. But this proportion is not much larger than it is for individuals who feel "very comfortable" (25.5% to 22.6%).

Q18a Thinking back on your experience during Election Day on May 2nd, please tell me whether you agree or disagree with each of the following statements...The first one is: <u>There were problems with setting up the touch screen voting machines.</u> Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

Table 30

	q29 Generally speaking, how comfortable do you feel using a computer...			
	Very comfortable	Somewhat comfortable	Not very comfortable	Not comfortable at all
Strongly agree	51	36	4	14
	22.6%	20.5%	12.1%	25.5%
Agree	73	58	14	20
	32.3%	33.0%	42.4%	36.4%
Neither	3	3	1	1
	1.3%	1.7%	3.0%	1.8%
Disagree	58	51	11	16
	25.7%	29.0%	33.3%	29.1%
Strongly disagree	41	28	3	4
	18.1%	15.9%	9.1%	7.3%
Total	**226**	**176**	**33**	**55**
	100.0%	**100.0%**	**100.0%**	**100.0%**

As shown below, a more pronounced trend emerges when examining the problems associated with "shutting down the touch screen machines at the end of the day." Thirty-eight percent of those "not comfortable at all" strongly agreed that they had problems shutting down the machines compared to 29% of those "very comfortable." It is worth noting that at all levels of computer comfort, majorities of respondents expressed some level of agreement with the statement suggesting that computer experience alone was not enough to mitigate trouble.

Q18b Thinking back on your experience during Election Day on May 2nd, please tell me whether you agree or disagree with each of the following statements...The first one is: <u>There were problems shutting down the touch screen machines at the end of the day.</u> Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

Table 31

	q29 Generally speaking, how comfortable do you feel using a computer...			
	Very comfortable	Somewhat comfortable	Not very comfortable	Not comfortable at all
Strongly agree	64	44	7	21
	28.6%	25.1%	21.9%	38.2%
Agree	64	51	12	14
	28.6%	29.1%	37.5%	25.5%
Neither	1	5	0	0
	.4%	2.9%	.0%	.0%
Disagree	55	48	12	15
	24.6%	27.4%	37.5%	27.3%
Strongly disagree	40	27	1	5
	17.9%	15.4%	3.1%	9.1%
Total	**224**	**175**	**32**	**55**
	100.0%	**100.0%**	**100.0%**	**100.0%**

The problems experienced setting up and shutting down the machines again point to the importance of improved training, especially training materials and training sessions that include proven, effective training techniques, such as hands-on practice and repetition for every booth worker with established procedures. This is even more important because the training does not appear to have been enough for many election workers to overcome their uncertainty about setting up and shutting down the machines regardless of their comfort level with computers. As the table below indicates, substantial majorities of those indicating they were "very comfortable" or "somewhat comfortable" using a computer agreed with the statement, "After the training, I was confident in my ability to do my job on Election Day." However, a third of those "very comfortable" with computers still expressed disagreement with the statement.

Q16j After the training, I was confident in my ability to do my job on Election Day. Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

Table 32

	q29 Generally speaking, how comfortable do you feel using a computer...			
	Very comfortable	Somewhat comfortable	Not very comfortable	Not comfortable at all
Strongly agree	69	31	6	5
	30.3%	17.5%	17.1%	9.1%
Agree	82	73	12	18
	36.0%	41.2%	34.3%	32.7%
Disagree	49	48	16	17
	21.5%	27.1%	45.7%	30.9%
Strongly disagree	28	25	1	15
	12.3%	14.1%	2.9%	27.3%
Total	**228**	**177**	**35**	**55**
	100.0%	**100.0%**	**100.0%**	**100.0%**

Once the machines were up and running, less that a quarter of the booth workers appear to have had many problems with them throughout the day (Q18C). Three-quarters of the booth workers agreed with the statement that the touch screen machines are reliable (Q18G). Confidence in the reliability of the machines is related to their own personal experience and is not a function of attention paid to post-election media reports about the machines. As shown in the table below, as election workers experienced fewer problems, they were more likely to agree that the machines were reliable. Of those that indicated that they "strongly agreed" that there were problems with the touch screen machines, only 40% "strong agreed" and 17% "agreed" that the machines are reliable for a total of 57%. Of those who "strongly disagreed" that they had problems with the machines throughout the day, 64% "strongly agreed" and 26% "agreed" that the machines were reliable for a total of 91 percent.

Q18g Thinking back on your experience during Election Day on May 2nd, please tell me whether you agree or disagree with each of the following statements...The first one is: The touch screen voting machines are reliable. Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

Table 33

	q18c There were problems with the touch screen machines throughout the day.				
	Strongly agree	Agree	Neither	Disagree	Strongly disagree
Strongly agree	14	6	3	41	95
	40.0%	10.2%	33.3%	19.2%	64.2%
Agree	6	35	3	150	39
	17.1%	59.3%	33.3%	70.4%	26.4%
Neither	1	2	2	8	5
	2.9%	3.4%	22.2%	3.8%	3.4%
Disagree	7	13	0	11	2
	20.0%	22.0%	.0%	5.2%	1.4%
Strongly disagree	7	3	1	3	7
	20.0%	5.1%	11.1%	1.4%	4.7%
Total	**35**	**59**	**9**	**213**	**148**
	100.0%	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Booth workers, presiding judges, and judges were asked about the Election Day Technicians (EDTs). A substantial majority (63%) of booth workers and judges agreed that the EDT "was able to solve technical problems with the touch screen machines." An area of possible concern is that about a third of booth workers and judges did not think that the EDT at their polling place was capable of solving technical problems. This concern emerged in the open comments at the end of the survey as well. More investigation needs to be done into the nature of those technical problems and whether or not they are problems that EDTs can reasonably be expected to solve on site or not.

About half of the booth workers attempted to call the command center during the day on Election Day (Q19) but only 35% of those callers were able to speak to someone on the first try (Q19A). Clearly the command center did not have sufficient capacity to handle the influx of calls from booth workers in a timely manner. The variety of problems reported in calls to the command center is unclear from these data but the calls are summarized in the analysis of the incident reports.

Identification

Survey respondents were asked how often they requested that voters showed identification before voting (Q22). When the analysis is limited to just the booth workers, judges, and presiding judges, most workers responded that they "never" (42%) or "hardly at all" (27%) asked for id while 14% said "some of the time," 7% said "most of the time" and 9.7% said all of the time.

Those that responded that they had asked voters for ID were then asked to give the most common reason why they asked for ID. The responses to these questions varied considerably and survey interviewers had difficulty fitting the response options into the available pre-coded categories. The majority of the time interviewers coded the response in an "other" category.

A look at the other category indicates that the vast majority of the responses are related to an indication in the poll book that ID should be requested or that there was some confusion or discrepancy about the voter's address.

The ID requirements in Ohio have changed since the primary and are still being clarified suggesting that additional analysis of these data, while interesting, will not directly apply to the November election. However, the variety of answers given by the election workers strongly suggests that great care be taken in future training so that booth workers clearly understand the ID requirements and how the law should be applied so that voters are treated fairly.

Section 3

Polling Place Incident Report Analysis

Project Team

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Project Overview

During the primary election, election workers in each precinct in Cuyahoga County were provided with incident report forms on which to note any incidents that arose during the conduct of the primary election. By nature, these reports most commonly note problems—not successes—at each precinct that occurred during the election. However, throughout this report the term "incident" not "problem" is used because it is incidents that the report asked be reported. Although in many cases the reported incidents might be viewed as "problems", in other reports it is unclear whether the reported incident may have caused "problems" for voters or booth workers. Still other reports noted what are clearly positive events. The forms from each precinct were obtained by the Project Team, and then were provided to the data entry firm Superdata, which made an electronic record for each unique incident from every precinct form. Superdata entered data for 6,285 cases from 1,217 precincts, and these constituted the electronic database from which the Project Team members then coded each report into specific (numeric) incident categories. These coded incidents provide the data for the analysis in this report. Given that the data were coded both by incident and by precinct, analysis is provided of the incident reports from both perspectives: first an examination of the incidents themselves and their rates of occurrence, then second a study of the incidents by precinct. This study concludes with discussion of five recommendations that arise from analysis of these data.

Summary of Findings: Overall Incident Rates

The overall incident data reported in the election generally fall into five broad categories, as shown in the Figure 1 below.

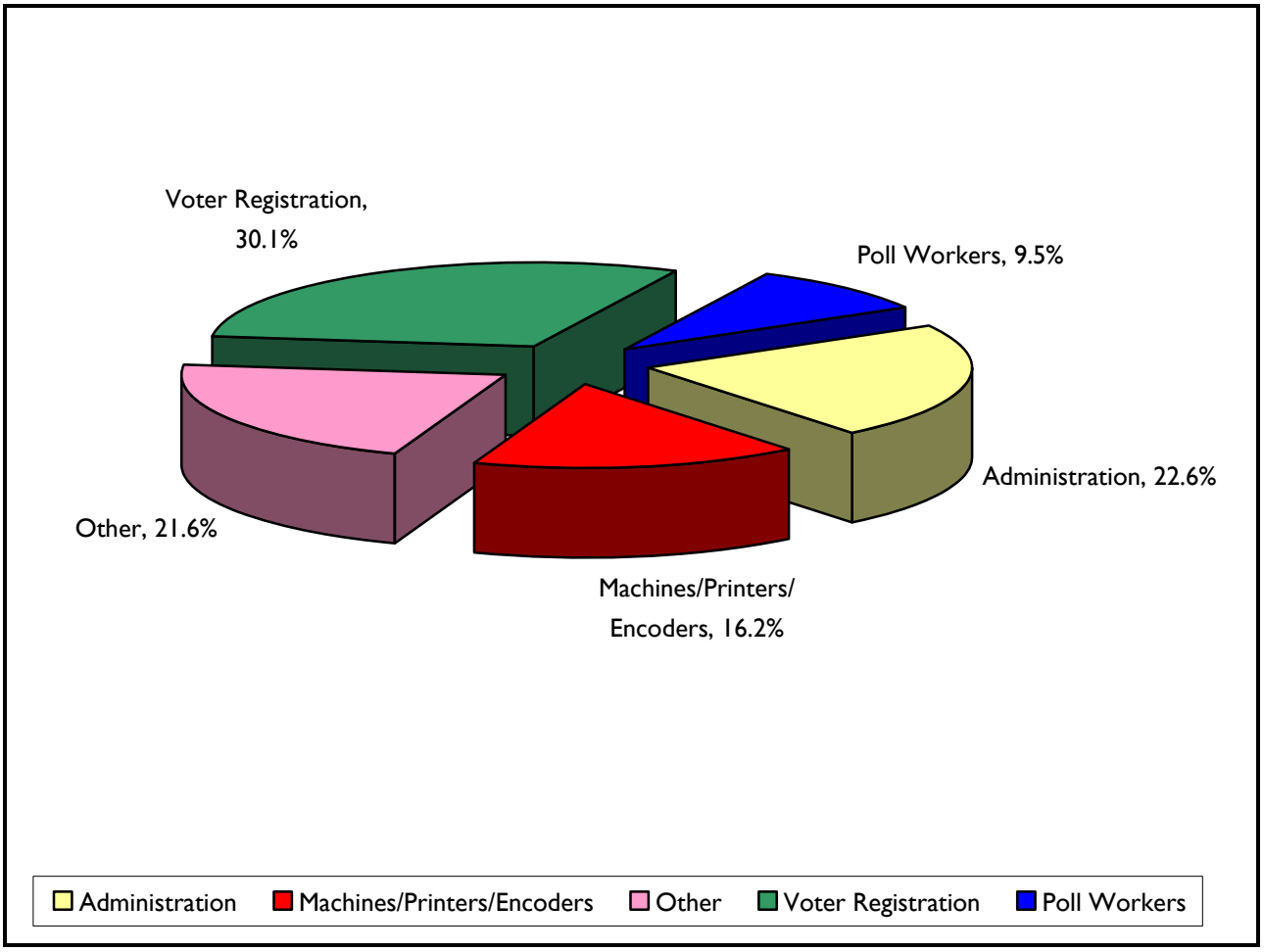
- First, booth workers reported numerous incidents related to the **voter registration file** used in the election; 30.1% of reported incidents involved voter registration issues. Most of these incidents involved inaccuracies in the voter registration file itself, for example, incorrect addresses, misspelled names, or inconsistencies with signatures. There were also a sizable number of provisional ballots being cast and reported as incidents.

- Second, there were an array of incidents reported that related to **election administration.** These incidents constituted 22.6 percent of reported cases and included issues associated with lack of supplies, not being able to reach the Board of Elections by telephone, issues with training, or procedural activities (e.g., not having voters sign the poll book when the polls were busy) being skipped.

- Third, there were many **incidents involving the voting equipment.** These constituted 16.2% of reported incidents and involved problems with the voting machines themselves, the printing devices, or the ballot access cards and encoder devices.

- Fourth, **the booth workers themselves** were the cause of 9.5 percent of reported incidents. The most common incident here was that a booth worker or technician failed to show up on Election Day.

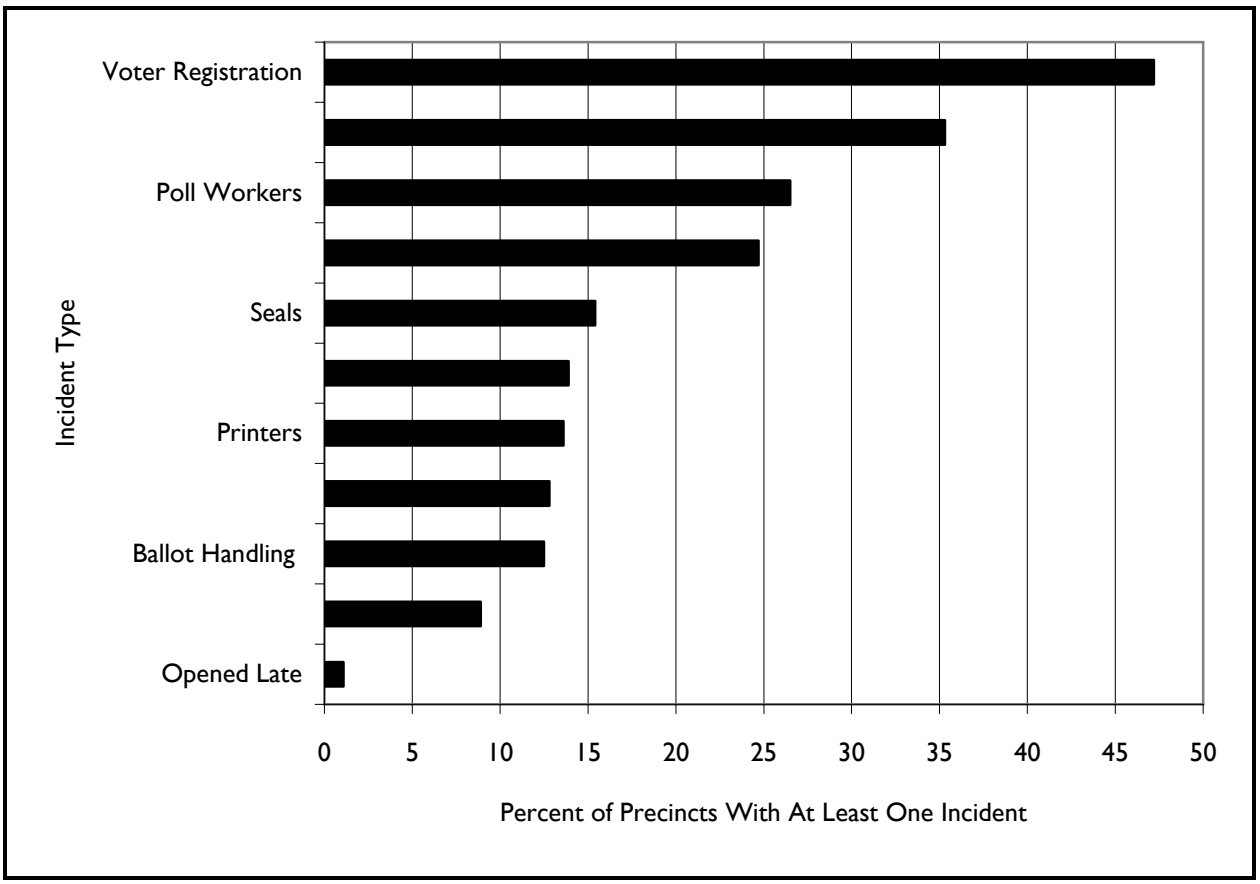
Figure III-1: Incidents Reported in the 2006 Primary Election, by Type



Summary of Findings: Precinct-Specific Incident Rates

When the incident reports are examined by precinct, the data show that 88.7 percent of precincts reported at least one incident. Figure 2 shows the number of precincts that had at least one incident among the various types of incidents reported.

Figure III-2: Precincts with at Least One Incident, by Incident Type



Summary of the Incidents

The complete set of incident codes developed by the Project Team is provided in Appendix Two. The Project Team then aggregated the specific codes into the fourteen following broad categories shown in the table below. An example also is provided from an actual precinct incident report to give some insight into how the codes were aggregated into the fourteen broad categories:

Table 34: Summary of incidents

Incident	Example
Voting Machine	Machine Stopped Working
Voting Machine Printer	Printer Jam Or Broken Printer
Voter Registration	Name Misspelled Or Listed Twice
Access Cards or Encoders	Access Card Dead Or Encoder Difficult To Code
Machine or Printer Seals	Seals Missing Or Easily Broken
End of Election Closeout	Problem Printing Closeout Reports
Ballot Handling	Voter Given Wrong Ballot
Polling Places	Polling Place Not Open For Workers
Election Administration	Board Of Elections Did Not Answer Call
Supplies	Supplies Missing
Booth worker-Machine Interaction	Booth worker Inserted Memory Card Into Machine Incorrectly.
Voter-Machine Interaction	Voter Failed To See VVPAT Printout
Voter Incidents	Voter Yelled At Booth worker
Booth workers	Booth worker Failed To Show Up Or Was Incompetent

Understanding the Incident Report Data

ESI's objective was to quantify the incident report data that was collected in the 2006 primary election in Cuyahoga County, Ohio. The materials provided to booth workers in each precinct contained an "Incident Report Form." The incident reports were completely open-ended in nature; they were not made in response to any set of questions, prompts, or queries. In addition, no categories of incidents were provided to the booth workers. There is no evidence that booth workers were given guidance about the types of incidents to report. The reports varied greatly from precinct to precinct in the number and significance of the incidents that were reported, they varied greatly in the amount of information that was provided on the form, and they also varied greatly in the legibility for data entry and analysis purposes. The incidents reported ranged from reports that a particular voter's name was spelled incorrectly in the alphabetical poll book, to praise of specific polling place workers, to a report that a voter had destroyed a voting machine.

Caveats About Interpreting the Data

This report and the data discussed below should be read and interpreted very carefully because of its uniqueness. It is important to remember that the incident reports, by design, are biased toward the reporting of problem incidents; "*voter is registered, voted, and left*" is a type of incident, but not one that would be reported on the incident reports.

Additionally, the incident report data is limited to what happened during the May 2 primary election, ***and there are no data with which to compare these incidents***. There are neither comparable incident report data from other elections in which the Diebold TS machines have been used nor incident report data from previous elections in Cuyahoga County using other voting technologies. In fact, the survey of booth workers found that the booth workers overall expressed considerable satisfaction with the TS-based system and that the new system is superior to the one it replaced. Thus, readers are cautioned from reaching any conclusions regarding how pervasive particular incidents might have been in this primary election, as there is no baseline of data available which can be used to compare with the data reported here. Qualitative analyses of polling place operations that the Project Team has conducted in recent years show that the incidents reported here are not atypical of primary elections, though again, there is no available quantitative baseline with which to compare these data.

The analysis below shows that **many of the incidents reported are likely to occur regardless of the balloting technology employed**. The most common incident in the election was with voter registration and less than 10 percent of reported incidents were related to the voting machines or machine memory cards. In general, the incident reports stated that the booth workers had encountered a particular incident but not the severity of the incidents. Some incidents appear to be far more serious than others and are more likely to compromise the accurate casting and tabulation of votes. In the case of incidents with a voting machine, in most instances it cannot be determined how quickly the incident was noticed or how much the balloting process was affected.

Furthermore, **there is also almost no data as to whether the incident was ever remedied, how soon it was remedied, or, perhaps most importantly, whether steps taken to address an incident resolved the incident at hand or actually created other incidents**. For example, there are many reports that a voting machine wasn't working properly but that the EDT was able to get it running again. What is missing from the incident reports in most cases is why the machine stopped running, how the EDT got the machine running again, how long it took for the EDT to get the voting machine running again, and whether or not prescribed actions (the following of standard operating procedures) were taken to fix the machine.

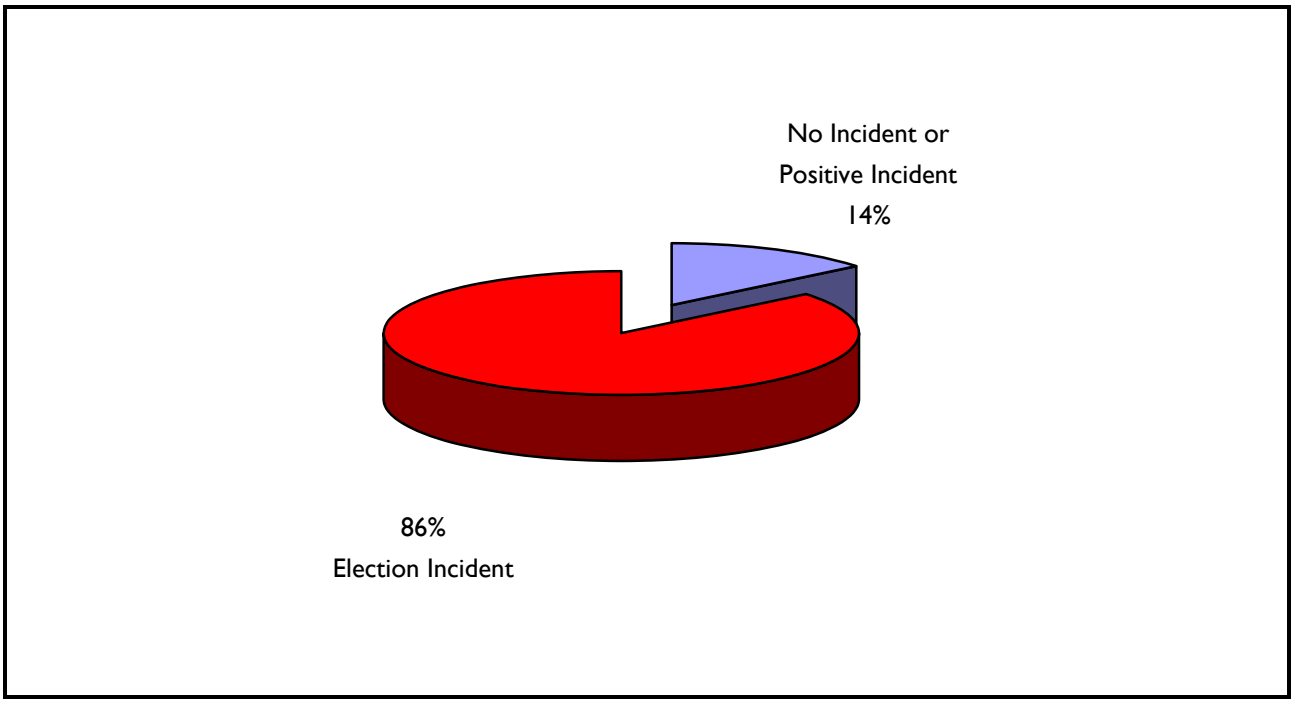
Last, given that it is not clear to the Project Team what training the booth workers or election judges had regarding the use of the incident report forms, there is concern that **the type of incidents reported, and the quality of the information reported, are highly inconsistent across the precincts for which data was obtained**. In some cases, the incident reports are very terse and difficult to understand; in others they are quite detailed. **The team also does not have any reports from 11% of the precincts**, and in some of the precincts that did report, it was noted that the reports were of a positive nature or indication of no problems encountered (14% of the reports were of this nature, typically glowing praise for the actions of a booth worker!). The team does not know whether the non-reporting precincts in fact had no problems, or whether the booth workers and judges forgot to complete the incident report, or that something happened to the incident report that removed it from our sample. The lack of perfect reporting, and the

inconsistency in the quality of data reporting, lead to a recommendation that in the future, booth workers and election judges be provided with better instructions on incident reporting and more training as to how to use the reporting forms effectively.

Findings: Overall Incident Rates

Figure 3 below shows the distribution of election incidents as compared to no incidents or positive events. Of the 6,285 incidents reported, including blank reports, 5,400 incidents were categorized as election incidents.

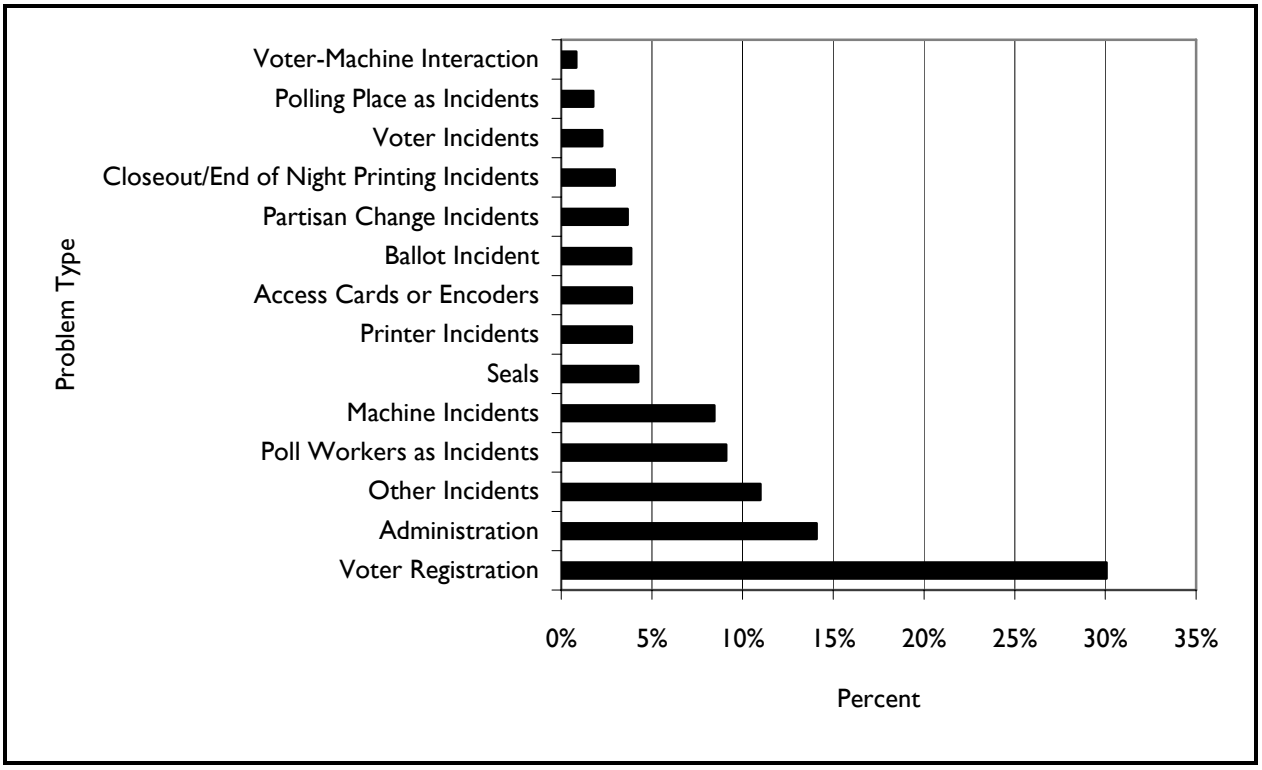
Figure III- 3 Overall Incident Rates



The following analysis excludes the "No Problem" and "Positive Event" categories and focuses on the 5,400 cases where clear election-related incidents were reported. The "Positive Event" reports are reviewed specifically below in a separate analysis of those data.

The data in Figure 4 shows the frequency of incidents reported in the May 2006 primary election. By far, the most common incident reported is with the voter registration file. Almost one-third of all incidents involved voter-registration issues. The second most common incidents were administrative. Administrative incidents included not having appropriate supplies, having lines, having difficult reaching the Board of Elections, or having difficulties with paperwork. The remaining incidents accounted for 10 percent or less of the total cases. Booth workers not showing up, machine failures, problems with seals, and printer failures rounded out the most common incidents.

Figure III-4: Frequency of Reported Incidents

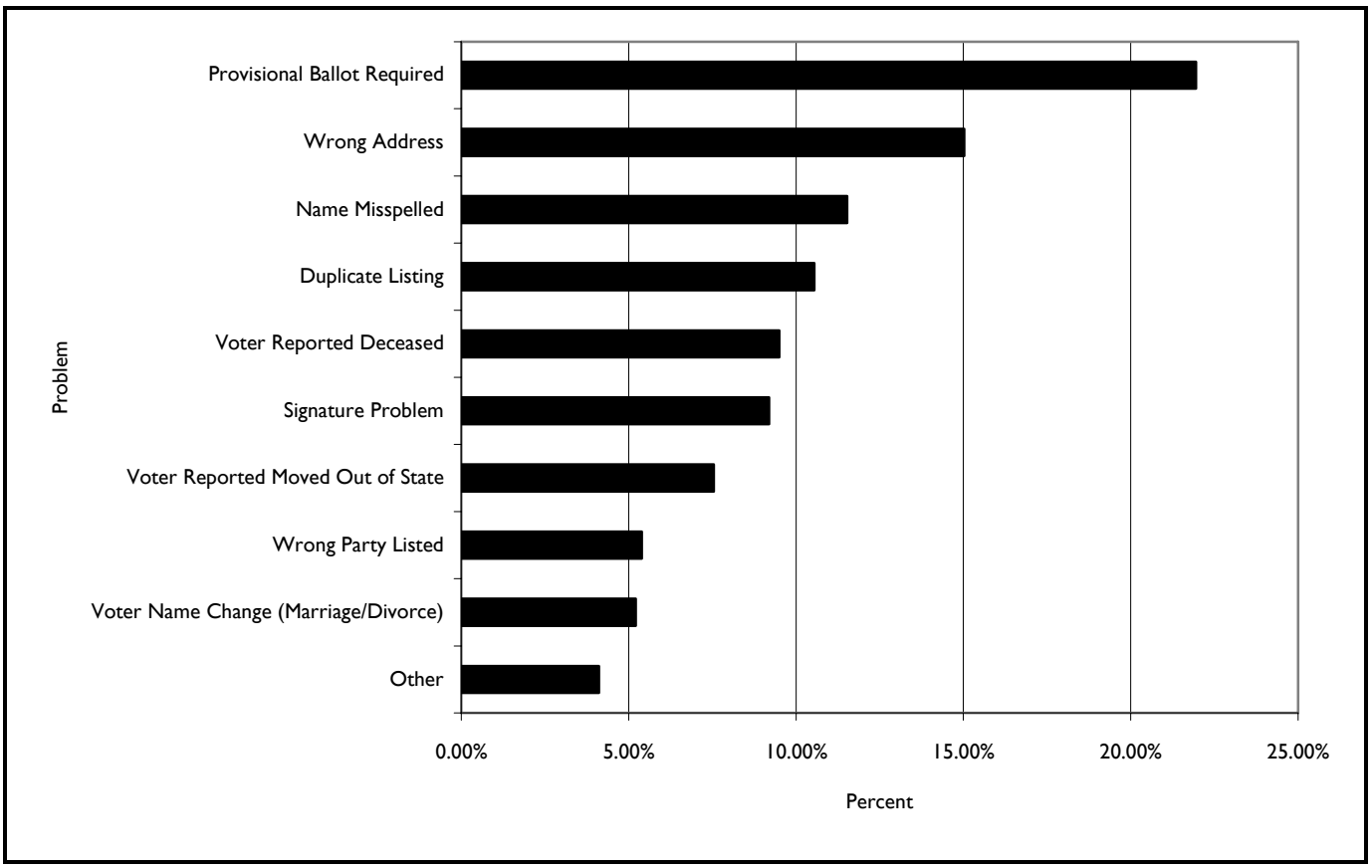


In the next sections, each of these common incidents is considered in more depth. The category "other incidents" is not discussed because in most cases it was not possible to determine with any reasonable degree of confidence the precise nature of the incident that was being reported.

Voter Registration Incidents

Voter registration issues were the most common incident reported in the data, accounting for 30.1% of all incidents reported. Figure 5 shows the frequency of the various forms of voter registration incidents reported. The most common voter registration incident was that the voter was not on the list and voted provisionally, or the voter was on the absentee ballot list and needed to vote provisionally at the polls. After this, there were a cluster of three incidents that accounted for between 10 and 15 percent of voter registration incidents: (1) the voter was listed in the book under the wrong address (14.3%); (2) the voter's name was misspelled (11.0%); or (3) the voter was listed twice (10.0%). In addition, in 8.8 percent of the cases there were issues with the signatures on file in the book. These incidents can be very troublesome to voters; in several cases, the incident report notes that voters did not vote provisionally when a problem arose because the voter did not have time to complete the provisional voting information. Additionally, several voters claimed that they had reported the error in their voter registration information when they had come to vote in previous elections but the data were never corrected or updated. These incidents also likely cause issues for booth workers and judges, who then need to spend additional time resolving these problems, taking them away from their other duties and also possibly causing lines to form in the polling places.

Figure III-5: Voter Registration Incidents Reported



Administration Incidents

The administration incidents were the second most commonly incident reported, accounting for 14.1 percent of all incidents. The administrative incident reports were wide ranging but were clustered into three categories. First, almost 15 percent of administrative incidents related to election workers not being adequately trained. In many cases, the incident reported is the booth worker stating that an issue that was encountered had not been discussed in training. Just over 25 percent of the administrative incidents were about the lack of supplies. These incidents included not having "I Voted" stickers—which may seem small but clearly caused booth workers consternation from some voters—as well as not having the requisite number of memory cards or access cards. Third, almost 60 percent of the administrative incidents fell into a broad, highly diverse set of incidents that ranged from not being able to reach the Board of Elections by telephone to not completing needed paperwork.

Figure III-6: Administration-Related Incidents Reported

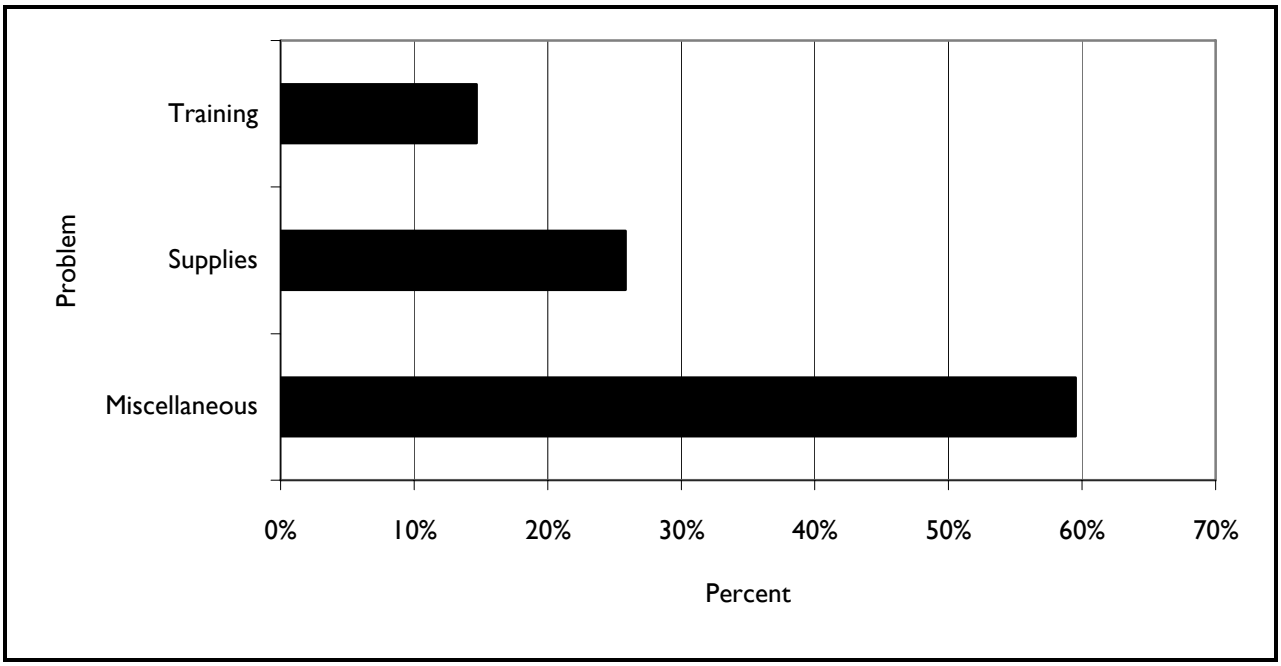
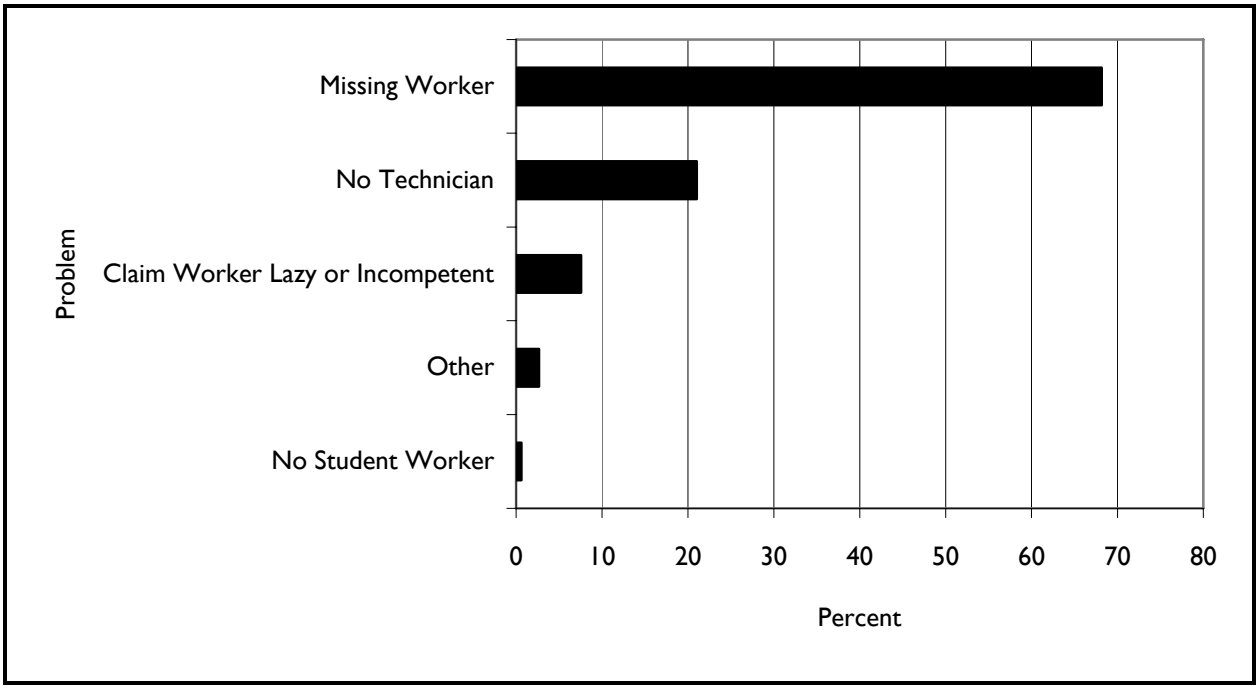


Figure III-7: Booth workers as Incidents



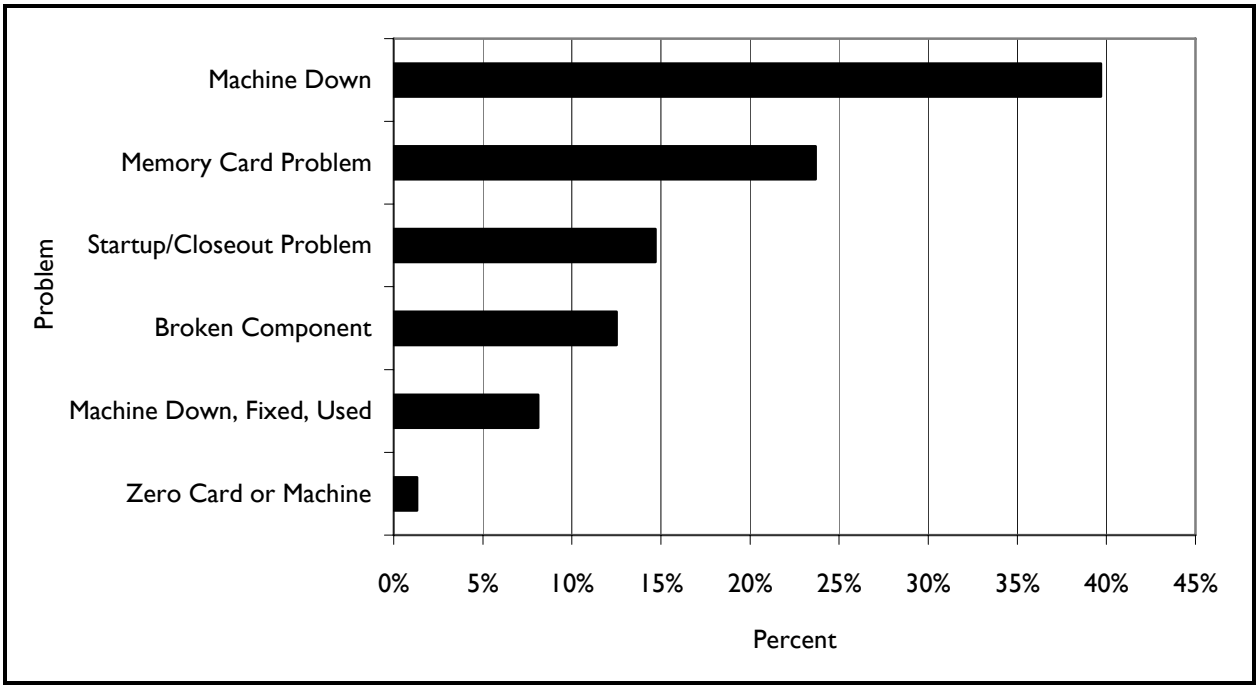
Booth workers as Incidents

In 9.1 percent of the cases, a booth worker, election judge, or technician was the cause of the incident. Most commonly, the booth workers caused an incident in the election because they did not show up to work on Election Day. Missing workers or missing technicians were more than 80 percent of the booth worker-related incidents. In addition, approximately 8 percent of related incident reports concerned judges, booth workers, or technicians who were deemed incompetent or lazy by their colleagues.

Machine Incidents

Voting machine incidents accounted for 8.4% of all incidents reported. Examination of the machine incidents shows that almost half of the incidents related to machine failures. Almost 40 percent of the time the incident was a machine failure that resulted in the machine being shut down. In an additional 8.1 percent of machine failure incidents, the machine failed but was then fixed.

Figure III- 8: Voting Machine Incidents



One quarter of the machine-related incidents related to memory cards. The most common incident reported here was that the booth workers often claimed that the specified card was not in the specified machine. For example, one incident report stated, "*realized we did not match memory card labels to numbers on voting units per orange sheet.*" In approximately 15 percent of the machine incidents, the incident was that the machines were difficult to start up or shut down. In 12.5 percent of the machine-related incidents, the incident was that something on the machine was broken, typically a leg on the voting machine stand or some other physical component of the voting machine.

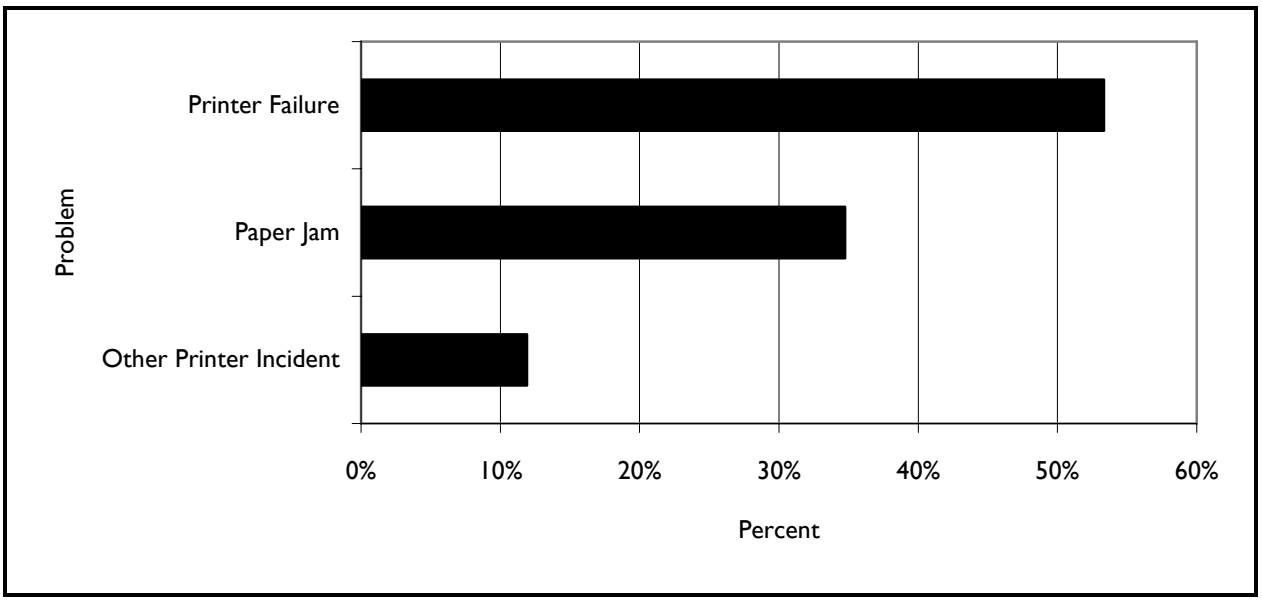
Seal Incidents

Incidents related to the seals on the voting machines, the printer canisters, and the bags in which post-election materials were to be returned to the election offices accounted for a small number of incidents. A total of 4.2 percent of all incidents were related to seals. Seals were reported broken on machines and canisters most often, with some precincts reporting that they could not seal all of their machines at the beginning of the election. The chain of custody of a voting machine and its ballots can be, in part, confirmed through the sealing and locking of the machine and the tracking of the seals and locks used. If after the election the authenticity of the seals and locks cannot be effectively known—or there are questions as to whether the machines were in fact even sealed and locked throughout the process—it raises questions about the balloting (both the electronic and the associated paper ballots).

Printer Incidents

Printers were also the source of a small number of incidents; 3.9% of all incidents were printer-related. These incidents have the potential to be pernicious because, according to Ohio law, the paper printout is the official ballot. It is also potentially problematic because the voter affected may lose the ability to review his or her ballot, thus defeating the purpose of the paper audit trail completely. Last, the printer incidents can lead to a chain of other problems in a precinct, if they are unresolved, including disruptions cased by unhappy or unruly voters, the development of long lines if booth workers are focused on the jammed printer or take the machine out of service, and possible even other problems depending on what steps booth workers and judges may take to restart a jammed printer. When a paper jam occurs, it has the potential to invalidate an official ballot. In more than half of the printer-related incidents, the incident reported is the printer failing. In approximately 35 percent of cases, the incident reported is the printer jamming. Other printer incidents reported were paper spooling issues, with the paper occasionally tearing in the canister.

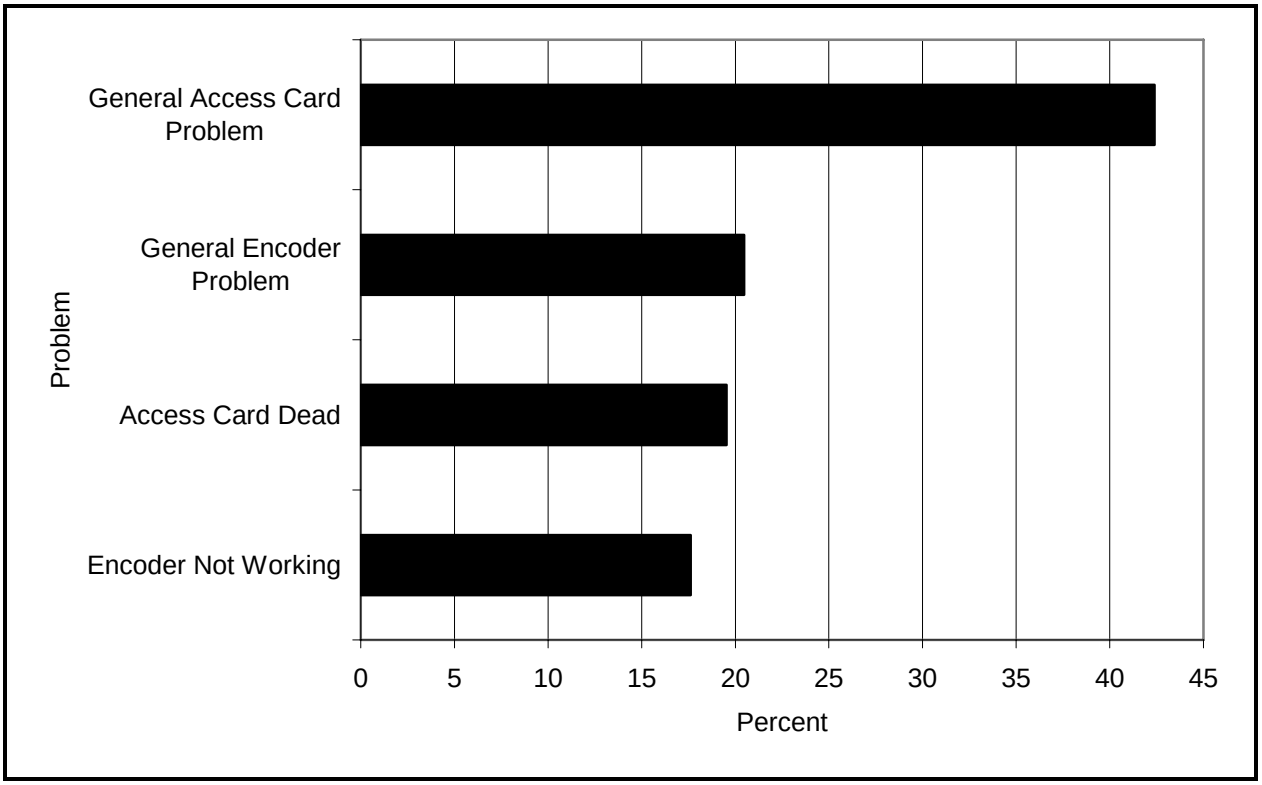
Figure III-9: Printer-Related Incidents



Access Card and Encoder Issues

The final type of incident examined related to the encoders and the access cards. The access cards and encoders accounted for 3.9 percent of incidents reported. There was an array of general access card incidents that arose. Access cards occasionally became stuck in machines, would work in some machines and not others, or would come out of a machine. Encoders, likewise, had occasional issues where the buttons would stick or not work effectively when the booth worker wanted to encode a ballot. In less than 20 percent of the access card- and encoder-related incidents, the card or encoder would completely fail. These failures account for less than one percent of all reported incidents, but could produce significant problems in polling places depending on their severity and how polling place workers and election judges responded to the incident.

Figure III-10: Access Card- and Encoder-Related Cases



Ballot Handling Incidents

There was an array of incidents that were categorized as ballot handling incidents. Although this category accounted for fewer than 4 percent of incidents reported, handling ballots is of critical concern. This category included issues such as voters being sent away because the ballot for the voter could not be encoded, a voter's ballots being cast and then that voter being allowed to vote again, or failing to have a voter complete the information on a provisional ballot. There were also cases where voters were given the wrong access card or wrong ballot.

Other Incidents and Events

There were a set of incidents reported that were more informational on the part of some booth workers and were not election-incident specific. The table below provides the number of such reports provided on the incident forms, and their percentage out of all such "positive event" reports. For example, booth workers listed when they had received telephone calls or visits from individuals represented the Board of Elections. The most common coding though was of a task being performed (nearly 77% of these reports). These included incidents such as "the first voter voted" or "filled out the correct payroll cards." These other incidents should not be viewed as being comprehensive; many events that are known to have occurred—such as exit polling at multiple precincts (more than at the four precincts noted below)—are not listed here. In general, these events are reports of common occurrences in elections

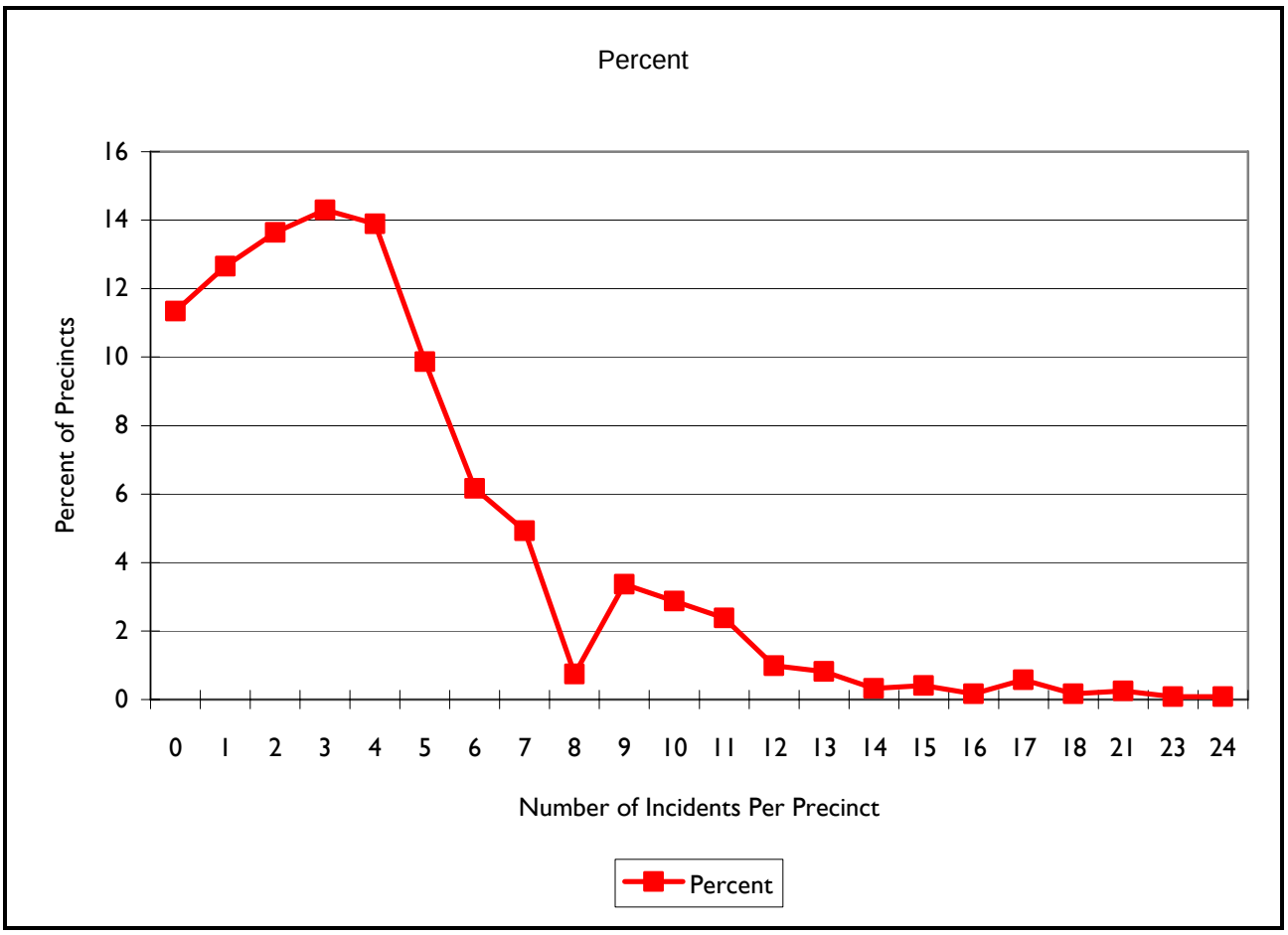
Table 35: Other events and incidents

Explanation	Frequency	Percent
Report of task being performed	534	76.95
Call from BOE, or visit by Diebold representative, inspector, or EDT	63	9.08
Arrival of booth worker, judge, or EDT	23	3.31
Praise for booth worker, student workers, EDT, Diebold reps	22	3.17
Praise for new system from voters and non-voters	20	2.88
Arrival of supplies	15	2.16
Procedures clarified	4	0.58
Voter expressed praise for old system	4	0.58
Exit pollster at precinct	4	0.58
Plain Dealer reporter visited precinct	2	0.29
Voting machines running	2	0.29
Supplies loaned to another precinct	1	0.14
Totals	**694**	**100.00**

Findings: Precinct-Specific Incident Reports

The previous section focused on overall incident rates. This section considers the likelihood of specific incidents occurring in any precinct. As was the case in the previous section, this analysis only focuses on serious incidents that could be categorized. Figure 11 shows the distribution of incidents by precinct. Half of all precincts had 3 or fewer incidents. 75 percent of precincts had 5 or fewer incidents. However, 9 percent of precincts reported having 10 or more incidents at the location and 5 precincts reported 20 or more incidents (0.5 percent of precincts analyzed).

Figure III-11: Number of Incidents Reported by Precinct

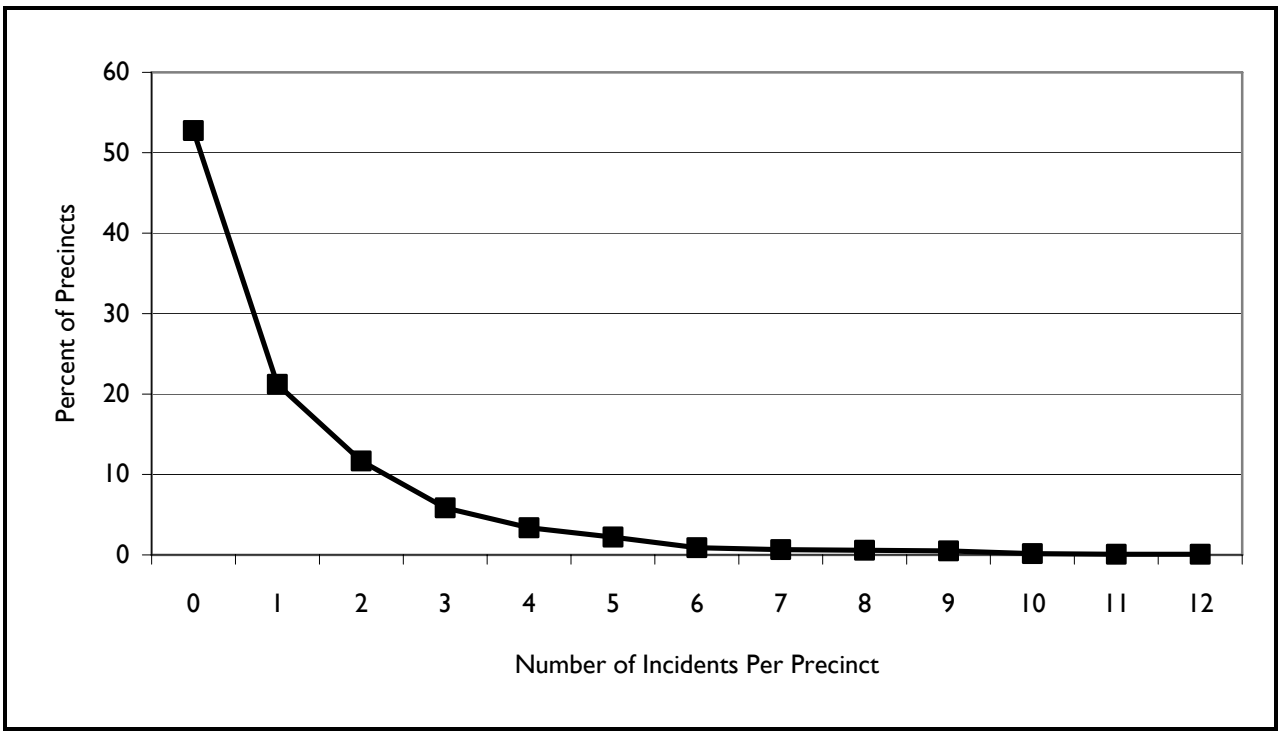


There are no data with which to compare these findings to know if the election in Cuyahoga County had more or fewer incidents than normal. However, the distribution does suggest that, overall, the vast majority of precincts had few incidents but certain precincts had a very high number of incidents. One of our main recommendations is that the precincts with many incidents be subjected to a thorough audit.

Voter Registration Incidents

More than half of all precincts reported no voter registration incidents; more than 80 percent of precincts had two or fewer voter registration incidents. There were 17 precincts, however, that reported eight or more voter registration incidents. It should be remembered that many of the voter registration issues were reported by voters—for example, reports that individuals on the rolls were dead, had moved, or noticed that their name was misspelled. In addition, not all booth workers may have felt that these notices of problems with voter registration constituted actual incidents.

Figure III-12: Percent of Precincts with Voter Registration Incidents



Machine Incidents

In the primary elections, 65 percent of precincts reported no incidents concerning the voting machine itself (this does not include printers, which are discussed below). Although the number of precincts with multiple incidents were small—87 percent of precincts had one or zero incidents—in a high turnout election multiple incidents could create other difficulties. The issues included as machine incidents included voting machine that did not work, were difficult to start or that stopped working during the course of the election. It is important to note that some of these machines were reset or restarted. This provided the precinct with a full complement of voting machines, but raises questions as to what state the machines were in after they were reset or restarted. (For example, were they restored to the state that existed immediately before the failure, or to the zero-count state, or some other state?). Some machine-related incidents were of smaller magnitude, including broken parts on machine, such as the magnifier, the sound, or the leg on the machine.

Figure III-13: Percent of Precincts with Voting Machine Incidents

Figure III-14: Percent of Precincts with Printer Incidents

Printer Incidents

Figure 14 shows that 86 percent of precincts had no incidents involving the printers. Nearly 11 percent of precincts had a single printer incident and 8 precincts had 3, 4, or 5 problems.

Booth worker Incidents

Booth workers accounted for a small but significant number of incidents. Just over 25 percent of precincts had a booth worker incident, primarily a missing booth worker.

Figure III-15: Booth worker-Related Incidents

These missing booth workers can negatively affect other aspects of the election and possibly contribute to the occurrence of other types of incidents. When this interaction between booth workers incidence and other incidents was examined more closely, there was a statistical relationship found between booth worker incidents occurring and certain other types of incidents occurring.[4] Specifically, compared with precincts with no reported booth worker incidents reported, in precincts with one or more booth worker incidents, there was a higher rate of: (1) machine incidents, (2) encoder or access card incidents, (3) printer incidents, (4) administrative incidents,

[4] A simple two by two cross tabulation was done with poll worker incidents (coded no incident, one or more incidents) and the other incident categories (also coded no incident, one or more incidents). The chi-square and t-statistics were statistically significant at the 0.05 level for the printer, administration, supplies, and machine variables and were statistically significant at the 0.10 level for the encoder/access cards, seals, and voter variables.

(5) supply incidents, (6) voter incidents, and (7) seal incidents. These data strongly suggest that not having a full complement of booth workers at a precinct can lead to other problems at the polling place.

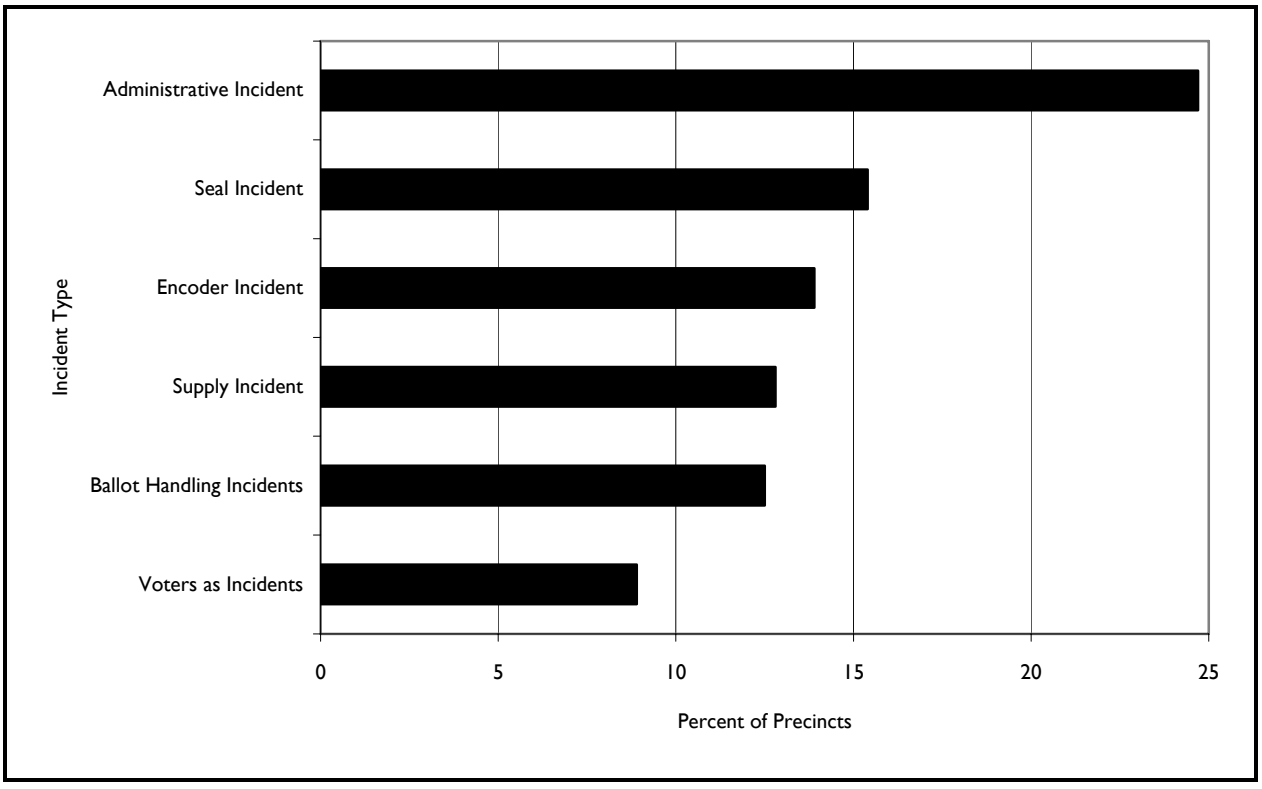
Human-Machine Interaction Incidents

In the incident reports, issues related to both voter-machine interaction issues and booth worker-machine interaction issues were tracked. A very small number of precincts reported such incidents. Only 1.9 percent of precincts reported a booth worker-machine interaction incident and 3.2 percent reported a voter-machine interaction incident. The lack of booth worker-machine incidents across precincts suggests that at least one booth worker in each precinct was competent in working with the voting machines.

Other Incidents

Figure 16 shows the number of precincts that reported other types of incidents. About 25 percent of precincts had at least one administrative incident in the election and 12.8 percent had at least one supply-related incident. Just fewer than 15 percent of precincts had an encoder or access card incident.

Figure III-16: Other Incidents



Slightly more than 15 percent of precincts had one or more incidents related to seals and locks. As discussed before, these seal and lock problems are important because of the questions they raise about the chain of custody in the balloting process.

In 12.5 percent of cases, there were incidents related to the handling of ballots. In these cases, voters were either given the incorrect ballot or allowed to vote when there was a question about their eligibility. For example, a voter who was known by booth workers to have been on the voter rolls in the past was allowed to vote, even though his name was not on the rolls in this election. Finally, in less than 10 percent of cases, the voters themselves were the cause of the incident, by being unruly or causing a disturbance at the polling location.

Opening Delays and Long Lines

There were two important incident types on which there were reports of the polls opening late and of the polling place reporting having long lines.

- There were 13 precincts—1.1 percent of the precincts from which reports were obtained —that opened late. Although the incident reports do not note how late, it was enough for booth workers to have reported it as an incident.
- There were 40 precincts—3.3 percent of all reporting precincts—that reported having long lines.

Next Steps

Our analysis of the May 2 incident reports leads us to make the following five recommendations:

Audit Machines And Equipment Involved In Incidents

In many cases, the precinct workers provided a list of the voting machines that were involved in incidents, including machine failures, printer failures, and memory card incidents. In each case, it may be extremely useful to examine the machines in order to determine the extent of the incidents and whether the incident affected the quality of the vote tabulation process. In addition, it may also be of benefit to determine whether the rate of encoder and access card failures warrants allocating more of each to precincts in order to ensure that incidents are minimized.

Accordingly, all machines, printers, memory cards and encoders that can be specifically identified from the incident reports that had any type of problem should be examined to determine the scope of the problem. This analysis should also insure that any problems with the equipment are resolved before subsequent deployment.

Audit Precincts With High Incident Rates

All precincts that had multiple incidents reported (a list of these precincts is provided in the Appendix One) should be audited thoroughly. The booth workers and election judges should be interviewed to determine why these precincts reported so many incidents, and appropriate steps should be taken to insure that any issues identified in this analysis are resolved before the next election in that precinct. Where necessary, voting equipment or other election administration materials should be audited to assess why these precincts reported so many incidents, and then devise an action plan to insure that these precincts minimize these incidents in the future.

Review Training And Procedures

The training and procedures used in the May primary election should be thoroughly reviewed to reduce the threat of systematic failures in future elections. A number of areas where polling place workers and election judges either were unaware about appropriate procedures or were unsure about the correct application of procedures are identified above. As a consequence, many of the incidents that were reported were related to failures in procedures and training. As was noted above, the failures with the seals and locks were very troubling, as were incidents with the memory cards. There were also many incidents associated with the voter registration file, and with appropriate ballot styles for voters. It would be beneficial to examine the processes, procedures, and training related to both of these issues. The Election Administration Commission (EAC) is currently conducting a review of state election laws and procedures that surround vote counts, and the issues of security and procedures are a component of that process. The EAC study will include the identification of successful practices related to these issues. Two of the authors of this report are involved in the EAC project (Hall is the principal investigator, Alvarez a consultant) and may be of help to consult as the County reviews its procedures.

Replace Challenging Booth Workers

Challenging polling place workers, those who in the incident reports were singled out for negative evaluation or did not show up, should be given the opportunity to provide reason for their action (or inaction); those who clearly are problematic should not be retained for future elections.

Retain And Improve Incident Reporting Process

The incident reporting process should be continued in future elections in Cuyahoga County, as the data reported here will provide baseline information from which to assess improvement in equipment, procedures, training, and other areas of change. However, it is recommended that the reporting process be improved, in particular that the reporting form is clarified (for both booth workers and subsequent data entry) and that booth workers and election officials receive training on how to identify and report incidents and their resolution.

Three recommendations are made for improving these forms.

- First, the forms should include information about how, or whether, the incident reported was resolved.
- Second, the form should be designed to help booth workers provide the most useful data possible. For example, providing basic categories of incidents may be of benefit. In addition, the incident reporting process should be explained during the booth worker training.
- Third, the reporting forms should include clear and useful instructions, and booth workers and election judges should receive pre-election instruction on how to use the revised incident reporting form.

Appendix Three provides an example of how the incident reporting form might be revised for future elections; ESI and the Project Team can provide further input into improving the incident reporting process.

Section 4

Optimal Voting Machine Allocation Analysis

Project Team

Ted Allen

Mikhail Bernshteyn

Project Overview

This project extends earlier work (Allen and Bernshteyn, in press) in which very approximate models were used. The previous work concluded that failure to allocate machines accounting for different ballot lengths in Franklin County, Ohio caused long waits and unequal treatment of demographic groups, e.g., African Americans. In the current project, relatively realistic simulation models were generated. These models include the complications of direct recording equipment (DRE) machines out-of-service conditions and repair. Also, the models include the start (6:30 am) and stop (7:30 pm) of the door entry, the higher rate of arrivals between 4 pm and 6 pm, and machine breakdowns.

Summary of Preliminary Findings

- **Current machine allocation**

  Simple tabulation of data from in the current official allocation (see Appendix – data provided to ESI by the Cuyahoga BOE) indicates that a potentially perilous allocation strategy is currently in place. The simulation model indicates that even a moderate turnout ratio will likely cause certain polling locations to be overwhelmed unnecessarily. This will likely lead to long average waits for voters in those precincts and the appearance of unequal treatment. For example, the simulation model predicts average waiting times in Millridge School (440 voters per machine) of greater than 3 hours (see Figure 1).

- **Sharing machines substantially reduces voter waiting time**

  Permitting voters to use any machine in a polling location or vote center greatly improves performance measures, including average waiting times, compared with restricting voters to use only precinct-dedicated machines. For example, applying ESI's proposed allocation strategy to both restricted and unrestricted situations, eliminating restrictions typically results in 25% fewer machines needed to achieve the same service levels.

- **Proposed Simulation Method Successful (see Figure 5)**

  In the same scenario and far more difficult scenarios, our simulation method appears to reasonably assure maximum long term (i.e. over several elections) average waiting times of less than 10 minutes, with fewer than the currently used 5,200 machines. This method does, however, require thousands of more machines if public officials want to guarantee that all polling locations will have short lines on any given Election Day. This follows because a precinct might have a respectable long term average waiting line length but may experience significant challenges on a given election. With so many polling locations, the chance of at least one experiencing a disproportionate level of challenges, causing Election Day delays, is high.

- **Ballot Variability Causes Inequality**

  Results here confirm conclusions from a previous study of Franklin, Ohio 2004 in Allen and Bernshteyn (to appear). Allocating machines without accounting for variability in ballot lengths might result in the appearance of unequal treatment, as certain demographic groups are likely to be associated with longer or shorter ballots. The longer ballots translate into longer times required to operate the DRE machines and, potentially, dramatically longer lines and waiting times. For example, in certain simulations, increasing the average voting time by 30 seconds (or 15%) results in average waiting time increases of 30 minutes (or 400%).

Overview of Approach

- A computer simulation model of voting at a location is used to evaluate service quality measures such as average waiting time, which depends on the number of direct recording equipment (DRE) voting machines, policies that govern operations, and assumption parameters that include the average time it takes to vote (which differs from precinct to precinct), the breakdown rate of DRE machines, the average repair times, and the precinct specific turnout rate.
- Experimentation on the simulation models is used to study the sensitivity of performance to decision variable selections and assumptions. By viewing plots of dependencies, it is possible to generate reasonable recommendations while addressing many uncertainties.
- It is assumed that the polling locations in Cleveland, Cleveland Heights, and East Cleveland require on average 20% longer voting times (times required in front of the DRE) than at other polling locations. This assumption follows because city area precincts often have more issues to vote on than other precincts.
- Results in this document are approximate except where noted because accurate estimation of the "rare events" involved is still an active area of research (see Next Steps). Each Election Day typically results in the observation of at least one polling center at its "rare event" worst.

Methodology

The following methodology employed in this analysis is the generic model building and optimization process (e.g., see Banks et al., 2005).

Step 1. Analyze Cuyahoga BOE Data to Aid in Model Building
The data that ESI received from Cuyahoga County is summarized statistically.

Step 2. Build Models From Assumptions and Data
Details of how ESI's simulation model is built includes:

- assumptions and variable descriptions (Step 2a);
- simulation rules (Step 2b);
- definition of system performance measures (Step 2c);
- example simulation output (Steps 2d).

Step 3. Studying the Current Allocation used in Cuyahoga County
Since there are several assumption variables and uncertainty about their values, performance plots are used to offer intuition about the relationships and inter-relationships. These sensitivity results are combined with simulation results to evaluate the adequacy of the current allocation strategy (see Preliminary Findings).

Step 4. Using the Models in Optimization to Generate Recommendations
A simulation-based allocation strategy is proposed and analyzed with respect to the number of machines needed to achieve pre-specified service levels. Also, a comparison of allocations based on polling locations and precincts is presented (see Preliminary Findings).

In this section, the focus is on steps 1 and 2 and the associated key assumptions informed by the available data. In the next section, results from steps 3 and 4 are described as they relate to findings about the current and recommended allocation approaches. Overall, the goals are to evaluate the current allocation and to characterize how many machines are hypothetically needed if a sophisticated simulation-based approach were used.

Step 1: Analyze Cuyahoga BOE Data to Aid in Model Building

A table in the appendix shows the data obtained from the Cuyahoga County Board of elections. This table was derived using an assemblage of information from the Official SOVC Report.xls, AccuVote-TS Floppy Status Report, and the Polling Location Precinct List.xls (both reports supplied by the Cuyahoga BOE). During this assemblage two discrepancies were uncovered. First, "North Pointe Apartments" was not found in the AccuVote-TS Floppy Status Report. Second, "Watergate Apartments" was not found in the Polling Location Precinct List.xls. As a result, values were inserted into the table to make the combined source complete. Informal sensitivity analysis indicates that these inserted values, noted by "<>" in the table, did not affect any key results.

The ratio field in the table is simply the number of registered voters associated with a given polling location divided by the number of machines allocated. As is evident by inspection of the table and of Figure 1, one location constitutes a major outlier. "Millridge School" was apparently only allocated 4 machines with a registered voter population of 1,763 voters. While there might be a reason for this choice, our preliminary analysis treats all polling locations equally with respect to turnout ratio. Therefore, this location plays a major role in the performance evaluation of the existing allocation.

In this report, "polling location" and "vote center" are used interchangeably. The appendix data shows that the average number of precincts meeting together at a polling location is 2.5. Also from the data, 41% of the vote centers house precincts with "Cleveland" in their name. This includes Cleveland proper, Cleveland Heights, and East Cleveland. ESI assumes that Cleveland related polling locations typically require that voters spend more time in front of the DRE machines due to additional ballot initiates and/or candidates. Ideally, this assumption should be checked using specific ballot information before each election.

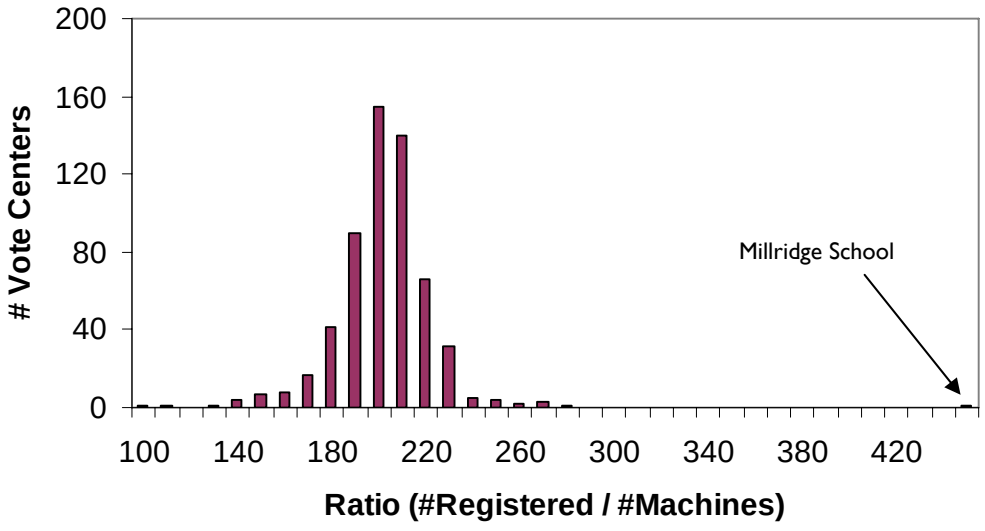


Figure IV - 1: Histogram of the number of vote centers associated with different ratios

Step 2: Building Models from Assumptions and Data

ESI had preliminarily investigated the application of idealistic queuing theory models for analyzing the Cuyahoga system following previous work in Allen and Bernshteyn (to appear). Such models are easy to create and use for analysis. However, it was decided that DRE out-of-service conditions were a critical feature of the voting system. This led to what queuing experts call a "priority queue" with two classes of arriving entities (voters and out-of-service events) having unequal service times. Also, ESI wanted to permit officials to specify service level requirements based on the expected worst polling location on a given Election Day and not only the polling location with the long term worst average waits. As a result, it was necessary to develop a discrete event simulation of the polling locations that permits modeling the relevant behavior accurately.

Once selected, discrete event simulation offered other benefits including an ability to model the start-stop nature of Election Day and the fact that arrivals typically cluster between 4 pm and 6 pm. In fact, using discrete event simulation, ESI has extreme freedom in the sense that assumptions can be selected to mirror actual voting behavior in an extremely realistic way. However, associated with this freedom is the burden of defining and agreeing on the assumptions.

Step 2a: Assumptions and Variable Descriptions

Assumptions relate to turnout (also called "arrival"), time in front of the DRE machine (also called "service"), out-of-service condition incidence (also called "breakdown arrival"), and repair time (also called "machine service").

Key Assumption 1: Arrival Rate

Voter arrival at the polling location is in an uncoordinated manner, leading to a random pattern. This randomness is of critical importance because it often leads to highly variable waiting times. It is assumed that the chance of an arrival is constant over the day (constant average arrival rate). However, in certain cases as specified it is assumed that the average arrival rate doubles from 4-6 pm based on data from the literature (Magleby and Christensen, 1994). Probably the most commonly used assumption scheme is based on "non-homogeneous Poisson process" (e.g., see Banks et al., 2005). Yet, the arrival process is constrained in that it is not possible to have many more arrivals than there are possible voters living in the area covered by the polling location. Therefore, our approach is two step, i.e., first the number of voters is generated and then the arrival times are selected (as described in Key Assumptions 2 and 3).

Key Assumption 2: The Number of Voters

Strictly speaking, the number of possible voters is greater than the number of registered voters because provisional ballots are possible. Yet, our approach constrains the turnout using a randomly generated fraction of the number of registered voters. Define an overall turnout parameter, T, roughly corresponding to the overall turnout fraction, e.g., 0.5 for 50% turnout. Then, the simulation generates the turnout, $T(i)$ for each polling location i using:

$$T(i) = \begin{cases} (T) \times (\#\ \text{Registered}) \times 0.6 & \text{with probability } 0.25 \\ (T) \times (\#\ \text{Registered}) \times 0.8 & \text{with probability } 0.25 \\ (T) \times (\#\ \text{Registered}) \times 1.2 & \text{with probability } 0.25 \\ (T) \times (\#\ \text{Registered}) \times 1.4 & \text{with probability } 0.25 \end{cases} \quad (1)$$

Key Assumption 3: Voter Arrival Times

Two assumptions are considered. (A3) The first is that the probability of arrival any time during the day is a constant. This simple assumption does not mean that equal numbers of voters will arrive each hour and can handle fairly rush periods. (B3) Also considered is the assumption that the arrival probability doubles between 4 pm and 6 pm and is otherwise constant throughout the day. This seems reasonable considering results in Magleby and Christensen (1994). However, as the second assumption is more complicated, results are developed for both assumptions. To preview results, most of the metrics considered are only marginally affected by the change.

Key Assumption 4: Time in Front of DRE

(Service Assumptions)

Voters spend an uneven amount of time in front of the DRE equipment when they are casting their ballot. Differences stem in part from interest and ability to synthesize the ballot and the amount of material presented. Also, certain precincts and thus polling locations include longer or shorter amounts of text and screens presented. ESI uses the phrase "ballot length" to refer to the amount of text and ideas that the voter must consider. Allen and Bernshteyn (to appear) established that ballot length played a key role in the appearance of unequal treatment of voter in the 2004 Franklin County presidential election.

In our simulations, an important parameter is *AVT* which corresponds roughly to the grand average time it takes voters in front of DRE machines in minutes. If there are more initiatives, longer explanations, more screens, and/or more candidates, *AVT* would be higher. To account for polling location ballot length variability, again two types of assumptions are considered. (A4) The first corresponds to the case in which the planner does not know which polling locations will have long or short ballots. For these cases, the simulation generates the average time in front of the DRE, $AVT(i)$ for a voter in polling location i using:

$$AVT(i) = \begin{cases} (AVT) \times 1.2 & \text{with probability } 0.5 \\ (AVT) \times 0.8 & \text{with probability } 0.5 \end{cases} \quad (2)$$

(B4) The second assumptions that are considered are based on the common occurrence that urban areas typically have longer ballots than rural ones. This was true for the 2004 November election in Franklin County (Allen and Bernshteyn, 2006). This assumption was used to generate the allocations in the appendix used to illustrate our approach. The simulation generates the average time in front of the DRE, $AVT(i)$ for a voter in polling location i using:

$$AVT(i) = \begin{cases} (AVT) \times 1.2 & \text{for locations in Cleveland, Cleveland Heights or East Cleveland} \\ AVT & \text{for other locations.} \end{cases} \quad (3)$$

Note that specific knowledge of the actual averages $AT(i)$ could (and should) be known before Election Day. The numbers should be measured by running mock voters through different voting scenarios and used for planning. Clearly, precincts with longer ballot lengths need more machines.

Key Assumption 5: Out-of-Service Condition Incidence

(Breakdown Arrival)

Out-of-service conditions refer here to situations in which the DRE machines become unavailable to voters. This could occur for any of the reasons noted in ESI's incident report analysis ranging from a paper jam to a computer system crash. Like voters, these out-of-service (OOS) conditions arrive at random times. In our simulation, these conditions arrive according to a Poisson process with an average rate of BD expressed in units, # per hour. Therefore, in a 13 hour Election Day, the fraction of machines experiencing at least one out-of-service condition is:

$$\text{Fraction Going Out-of-Service} = 1 - \text{EXP}[-13 \times (\text{BD})] \quad (4)$$

Table 1 shows some example conversions using this formula These conversions relate the arrival rates of out-of-service (OOS) conditions to the fraction of machines going OOS at least one time during Election Day.

Table IV - 1: Example conversions using the formula in equation (4).

Out-of-Service Rate (Problems Per Hour)	Fraction DRE Going OOS	Out-of-Service Rate (Problems Per Hour)	Fraction DRE Going OOS
0.001	0.013	0.011	0.133
0.002	0.026	0.012	0.144
0.003	0.038	0.013	0.155
0.004	0.051	0.014	0.166
0.005	0.063	0.015	0.177
0.006	0.075	0.016	0.188
0.007	0.087	0.017	0.198
0.008	0.099	0.018	0.209
0.009	0.110	0.019	0.219
0.010	0.122	0.020	0.229

The importance of the relationship in Table 1 derives from the fact that ESI's simulation includes out-of-service (OOS) conditions arriving with constant probability. Yet, it may be simpler to think in terms of fractions of machines entering an OOS condition during the day.

Key Assumption 6: DRE Repair Time

The ESI simulation is based on the assumption of highly variable DRE repair times. The time is assumed to be exponentially distributed with average time written RT. The exponential distribution is the most common distribution used for modeling repair times (e.g., see Banks et al., 2005) because it captures the typically high level of uncertainty associated with repair. For example, if the average repair time is 10 minutes, actual repairs could likely range between 1 minute and 50 minutes.

Key Assumption 7: Vote Center Availability

Unless mentioned otherwise, our results assume that voters in a vote center or polling location can go to any machine at the center. If that is not true, then the performance estimates in this analysis are far better than should be expected in the field (i.e., the real performance will be worse).

Step 2b: Simulation Details (Long Term Versus Short Term)

The simulation is formed by considering the four types of events that can, in general, occur: voter arrival to the vote center, voter completion of service upon exiting from the DRE machine, an out-of-service condition, and a repair. By following the rules associated with the abovementioned assumptions, the simulation proceeds to reproduce a potentially plausible Election Day scenario. Some simulations were conducted only on a single polling location at one time. Other computationally slower simulations were conducted taking into account all polling locations in Cuyahoga County simultaneously. The single location results ignore simultaneity and therefore access the performance that location would observe over many years of operation, i.e., "long term" performance. The county-wide simulations permit the study of worst case performance among any of the 580 locations on a given Election Day, i.e., "short term" performance.

Step 2c: Definitions of System Performance Measures

Performance Measures	Explanation
Maximum of Average Waiting Times (Short Term)	Each Election Day there is a single polling location with the longest sample average wait. The location is generally unknown before the election and varies from election to election because of the random combined occurrence of frequent arrivals, long times in front of the DREs, and machine breakdowns. This is the average or expected value of this worst location wait.
Expected Number of Polling Locations with Average Waits Longer Than… (Short Term)	Each Election Day there could be a few polling locations whose sample average waits are longer than a given value, e.g., 2 hours. The number and locations of these are generally unknowable before elections.
Average Maximum Waiting Time (Short Term)	Each polling location has its voter who waited the longest. The average maximum waiting time is the average time all of these most waylaid voters waited in queue.
Average Overtime at All Locations (Short Term)	This is the average time in minutes that all locations kept processing voters after the doors closed at 7:30PM. For example, if the turnout was light and voting was quick, the average time might be 5 minutes later than the time when the doors close, i.e., 7:35PM.
Average Waiting Time (Both Long Term and Short Term)	This is the average time (in minutes) that all voters from all precincts wait in line before being allowed to interact with the direct recording equipment (DRE) machine on which they actually vote. In most cases, this is simply the average waiting time before they interact with their first DRE. However, considering that out-of-service conditions might occur, it is the average of the sum of all waiting times.
Maximum of the Average Waiting Times (Long Term)	The average time voters from the polling location with the longest long term average wait. Considering the desire to treat all precincts equally, this is the average time experienced in the precinct treated most harshly by the voting system.

Step 2d: Example Simulation Output

In this section an example simulation output is described which is derived from key assumptions that are employed in the simulation model. The results are based on the constant arrival probability assumption (assumption "A") to show how it even this simple assumption can result in a realistic rush period. Specifically, a case is considered with $T(i) = 0.5$ or 50% voter turnout and an average time in front of a DRE of $AVT_i = 5$ minutes and an out-of-service rate of $BD = 0.0178$ per hour. From Table 1, it can be seen that these assumptions imply that roughly 9% of the machines are expected to experience at least one out-of-service condition. Further, assume that the average repair time is $RT = 60$ minutes. Figure 2 shows the waits experienced by the 1,204 simulated voters over the Election Day. The cluster in the middle would be typical of a lunch-time rush.

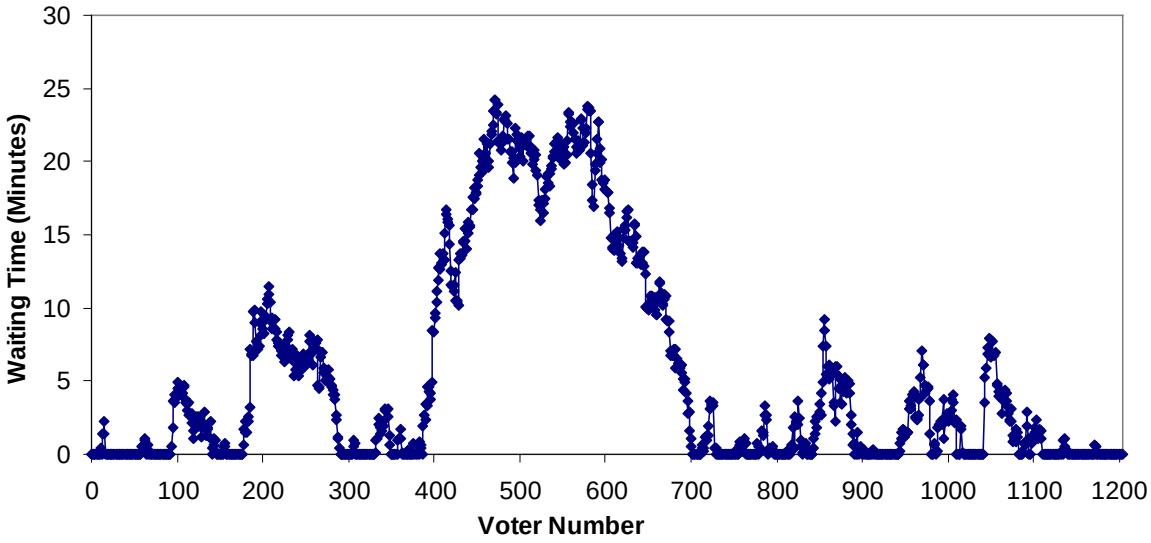


Figure IV - 2: The wait time experienced by simulated voters over the course of an Election Day in a single vote center.

Using simulation, many system performance measures can be calculated and used to predict what might happen if the board of elections took different courses of action.

Findings

In this section, results from applying the developed simulation model are described. The model is first applied to evaluate the current allocation strategy used in Cuyahoga County. Next, the model is built into a proposed simulation-based machine allocation strategy. Simulation is then used to evaluate the properties of the proposed approach. Then, focus is shifted to the number of machines that would be needed if the method were applied and certain conditions were met.

Step 3: Studying the Current Allocation used in Cuyahoga County

By some measures and for many relevant assumptions, the current allocation of machines as shown in the appendix is highly problematic. Clearly, if "Millridge school" polling place is only allocated 4 machines with its 1,763 registered voters, waits will likely be long at that location. Table 2 shows two scenarios and the system performance measures derived from the simulation model. The first scenario corresponds to a relatively moderate Election Day, scenario 2 corresponds to a relatively moderate case, and scenario 3 corresponds to an extremely heavy turnout with long ballots. All scenarios are based on the assumption (B) of a 4-6 pm rush period and (B) in equation (3) of longer ballots in Cleveland precincts. In parenthesis, the results are given assume the Millridge school polling location is allocated 9 machines instead of 4.

Table IV - 2: Simulation predictions for three scenarios based on 10 county-wide simulated elections.

Variable	Scenario 1	Scenario 2	Scenario 3
Turnout Parameter (*T*)	0.5 or 50%	0.55 or 55%	0.6 or 60%
Average Time In Front of DRE (*AVT*)	3.75 minutes	4.5 minutes	6 minutes
Fraction of Machines with At Least 1 Out-of-Service Condition	0.21 or 21%	0.21 or 21%	0.21 or 21%
Average Repair Time (RT)	60 minutes	60 minutes	60 minutes
Simulation Predictions			
Maximum of Average Waiting Times	80 ± 17 min (44 ± 6 min)	116 ± 17 min (102.5 ± 7.5 min)	430 ± 50 min (345 ± 15 min)
Expected or Average Number of Polling Locations with Average Waits Longer Than 60 minutes	0.4 ± 0.2 (0.0 ± 0.3)	6.2 ± 0.8 (5.8 ± 0.4)	188.1 ± 2.8 (188.6 ± 2.7)
Average of Maximum Waiting Times	18.8 ± 0.2 min (18.2 ± 0.3 min)	43.4 ± 0.7 min (43.4 ± 0.6 min)	149.3 ± 1.4 min (148.4 ± 0.8 min)
Average Overtime at All Locations	11.9 ± 0.2 min (11.5 ± 0.2 min)	37.3 ± 0.7 min (37.2 ± 0.7 min)	150.3 ± 1.4 min (149.1 ± 1.0 min)
Average Waiting Time	3.0 ± 0.1 min (2.9 ± 0.1 min)	9.7 ± 0.1 min (9.6 ± 0.2 min)	53.1 ± 0.6 min (52.6 ± 0.4 min)

In the first scenario, the typical voter experiences minimal (if any) wait. Most polling locations would close within 10 minutes of 7:30PM with minimal issues. The main concern is inequity in the sense that voters in a few locations, such as Millridge school, wait for a long time on average. Voters at these few locations are likely to wait over 3 hours (193 mins) on average.

In the second scenario, turnout is relatively high and there are relatively many candidates and issues to vote on. Here, many voters would perceive lines but few would wait longer than 15 minutes. In a few precincts (on average 6) the average voter would wait longer than 1 hour. In the third scenario, turnout is relatively high and the ballots are generally long, with many issues to vote on. In this scenario, at least one polling location is greatly stagnated with the average voter waiting over 6 hours. Many precincts, likely over 188 have average waits longer than 1 hour and likely many voters would be deterred from voting because of the lines.

It is important to realize that, except for Millridge school, it is difficult to predict in advance which locations will experience the problems only that by random coincidences of bunched arrivals, long times in front of the DREs (voting times), and machine breakdowns, long waits are extremely likely. However, in the next section there is a description of how a simulation-based allocation approach would likely produce greatly improved system performance for a variety of assumptions. **Such an approach might require no additional machines while achieving desired performance goals**.

In the remainder of this section, predictions from the simulation model are plotted to aid in intuition building about how assumptions regarding the elections affect expected performance. These plots are based on the simplest assumptions, i.e., (A3) that the arrival probability is constant and (A4) that which locations have longer ballots is unknown. To construct these plots, ESI conducted formally planned experiments using the EIMSE optimal design approach described in Allen (2006) and available in Sagata® software. It is believed that this added negligible errors such that the plots can be taken for averages coming directly from the simulation models.

Figure 3 shows the simulation predictions with assumptions varied singly and others averaged over. The plot shows that waiting times are not substantial on average unless the turnout parameter, *T* (roughly equal to average precinct turnout), is over 0.45 or 45%. Similarly, unless the average time required in front of the DRE, AVT, is above 4.5 minutes. Also, for the current allocation breakdowns do not strongly influence the performance over the ranges considered.

Figure V - 3: Pseudo-Main Effects plot showing how assumptions varied singly affect waiting times

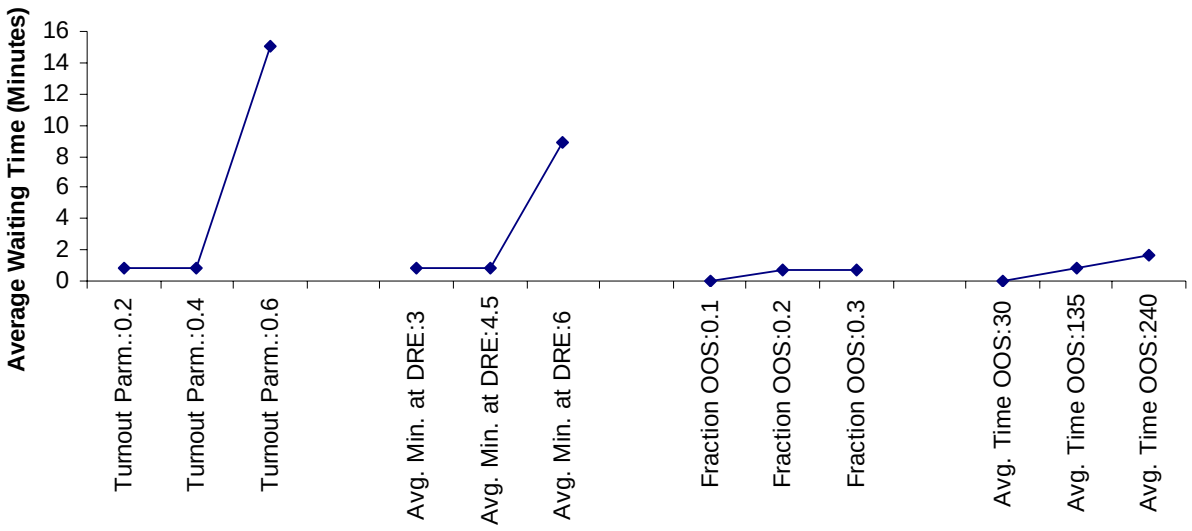


Figure 4 shows the simulation predictions for the average waiting times for all voters. The plot shows the strong interaction between high turnout and long average times in front of DRE equipment, i.e., long ballot lengths. Both Figure 3 and Figure 4 indicate that ballot lengths play a comparable role to turnout issues in long waiting times. Yet, unlike turnout the average times in front of the DRE can be predicted fairly accurately before the election by testing people on the DREs.

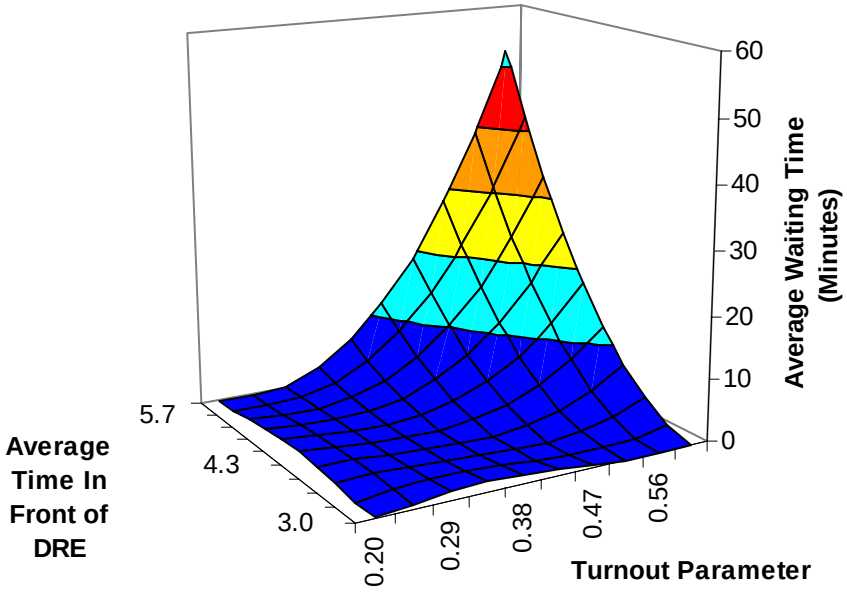
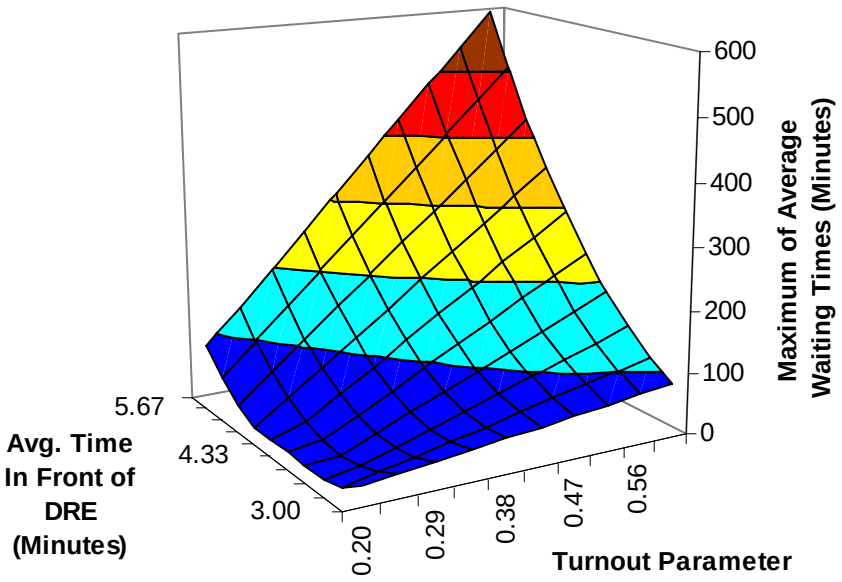


Figure IV - 4: 3D surface of outputs from the simulation model with fraction OOS = 0.2 and RT = 135 minutes

Figure 5 shows how much longer the worst precinct performance (Millridge School) is than the average in terms of average waiting time performance. The plot also shows one of the limitations of the simulation model. If voters were waiting for 600 minutes on average (10 hours), turnout would likely be affected. The effect of long lines on deterring voters is not accounted for in the simulation.

Figure IV - 5: 3D surface of outputs from the simulation model with fraction OOS = 0.2 and RT = 135 minutes



Step 4: Using the Models in Optimization to Generate Recommendations

Proposed Method: Simulation-Based Allocation Generation (SAG)

In this section, a novel simulation-based method for allocating machines to precincts is described. The method in words is simple. Estimate the average times in front of DRE machines, AVT(i) for all precincts *i* and then allocate enough machines such that the simulation model indicates maximum of average waiting time (long term) performance is good enough. The following pseudo code defines more precisely the simulation-based allocation generation SAG method. Let *N* be the number of polling locations considered, e.g., *N* = 579 in Cuyahoga.

SAG Pseudo Code

i = 0; <setting the polling center counter to zero>
Do { *i* → *i* + 1; Use data to estimate the average voting time for precinct *i*;
j = 0; <setting the machine counter to zero>
Do { *j* → *j* + 1; } While { Maximum Average Waiting Time (Long Term) < Set Number }
(Number allocated to precinct *i*) = *j*;
} **While** {*i* < *N*}

The SAG method is computationally efficient because it is based on the maximum average waiting time (long term). Therefore, the simulations in the central loop only consider a single location at one time. The allocations in this report are based on 50 replicates or simulated election days. Note that the maximum average waiting time (long term) may be only 3 minutes but the maximum of average waiting times may be 300 minutes or higher. This follows because of the explosive nature of election systems and the high number of polling locations. On any given Election Day, one or more locations might easily have its worst performance experienced in 580 elections.

The appendix contains allocations using 5226 and 6978 machines. These numbers where chosen because they achieve specific performance thresholds. Using 5226 machines, the SAG method effectively guarantees (under scenario 2) that the worst precinct has an expected average waiting time of 30 minutes or less (within simulation errors). Using 6978 machines, the SAG method effectively guarantees (under scenario 3) that all polling locations will experience less than 1 hour expected or average waiting times (within simulation errors).

Figure 6 shows the benefits of using the SAG method compared with the Cuyahoga allocation as given and with 9 machines allocated to Millridge. The results indicate that it is possible to greatly reduce the waits experienced by voters with minimal addition in the number of machines. For example, under scenario 3, voters in the worst precinct are expected to wait half as long on average using the 5226 machine SAG allocation compared with the current Cuyahoga County allocation. These votes would likely be much more appreciative of the efforts made by the board of elections using the SAG method than otherwise.

Figure 7 shows the benefits in terms of being able to completely shut down locations and report results. Under scenario 3, using the 5226 machine SAG allocation would permit closing 22 minutes earlier on average than using the current Cuyahoga allocation (127.7 $\pm$ 1.0 minutes after 7:30 pm compared with 150.3 $\pm$ 1.4 minutes after 7:30 pm). This could save time for thousands of volunteers and voters.

Figure IV - 6: Simulation based comparison of alternative allocations focusing on average waits at the worst location

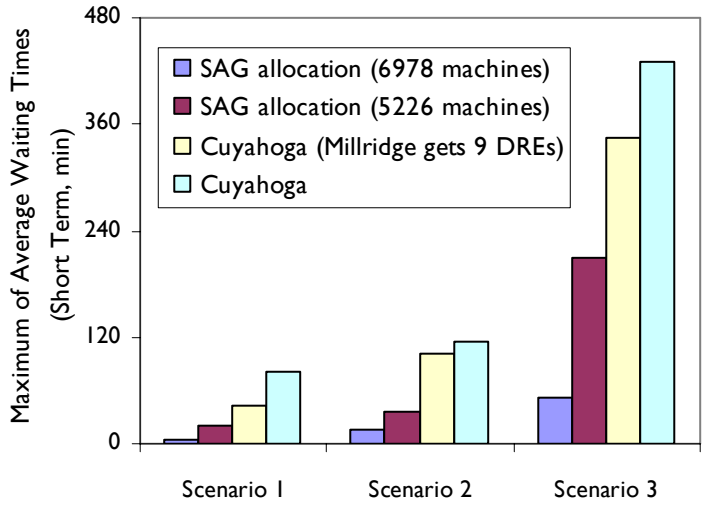


Figure IV - 7: Simulation based comparison of alternative allocations focusing on the average overtimes

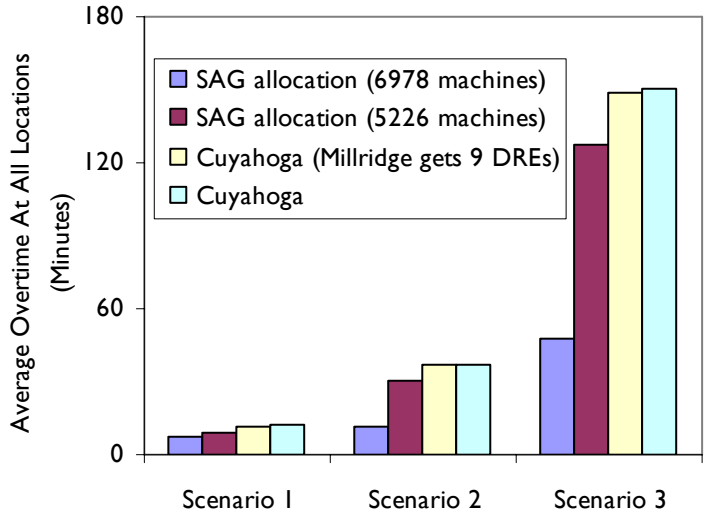
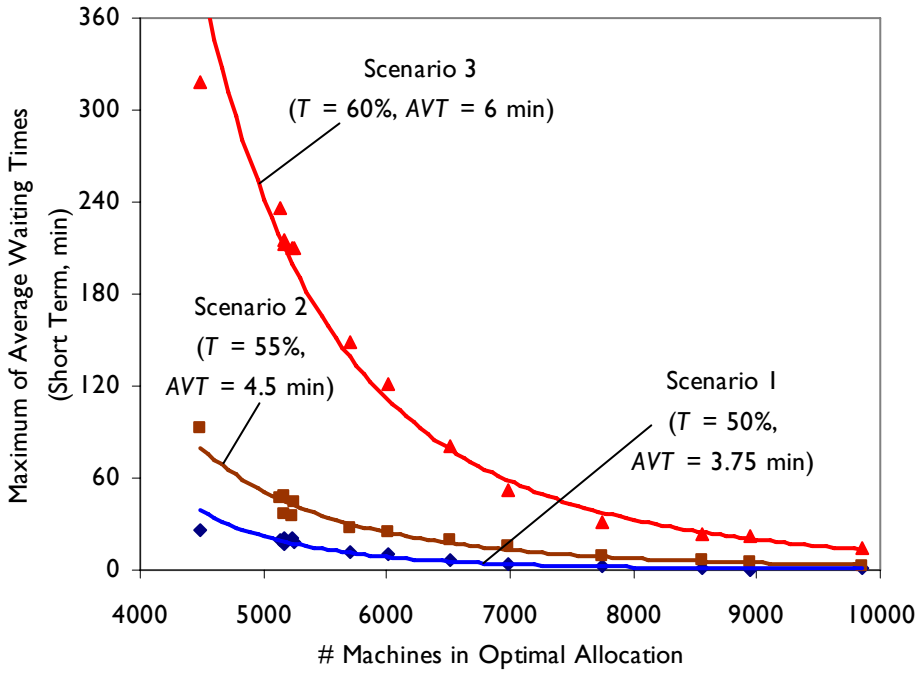


Figure 7 shows the simulated performance as a function of the number of machines. The plot assumes that the SAG optimal allocation is used, which is subject to all of the limitations described next. This plot provides information pertinent to selecting the number of machines needed for effective operation. For example, under scenario 1 (T = 0.5 or 50% turnout parameter and AVT = 3.75 minutes), it seems likely that 5200 machines will suffice and voters will experience waits that might be considered acceptable.

Figure IV - 8: Simulation performance focusing on the average waits in the worst polling location



SAG Method Limitations

Limitations associated with the SAG method include:

1. The average times in front of voting equipment, AVT(*i*) for all *i* = 1,…,N must be estimated accurately before the election. (Presumably by a time study using identical ballots.)
2. Every hour of the Election Day has an equal chance of getting a given number of voters arriving except for 4-6 pm which has double the rate (i.e. the arrival rate is constant at other times of the day).
3. Voters are permitted to use any machine available in a polling location or vote center (i.e., there is no constraint that voters must use machines from their precinct only).
4. Care is taken by the election officials in applying the election allocation of machines such that no anomalous allocations such as the current Millridge school allocation are included.
5. The DRE machine breakdown rates and times are estimated accurately before the election. Smaller breakdown rates and shorter repair times, of course, only improve performance.

Precincts Versus Vote Centers

ESI has concluded that restricting voters to machines from their precinct offers benefits in terms of accounting for and auditing elections. However, from the waiting line perspective permitting voters to use any machine in a vote center leads to a performance improvement. In 53 scenarios of assumptions selected to be roughly representative of possible election conditions, restricting voters to use precinct machines only caused the SAG method to require on average 25% more machines to achieve the same service levels.

Recommendations

ESI recommends the following next steps:

1. Cuyahoga officials select desired assumptions, i.e., pick a scenario such as T = 0.55 or 55% turnout parameter and AVT = 4.5 minutes required by the average voter.

2. Cuyahoga officials select a desired performance measure and a level for than measure. For example, officials might select maximum average waiting time (short term) and set a threshold of 40 minutes.

3. Apply the SAG method to generate allocations for pre-specified maximum average waits (long term). For example, the 5226 machine allocation in the appendix was generated with the long term actual wait constrained to be less than 2.7 minutes.

4. Iterate Step 3 until the performance requirements are satisfied adjusting the maximum average waits (long term). For example, the 5226 machine allocation already achieves a maximum average wait equal to 35.6 minutes which is less than 40 minutes. Therefore, in this case iteration is not needed.

5. Move machines to locations according to the allocation generated and apply best practices to minimize problems.

Using the SAG method, good performance and short lines are not guaranteed. However, ESI believes that the chance of short lines and satisfied voters substantially increases when the optimal approach is applied.

Ideally, it would be desirable to have machines "at the ready" for speedy allocation to the polling locations where long lines develop (if any). However, this "recourse" approach may not be technologically feasible. Still, considering that the problem locations cannot be predicted in advance (generally) speedy recourse might be valuable. Conceivably, a speedy recourse approach could permit a county to save millions of dollars in added machine costs without increasing the waits experienced by voters.

Opportunities for future study

1. The SAG method is reasonably efficient but iteration to achieve performance requirements can be time consuming. A more direct and efficient method could be developed, e.g., exploiting technology for "rare event" simulation and applying design of experiments meta-modeling to individual precincts.

2. Tuning the parameters of a recourse strategy could be important. Such work could address the question of how many machines should be held back for rapid deployment and the implications associated with slow setup times of the deployed machines.

3. Careful attention can be given to estimating the voting times AVT(*i*) at all the locations *i* before the 2006 November election. Ideally, mock voting would be conducted and timing used to estimate these times. Also, a compilation of numbers associated with the ballot lengths at all elections would be made. For example, simply counting the number of issues to be voted on at all locations could be conducted.

4. Observing the actual November election would permit direct study of the arrival distribution. It could answer questions such as whether arrivals have approximately constant probabilities throughout the day or bunch up at certain times.

5. Observing the actual November election would also permit direct study of the time in front of DRE machines needed by actual voters. Then, an empirical or other distribution could be used in place of the exponential distribution. Such a substitution would be expected to increase the accuracy of simulation predictions for future allocations and studies.

Section 5

Manual Count of Paper Ballots

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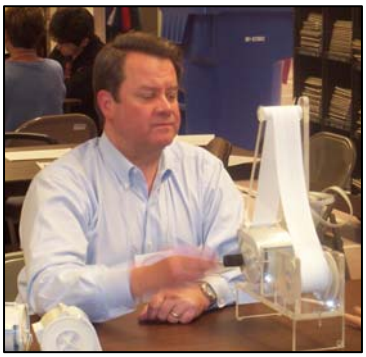
Overview of Approach

- The manual count was conducted across a scientific sample of 50 polling places. The polling places are a stratified probability sample of Cuyahoga County. Approximately 145 precincts were included in these 50 polling locations, comprising 467 DRE voting machines. The team reviewed a total of 414 VVPATs.
- 100% of the regular ballots cast by voters on DRE voting machines at each of the chosen precincts were manually counted by a team of election officials, booth workers and students working in pairs. The result of the Governor's race was counted from each paper ballot.
- ESI compared the manually-tabulated results to the electronic results from the DRE voting machines based at each of the same polling places chosen in the scientific sample.
- When or if discrepancies were found in the sampled polling places, ESI assessed the magnitude of the discrepancies.

Summary of the Manual Count Process

In 2006, Cuyahoga County implemented the Diebold TSX Accu-Vote touch-screen voting machines. According to Ohio state law, all voting machines require a Voter Verified Paper Audit Trail (VVPAT). Furthermore, the VVPAT ballot – that is, the printed ballot created during the voting process which the voter can read in order to verify his or her selection – constitutes the official ballot in the event of a recount or contest. Following the 2006 primary election, Cuyahoga County conducted a manual recount of three percent of the manual ballots. In order to assess the accuracy of a manual ballot count, ESI conducted an independent recount and analysis.

Using standard and accepted statistical principles, ESI designed a manual count sample selection process. ESI aimed to conduct a manual recount of gubernatorial votes cast in 50 polling locations. The polling locations are a stratified probability sample of Cuyahoga County. Approximately 145 precincts were included in these 50 polling locations, comprising approximately 375 DRE voting machines.



The polling locations selected for the manual recount matched the precincts selected for the exit polling and the booth worker survey, which allowed ESI to build a multi-dimensional picture of what happened on Election Day. Information collected from the recount, the exit polling, the incidents report and the booth worker survey allows us to recreate with considerable detail the events occurring in a representative sample of polling locations on Election Day.

ESI recruited a team of election officials, booth workers and students to conduct a recount of 100% of the ballots at each of the chosen polling locations. The team worked in pairs to tally the total number of votes counted for each of the four gubernatorial candidates on each voting machine.

These tallies were initially compared to results summaries printed on the VVPAT. Discrepancies triggered a blind second count by a different team. Manual count teams were asked to record and describe all physical anomalies such as torn VVPATs, printer jams, missing portions of the ballot, ink problems and any other physical anomaly that might affect the printing and reading of the ballot. Manual count teams were also asked to record any anomalies affecting the reports printed on the VVPATs.

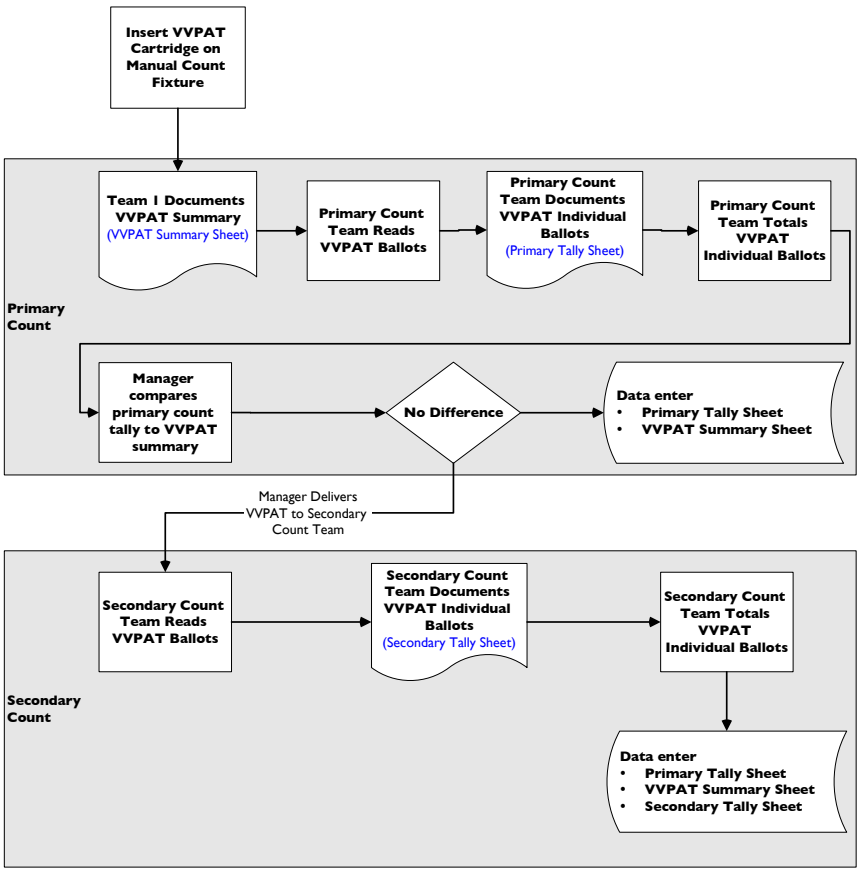


Figure V- 1: Manual Count Process Flow

ESI developed a "recount fixture" to allow manual count teams to view the ballots without handling the ballots. These devices allowed for a quick, efficient review of the ballots. ESI also developed several forms (see Appendix A) to collect the information: a tally sheet, a summary sheet, and a recount fixture evaluation form. And finally, ESI developed a set of procedures and policies (see Appendix B) to ensure the accuracy, objectivity and integrity of the process.

Findings[5]

ESI's objective was simple: a statistically valid comparison of the manual ballot count to the electronic results. As ESI took steps to implement the manual count and comparison, unforeseen obstacles not only forced ESI to redefine the project, they also posed a risk to the validity of the data collected.

In the course of conducting a manual count of VVPAT ballots, ESI documented anomalies that could potentially raise questions about the validity of the ballots themselves or of results compiled from these ballots. In the following discussion of ESI's preliminary findings, there is an attempt to describe the anomalies and how they affected this project. These anomalies can be divided into the following categories:

- issues concerning the reporting of regular ballots cast at the polling place on Election Day
- issues with the paper ballots and the printers (mechanical failures)
- lapses in the chain of custody governing machines and ballots
- irregularities with the content of the VVPAT, specifically the zero and results reports
- administrative process issues

Further, while developing and conducting the tallying process with appropriate checks and balances, ESI observed the following significant challenges to auditing election results:

- Due to a confluence of events and factors including booth worker practices, voting machine and printer malfunction, and ambiguous policies and procedures, conducting a reliable audit of the 2006 Primary Election results presents a considerable challenge.
- In the event of a recount or election contest, the risk of legal challenge in future elections is exceptionally high if no significant modifications are made to the current election system. Under current Ohio law, the VVPAT is the official ballot. During this manual count, the ESI team discovered 40 VVPAT ballots (9.66 percent) that were either destroyed, blank, illegible, missing, taped together or compromised in some way. 1.4 percent of the VVPATs were missing ballots.
- Inconsistency in the identifying information printed on the VVPAT such as precinct information and machine ID, as well as inconsistency in the VVPAT summary results report information printed out at the close of Election Day (booth workers could choose from several reporting options) increases the difficulty of a meaningful audit, while raising questions that about the integrity of the vote count. For example, 2.8 percent of the VVPAT's were missing Machine ID numbers; 5.4 percent did not identify the precinct.

[5] Limitation of Findings

The "Statement of Votes Cast" (SOVC) report including only regular voted ballots cast on precinct-based DRE voting machines is not yet available from the BOE and must be re-created from DRE memory cards utilized on Election Day. When this SOVC report is available, ESI will be able to compare the results of the Manual Count with the electronic count.

- Failures in the chain of custody also increase the risk of a legal challenge. For example, 72 percent of the labels identifying canisters containing the VVPAT tapes were missing information. (Booth workers were responsible for labeling canisters at the end of Election Day.) 46 percent of the labels were blank.
- Voters frequently cast regular voted ballots on DRE voting machines located in their polling location but not in their designated precinct. This not only does not comply with Ohio law regarding provisional voting, but breaks down one's ability to compare total ballots cast in a given precinct to the number of voters signing the Signature Poll Book.
- Many challenges faced during this manual count are the result of complicated scenarios and nomenclature that are difficult to understand, even among those well versed in election administration. It will be a significant test to adequately explain these scenarios to media and government oversight groups. Therefore, negative exposure, eroding public confidence, is likely following a close and important contest.
- Many of the challenges uncovered during this manual count are not unique to Cuyahoga County, but are systemic and therefore faced by other counties nationally and across Ohio.
- The manual count fixture developed by ESI promises to make the manual count easier and more efficient.
- Both ESI and the Ohio election officials participating in this Manual Count project found the process extremely rewarding. The project fostered a new level of cooperation between Ohio election officials and external stakeholders, formulating a positive seed for a new collaborative approach to problem solving.
- The Manual Count project resulted in the creation of a preliminary draft set of Manual Count procedures that the Cuyahoga BOE may utilize to improve the manual count process in November 2006.

Meeting the Challenge for November 2006 and Beyond

Meeting the challenges that surfaced as a result of this manual count in future elections will require the cooperation of all stakeholders: Cuyahoga County Commissioners, the Board of Elections, BOE management and staff, booth workers, and all vendors. It is ESI's strong recommendation that all parties roll-up their shirt sleeves and immediately focus on developing and implementing a plan for conducting a successful election in November 2006, which is certain to experience greater scrutiny and higher turnout than the most recent Primary election.

ESI's recommended immediate next steps are:

- Commence the development of a prioritized implementation plan for the November 2006 General Election, focusing on achievable and realistic goals. This implementation plan[6] should focus on the

[6] As part of this engagement with Cuyahoga County, ESI is also developing a Threat Analysis report that will identify many of the issues uncovered during the manual count. This report will help the county prioritize the impact of the issues uncovered during this manual count, thereby forming the basis for a future implementation plan.

development of an audit process of VVPAT ballots and the essential upstream processes necessary to facilitate this audit process.

- Meet with all relevant election stakeholders and secure the buy-in of all parties to implement strong processes, procedures and training that support a reliable audit protocol in future elections.

A Comparison of the Manual Count Data and the Electronic Data

As mentioned above, the original ESI proposal called for comparing data from the manual count of the paper ballots with the initial "Statement of Votes Cast" (SOVC). The SOVC is a precinct-based report of regular votes cast on DRE machines produced from the memory cards delivered on Election Night. In the BOE's compilation of unofficial election results, however, the precinct tallies included not only regular votes cast on the DRE machines, but also the votes cast on optical scan ballots: curbside ballots, emergency ballots, ballots cast by 17 year olds and some provisional ballots. In order to compare apples to apples, ESI asked the BOE to return to the memory cards delivered on Election Night, which only contained votes cast on DRE's only, and collect results from the polling locations included in the ESI sample. ESI then compared the votes tallied from VVPAT ballots from each polling location with the accumulated totals taken from the memory cards from the same polling locations.

While ESI's analysis is ongoing, the recount process has nonetheless provided a unique perspective on the events of Election Day. What follows is a summary presentation of some of the important issues highlighted by the attempt to tally the VVPAT ballots printed on Election Day.

Ballots

Issues encountered in reading ballots were physical problems endemic to the paper medium. Issues encountered either in the course of trying to read a specific ballot or in the course of reviewing the entire VVPAT were manifold. ESI also asked the recount team to record and describe anomalies found on the VVPATs. Some examples of such issues and anomalies include:

- Blank VVPAT – that is, VVPATs with nothing printed on them
- Accordion-style crumpling of the VVPAT
- Inexplicable long blank spaces
- Torn VVPAT and VVPATs joined together with tape
- Printing anomalies (faded ink or irregular ink distribution)
- Text missing from VVPATs

In each case, the physical integrity of the ballot is compromised. As, under Ohio law, the paper receipt is considered the official ballot (see appendix), the fact that the physical ballots were in so many cases destroyed means that ballots would be lost in a recount or contest.

Specifically, the manual count team reported the following:

- Six VVPATs (1.4 percent) of the total VVPAT Cartridges were blank. In one of these cases, the transfer case that was supposed to be used to deliver the ballots on Election Nights contained one empty canister.

- Forty-three (10.4 percent) of the VVPATs were physically compromised in any of the following ways: smeared print, torn paper, crumpled or folded paper, paper taped together, blank spaces or printer anomalies

Printer problems were not evenly distributed throughout but rather were clustered in particular vote centers. For example, 18 vote centers experienced 100 percent of the printer errors (4 vote centers experienced 46% of the printer errors).

Results reports

Vote Centers ranged in size from two to nine precincts. On average, each precinct had three voting machines. Most voting machines produced only one VVPAT containing both the zero report and the results report; however, manual counting teams frequently found multiple VVPATs produced by a single machine. In some cases, it was not possible to identify which machine produced the VVPAT.

In conducting an initial comparison between the individual VVPAT ballots the manual count team encountered difficulties resulting from missing summary information – including missing zero reports or missing results reports. VVPATs showed evidence of booth workers using trial and error to print reports and start up or close down the machines. For example, some VVPATs had multiple reports. Booth workers apparently attempted to overcome printer problems by shutting down machines, removing and replacing cards, and restarting the machines. One team, for example, encountered a VVPAT that consisted of seven zero reports, and three ballots (two of which were marred by apparent printer jams and no results report).

A review of the data revealed the following:

- 13 VVPATs (3.1 percent) were missing results summaries; 7 VVPATs were missing zero reports
- 12 of the VVPAT summaries (2.8 percent) were missing Machine ID numbers
- 23 of the VVPAT summaries (5.4 percent) were missing Precinct information
- 7 of the VVPAT summaries (1.6 percent) were missing serial numbers
- An unknown quantity of VVPATs either contained a discrepancy in the date stamp (some had dates prior to the election and some after the election) or appeared to have been printed from the memory cards

The manual count team reported inconsistencies in the content and format of results reports. For example, since voters at the polling location could cast a vote on any machine in the polling location, machines recorded votes for multiple[7] precincts. While most reports provided a summary of votes cast for gubernatorial candidates on that machine broken down by precinct, some reports did not. In some cases, the report format prevented comparing the ballots to the summary

Some reports provided vote totals by precinct along with a summary accumulating votes cast for each race on the machine; some reports provided contest totals by precinct but without a summary accumulating votes cast for governor on that machine; some reports provided accumulated totals by party and precinct.

[7] Another potential source of error lies with the ballot encoder. It is possible that booth workers either encoded the voter access cards incorrectly or, in the event of encoder failure, allowed voters to utilize access cards encoded at a different precinct. Such a circumstance would not be detected in a manual recount of the VVPAT (although this may explain the numbers of cancelled ballots). Such problems would be uncovered by matching the Signature Poll Book with the regular and provisional votes recorded in that precinct. This issue deserves further investigation.

- One team encountered a VVPAT that provided summaries of the total number of votes cast in other precincts but no summary of gubernatorial votes cast on that machine. In this case it was impossible to compare the tally of votes on that machine with the summary report.

Comparing the VVPAT Individual Ballots and the VVPAT Summaries

As described above, the team conducted an initial comparison of the VVPAT individual ballots with the VVPAT summaries. Discrepancies triggered 67 second manual counts (i.e. Secondary Count) by a separate manual counting team. In 13 (16.2 percent) cases, the second count resolved the discrepancy between the VVPAT Ballot Count and the VVPAT Summary Count.

The following additional discrepancies remained unresolved.

- On 347 VVPATS (84 percent) the number of individual VVPATS reconciled with the number recorded in the report summary.
- 50 VVPATs (12.1 percent) showed a discrepancy of 1-5 votes
- 9 VVPATs (2.2 percent) showed a discrepancy of over 25 votes.

A final tally of the total number of individual votes was 15,386; the total number of votes recorded in the VVPAT summaries was 15,431 – a discrepancy of 45 votes. (as this is not an absolute value of the difference in votes cast, these numbers may not agree with similar appearing comparisons in the Comparing the County section of this report).

Table V- 1: Discrepancies did not affect candidates in the same way

Candidate	VVPAT Ballot Count	VVPAT Summary	Vote Difference (VVPAT Ballot Count – VVPAT Summary)
Strickland:	7391	7467	-76
Flannery:	3017	3008	+9
Petro:	2825	2822	+3
Blackwell:	2153	2134	+19

While the tally for Strickland showed fewer individual VVPAT ballots than were recorded in the summary, all the other candidates had fewer votes recorded in the VVPAT summaries.

While the tally for Strickland showed fewer individual ballots than were recorded in the summary, all the other candidates had fewer votes recorded in the summaries.

Given the numbers of missing, damaged or otherwise unreadable ballots combined with missing or incomplete summaries, these results are not unexpected. Notably, the highest vote getter, Strickland, was disproportionately affected by the loss or damage of individual votes. Totals for other candidates appeared to be affected by the incidence of missing reports.

Notably, discrepancies were not uniform across the sample. Some vote centers experienced a disproportionate number of problems.

Lapses in the Chain of Custody

Inconsistent application of chain of custody procedures and process by booth workers compromised the validity of the data. Booth Workers were instructed to fill out a label on each VVPAT canister. These labels were to provide the jurisdiction, date, vote center and machine serial number. If there was more than one tape for a machine, booth workers were to record the sequence – in other words, 1 of 3 canisters, 2 of 3, 3 of 3.

- 174 of the VVPAT Canisters (42 percent) were returned with blank labels.
- 308 canister labels (72 percent) were incomplete.
- 143 of the VVPAT Canisters (34.5 percent) were missing poll location information
- While the specific figure is unknown, we frequently witnessed that the booth workers failed to sign the VVPAT.

Accordingly, ESI manual count teams had to rely on information found on the printed VVPAT such as the terminal serial number, the machine ID number, the precinct and the polling location. As noted above, however, the VVPATs did not always provide this information.

The canister label, which the booth workers are required to sign, is part of the chain of custody; the absence of this information constitutes a break in that chain.

Comparing Total Ballots Cast to Total Signatures in the Signature Poll Book

In polling locations housing multiple precincts, voters could have their voter access cards encoded in their precinct but were allowed to actually cast their votes in any precinct. As a result, the number of voters who signed the precinct poll books cannot be matched against the number of voters who voted on the machines in that precinct. And because there was no total of regular ballots broken down by precinct, it is impossible to determine if the number of voters who signed the poll book matched the total number of votes. Moreover, prior to the election, the BOE approved a waiver permitting a difference of 35 ballots between the total signatures in the Signature Poll Book and the total ballots cast in the same precinct.

Next Steps

Further examination of the data should reveal the reasons for some of the patterns observed in the data. These examinations should include the following steps:

Improving Auditability and Transparency

An integral component of auditability is the ability to determine the accuracy of the VVPAT ballots. Accordingly, the BOE should develop and formalize a Manual Recount and Audit Procedure to be conducted after each election. This procedure would allow the BOE to determine if there are:

- discrepancies between votes and totals recorded on the VVPAT ballots and the memory cards,
- discrepancies between the votes and totals recorded on the memory cards and the internal memory, or
- discrepancies between the number of voters who sign the signature poll book and the number of voters casting votes in that precinct.

In order to develop and implement this kind of audit process, the BOE will need to analyze upstream policies and procedures – audit points – that have an impact on the recording and reporting of votes cast. In other words, the BOE needs to determine what information must be collected on Election Night and in the post-Election period and work backwards to develop the procedures necessary to ensure that information will be consistent and available. For example, to determine whether the number of voters who entered the precinct matches the number who voted in that precinct (even if they used terminals outside their precinct), there must be a report of regular votes cast in each precinct on Election Day.

The "recount fixture"

The "recount fixture" should be developed and further refined for extensive use in a count of the VVPAT ballots. While ESI recommends that BOE conduct a manual count of the VVPAT ballots after every election, even if the BOE fails to take this recommendation, a recount device will be necessary in the event of a recount or contest.

Practice Audit

To ensure the audit process works prior to the November General Election, ESI recommends that the BOE conduct a practice audit. This practice audit would test whether key personnel and departments are able to produce the information and data necessary for the audit.

Consistency

In order to be able to reconstruct the events of Election Day, the procedures for opening and closing machines and processing voters must be consistent. For example, every machine must provide the same zero report prior to being used for voting. The data gathered by ESI in the course of the manual recount suggested a lack of consistency, which hindered auditability. This inconsistency is especially prominent in how booth workers complied or failed to comply with established policies. ESI recommends that the BOE take strong measures to improve consistent application of policies and procedures associated with the creating and handling of memory cards and VVPATs.

Developing Contingency Measures

Contingency measure for op-scan failure

If the BOE is not able to correct the problem that prevented an Election Night tally of op-scan ballots, a contingency plan must be in place for how to process and tally votes from "un-scannable" ballots cast at the precinct on Election Day.

Contingency measures for printer failure

The attempt to count VVPAT ballots revealed multiple problems with the DRE printers. Some of these problems can be mitigated with improved booth worker training and greater familiarity on the part of the booth worker. The printer will likely continue as a significant risk point in the elections process. And because the printer is necessary to create the official ballot, such a risk is deeply problematic. ESI strongly recommends that the BOE develop contingency strategies.

Contingency measures for encoder failure

The encoder is a single point of failure at the precinct level, and therefore requires the utmost attention when contingency planning. Encoder failure presents two types of issues; (1) if undetected, voters may be casting votes for races they are not eligible to vote in and (2) if detected, the precinct may shut down. The BOE must have established procedures for how to handle encoder failures on Election Day.

Section 6

Comparing the Count

Project Team

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Project Overview

In order to assess the accuracy of Election Day vote tabulations by the Cuyahoga County BOE, ESI analyzed the election data regular voted ballots from the onboard machine memory located on each individual Diebold DRE voting machine and compared these data to manual counts of the paper ballots, official results, and other interim and official election reports.

Key Findings

In the course of conducting the manual recount, ESI developed a tallying process (see Section 5 – Manual Count of Paper Ballot) with appropriate checks and balances to ensure that the counting and comparing process was conducted as accurately as possible. Comparisons revealed a wide range of discrepancies among the counts. It was concluded, based on this analysis, that:

- A lack of inventory control and gaps in the chain of custody of mission critical assets (i.e. DRE memory cards, TSX units, and VVPAT cartridges) resulted in a significant amount of missing data, which likely produced some of the count discrepancies that were observed.
- Because of the missing data, ESI is unable to render a definitive opinion as to the accuracy of the TSX system. There were discrepancies in the ballot data in each of the comparisons that were made, but the missing data present a more serious problem in assessing the performance of the DRE system.
- The formatting of the VVPAT printouts did not support a robust recount of the VVPATs. This is primarily because each VVPAT lacked a header with precinct information that would allow for precinct by precinct recounts.
- Due to limits in the data, software computational defects contributing to the count inaccuracies found could not be ruled out. Such computational defects could be the result of a failure to adequately test the voting equipment prior to the election or to manage the various databases appropriately.

Summary of Preliminary Recommendations

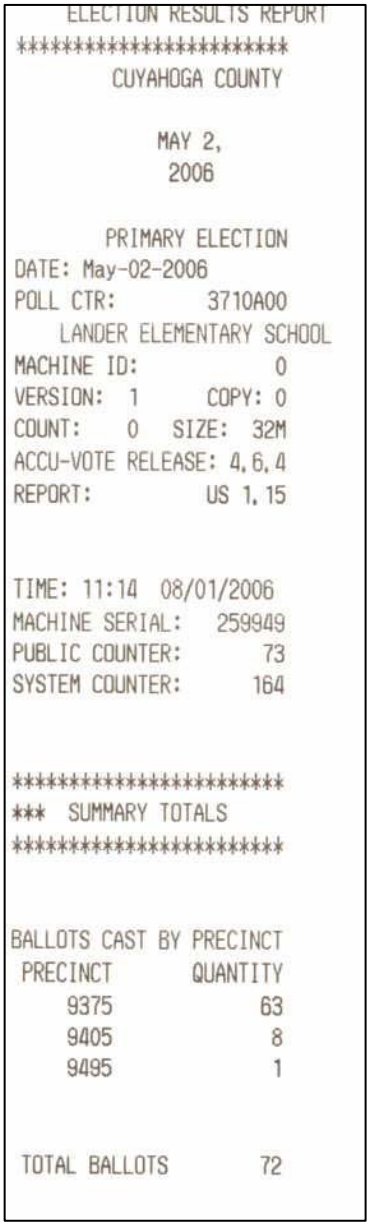
- A meeting between BOE officials, Cuyahoga County and the voting system vendor should be scheduled as soon as possible to discuss the anomalies found in this report and to determine the cause of these anomalies.
- An audit process should be developed so that any subsequent recounts and audits can be conducted easily and effectively. This will require developing a consistent header for the VVPATs and consistent reports from the GEMS system that can facilitate the audit, as well as more effective procedures to ensure that booth workers check in voters in the voter registration process effectively.
- Appropriate inventory control systems must be implemented immediately to track and record key election assets so that audit data can be collected accurately and disseminated quickly. Timeliness of the BOE's response to data requests is especially critical in the case of a contested election result, where a judge may impose an extremely tight schedule.

Comparisons of Ballot Data

ESI undertook comparisons of ballot data from 467 voting machines used at 145 precincts located in 50 different polling locations, and analyzed the data produced by these machines for the statewide gubernatorial primaries in the May 2 Primary Election. Four different forms of ballot data were compared, as shown below: (1) the VVPAT summary, (2) the VVPAT ballots, (3) the DRE memory cards, and (4) the DRE election archive stored inside the AccuVote-TS voting device.

Table VI- 1: Types of Ballots Chosen for Comparison

Data Set	Description[8]
VVPAT Summary	The VVPAT Summary (see sample image to right) is a summary of results for all VVPAT Ballots on each VVPAT Cartridge[9]. The summary is printed when each VVPAT Cartridge is full or at the end of Election Day.
VVPAT Ballots	VVPAT Ballots are the aggregate of all voter verified ballots on a single VVPAT Cartridge. A VVPAT Cartridge may contain over 100 VVPAT Ballots, with each VVPAT containing a record of the vote cast by an individual voter.
DRE Memory Card	The removable storage medium utilized by the AccuVote-TS voting devices to which election and ballot information are written, and from which election results are tallied. DRE Memory Cards are standard off-the-shelf PCMCIA Type II memory cards typically holding 512MB of data.
DRE Election Archive	A storage medium located inside the AccuVote-TS voting device in which election results are stored and election archives are stored. While ESI has not confirmed the nature of this storage device, it is believed to be a standard hard disk drive that stores backup of the data stored on the DRE Memory Card.



ELECTION RESULTS REPORT
****
CUYAHOGA COUNTY

MAY 2,
2006

PRIMARY ELECTION
DATE: May-02-2006
POLL CTR: 3710A00
LANDER ELEMENTARY SCHOOL
MACHINE ID: 0
VERSION: 1 COPY: 0
COUNT: 0 SIZE: 32M
ACCU-VOTE RELEASE: 4,6,4
REPORT: US 1,15

TIME: 11:14 08/01/2006
MACHINE SERIAL: 259949
PUBLIC COUNTER: 73
SYSTEM COUNTER: 164

****
*** SUMMARY TOTALS
****

BALLOTS CAST BY PRECINCT

PRECINCT	QUANTITY
9375	63
9405	8
9495	1

TOTAL BALLOTS 72

[8] Please see Glossary of Terms at the end of this report for additional definition of terms.

[9] The VVPAT Cartridge contains a single roll of VVPAT paper that is inserted in each touch screen voting device by booth workers.

How Comparisons Were Conducted

1. ESI team members conducted a manual count, i.e., hand-counting, of VVPAT ballots.
2. The Cuyahoga BOE created a new empty database within the GEMS server and uploaded[10] the DRE Memory Cards from the AccuVote-TS voting devices utilized in the 50 selected polling locations during the May 2nd primary. A SOVC[11] data file was created from this database and provided to ESI.
3. The Cuyahoga BOE staff formatted approximately 450 DRE Memory Cards from the Election Day database stored on the GEMS Server[12]. BOE staff along with ESI observers then worked from the BOE warehouse in order to identify and separate the AccuVote-TS voting devices utilized in the 50 selected polling locations during the May 2nd primary. The voting devices were then powered on, the formatted DRE Memory Card inserted, and the May 2nd primary election data extracted onto the DRE Memory Card. The data stored on these DRE Memory Cards was then uploaded to a new empty database within the GEMS server. An SOVC data file was created from this database and provided to ESI.
4. The votes cast for each Gubernatorial candidate on each data file were then compared to each other on a precinct and vote center basis.[13]

[10] An ESI observer witnessed the entire upload process and maintained a detailed log of all activity.

[11] SOVC – Statement of Votes Cast is a simple data set of all votes cast on all races for the given data base. Typically, the SOVC is produced for all votes cast in a given jurisdiction in order to determine the final election results.

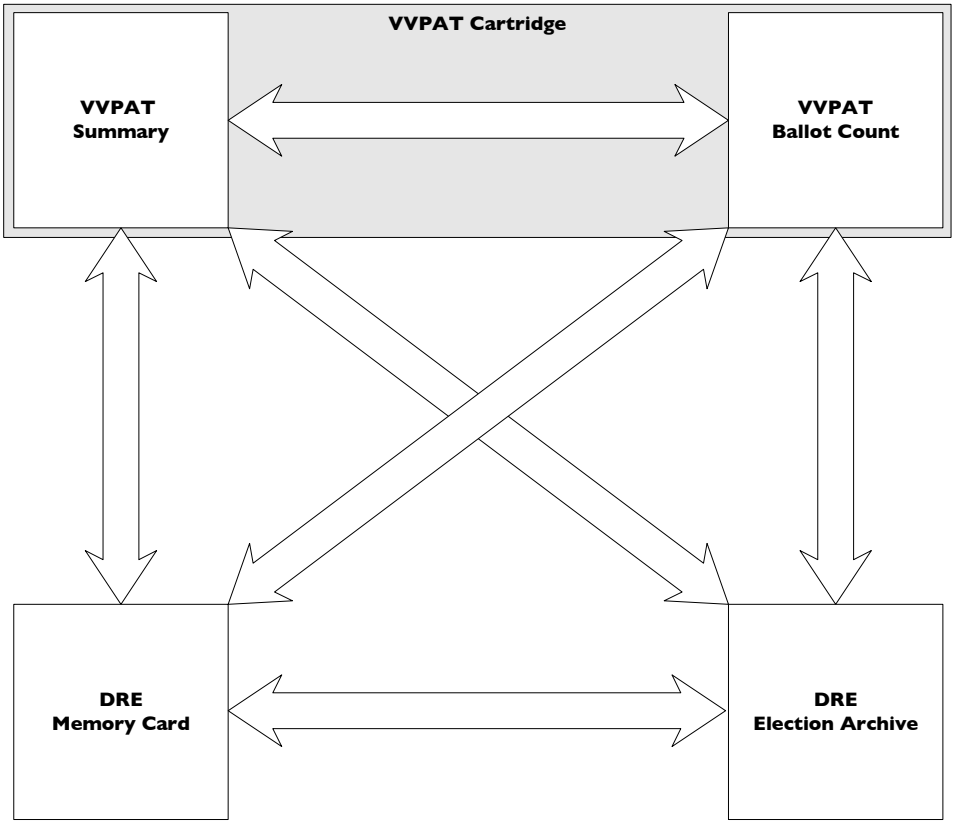
[12] GEMS Server is the Microsoft Windows 2000 based application that Diebold provides to election official to accumulate votes and report results.

[13] The comparative data set is too large for inclusion in this report but is being offered separately on the ESI web site.

Primary Comparisons

Figure 24 below shows the various comparisons of voting data that are being made in this analysis. Table 2 reports the number of observations analyzed for each type of data.

Figure VI- 1: Data Set Comparisons



Analyzing the Data

A number of graphical tools are incorporated in order to illustrate the results of each analysis. For a more thorough explanation and examples, please see Figure 17 -18 in the appendix.

Table VI- 2: Quantity of Election Items Targeted for Comparison

Election Item	Quantity	Notes
Polling Locations	50	These locations were chosen using the same statistical sampling methodology developed for the May 2nd, 2006 Exit Poll conducted by ESI.
Precincts	145	The 50 Polling Locations included145 precincts. However, the audits were not full precinct counts but were machine counts.
DRE Machines	467	467 DRE machines were deployed to the Precincts within the sample chosen. However, data for only 414 was found and utilized in this report. (See Table 1: Incomplete or Missing Data from 50 Polling Locations)
VVPAT Cartridge	≥ 467	As more than one VVPAT Cartridge per DRE Machine can be created, at least 467 VVPAT Cartridges should exist, unless ballots were not cast on some of the DRE Machines.

Example: Vote Count Comparison Calculation

To illustrate how the comparisons described above were made, Table 3 entries are reported from the first four voting centers in the sample. It is seen, for example, that at Bay Village Middle School, Flannery received 44 votes in the VVPAT Ballot Count, but had 53 votes registered in the DRE Election Archive. The analysis continued with the following steps to calculate the total difference of vote counts at Bay Village Middle School:

1. For Flannery, calculate the absolute value of the difference of the vote counts between the VVPAT Ballot count and the DRE Election Archive count.

   Candidate Vote Count Difference = absolute value (VVPAT Ballot Count - DRE Election Archive)[14]

2. Continue onto the next candidate, in this case Strickland, and calculate the absolute value of the difference of the vote counts between the VVPAT Ballot count and the DRE Election Archive count

3. Repeat step 2 until this calculation is made of all candidates in the race

4. Sum the Candidate Vote Count Difference across all of the candidates within the race to calculate the Total Absolute Vote Count Difference for Bay Village Middle School.

[14] By looking at the absolute value ESI is looking at the true total number of discrepancies in order to avoid discrepancies in opposite directions that ultimately cancel each other.

This same calculation process was then continued across the four election data sets: VVPAT Ballot Count; VVPAT Summary; DRE Memory Card; DRE Election Archive.

Table VI- 3: Example Vote Count Comparison Calculation
VVPAT Ballot Count - DRE Election Archive

	VVPAT Ballot Count				DRE Election Archive				VVPAT Ballot Count - DRE Election Archive				
Vote Center	Flannery	Strickland	Blackwell	Petro	Flannery	Strickland	Blackwell	Petro	Flannery	Strickland	Blackwell	Petro	Total Absolute Vote Count Difference
Bay Village Middle School	44	138	83	165	53	166	107	215	-9	-28	-24	-50	111
Bedford Heights Service Building	34	119	13	10	54	224	19	13	-20	-105	-6	-3	134
Boulevard Elementary School	33	285	34	65	31	282	34	60	2	3	0	5	10
Bratenahl Community Center	12	126	20	68	19	167	29	83	-7	-41	-9	-15	72

Findings

It is seen that discrepancies in ballot totals were present in the case of each of the comparisons across types of ballot data. This was apparent when the VVPAT summaries were compared with the memory cards and the SOVC reports; the data format for the VVPAT is different than the format for the electronic reports. Each data source should produce identical results, within certain limits. For example, the VVPAT ballot count is not expected to perfectly match either the VVPAT summary or the electronic counts because it was seen throughout the manual count that a small number of the VVPAT ballots were damaged in the printing process. Printers jammed, ink ran low, and other issues with the printers manifested themselves. It should also be noted that the discrepancies found during the audit procedure may have resulted from the difficulties entailed in matching data across different storage mediums at different levels of aggregation. Therefore, human error cannot be ruled out as the source of the discrepancies reported.

With this caveat in mind, it was found that data that should be identical were not always identical. These anomalies are difficult to reconcile. They could possibly be reconciled through further forensic analysis, but one can't be sure. The problem of reconciling individual machine vote totals is nontrivial because of the challenges involved in tracing back vote totals to individual machines. The system, as currently configured, is designed to compare vote totals at an aggregated level, either at the precinct or vote center. For example, the VVPAT summaries are aggregated at the machine level, and then these summaries are reported to a higher level of aggregation. When discrepancies arise, it is difficult to determine which machine created the discrepancies. Discrepancies can be identified only through further forensic analysis of individual DRE machines. The critical means for addressing this problem is for data and reports to be produced at the lowest level of aggregation. For example, the VVPAT summary should report the number of votes by precinct and the VVPAT ballots should contain a header noting the precinct for that ballot.

General Issues

As noted previously, the system as implemented was not configured to provide consistent data reporting across various data sets and media. Equally as important, the administrative process and the chain of custody procedures exacerbated these issues. For example, locating DRE machines in the warehouse was a difficult task. The VVPAT ballots did not include precinct numbers or machine/memory card linkage numbers that would allow the ballots to be tracked and compared to the corresponding electronic data. In addition, the systems of seals, signatures, and other security features of the VVPAT canisters and machine memory cards were not implemented on a consistent basis. These inconsistencies led to several missing data sources, as noted below.

Table VI- 4: Incomplete or Missing Data from 50 Polling Locations

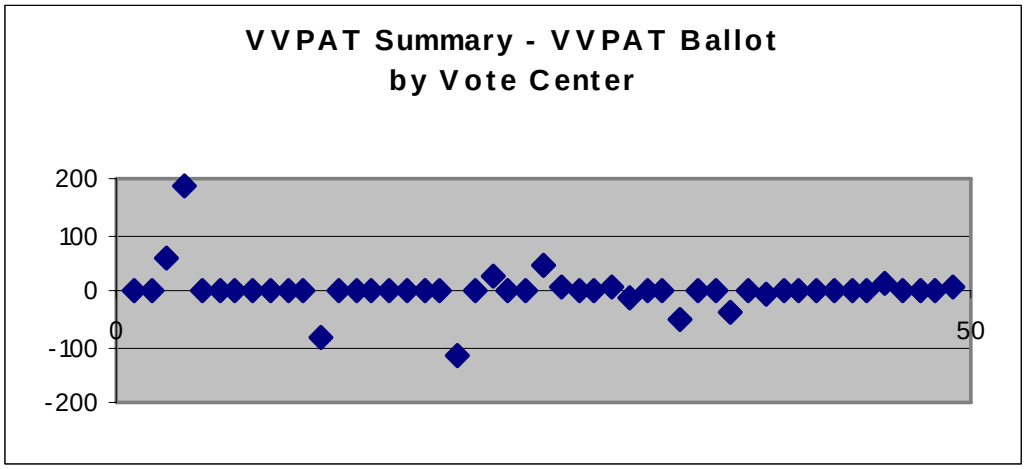
Election Asset	Quantity Missing	Notes
VVPAT Summary	13	
VVPAT Cartridge	≤ 87[15]	As machines sometimes use more than one VVPAT cartridge, we cannot confirm that additional VVPAT Cartridges are not missing. In addition, 24 of the DRE Election Archives displayed no data for the May 2nd Primary Election (see DRE Election Archive display no data). Therefore, it is possible that 24 of these VVPAT Cartridges were not created, as the DRE Machine may have not been utilized during the election, thereby reducing this figure to 63. VVPAT Cartridges are missing from two Polling Locations, impacting comparisons between VVPAT data and DRE data.
DRE Election Archives (not found)	29	28 DRE's could not be located at the BOE warehouse due to being unmarked. One DRE was found broken and we were unable to retrieve the Election Archive. BOE provided ESI with a list containing 3 missing DRE's. Of these 3 DRE's, ESI's data shows that 2 of the DRE Machines exist and were found and therefore are not included in this total of 29.
DRE Election Archive (display no data)	24	These DRE Election Archives displayed no data for the May 2nd Primary Election. However, we are unable to independently validate that these 24 DRE Machines did not record votes on Election Day. No VVPAT Cartridges were found for these 24 DRE Machines.
DRE Memory Card	3	1 DRE Memory Card was missing data (ESI made BOE aware of this) and 2 DRE Memory Cards were corrupted. .

[15] Please see appendix 6.7 for an explanation of how this figure was calculated.

Comparison of VVPAT Summary vs. VVPAT Ballot Count

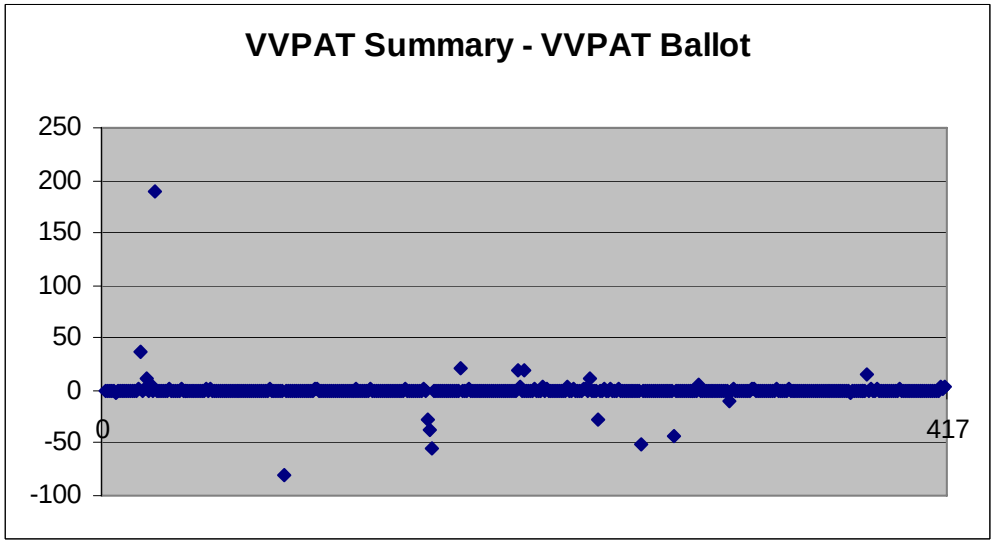
In Figure 2, it is seen that when comparing the paper VVPAT ballots with the VVPAT summaries by vote center, most of the cases have zero differences, and most of the rest are quite small. However, there were cases in which there were large differences between the two paper counts.

Figure VI- 2: VVPAT Summary vs. VVPAT Ballot Count, by Vote Center
(difference in votes between VVPAT Summary and VVPAT Ballot)



The next figure displays the same data, but by precinct instead of vote center. The same data are shown, but instead of examining the data by vote center, the data are shown by precinct. Findings were quite similar.

Figure VI- 3: VVPAT Summary vs. VVPAT Ballot, by Precinct
(difference in votes between VVPAT Summary and VVPAT Ballot



The following bar charts break these same data down by the size of the discrepancy that was found. They confirm the sense that most precincts had negligible differences, but that a small number of precincts had very large discrepancies between the VVPAT summaries and the VVPAT ballots themselves.

Figure VI- 4: VVPAT Summary vs. VVPAT Ballot - Vote Count Differences, by Precinct
(Absolute Value of Difference between VVPAT Summary and VVPAT Ballot Count)

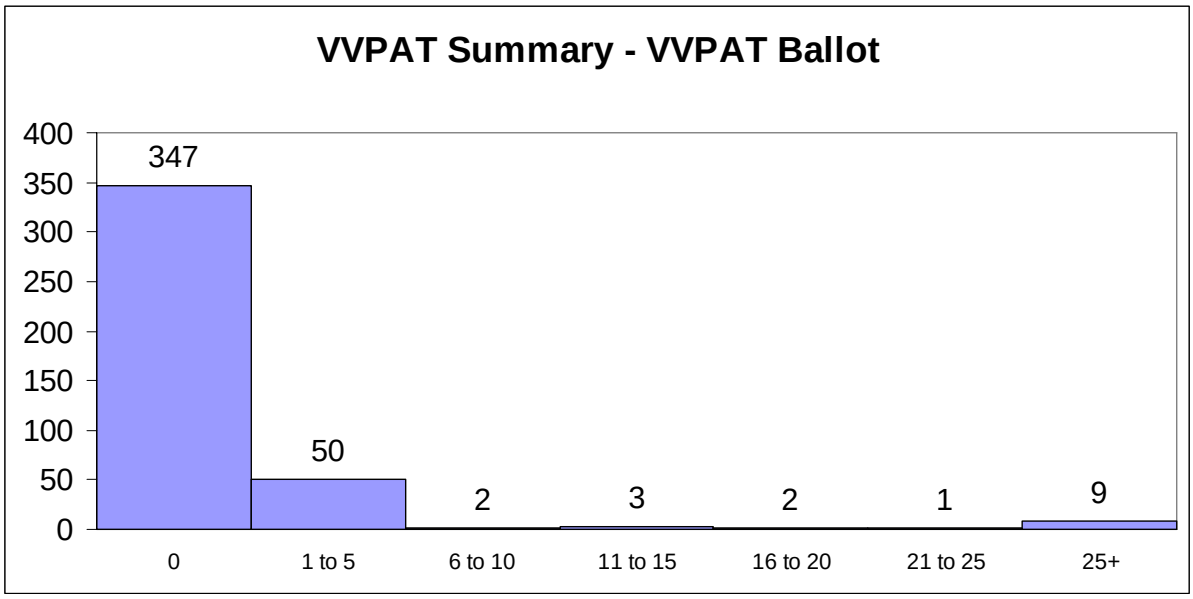
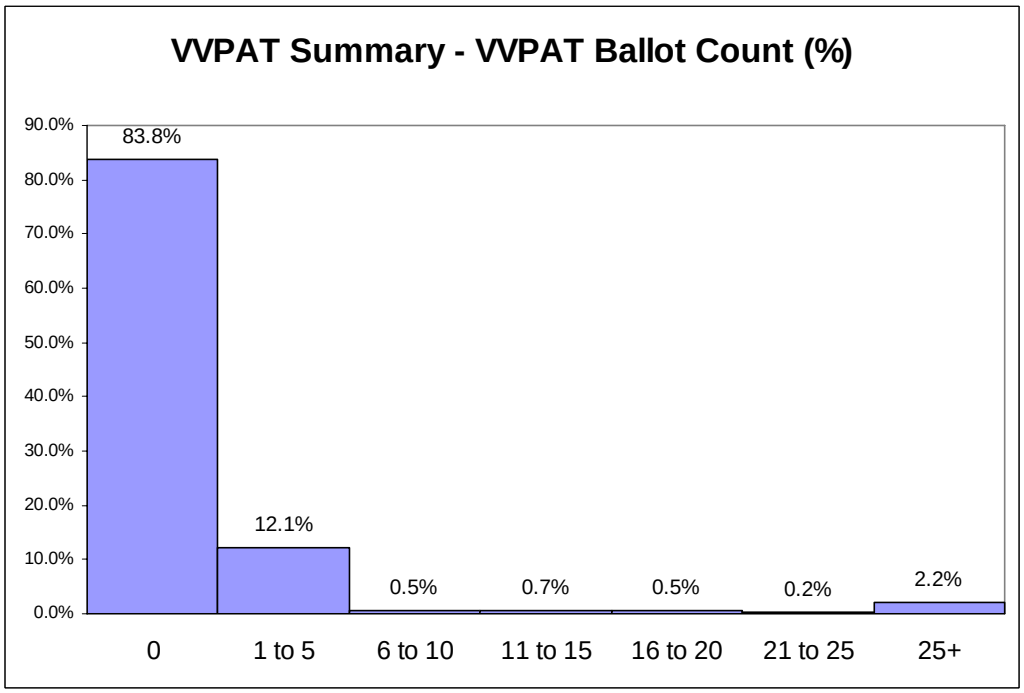


Figure VI- 5: VVPAT Summary vs. VVPAT Ballot - Vote Count Differences, by Vote Center
(Percent of Absolute Value of Difference between VVPAT Summary and VVPAT Ballot Count)



VVPAT Summary vs. DRE Memory Card

Comparison of the DRE memory card and the VVPAT summaries produces more variation, as the two figures below show. The data tend to have a bimodal distribution, with most cases clustering at either zero or at 25 or higher.

Figure VI- 6: VVPAT Summary vs. DRE Memory Card, by Vote Center
(difference in votes cast between VVPAT Summary vs. DRE Memory Card)

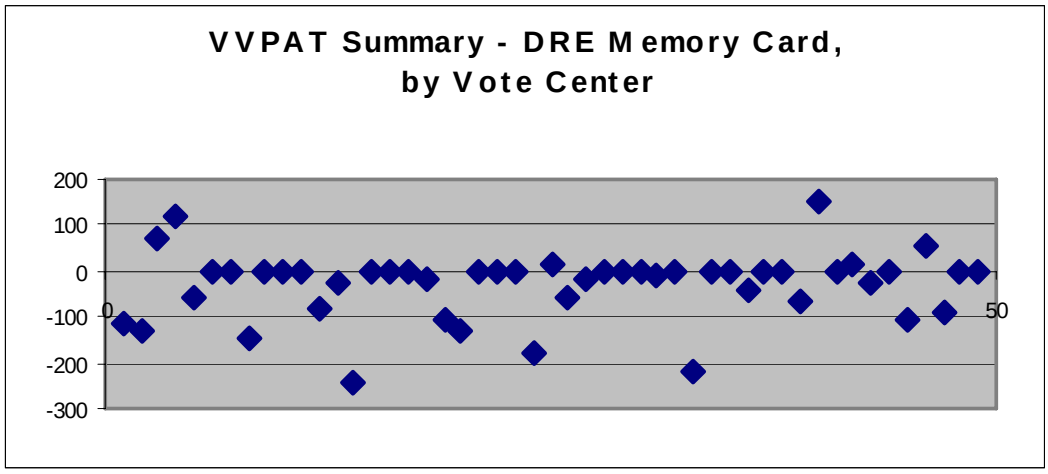
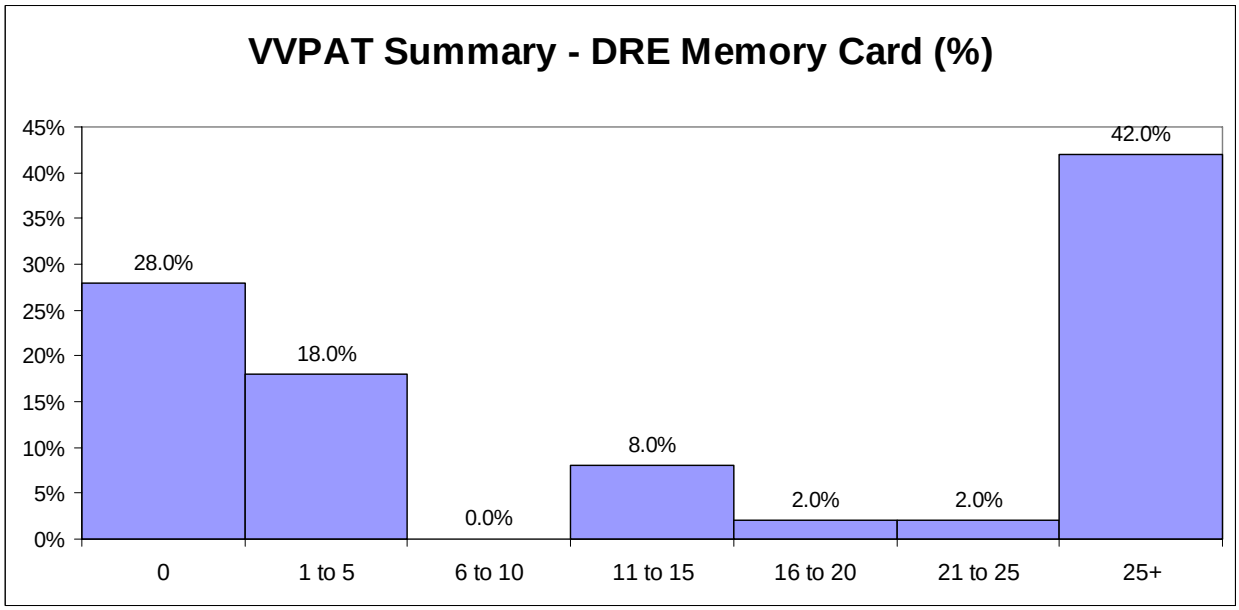


Figure VI- 7: VVPAT Summary vs. DRE Memory Card - Frequency of Vote Count Differences
(absolute value of difference in votes cast between VVPAT Summary vs. DRE Memory Card)



VVPAT Summary vs. DRE Election Archive

Comparison of the VVPAT summary with the DRE election archive also produces a bimodal distribution, with the cases clustering around zero to small differences and also around rather large differences, as shown in the following two tables.

Figure VI- 8: VVPAT Summary vs. DRE Election Archive - Difference in Total Votes Cast for Governor

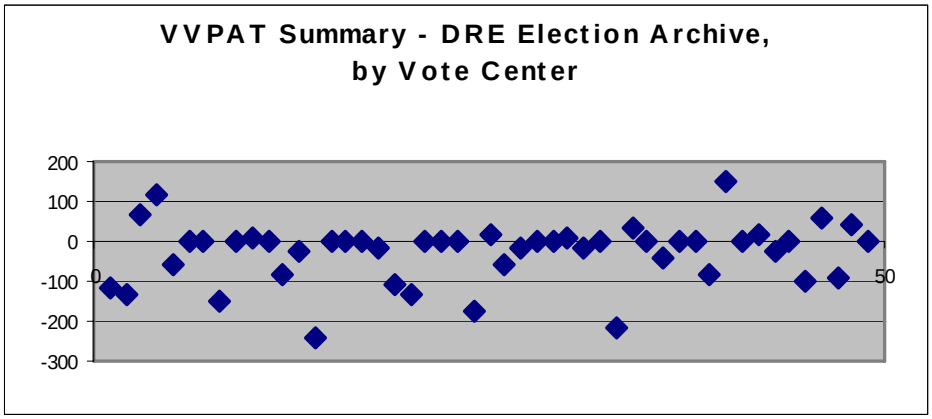
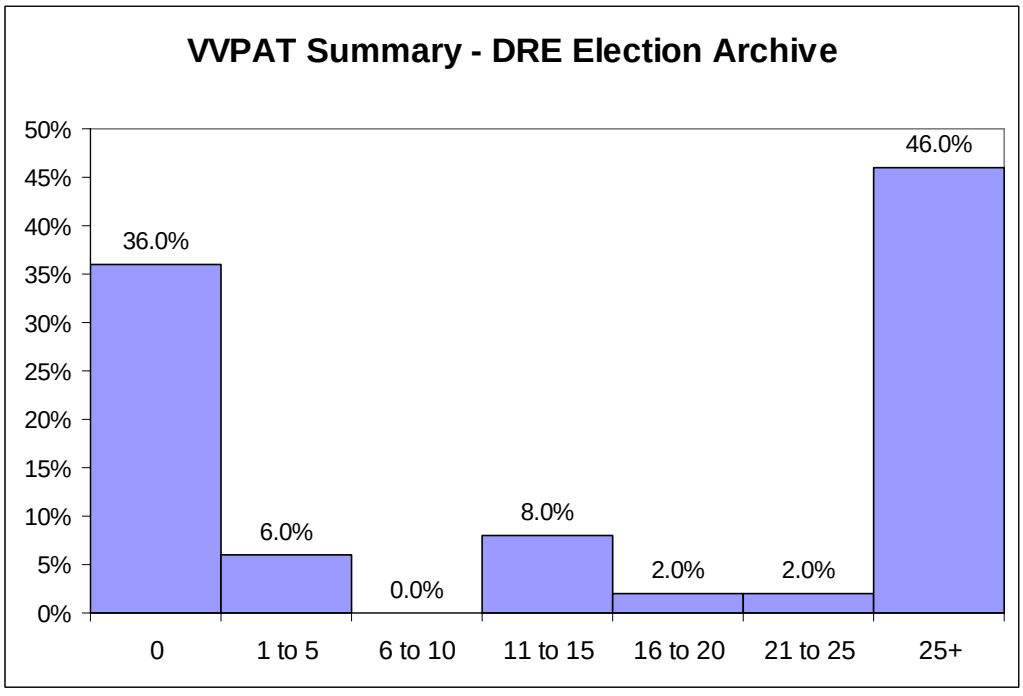


Figure VI- 9: VVPAT Summary vs. DRE Election Archive - Frequency of Vote Count Differences
(absolute value of difference in votes cast between VVPAT Summary vs. DRE Election Archive)



VVPAT Ballot vs. DRE Memory Card

The VVPAT count of the ballots compared to the DRE memory cards was more variable than the summary comparisons. This is not surprising, given the variations ESI knows to exist in the ability of people to count paper ballots and the issues that pertain to printers generally.

Figure VI- 10: Difference in Total Votes Cast for Governor

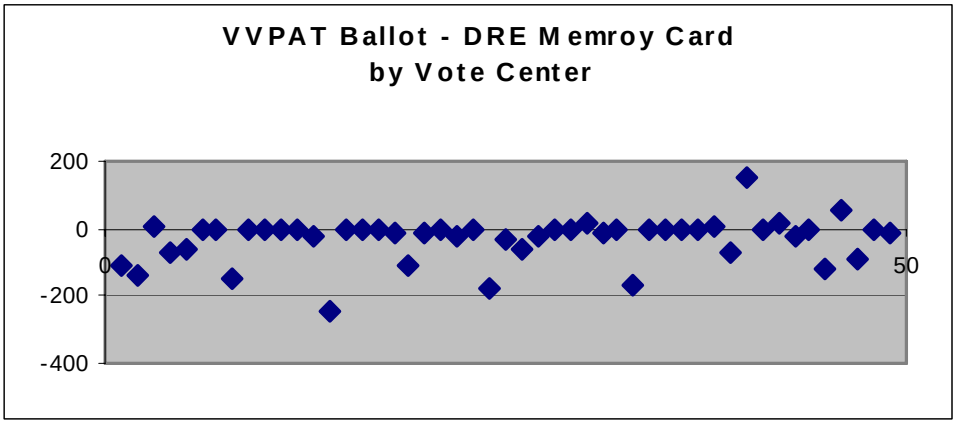
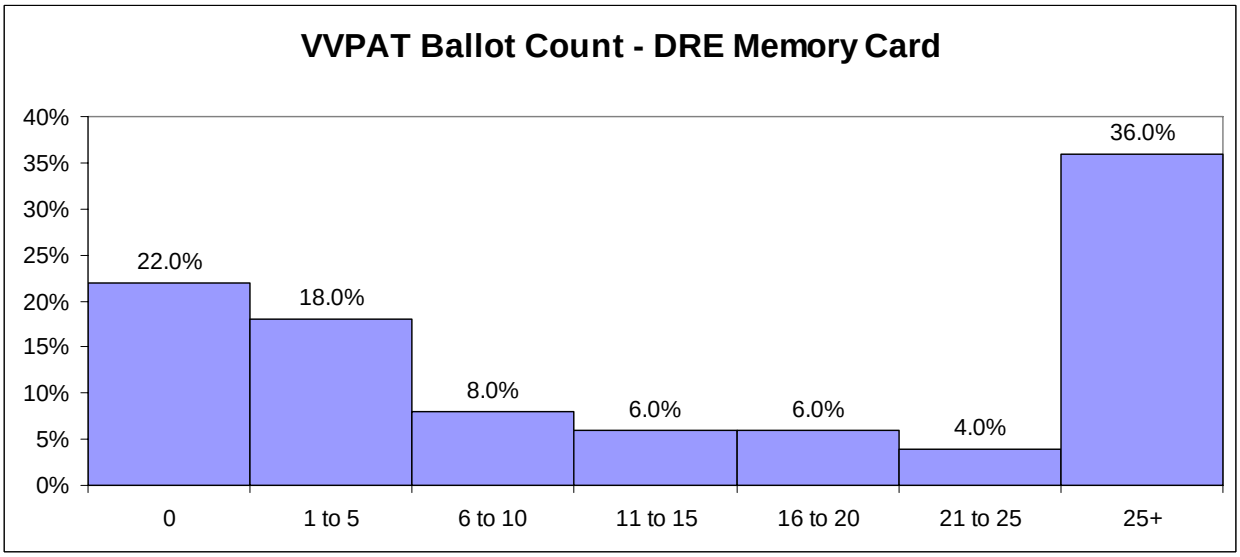


Figure VI- 11: VVPAT Ballot Count vs. DRE Memory Card - Frequency of Vote Count Differences
(absolute value of difference in votes cast between VVPAT Summary vs. DRE Memory Card)



VVPAT Ballot vs. DRE Election Archive

The comparison of the VVPAT paper ballots and the DRE archive showed that there were many cases where there were many differences. This is not a typical comparison made with voting machines and ESI is not sure why there is such variation between these two data sources.

Figure VI- 12: Difference in Votes for Governor between VVPAT Ballot & DRE Election Archive

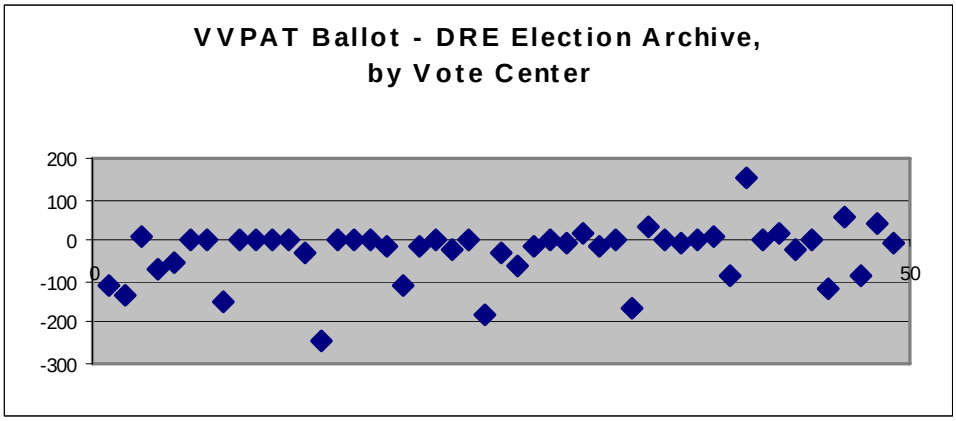
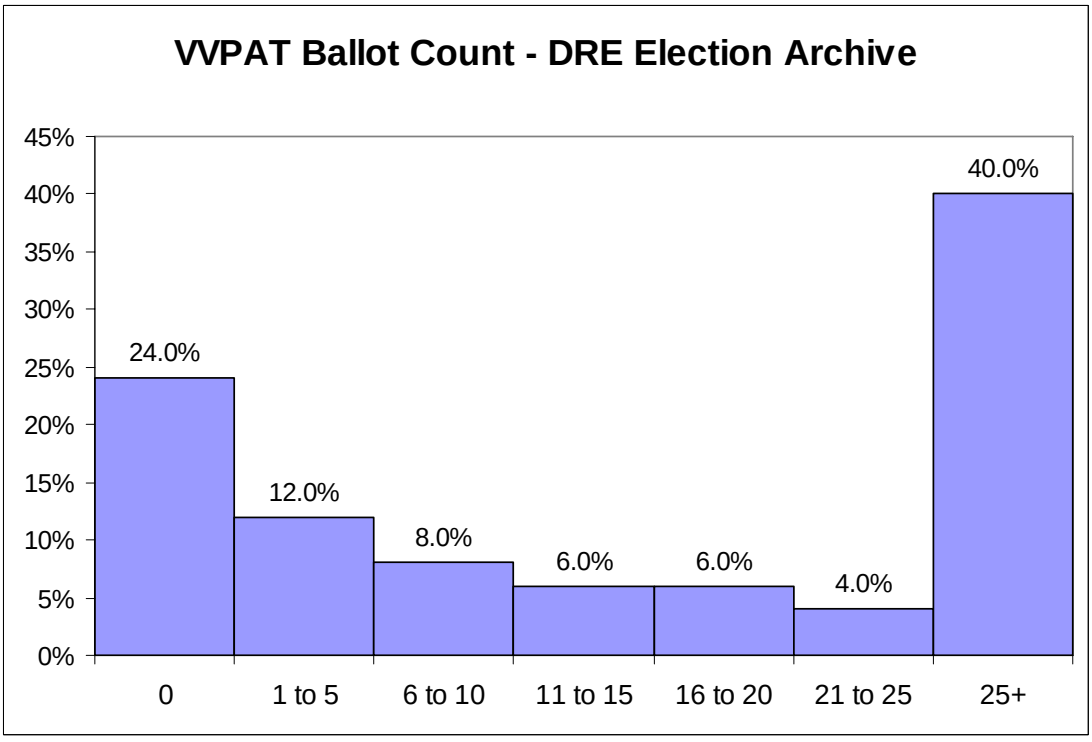


Figure VI- 13: VVPAT Ballot Count vs. DRE Election Archive - Frequency of Vote Count Differences
(absolute value of difference in votes cast between VVPAT Summary vs. DRE Election Archive)



DRE Memory Card vs. DRE Election Archive

The variation between the electronic formats was extremely low. The question these data raise is why there should be any discrepancy whatsoever between the two electronic media.

Figure VI- 14: DRE Election Archive – DRE Memory Card, by Vote Center

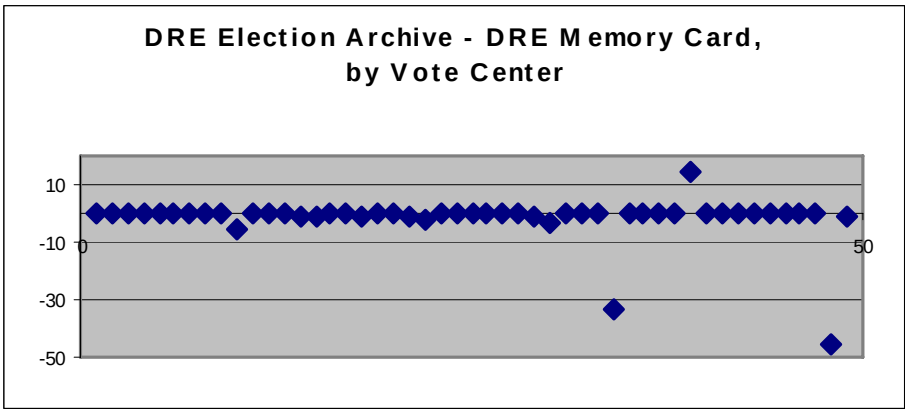


Figure VI- 15: DRE Election Archive – DRE Memory Card, by precinct

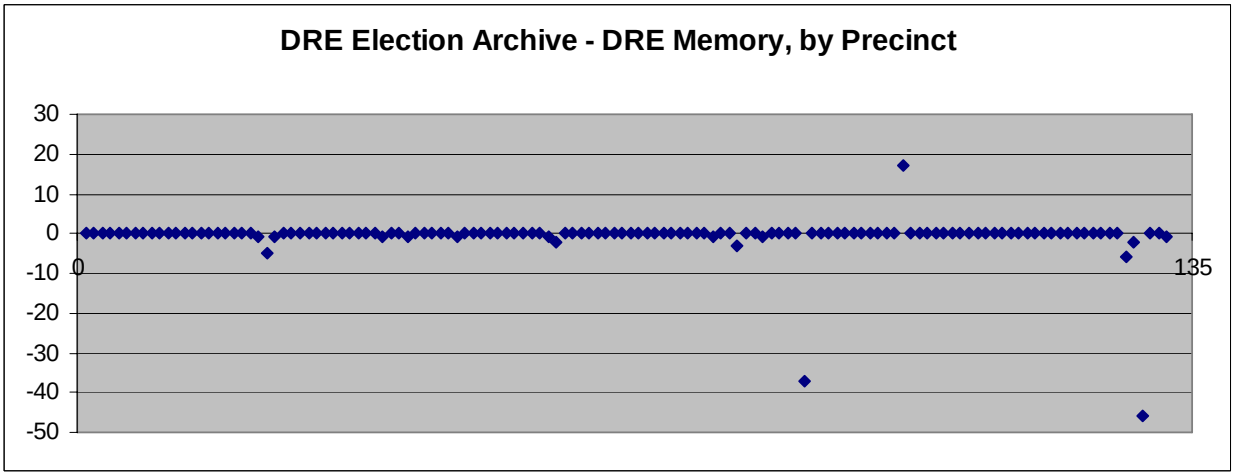
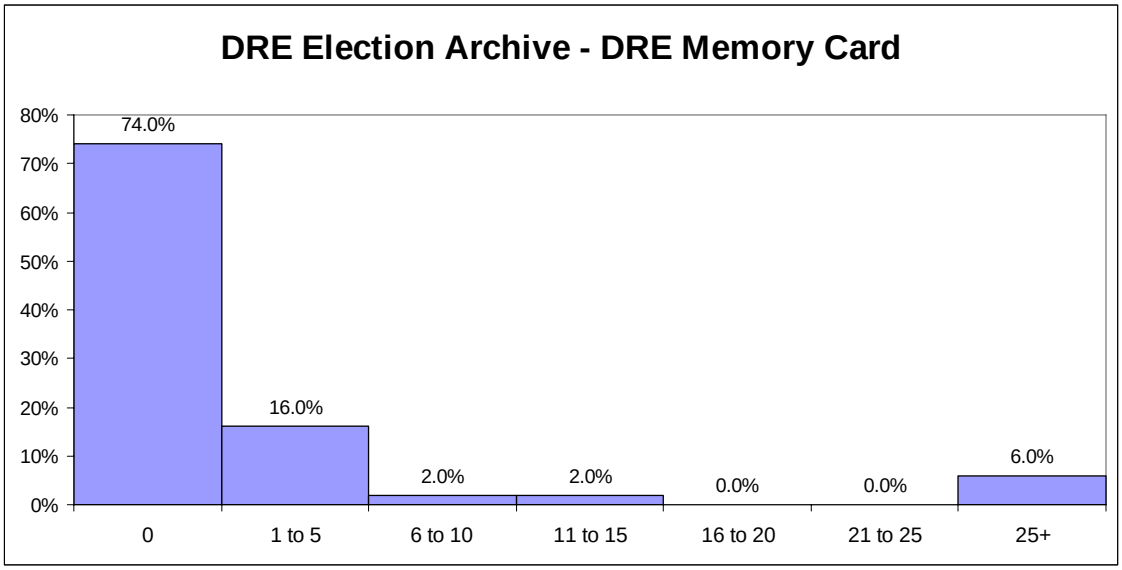


Figure VI- 16: DRE Memory Card vs. DRE Election Archive - by Vote Center
(absolute value of difference between DRE Memory Card vs. DRE Election Archive)



Comparing Candidate Results

In comparing the election results, we see that same-type comparisons—electronic to electronic and paper to paper—produced the best comparisons. Cross-mode comparisons were more difficult. Also, the changes below should be read carefully. There were turnout differences in the Democratic and Republican primaries, so one should expect differences in magnitude in how these variations affect different parties and candidates.

Table VI- 5: Vote Count Comparisons by Candidate
Precincts with missing VVPAT Summary data have been omitted from this table

Vote Count Comparison	Total Change	Flannery (D)	Strickland (D)	Blackwell (R)	Petro (R)	DEM	REP
VVPAT Summary – VVPAT Ballot	235	25	168	10	32	193	42
DRE Election Archive – DRE Memory Card	-80	-6	-57	-8	-9	-63	-17
VVPAT Ballot - DRE Election Archive	-1,425	-274	-764	-149	-238	-1,038	-387
VVPAT Ballot - DRE Memory Card	-1,505	-280	-821	-157	-247	-1,101	-404
VVPAT Summary - DRE Election Archive	-1,380	-283	-688	-168	-241	-971	-409
VVPAT Summary - DRE Memory Card	-1,460	-289	-745	-176	-250	-1,034	-426

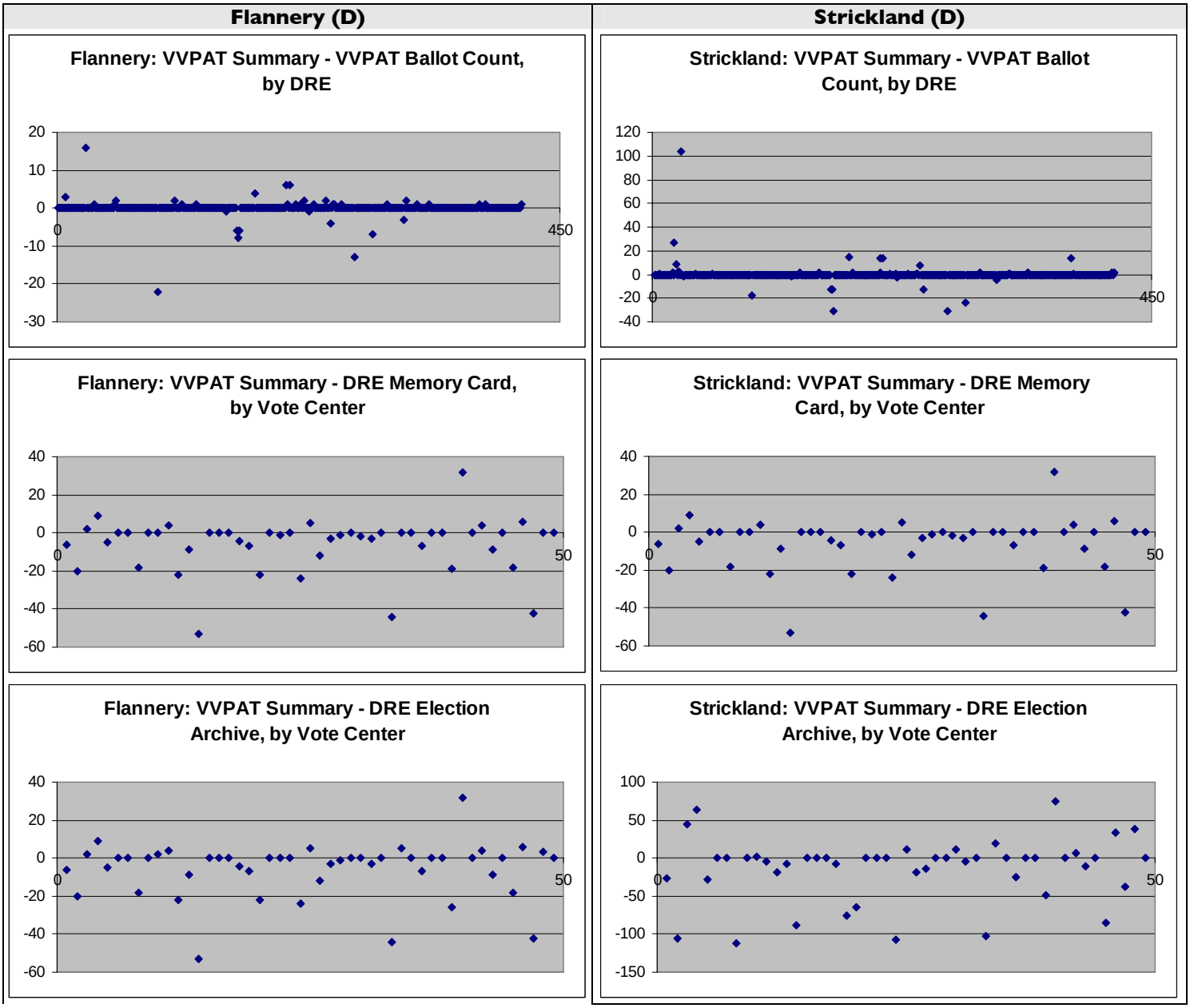
Table VI- 6: Candidate Election Results by Election Asset (%)
Precincts with missing VVPAT Summary data have been omitted from this table[16]

Results by Election Asset	Flannery (D)	Strickland (D)	Blackwell (R)	Petro (R)
VVPAT Summary	28.7%	71.3%	43.1%	56.9%
VVPAT Ballot	29.0%	71.0%	43.2%	56.8%
DRE Archive	28.8%	71.2%	42.9%	57.1%
DRE Memory Card	28.6%	71.4%	42.9%	57.1%

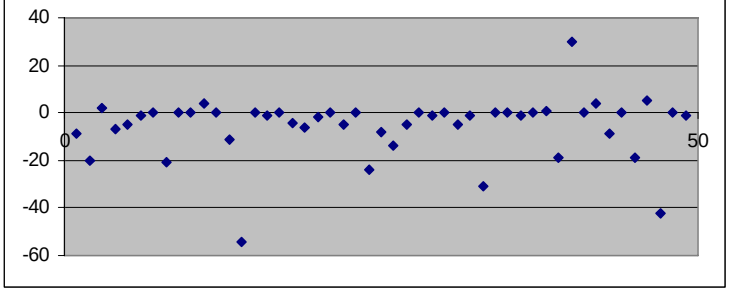
[16] 13 VVPAT Cartridges do not contain VVPAT Summaries. These 13 VVPAT's have been removed from this analysis.

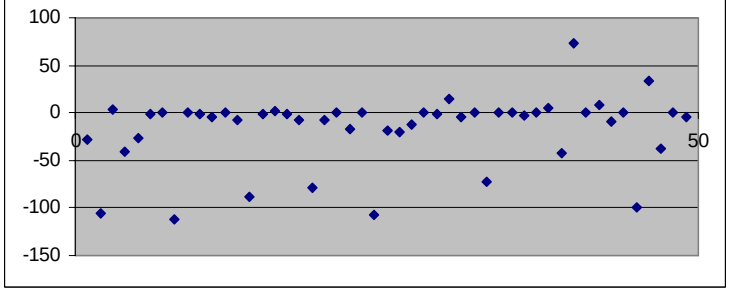
In the next two set of figures, we consider how the ballot counting differences would have affected different candidates. As is seen, there are generally similar graphs for both Democrats and Republicans, with candidates who had bigger vote totals showing larger variations.

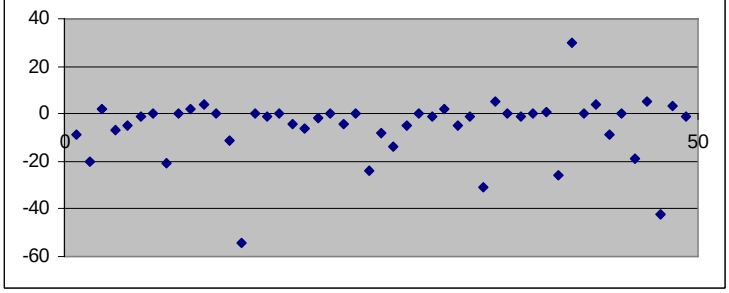
Figure VI- 17: Comparison of Vote Counts by Candidate (DEM)

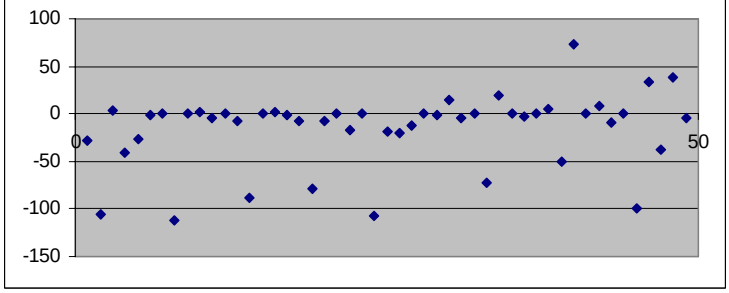


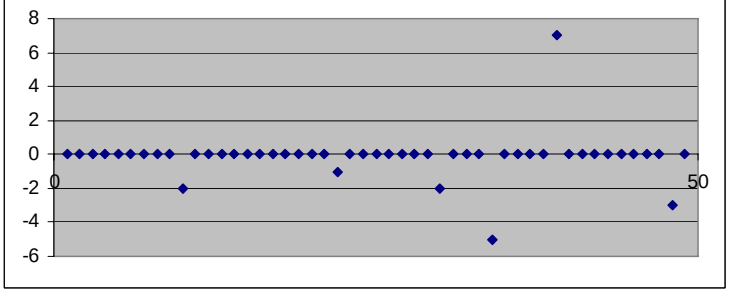
Flannery (D)	Strickland (D)
Flannery: VVPAT Ballot Count - DRE Memory Card, by Vote Center	Strickland: VVPAT Ballot Count - DRE Memory Card, by Vote Center
Flannery: VVPAT Ballot Count - DRE Election Archive, by Vote Center	Strickland: VVPAT Ballot Count - DRE Election Archive, by Vote Center
Flannery: DRE Election Archive - DRE Memory Card, by Vote Center	Strickland: DRE Election Archive - DRE Memory Card, by Vote Center
Flannery: DRE Election Archive - DRE Memory Card, by Precinct	Strickland: DRE Election Archive - DRE Memory Card, by Precinct

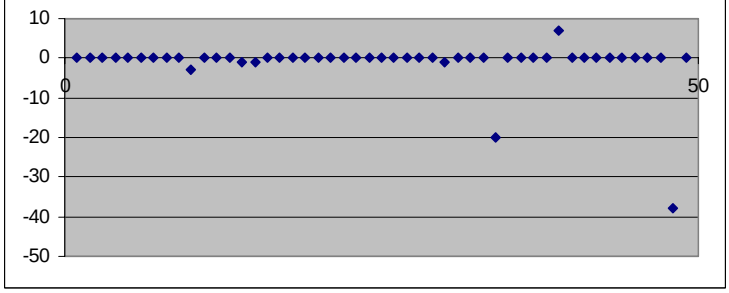


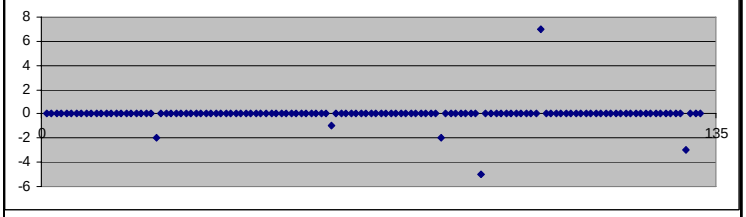












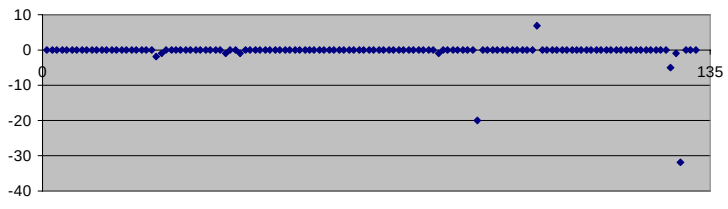
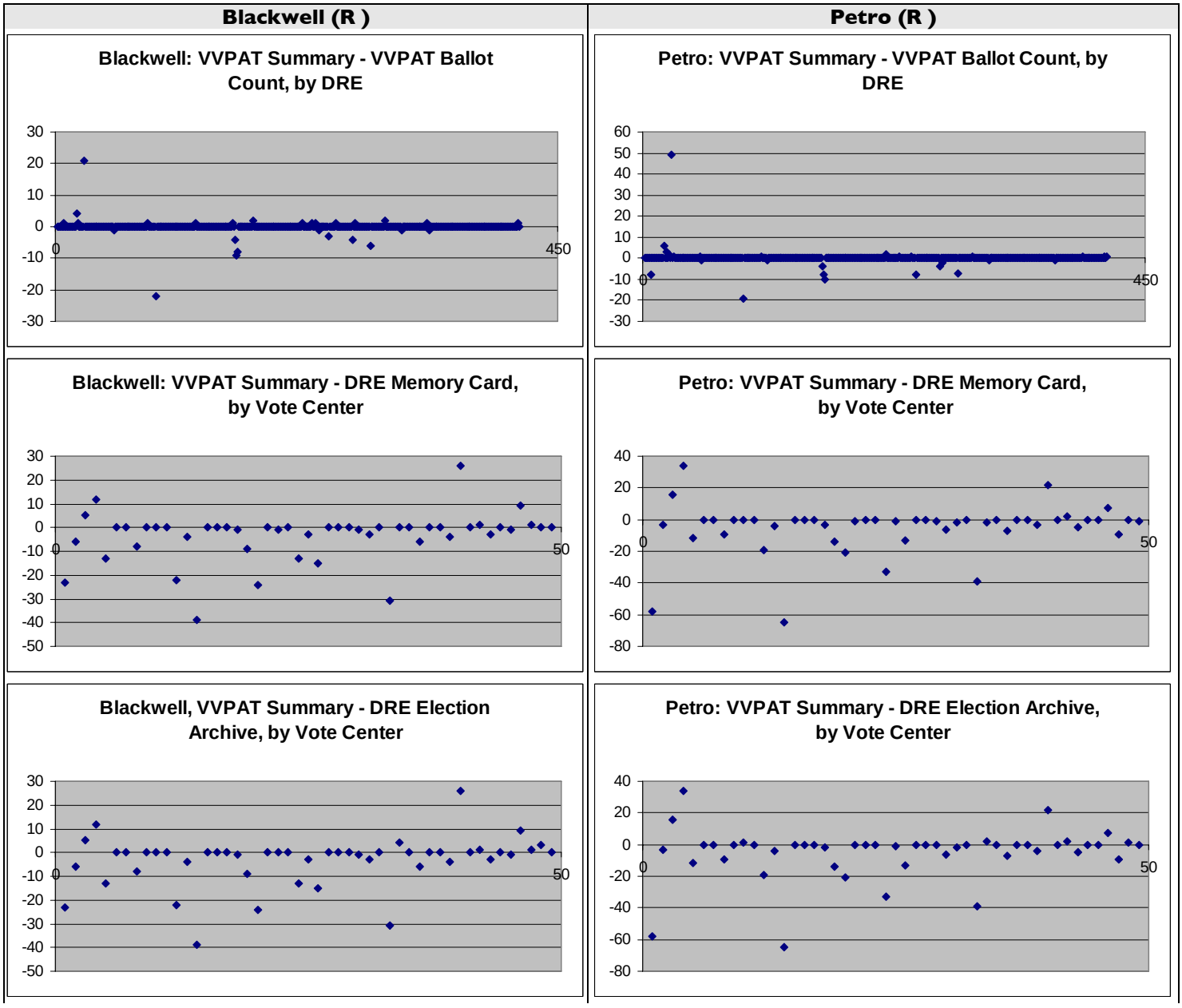
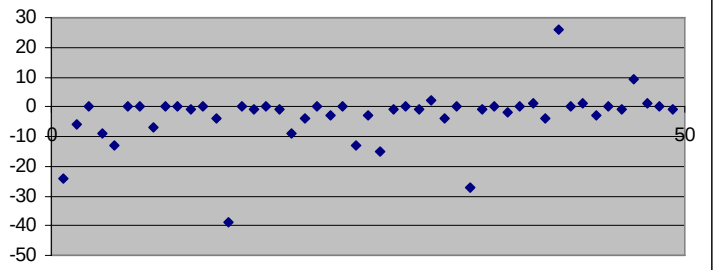


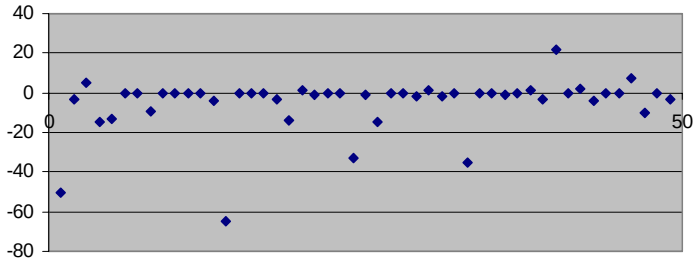
Figure VI- 18: Comparison of Vote Counts by Candidate (REP)



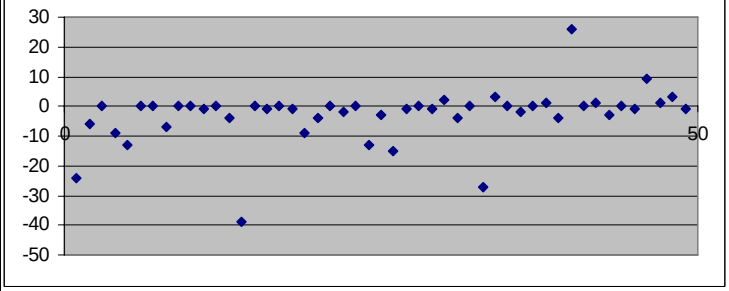
Blackwell: VVPAT Ballot Count - DRE Memory Card, by Vote Center



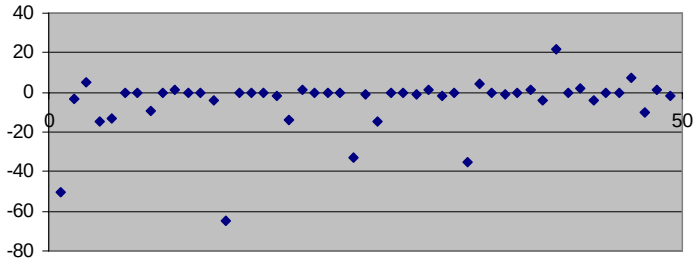
Petro: VVPAT Ballot Count - DRE Memory Card, by Vote Center



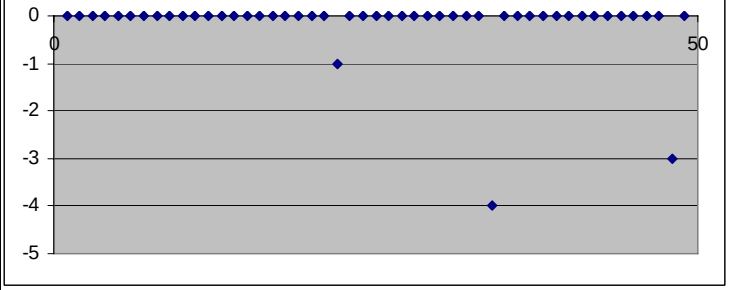
Blackwell: VVPAT Ballot Count - DRE Election Archive, by Vote Center



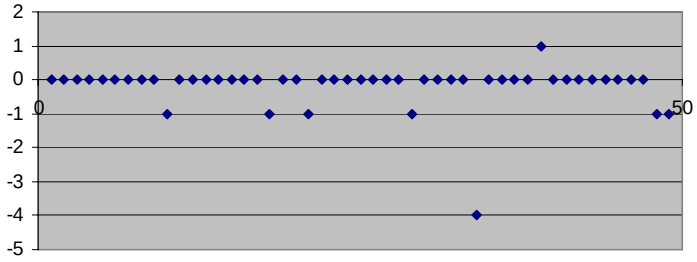
Petro: VVPAT Ballot Count - DRE Election Archive, by Vote Center



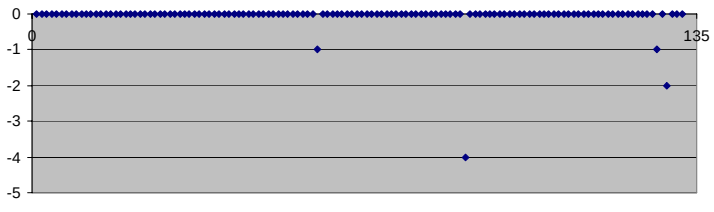
Blackwell: DRE Election Archive - DRE Memory Card, by Vote Center



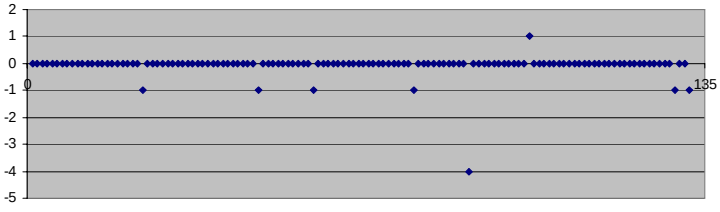
Petro: DRE Election Archive - DRE Memory Card, by Vote Center



Blackwell: DRE Election Archive - DRE Memory Card, by Precinct



Petro: DRE Election Archive - DRE Memory, by Precinct



Summary

On the basis of the data displayed in these many tables, ESI believes that the main conclusions to be drawn are straightforward. One can see, first of all, that the discrepancies between the two paper media (VVPAT summaries and the VVPAT ballots themselves), in the case of both total votes as well as votes for candidates, were relatively small. On the whole, the VVPAT summaries indicate that more votes were cast than what ESI can account for with the VVPAT ballots themselves. Similarly, differences between the figures obtained from the two electronic media (the DRE memory cards and the DRE Election Archive) were also very small, and confined to a small number of precincts. These discrepancies were of no consequence in the May 2 gubernatorial primaries, in that both winning candidates won by substantial margins. However, discrepancies of the size reported here can be larger than the difference between the winning and losing candidates' vote totals in a close election.

In contrast, discrepancies between the data from the paper media and the electronic media were considerably larger and considerably more pervasive. For the most part, the discrepancies can be characterized as the DRE memory cards and Election Archives registering more votes than were produced by the VVPAT summaries or by the hand counts of the VVPAT ballots themselves. Printer issues are likely the cause of some of this shortfall, but it is also the case that ESI may not have located all the paper ballots printed by the machines that were analyzed. Finally, ESI would like to stress that its comparisons are based only upon the data it was able to obtain from the May 2 election. As noted in Table 4, it was unable to obtain data for 13 VVPAT summaries, 87 VVPAT cartridges (i.e., printed ballots) 53 Data Archives, and 3 memory cards, which were the media used to tabulate official vote totals.[17]

Next Steps

Further examination of the data should reveal the reasons for some of the patterns observed in the data. These examinations should include the following steps:

- Conduct additional forensic analyses to determine why the discrepancies between the different forms of ballot data occurred.
- Meet with Diebold representatives to determine the cause of incongruities and develop a plan for corrective action.
- Conduct a source code review of the TSX unit to rule out count inaccuracies or other issues with the software
- Take whatever steps are necessary to address chain-of-custody issues
- Make necessary improvements in inventory control of mission-critical election assets such as memory cards and VVPAT cartridges.
- Develop a machine-level auditing capability that will make it simple and transparent to compare electronic and paper ballot data, and to thus identify the specific anomalies associated with specific machines.

[17] ESI received additional data in an email from the Cuyahoga BOE (see appendix) with additional information about the discrepancies found. This information is not included in this current analysis, but should be studied and included in future forensic analysis.

Section 7

Election System Functional Threat Analysis

Project Team

Ted Allen

Steven Hertzberg

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Goals

The goals of this report are to prioritize threats to the Cuyahoga county election system and to propose visions for possible system improvements based on a formal consensus-based approach. Also, we seek to provide an example of a formal approach to reducing election system risks that might inspire additional inquiry.

Focus

Given the breadth and complexity of the electronic voting system deployed in Cuyahoga county, and given the relatively short period of time available for study, the report will focus on information, processes and material critical to an election audit. Specifically, in this report we will concentrate on elements that are crucial to protecting the integrity and accuracy of the vote count, specifically the DRE memory cards and VVPAT[18]. Going forward, we will refer to these elements as "mission critical" processes.

Methodology Overview

In this analysis, "six sigma" techniques are leveraged, which are a series of problem solving tools employed to design and improve systems. Six sigma is defined as:

> *An organized and systematic problem-solving method for strategic system improvement and new product and service development that relies on statistical method and the scientific method to make dramatic reductions in customer defined defect rates and/or improvements in key output variables.*

In the case of this threat analysis, the following discrete steps are taken:

Step 1. Threat Identification & Prioritization

A prioritization of the risks facing the system is generated from a consensus of officials and people familiar with the election system. The approach used is failure mode and effects analysis (FMEA) in which the severity, occurrence, and detection ability ratings are separately evaluated for each threat. The risk priority number is then calculated by multiplying these ratings together.

Step 2. Information & Material Flow

A map of the election system is constructed through interviews of people familiar with the election system and building on the results from other projects. This map summarizes the flow of information and materials through the target systems and provides a listing of variables whose settings *might* be changed to improve system performance.

[18] Future analysis should include a threat assessment of the optical scan voting system.

Step 3. Key input Variables

The operation of an election system is associated with many key input variables whose settings can affect the accuracy of election results, transparency and auditability. Hence, in this section the focus is on identifying key input variables and describing the potential election performance issues related to these variables.

Step 4. Identifying Highest Priorities

Those variables, identified in Step 2, associated with the highest priority risks, as identified in Step 3, are highlighted for later inclusion in a system improvement plan.

Limitations of this Analysis

This is an initial attempt at identifying threats within the DRE sub-system. Given the sheer breadth of the issues and the complexity of the election system, it is likely that key threats were omitted. Yet, this serves as an important example for similar analyses that should continue until the detailed processes across the entire system are well understood. Also, the critical issues should be crosschecked from multiple points of view, including essential input from Board of Election personnel.

Findings

This section describes ESI's analysis of the threats relating to the Cuyahoga election system. In particular, it attempts to focus on threats that impact the auditability of the election and expose the county to legal liability through election contests or direct lawsuit. The analysis utilizes standard engineering problem solving methods, with the goal of prioritizing high impact issues that may be studied further and corrected in future elections.

Top priority threats related to the direct recording equipment (DRE) machines include:

1. DRE printer mishaps that impact the manual count.
2. A non-standardized, unproven manual count process that leads to recount error.
3. Too few working DREs in a specific vote center, resulting in long lines and people not staying to vote.
4. An inconsistent DRE setup that causes glitches in the electronic count.
5. A memory card that is lost or substituted.

ESI believes there is a strong chance that if left unaddressed, these threats will degrade public confidence in a close election, making it important that steps are taken to mitigate the threats. To the extent that the legal ballot is the VVPAT record, printer errors will likely have profound effects. Also, at least 1 vote center will almost surely have long lines.

1. Critical system variable settings or issues requiring **immediate** attention include:

- DRE and encoder recovery strategy (i.e., resolving out-of-service conditions without adding additional threats such as breaking the security seal on a memory card).
- Streamlining of chain of custody of memory cards & VVPAT cartridges using center managers.
- Training of elections staff to:
  - standardize DRE setup and reporting;
  - successfully open DREs on Election Day (and shift some tasks to more qualified technicians);
  - successfully close DREs and label and account for mission-critical assets (e.g., cartridge and card);
  - have a consistent and effective strategy for addressing printer problems on the DREs.

Step 1: Threat Identification & Prioritization

This section is intended to help prioritize risks associated with mission-critical information and material flow, enabling resources to be focused on the highest priority threats. The Cuyahoga County Board of Elections is responsible for a relatively large election system and the complexity of all election systems continues to increase. Current issues in Cuyahoga include paper voter verification and vote center-focused (not precinct-focused) operations. Therefore, adopting new systems and processes, and undertaking new efforts, are critical to carrying out the county's mission to accurately record the will of would-be voters on Election Day.

The FMEA Method

Failure Mode and Effects Analysis (FMEA) is a commonly used method for prioritizing possible threats to a system in relation to its achievement of critical, acceptability goals (Allen, 2006, pp. 125-133). The inputs to FMEA, while subjective, generally represent the considered consensus of knowledgeable people. Crosschecking and creativity can increase the "rigor" of the process. They can be informed by real data from the system. The failure modes are ways that the system can generate outcomes that are unacceptable or undesirable. Their severity indicates the degree to which stakeholders in the system are affected by failures associated with the given failure mode (should these failures occur). An assigned severity of 11 indicates the severest possible negative outcome while 1 indicates a light or negligible penalty.

Similarly, an assigned occurrence of 10 indicates a judgment that failures associated with the given failure mode are very common to the extent that they might happen all the time. An assigned occurrence of 1 indicates that these failures are believed to be very rare and may never occur in practice. Also, a detection value of 10 corresponds to the belief that failures of the given type would never be detected and would surely affect the stakeholders. A detection value of 1 implies that these failures are of minimal concern because the system will immediately identify and fix them all before they reach the affected people.

Failure Mode Priorities

In this section, eleven failure modes are considered which are ranked in the Table below.

FMEA Including Risk Priority Numbers (RPN).[19]

RPNs are subjective numbers depicting levels of risk, gathered by ESI researchers through interviews with election officials and other stakeholders. The RPN is derived by multiplying the assigned risk occurrences for severity, occurrence and detection.

Table VII- 1: FMEA (RPN = Severity x Occurrence x Detection)

Failure Mode	Potential Effect(s)	Severity (10 is serious)	Occurrence (10 is common)	Detection (10 is never found)	Comment	RPN
DRE printer mishaps impact manual count.	Manual count is unclear.	9	7	7	Voters are no-fault disenfranchised.	441
Lack of standardized proven manual count process results in recount error	Loss of confidence and/or legal issues	7	5	7	Observers will witness anomalies first hand and report publicly	245
No. of working DRE's results in discouragement	Loss of confidence and/or legal issues	4	9	5	Deterred voters affect the election	180
Inconsistent DRE setup causes glitches in electronic count.	Electronic count is wrong.	9	2*	9	Given VVPAT issues, detecting electronic glitches is difficult.	162
Memory card is lost or substituted.	Electronic count is wrong.	10	1.5*	8	Print and machine give backups.	120
Other mistakes in database management.	Electronic count is wrong.	10	1*	8*	Unclear how many checks in system.	80
Inconsistent DRE configuration causes manual count mistakes.	Legal challenges and loss of public confidence	10	1.5*	5	Effecting VVPAT has legal & public confidence impacts.	75
Inconsistent DRE closedown causes manual count mistakes.	Legal challenges and loss of confidence	10	1.5*	5	Effecting VVPAT has direct legal and perception consequences.	75
Booth worker encoder management leads to audit confusion.	Difficult manual and electronic correspondence.	6	5	2	Count differences cause perception issues and lost votes.	60
Inadequate booth worker and L&A testing raises variability.	Counts are ultimately wrong.	6	2*	4	Indirect through inconsistent reporting.	48
Vote center approach complicates manual count.	Manual count takes time and/or errors	3	5	2	Ballot style variability on same machine confuses.	30
Format of incident reports complicates improvement.	Lost opportunity to interpret problems.	4	3	2	A huge effort is needed to make use of incident report data.	24

*This is an unsubstantiated estimate pending additional information.

[19] This table data should be reviewed by a committee of Ohio election officials in order to gain consensus on the values.

Failure Modes Described

1. **DRE printer mishaps impact manual count:** Operating thousands of voting machines on Election Day offers many opportunities for unacceptable occurrences. Consider that each machine has a printer and potentially multiple rolls of paper. Paper records of votes (the official records) may be lost without would-be voters' awareness because of paper jams, paper not being loaded properly, ink issues, and other problems.

2. **Lack of standardized proven manual count process results in recount error**: With no proven VVPAT manual count process or counting aids in place, the BOE is susceptible to significant error and inefficiency that can be witnessed directly by the media, partisan attorneys and activist groups. This exposure could result in significant negative public opinion, not to mention inaccurate or unexplainable results.

3. **Number of working DREs results in discouragement**: High turnouts, long ballots, and (to a lesser extent) machine breakdowns make the chance of at least one vote center with very long lines a virtual certainty. With a sensible allocation, it still can be impossible to predict which center will have the incidents.

4. **Inconsistent DRE setup causes glitches in electronic count:** Any issue that causes unreliable consolidation of data is serious because thousands of votes could be lost or shifted by accident in the electronic count. The cause considered here is that the setup variation observed in the manual count could cause unexpected difficulties in interacting with the computers during consolidation.

5. **Memory card is lost or substituted:** Considering that the DRE Memory Cards used are fairly standard and the encryption efforts are questionable, straightforward issues with card security (lost, stolen, or substituted) are conceivable.

6. **Other mistakes in database management:** Without direct observation of the data consolidation and electronic counting process and/or interviews with relevant personnel, ESI can only speculate about causes and issues in data management. Moreover, checks and balances of the consolidation process can be designed to improve detectability. However, without poll managers present, issue resolution is difficult.

7. **Inconsistent DRE configuration causes manual count mistakes:** Variability in how machines are configured in the warehouse before Election Day makes it difficult to count manually.

8. **Inconsistent DRE closedown causes manual count mistakes:** Variability in how machines are closed down at the polling place on Election Day makes it difficult to count manually. These difficulties could lead to mistakes in the counting.

9. **Booth worker encoder management leads to audit confusion:** When encoders go out-of-service, workers may take actions that complicate the paper trail and correspondence in the name of saving time for voters. The results include a less transparent system.

10. **Inadequate booth worker and L&A testing leads to higher variability**: Sophisticated approaches are already in use to validate each machine. However, it is possible that these validations will fail to guarantee acceptable quality.

11. **Vote center approach complicates manual count**: Reduces waiting times but may increase complexity of audit or manual count, as voters from multiple precincts vote on each AccuVote-TS voting device.

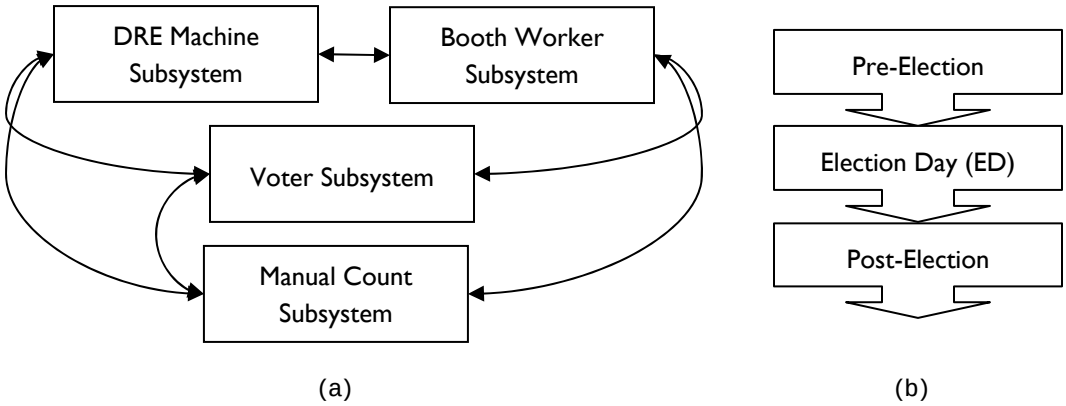
12. **Format of incident reports complicates improvement**: The variability in how incident reports are created on Election Day makes post Election Day analysis and improvements difficult. The same issues are documented in different ways and statistics are generally only possible after considerable transcription.

Step 2: Information & Material Flow

This section describes the process map which is a review of the election system (e.g., see Allen pp. 117-121). This process map contributed to the risk prioritization. The process map establishes vocabulary used to describe the threats relating to the voting process. Also, key input variables (KIVs) are identified that might be relevant to future process improvement efforts. These KIVs constitute parameters whose settings are directly controllable and whose settings might be changed to improve a system. Only an initial attempt is made to prioritize them in relation to system improvement, as further prioritization is beyond the scope of the current project.

The process map divides the overall election system into four subsystems: the direct recording equipment (DRE) machine subsystem, the voter subsystem, the Booth Worker subsystem and the manual count subsystem. Also, the chronology is separated into: pre-Election Day, Election Day, and post Election Day. These designations are shown in Figure 1 and are intended to aid in communication about the location and nature of threats in the system. The intent of Figure VI-1 (a) is to clarify that, while interactions exist between subsystems, there is a fairly definite and appropriate division of concern. In relation to Figure 2 (b), the majority of issues that affect post-Election Day results in this report are associated with the pre-election period.

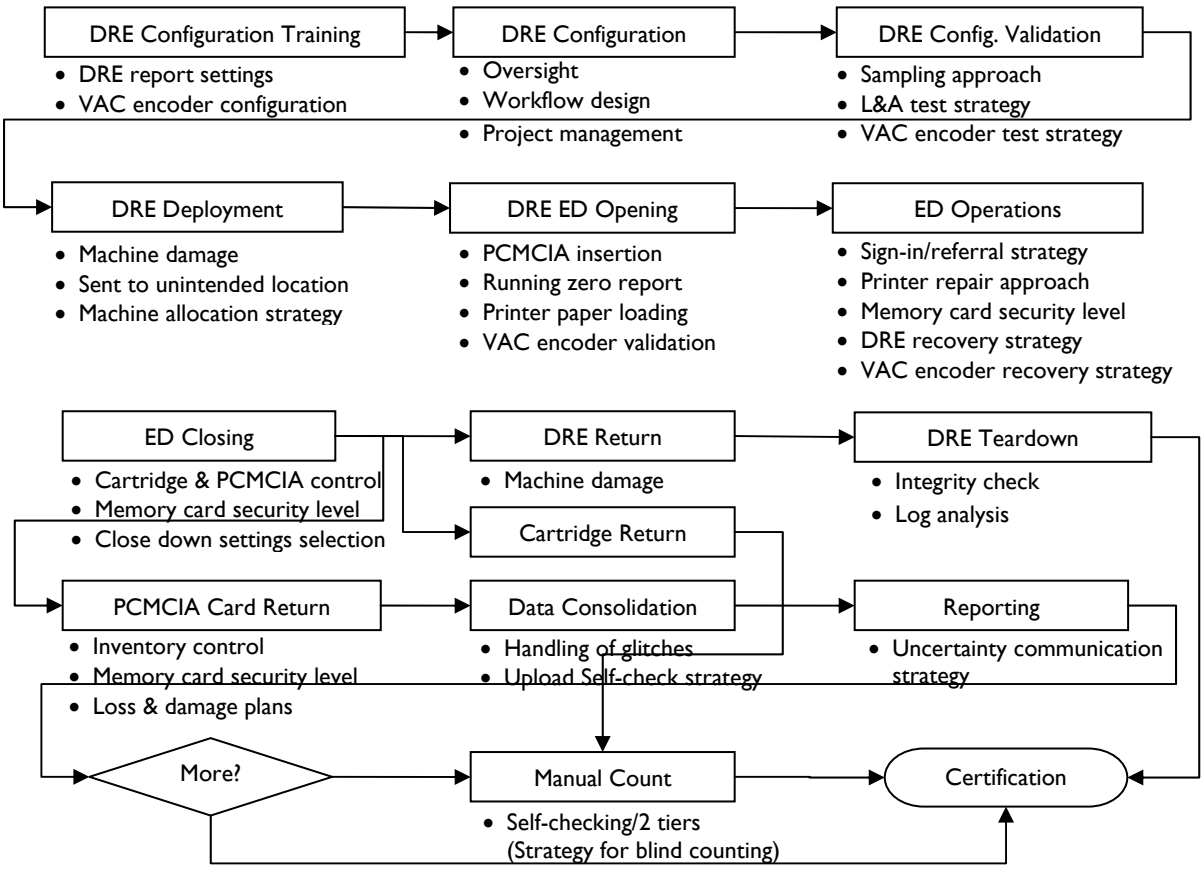
Figure VII-1. (A) The 3 Interacting Election Subsystems And (B) Time Periods.



Mission Critical Process Map

The process map in Figure VI-2 derives from interviews of people familiar with the Cuyahoga County voting system. The purpose of this figure is to describe many of the mission critical processes within the election system that may warrant additional attention.

Figure VII-2. Process Map Of Mission Critical Election Processes And Relevant Key Input Variables (KIVS).



Step 3: System Variables

Each mission-critical process may include several key input variables (KIVs), which are directly controllable by BOE staff. When a KIV is changed, these changes likely affect election system performance. KIVs defined in the Process Map found in Figure 2 are identified below, along with a description of the principal system performance issues that the KIVs impact.

DRE Configuration Training

Board of Election (BOE) personnel must be trained to setup thousands of direct recording equipment (DRE) voting machine and hundreds of Voter Access Card encoders. Each of these must be configured and validated separately, and therefore BOE personnel must employ well defined processes to ensure consistency.

Table VII- 2

Key Input Variable (KIV)	Issue Description
DRE Report Settings	The Diebold Accuvote-Tsx voting system can be configured to print numerous reports during Election Day opening and closing procedures. Inconsistent DRE printouts discovered during the manual count indicate that training of warehouse staff may not have clearly explained the DRE configuration to be utilized for the election. Inconsistent reporting leads to potential discrepancy or uncertainty during the canvass reconciliation process or during a manual count.
Voter Access Card (VAC) Encoder Configuration	VAC encoders are uniquely configured for their target precinct and deployed to precincts in pairs. If the Voter Access Card encoder delivered to a precinct and is not setup for that precinct, or is setup for another precinct, then: (i) Voters may receive incorrect ballot style. (ii) Votes may be attributed to incorrect precinct.

DRE Configuration

Setting up thousands of complicated direct recording machines (DREs) for elections is a challenge. The associated complexities are similar to high-volume manufacturing processes.

Table VII- 3

Key Input Variables (KIV)	Issue Description
Oversight	Oversight personnel must manage configuration processes and schedules, as well as oversee warehouse personnel selection, operations and incentives. Underdeveloped oversight personnel and oversight processes will contribute to inconsistent DRE and VAC encoder configuration.
Workflow Design	Poorly designed equipment and personnel workflow in the BOE warehouse will lead to workplace inefficiency and configuration inconsistencies.
Project Management	The sheer quantity of tasks that must be performed across approximately 5,000 DRE voting machines can be overwhelming, especially when constrained by limited resources or tight deployment schedules. Setting daily achievable goals, coordinating various teams with unique assignments and correlating cross-team dependencies are all critical to successfully configuring a large inventory of DRE voting systems in a systematic and unhurried manner. While the Cuyahoga BOE's policy remains to be confirmed, some election offices rely on temporary workers to perform the pre-election preparation of machines, but these workers are limited by the training they receive. It is crucial that temporary workers, who do not receive the benefit of regularly repeating their job functions, receive well designed tasks, milestones and task oversight.

DRE Configuration Validation

Table VII- 4

Key Input Variables (KIV)	Issue Description
Sampling Approach	Testing or validating of too few, or a statistically inadequate number, of devices can unnecessarily increase the probability of deploying DRE voting machines or VAC encoders that are incorrectly configured for their destination on Election Day. This can lead to VVPAT reports that are inconsistent or devoid of critical information during the canvass reconciliation process or a manual count.
Logic & Accuracy Test Strategy	Configuration of DRE voting machines is validated via the L&A test. Currently, code configuration and version is not checked and compared to code that is held in escrow by the state of Ohio. Without this level of testing, it can not be know what version of code is deployed on to a DRE, and whether the installed code base includes malicious code.
Voter Access Card (VAC) Encoder Test Strategy	Voter Access Card encoder configurations must undergo an adequate level of validation testing to provide confidence that these devices are appropriately configured for Election Day use in their intended precinct. It is unclear what level of validation encoders currently undergo.

DRE Deployment

Table VII- 5

Key Input Variables (KIV)	Issue Description
Machine Damage	DRE machines and VAC encoders experience damage during transportation. In ESI's incident report analysis there exist reports of broken DRE stands, missing power cords, and plastic covers being broken off of VVPAT reader. Booth Workers currently address these issues in an ad-hoc manner, typically resorting to duct tape for make-shift repairs. Currently, there is no formal process in place at the polling place to inspect for machine damage and mitigate this damage, possibly rendering a machine out-of-service.
DRE Sent to Unintended Location	As DREs are dumb terminals, they can be configured with home precinct memory cards and utilized in home precinct as normal. However, these DREs' serial numbers are currently not recorded and therefore it may be a challenge to access a DRE's onboard election data archive if a memory card is lost.
Voter Access Card (VAC) Encoder sent to Unintended Location	If the issue is not detected by Booth Workers, then voters may receive incorrect ballot styles and votes may be attributed to an incorrect precinct. If this results in voters casting ballots that would not be counted in a legal challenge because they were cast out-of-precinct, then this may be a significant issue in the event of a contested election.
Machine allocation strategy	Allocation that does not account for longer ballots in certain precincts is likely to yield much poorer performance than is necessary. However, under high turnout and long ballot length conditions, even a very thoughtful allocation of a large number of machines (~8000) could easily cause very long lines in specific vote centers. This will occur because of the randomness in voters' arrival times and lengths of time they take to vote. Therefore, a "recourse" strategy in which machines are quickly deployed on Election Day may be the only way to feel confident that there will be reasonable waiting times in all vote centers.

DRE Election Day (ED) Opening

Table VII- 6

Key Input Variables (KIV)	Issue Description
Memory Card Insertion	Memory cards are precinct-specific devices that must be properly inserted into a DRE. Booth workers are able to insert memory cards into DREs that are not part of their precinct and there is evidence that memory cards were incorrectly inserted into the DRE MEMORY slot, thereby rendering the DRE out-of-service until the memory card was properly inserted.
Running Zero Reports	If the zero report does not run properly, then appropriate data does not exist on the DRE and the machine is out-of-service until this is rectified.
Printer Paper Loading	Feeding the VVPAT paper into the printer on DRE opening can lead to paper jams or tears, either rendering the DRE out-of-service or resulting in VVPAT records that are illegible, thereby affecting the manual count.
Voter Access Card (VAC) Encoder Validation	Currently, there is no process in place for Booth Workers to validate the configuration of the VAC encoder at the polling location.

Election Day Operations

Table VII- 7

Key Input Variables (KIV)	Issue Description
Sign-in/Referral Strategy	The sign-in system may not accurately account for the quantity of ballots cast in a given precinct, as voters may cast their ballots in an adjoining precinct within the same vote center (it is unclear at this time whether voters signed-in at one precinct who then vote within another are outside the intent of the law, which requires a voter to cast a provisional ballot when not voting within their home precinct). Additionally, voter registration database anomalies threaten to disenfranchise eligible registered voters.
Printer Repair Strategy	A printer out-of-service not only results in VVPAT report inconsistencies, as Booth Workers attempt to mitigate the printer issue, but cause a DRE to become out-of-service, increasing voter service times.
Memory Card Security Level	It appears that memory cards are regularly removed and re-inserted when a DRE becomes out-of-service. Security tabs are broken and no log of this remove and replace activity is maintained. If cards are swapped onto other DRE machines, then two DREs must be recovered in order to access their onboard election data archives. There is no indication that a record comparing memory card to DRE serial number is kept.
DRE Recovery Strategy	Booth Workers attempting to restore an out-of-service DRE can cause other serious issues, such as mid-Election Day memory card switching, paper jams, torn or non-printing VVPAT records.
Voter Access Card (VAC) Encoder Recovery Strategy	VAC encoders are precinct-specific configured, with 2 encoders allocated to each precinct. ESI incident report analysis indicates that either encoders are failing, or that the voter access cards are becoming contaminated and therefore are not encoding properly. If voters in a given precinct are unable to obtain a voter access card from their home precinct, then these voters may not be able to cast the appropriate ballot.

Election Day Closing

Table VII- 8

Key Input Variables (KIV)	Issue Description
Printer Cartridge Security & Control	VVPAT cartridges are not always labeled and there is no external record kept of the quantity of VVPAT cartridges used per machine, or the memory card that the VVPAT records correspond with. It is possible that, unknowingly, a VVPAT cartridge could go missing or be placed in an inappropriate transfer case.
Memory Card Security & Control	Security seals are not checked for integrity at the end of Election Day, nor are they matched with a deployment list of Security seal serial numbers. There is no attempt to reconcile memory cards intended for the precinct with memory cards removed from the DREs at the end of the day. Nor is there any process in place to match the serial number of the memory card with the summary report on the VVPAT report. Therefore, it is unknown whether these memory cards were tampered with during Election Day.
DRE close down Selection	DREs can be mis-configured to offer Booth Workers more summary report choices than a Booth Worker was trained to recognize. This results in the printing of a wide array of summary reports that can make it difficult to reconcile a manual count. Further, VVPAT reports do not print precinct identification on ballots.

DRE Return and DRE Teardown

Table VII- 9

Key Input Variables (KIV)	Issue Description
DRE Machine Damage	Studying the DREs after the election could be important to ensure the machines will be ready in the future. Currently, there is no post-election functional inspection or systematic review of the DRE audit logs to assess machine performance and/or integrity.

Memory Card & VVPAT Cartridge Return

Table VII- 10

Key Input Variables (KIV)	Issue Description
Inventory Control	Controlling the inventory of over five thousand critical MEMORY cards is critical to the mission of the election system. There is no established chain-of-custody during the transfer of the memory cards nor the VVPAT records from the vote center to the BOE.
Memory Card Security Level	Security seals are collected upon return to the BOE, but these serial numbers are neither logged nor checked against the original security seal serial numbers deployed with the memory cards. Therefore, it is unknown whether these memory cards were tampered with during transport to the BOE from the polling location.
VVPAT Security Level	As neither the ID nor the quantity of VVPAT canisters is logged or tracked, it is feasible that the BOE will not know that VVPAT canisters are missing until a recount is in process.
Loss and Damage Plans	DREs are not quickly recovered in order to secure the onboard election data archive. In the event of VVPAT record or memory card loss, re-creation of critical Election Day data is not easily performed. Further, no record matching memory card to machine serial number is kept, hence it will be difficult to locate the onboard archive if required. Beyond security issues, loss or damage contingency planning can be detailed. Conceivably, paper records maybe required for recovery, without the call for a recount.

Data Consolidation

Table VII- 11

Key Input Variables (KIV)	Issue Description
Upload Self-check Strategy	The assemblage of the thousands of memory cards to create the completed election database is a massive and technical task. This task is potentially vulnerable to many of the issues associated with computer use, including unexpected data corruption and/or difficulties reading the cards. It is not clear that a well defined system is in place to check procedural integrity.
Handling of Data Glitches	While it is not clear how the BOE will identify data corruption, once data corruption is found, a systematic process for isolating and repairing the corruption does not appear to be in place.

Reporting

Table VII- 12

Key Input Variables (KIV)	Issue Description
Uncertainty Communications Strategy	Considering that many issues with running the election will inevitably occur, officials may need additional planning for multiple contingencies in their reporting of information. With all of the complications associated with the many upstream processes, it seems likely that any reporting of results on election night or soon after is associated with uncertainty. While discretion must, of course, be afforded to officials, it might make sense to plan in advance how uncertainty might be presented to the public in different situations, i.e., to make transparent contingency plans

Manual Count

Table VII- 13

Key Input Variables (KIV)	Issue Description
Self-checking/2-tiers (Strategy for Blind counting)	In auditing the process, ESI developed a streamlined approach for manual counting. In this process, custom-made hardware to view the paper data was used. Also, careful layout of personnel was used together with a sophisticated, two-tiered approach for checking the results of the human counters. If a first team failed to generate a count that another person found to agree with the machine printed totals for that cartridge or roll, a backup team recounted the associated roll of paper. Otherwise, only one count was made for that roll. The individual counters were not given knowledge of what the summary table said, i.e., they were "blinded" in the counting. It might be advisable to make some or all of these methods standard for manual counting.

Step 4: Identifying Top Priorities

Highest Priority Failure Modes

The analysis indicates that the highest priority issues are:

1. DRE printer mishaps impact manual count.
2. Lack of standardized proven manual count process results in recount error
3. Inconsistent DRE setup causes glitches in electronic count.
4. Memory card is lost or substituted.

Without additional efforts to make these issues less severe, less common, or more detectable, the risk is high that these failures will occur in important elections. Also, such occurrences are severe enough in nature that substantial loss in public confidence would likely occur as a result.

Highest Priority Failure Modes assuming a Manual Count is Certain

It is also interesting to consider what the top priorities would be assuming that a manual count is certain to be needed. For this case, the revised FMEA is shown in the table below. ESI estimates that inconsistencies in the DRE configuration and the closedown of the machines are among the highest priority risks, i.e., they have the highest risk priority numbers.

Table VII- 14: Highest RPN Failure Modes Assuming That A Manual Count Is Certain

Failure Mode	Potential Effect(s)	Severity (10 is serious)	Occurrence (10 is common)	Detection (10 is never found)	Comment	RPN
DRE printer mishaps impact manual count.	Manual count is unclear.	9	10	7	Voters are no-fault disenfranchised.	630
Inconsistent DRE configuration causes manual count mistakes.	Legal challenges and loss of public confidence	10	8	5	Effecting VVPAT has legal & public confidence impacts.	400
Inconsistent DRE closedown causes manual count mistakes.	Legal challenges and loss of public confidence	10	8	5	Effecting VVPAT has direct, legal and perception consequences.	400
Lack of standardized proven manual count process results in recount error	Loss of confidence and/or legal issues	7	10	9	Observers will witness anomalies first hand and report publicly	630

It is possible that configuration and worker setup inconsistencies are more serious than close down issues, because these setup issues are further upstream in the process. If proves true, then vulnerabilities associated with subsequent sub-processes in Figure 1 may be negatively impacted by this upstream issue. Figure 2 is a cause and effects diagram designed to emphasize the possible roles these inconsistencies might play in system malfunction, which is defined as an inability of the voting system to generate results reflective of the collective will of voters.

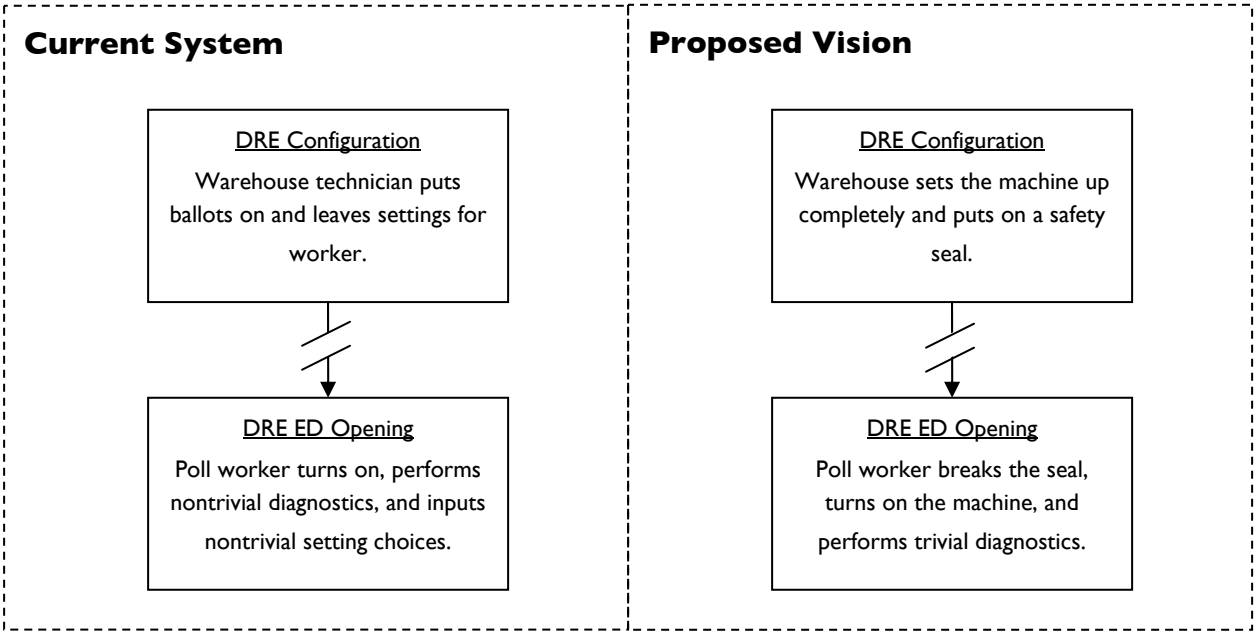
Towards An Ideal System

Figures VI3, VI 4 and VI 5 depict possible directions that the Cuyahoga election system might take. The depictions are designed to address the threats prioritized by the FMEA and identified in the process maps. Each depiction and the preferred practices they relate to is adapted from actual practices used by other counties in election systems and is based on what ESI believes are best practices. For example, no "recourse" strategy is included in which machines are held in reserve and allocated as needed on Election Day, because ESI is not aware of any counties using such an approach.

Ideas for DRE Configuration Validation and Opening

During the mock manual count, challenges to efficient and accurate results were traced to the direct recording equipment (DRE) Election Day opening process. As a security measure, booth workers run diagnostics on the equipment to make sure there has been no tampering. These workers also select settings including printer options. It might make sense to transfer these responsibilities to the more qualified personnel who configure the machines in the warehouse. Other counties do this using a safety seal to verify that no one has tampered after the technician setup the machine. Then, the usually lower skilled booth workers only need to unseal the machines, push the power button, and verify basic facts about the setup. This vision is depicted in Figure VI-3.

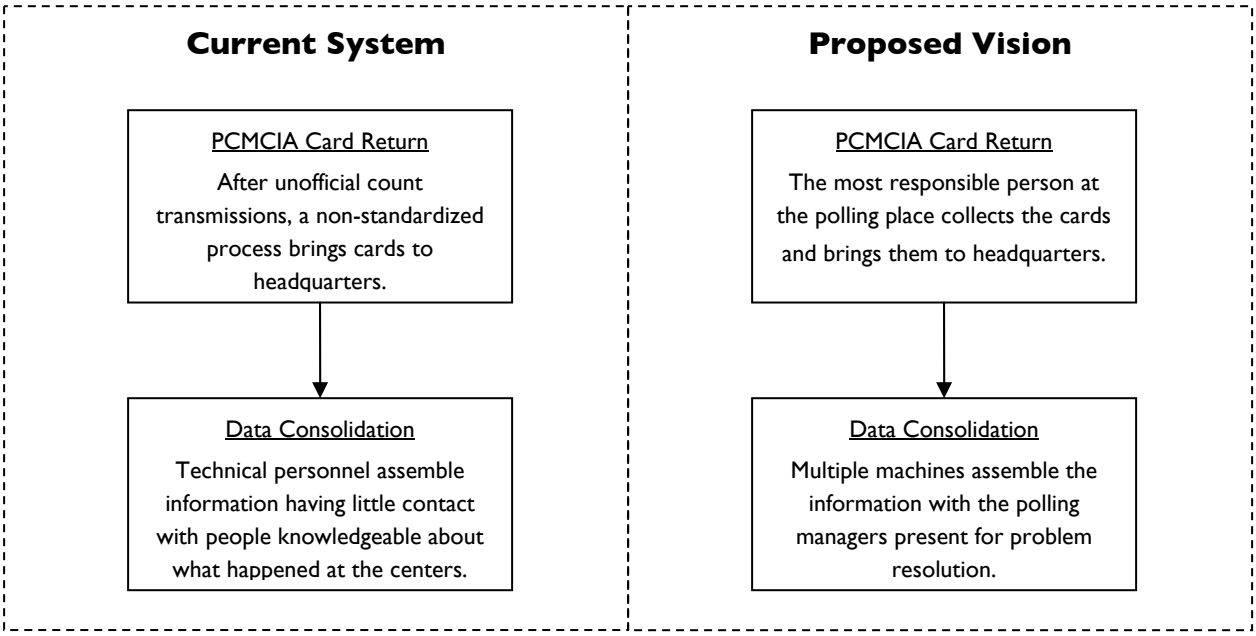
Figure VII-3: Description Of A Vision For DRE Configuration And Opening.



Ideas for Memory Card Return

Anecdotal information has indicated chain of custody issues related to card return. While Cuyahoga is a relatively large county, it might make sense to adapt custody strategies used by smaller counties. Further, while high tech systems such as radio frequency identification (RFID) or e-tags could conceivably help, ESI suggests starting with simpler, more time tested approaches as a starting point. Poll center managers can collect the cards and bring them personally to the headquarters. There, they would queue to have their precinct entered. In this way, trusted people have the cards under control all the time. Also, if any issue is detected about missing cards or security, the most knowledgeable people are on-hand for resolution. Clearly, this approach would be easier to implement if more than a single set of servers (primary and backup) were available at headquarters. Admittedly, this could require additional effort and oversight and no networking is, of course, permitted. This vision is depicted in Figure VI-4.

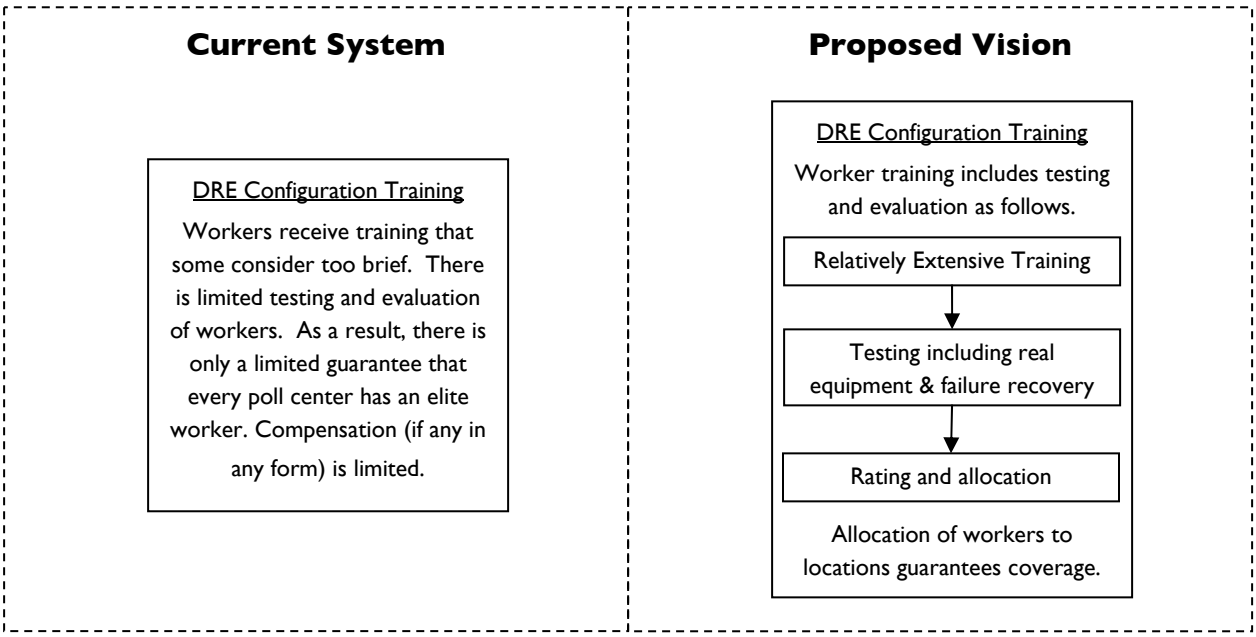
Figure VII-4. Description Of A Vision For Memory Card Return And Consolidation.



Ideas for Configuration Training

States including Ohio continue to place added burdens on their election systems without necessarily provisioning for increased resource needs. In the face of these challenges, voting systems need to adapt. Maintaining staffing levels and policies at status quo levels is unlikely to address current or new threats effectively. Anecdotal information suggests that Cuyahoga needs to invest more resources in booth worker training, recruitment, and compensation. It is practically imperative that each polling place have at least one very well trained worker who can skillfully resolve equipment failure issues and articulate poll management policies. This is complicated by the fact that, to our knowledge, the county has no formal system in place to rate the quality of booth workers. Specifically, operating thousands of mechanical printers is an intrinsically hazardous challenge requiring highly competent and well-tested personnel.

Figure VII-5: Description Of A Vision For DRE Configuration And Opening.



Next Steps

It is perhaps true that only a few simple steps can be accomplished before the May 2006 election occurs, especially as the Cuyahoga system is obligated to address concerns raised by other entities besides ESI. However, general concerns and opportunities for future investigation include:

- Addressing printer issues (consistent training related to the aggressive detection of problems and contingencies for the voters affected),
- Oversight of the data consolidation process (further evaluation of the internal checks on the consolidation process using interviews and, if possible, observation),
- Memory card chain of custody issues (how policy interacts with machine out-of-service incidents and transportation logistics),
- Develop and practice a manual count process prior to the November 2006 election.

Related to this, ESI recommends the completion of a cause and effects (C&E) matrix to prioritize which key input variables in Figure 1 should be further investigated (Allen, 2006, pp. 121-123). The resulting prioritization reflects information about the risk posed as noted in Table 1 and the correlations estimated by election experts. This analysis will lead to recommended changes to the system's standard operating procedures including contingency plans.

Also, ESI recommends that results should be documented in a control plan (Allen, 2006, 148-151). This plan will include plans for monitoring and controlling key output variables associated with the important threats. Also, reaction or contingency plans should be detailed when monitoring encounters unanticipated variables. Finally, ESI recommends documenting results in a case study submission to an appropriate publication. Ideally, officials within Cuyahoga County will become coauthors who are interested in being associated with a formal, data-driven process improvement effort.

High Level Recommendations

- Place more responsibility for setting up machines on warehouse technicians and leave less work for the booth workers to do on Election Day. Other counties use a seal to ensure non-tampering.
- Streamline the chain of custody of MEMORY cards such that managers are with them until the data is safely in the database. This provides greater security and capacity for problem resolution.
- To the extent possible, have several hundred machines ready to allocate on Election Day where needed.
- Have training include hands-on testing involving printer machines and failure resolution. Use test rating results to help allocate workers, so at least one highly rated worker is at every location.

References

Allen, T. T. (2006), *Introduction to Engineering Statistics and Six Sigma: Statistical Quality Control and Design of Experiments and Systems*, Springer Verlag: London.

Allen, T. T. (in press), "Mitigating Voter Wait Times," *Chance Magazine*, The American Statistical Association.

Section 8

Appendices

Appendix 1 – Election Day Voter Exit Poll Survey

1.1 Voter Exit Poll Questionnaire

ELECTION SCIENCE INSTITUTE | Improving the American Election Process

YOUR ANSWERS ARE CONFIDENTIAL

Please check only ONE response for each question.

[A] **Are you:**
1 ☐ Male 2 ☐ Female

[B] **To which age group do you belong?**
1 ☐ 18-24
2 ☐ 25-34
3 ☐ 35-44
4 ☐ 45-54
5 ☐ 55-64
6 ☐ 65 or over

[C] **Which primary did you vote in today?**
1 ☐ Democratic Primary
2 ☐ Republican Primary
3 ☐ Local issue only

[D] **Did you have any trouble finding your polling place today?**
1 ☐ Yes
2 ☐ No

[E] **Was your name on the registration list?**
1 ☐ Yes
2 ☐ No

[F] **Before today's election, where and when had you last voted?**
1 ☐ In Cuyahoga County
Write in year: _____
2 ☐ Not in Cuyahoga County
Write in year: _____
3 ☐ This is my first time voting

[G] **How confident are you that your vote today will be recorded correctly?**
1 ☐ Very Confident
2 ☐ Somewhat Confident
3 ☐ Not Very Confident
4 ☐ Not Confident At All
5 ☐ Was not able to vote

[H] **Did you vote today using a provisional paper ballot?**
1 ☐ Yes **=> If Yes, Skip to Question N on side 2**
2 ☐ No **=> If No, Continue to Next Question**

[I] **How would you rate the ease of use of the touchscreen voting system?**
1 ☐ Extremely Easy
2 ☐ Somewhat Easy
3 ☐ Somewhat Difficult
4 ☐ Extremely Difficult
5 ☐ Did not use touchscreen voting system

[J] **How would you compare the touchscreen voting system to the punch card system that had been used previously at your polling place?**
1 ☐ Touchscreen is Much Better
2 ☐ Touchscreen is Somewhat Better
3 ☐ Touchscreen is Somewhat Worse
4 ☐ Touchscreen is Much Worse
5 ☐ Did not use touchscreen voting system
6 ☐ Have never used punch card system

[K] **Did you have any problems using the touchscreen voting system?**
1 ☐ Yes
2 ☐ No

[L] **Did you ask for help using the touchscreen voting system?**
1 ☐ Yes, and I got it
2 ☐ Yes, and I did not get it
3 ☐ No

[M] **Did a precinct booth worker offer you instruction on using the touchscreen voting system before voting?**
1 ☐ Yes, but I did not need it
2 ☐ Yes, I needed it
3 ☐ No

PLEASE TURN THE QUESTIONNAIRE OVER →

OHIO (P-2006)

[N] **Had you seen or heard any information about the touchscreen voting equipment on radio, on television, in the newspaper, by mail or by public demonstration before you came to vote today?**

1 ☐ Yes
2 ☐ No

[O] **Were you asked to present any identification when you went to vote today?**

1 ☐ Yes
2 ☐ No

[P] **What form of identification did you provide?**

1 ☐ Driver's license
2 ☐ Utility bill
3 ☐ Other: What?_____
4 ☐ Was not asked to provide identification

[Q] **Was the identification you provided accepted or rejected?**

1 ☐ Accepted
2 ☐ Rejected
3 ☐ Was not asked to provide identification

[R] **Are you:**

1 ☐ White
2 ☐ African American
3 ☐ Native American
4 ☐ Asian
5 ☐ Hispanic/Latino
6 ☐ Other

[S] **What was the last grade of school you completed?**

1 ☐ Did not complete high school
2 ☐ High school graduate
3 ☐ Some college or associate degree
4 ☐ College graduate
5 ☐ Postgraduate study

[T] **In today's gubernatorial primary, did you just vote for:**

Democrat
1 ☐ Bryan E. Flannery
2 ☐ Ted Strickland
3 ☐ Other Democrat: Who? _____
Republican
4 ☐ J. Kenneth Blackwell
5 ☐ Jim Petro
6 ☐ Other Republican: Who? _____
7 ☐ Did not vote for Governor

[U] **In today's senatorial primary, did you just vote for:**

Democrat
1 ☐ Sherrod Brown
2 ☐ Merrill Samuel Keiser Jr.
3 ☐ Other Democrat: Who? _____
Republican
4 ☐ Mike DeWine
5 ☐ William G. Pierce
6 ☐ David R. Smith
7 ☐ Other Republican: Who? _____
8 ☐ Did not vote for Senator

Thank you.

OHIO (P-2006)

Appendix 2 – Post Election Survey of Booth workers & Election Day Technicians

2.1 Selected Topline Results

Q3:
Overall, how satisfied are you with your job as an election worker in Cuyahoga (KI-YA-HO-GA) County...

N =		527	100%
Very satisfied	1	218	41%
Somewhat satisfied	2	194	37%
Somewhat dissatisfied	3	79	15%
Very dissatisfied	4	30	6%
Don't know / Uncertain (DO NOT READ)	8	2	0%
Refused (DO NOT READ)	9	4	1%

Q4:
How much attention have you paid to news media reports since the May 2nd primary election about the touch screen voting machines, the performance of election officials, and the certification of the election results? Have you given the media reports...

N =		527	100%
A lot of attention	1	211	40%
Some attention	2	198	38%
Not very much attention, or	3	87	17%
No attention at all	4	26	5%
Don't know / Uncertain (DO NOT READ)	8	5	1%
Refused (DO NOT READ)	9	0	0%

Q6:
How confident are you that votes in the May 2nd primary were recorded correctly? Are you...

N =		527	100%
Very confident	1	229	43%
Somewhat confident	2	233	44%
Not very confident, or	3	36	7%
Not confident at all	4	16	3%
Don't know / Uncertain (DO NOT READ)	8	13	2%
Refused (DO NOT READ)	9	0	0%

Q7:
How would you compare the touch screen voting system to the punch card system that had been used previously at your polling place? Is the touch screen...

N =		527	100%
Much better	1	327	62%
Somewhat better	2	146	28%
Somewhat worse, or	3	19	4%
Much worse	4	19	4%
Never used the punch card system (DO NOT READ)	5	4	1%
Don't know / Uncertain (DO NOT READ)	8	10	2%
Refused (DO NOT READ)	9	2	0%

Q8 Introduction:
I'm going to read you a list of reasons that people give for being an election worker. Thinking about your decision to be an election worker, please tell me if each of these reasons was very important, somewhat important, not very important, or not at all important in your decision to be an election worker...

Q8A:
The first one is: I found it exciting. Please tell me if this was very important, somewhat important, not very important, or not at all important to your decision to be an election worker.

N =		527	100%
Very important	1	207	39%
Somewhat important	2	172	33%
Not very important	3	73	14%
Not at all important	4	71	13%
Don't know / Uncertain	8	1	0%
Refused	9	3	1%

Q8B:
The next one is: I wanted to learn about politics and government. Please tell me if this was very important, somewhat important, not very important, or not at all important to your decision to be an election worker.

N =		527	100%
Very important	1	170	32%
Somewhat important	2	176	33%
Not very important	3	95	18%
Not at all important	4	77	15%
Don't know / Uncertain	8	6	1%
Refused	9	3	1%

Q8C:
I was asked to be an election worker by someone in my political party.
PROMPT IF NECESSARY: Please tell me if this was very important, somewhat important, not very important, or not at all important to your decision to be an election worker.

N =		527	100%
Very important	1	153	29%
Somewhat important	2	105	20%
Not very important	3	66	13%
Not at all important	4	170	32%
Don't know / Uncertain	8	31	6%
Refused	9	2	0%

Q8D:

I like to be with people who share my ideals.

PROMPT IF NECESSARY: Please tell me if this was very important, somewhat important, not very important, or not at all important to your decision to be an election worker.

N =		527	100%
Very important	1	201	38%
Somewhat important	2	164	31%
Not very important	3	76	14%
Not at all important	4	79	15%
Don't know / Uncertain	8	5	1%
Refused	9	2	0%

Q8E:

I think it is my duty as a citizen.

PROMPT IF NECESSARY: Please tell me if this was very important, somewhat important, not very important, or not at all important to your decision to be an election worker.

N =		527	100%
Very important	1	389	74%
Somewhat important	2	106	20%
Not very important	3	17	3%
Not at all important	4	15	3%
Don't know / Uncertain	8	0	0%
Refused	9	0	0%

Q8F:

I am the kind of person who does my share.

PROMPT IF NECESSARY: Please tell me if this was very important, somewhat important, not very important, or not at all important to your decision to be an election worker.

N =		527	100%
Very important	1	428	81%
Somewhat important	2	84	16%
Not very important	3	9	2%
Not at all important	4	4	1%
Don't know / Uncertain	8	1	0%
Refused	9	1	0%

Q8G:

I wanted to make some extra money.

PROMPT IF NECESSARY: Please tell me if this was very important, somewhat important, not very important, or not at all important to your decision to be an election worker.

N =		527	100%
Very important	1	202	38%
Somewhat important	2	197	37%
Not very important	3	69	13%
Not at all important	4	56	11%
Don't know / Uncertain	8	2	0%
Refused	9	1	0%

Q8H:

I received recognition from people I respect.

PROMPT IF NECESSARY: Please tell me if this was very important, somewhat important, not very important, or not at all important to your decision to be an election worker.

N =		527	100%
Very important	1	205	39%
Somewhat important	2	137	26%
Not very important	3	92	17%
Not at all important	4	85	16%
Don't know / Uncertain	8	7	1%
Refused	9	1	0%

Q8I:

I can be with people I enjoy.

PROMPT IF NECESSARY: Please tell me if this was very important, somewhat important, not very important, or not at all important to your decision to be an election worker.

N =		527	100%
Very important	1	286	54%
Somewhat important	2	151	29%
Not very important	3	46	9%
Not at all important	4	36	7%
Don't know / Uncertain	8	7	1%
Refused	9	1	0%

Q8J:

I did not want to say no to someone who asked.

PROMPT IF NECESSARY: Please tell me if this was very important, somewhat important, not very important, or not at all important to your decision to be an election worker.

N =		527	100%
Very important	1	99	19%
Somewhat important	2	93	18%
Not very important	3	120	23%
Not at all important	4	187	35%
Don't know / Uncertain	8	23	4%
Refused	9	5	1%

Q9:

At any time during the training and recruiting process, did you consider not working at the polls on Election Day?

N =		519	100%
Yes	1	146	28%
No	2	371	71%
Don't know / Uncertain	8	2	0%
Refused	9	0	0%

Q9A:

What was the most important reason you considered not working at the polls on Election Day?

N =		146	100%
Illness	01	5	3%
Had to work other job	02	0	0%
Felt training wasn't good enough / Training didn't prepare me well enough	03	70	48%
Concerned about operating the new voting equipment / New equipment too complicated	04	33	23%
Could not find transportation / Get a ride to the poll	05	0	0%
Could not get child care	06	0	0%
Pay was too low	07	3	2%
Booth worker pay was unfair compared to EDT / Technician pay	08	0	0%
Did not think I could do a good job	09	2	1%
Day was too long	10	5	3%
Was assigned to a location I didn't like	11	0	0%
My assigned location was changed a few days before election	12	0	0%
Other reason (SPECIFY)	13	26	18%
Don't know / Uncertain	88	2	1%
Refused	99	0	0%

Q10:

How likely are you to work as a booth worker in the elections this coming November...

N =		527	100%
Very likely	1	375	71%
Somewhat likely	2	109	21%
Not very likely	3	23	4%
Not at all likely	4	14	3%
Don't know / Uncertain (DO NOT READ)	8	6	1%
Refused (DO NOT READ)	9	0	0%

Q11:

How were you first recruited as a booth worker? Were you recruited by...

N =		527	100%
A political party official	1	96	18%
Another booth worker	2	182	35%
An advertisement in the local media	3	23	4%
A teacher or professor	4	6	1%
An official job posting by the county	5	30	6%
Or some other way (SPECIFY)	6	159	30%
Don't know / Uncertain (DO NOT READ)	8	29	6%
Refused (DO NOT READ)	9	2	0%

Q13:
Cuyahoga (KI-YA-HO-GA) County sponsored training sessions for booth workers prior to the May 2nd primary to teach workers how to use the new touch screen voting machines. How many training sessions did you attend?

N =		527	100%
Zero	0	3	1%
One	1	359	68%
Two	2	135	26%
Three	3	26	5%
More than three	4	3	1%
Don't know / Uncertain	8	1	0%
Refused	9	0	0%

Q14:
Did you receive a copy of the <Q14FI> from the Board of Elections?

N =		527	100%
Yes	1	511	97%
No	2	16	3%
Don't know / Uncertain	8	0	0%
Refused	9	0	0%

Q14A:
About how much of the <q14fi> supplied to you by the Board of Elections did you read prior to Election Day? Did you read...

N =		511	100%
All of it	1	345	68%
Most of it	2	134	26%
Some of it, or	3	27	5%
None of it	4	5	1%
Don't know / Uncertain (DO NOT READ)	8	0	0%
Refused (DO NOT READ)	9	0	0%

Q15:
Did you receive a copy of the training video or DVD from the Board of Elections?

N =		527	100%
Yes	1	445	84%
No	2	81	15%
Don't know / Uncertain	8	1	0%
Refused	9	0	0%

Q15A:
About how much of the training video or DVD supplied to you by the Board of Elections did you watch prior to Election Day? Did you watch...

N =		446	100%
All of it	1	343	77%
Most of it	2	21	5%
Some of it, or	3	11	2%
None of it	4	68	15%
Don't know / Uncertain (DO NOT READ)	8	3	1%
Refused (DO NOT READ)	9	0	0%

Q15X:
Which did you find most helpful in preparing for Election Day, the printed manual or the video/DVD?

N =		438	100%
Manual	1	177	40%
Video	2	147	34%
Both equally (DO NOT READ)	3	91	21%
Neither one was helpful (DO NOT READ)	4	18	4%
Don't know / Uncertain (DO NOT READ)	8	5	1%
Refused (DO NOT READ)	9	0	0%

Q16 Introduction:
Thinking back on your training before the May 2nd primary election, please tell me whether you agree or disagree with each of the following statements. The first one is...

Q16A:
The training session provided me with enough information to do my job well.
PROMPT IF NECESSARY: Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

N =		527	100%
Strongly agree	1	91	17%
Agree	2	158	30%
Disagree	3	181	34%
Strongly disagree	4	91	17%
Don't know / Uncertain	8	5	1%
Refused	9	1	0%

Q16B:
I was able to spend enough time doing hands-on practice with the voting machine.
PROMPT IF NECESSARY: Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

N =		527	100%
Strongly agree	1	84	16%
Agree	2	139	26%
Disagree	3	175	33%
Strongly disagree	4	126	24%
Don't know / Uncertain	8	2	0%
Refused	9	1	0%

Q16C:

I thought the new touch screen voting machines were easy to use.
PROMPT IF NECESSARY: Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

N =		527	100%
Strongly agree	1	264	50%
Agree	2	220	42%
Disagree	3	25	5%
Strongly disagree	4	8	2%
Don't know / Uncertain	8	10	2%
Refused	9	0	0%

Q16D:

The training sessions were too long.
PROMPT IF NECESSARY: Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

N =		527	100%
Strongly agree	1	42	8%
Agree	2	74	14%
Disagree	3	289	55%
Strongly disagree	4	116	22%
Don't know / Uncertain	8	5	1%
Refused	9	1	0%

Q16E:

The training sessions were boring.
PROMPT IF NECESSARY: Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

N =		527	100%
Strongly agree	1	32	6%
Agree	2	71	13%
Disagree	3	282	54%
Strongly disagree	4	132	25%
Don't know / Uncertain	8	10	2%
Refused	9	0	0%

Q16F:

The training sessions spent enough time covering election law and procedures.
PROMPT IF NECESSARY: Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

N =		527	100%
Strongly agree	1	87	17%
Agree	2	150	28%
Disagree	3	187	35%
Strongly disagree	4	95	18%
Don't know / Uncertain	8	8	2%
Refused	9	0	0%

Q16G:
Sometimes I am not sure I am doing my job correctly because the laws keep changing.
PROMPT IF NECESSARY: Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

N =		527	100%
Strongly agree	1	32	6%
Agree	2	140	27%
Disagree	3	212	40%
Strongly disagree	4	106	20%
Don't know / Uncertain	8	35	7%
Refused	9	2	0%

Q16H:
The training was easy to understand.
PROMPT IF NECESSARY: Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

N =		527	100%
Strongly agree	1	83	16%
Agree	2	203	39%
Disagree	3	154	29%
Strongly disagree	4	76	14%
Don't know / Uncertain	8	10	2%
Refused	9	1	0%

Q16I:
The training prepared me well for Election Day.
PROMPT IF NECESSARY: Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

N =		527	100%
Strongly agree	1	73	14%
Agree	2	170	32%
Disagree	3	176	33%
Strongly disagree	4	100	19%
Don't know / Uncertain	8	8	2%
Refused	9	0	0%

Q16J:
After the training, I was confident in my ability to do my job on Election Day.
PROMPT IF NECESSARY: Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

N =		527	100%
Strongly agree	1	112	21%
Agree	2	198	38%
Disagree	3	137	26%
Strongly disagree	4	73	14%
Don't know / Uncertain	8	7	1%
Refused	9	0	0%

Q17:
Did you notice any differences between how you learned to use the voting machines in training and how the voting machines operated on Election Day?

N =		519	100%
Yes	1	211	41%
No	2	302	58%
Don't know / Uncertain	8	6	1%
Refused	9	0	0%

Q17A:
To what extent did the training differ from the actual procedures? Was it...

N =		211	100%
A lot different	1	59	28%
Somewhat different, or	2	97	46%
Just a little bit different	3	53	25%
Don't know / Uncertain (DO NOT READ)	8	2	1%
Refused (DO NOT READ)	9	0	0%

Q18 Introduction:
Thinking back on your experience during Election Day on May 2nd, please tell me whether you agree or disagree with each of the following statements...

Q18A:
The first one is: There were problems with setting up the touch screen voting machines. Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

N =		519	100%
Strongly agree	1	114	22%
Agree	2	173	33%
Neither	3	8	2%
Disagree	4	140	27%
Strongly disagree	5	79	15%
Don't know / Uncertain	8	4	1%
Refused	9	1	0%

Q18B:
There were problems shutting down the touch screen machines at the end of the day. Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

N =		519	100%
Strongly agree	1	144	28%
Agree	2	143	28%
Neither	3	7	1%
Disagree	4	140	27%
Strongly disagree	5	74	14%
Don't know / Uncertain	8	11	2%
Refused	9	0	0%

Q18C:

There were problems with the touch screen machines throughout the day.
PROMPT IF NECESSARY: Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

N =		519	100%
Strongly agree	1	38	7%
Agree	2	66	13%
Neither	3	9	2%
Disagree	4	238	46%
Strongly disagree	5	165	32%
Don't know / Uncertain	8	3	1%
Refused	9	0	0%

Q18D:

Generally speaking, voters were satisfied with the touch screen voting machines.
PROMPT IF NECESSARY: Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

N =		519	100%
Strongly agree	1	266	51%
Agree	2	222	43%
Neither	3	3	1%
Disagree	4	12	2%
Strongly disagree	5	11	2%
Don't know / Uncertain	8	5	1%
Refused	9	0	0%

Q18E:

The booth workers in my precinct worked well together.
PROMPT IF NECESSARY: Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

N =		519	100%
Strongly agree	1	284	55%
Agree	2	187	36%
Neither	3	3	1%
Disagree	4	28	5%
Strongly disagree	5	16	3%
Don't know / Uncertain	8	1	0%
Refused	9	0	0%

Q18F:

Most voters had no problems using the touch screen voting machines.
PROMPT IF NECESSARY: Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

N =		519	100%
Strongly agree	1	256	49%
Agree	2	222	43%
Neither	3	2	0%
Disagree	4	28	5%
Strongly disagree	5	9	2%
Don't know / Uncertain	8	2	0%
Refused	9	0	0%

Q18G:

The touch screen voting machines are reliable.
PROMPT IF NECESSARY: Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

N =		519	100%
Strongly agree	1	160	31%
Agree	2	233	45%
Neither	3	19	4%
Disagree	4	34	7%
Strongly disagree	5	21	4%
Don't know / Uncertain	8	52	10%
Refused	9	0	0%

Q18H:

The touch screen voting machines provide voters with enough privacy as they vote.
PROMPT IF NECESSARY: Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

N =		519	100%
Strongly agree	1	177	34%
Agree	2	243	47%
Neither	3	6	1%
Disagree	4	59	11%
Strongly disagree	5	32	6%
Don't know / Uncertain	8	2	0%
Refused	9	0	0%

Q18I:

The booth workers knew how to operate the touch screen voting machines.
PROMPT IF NECESSARY: Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

N =		51	100%
Strongly agree	1	11	22%
Agree	2	26	51%
Neither	3	0	0%
Disagree	4	8	16%
Strongly disagree	5	6	12%
Don't know / Uncertain	8	0	0%
Refused	9	0	0%

Q18J:

The Election Day Technician at my polling place was able to solve technical problems with the touch screen voting machines.
PROMPT IF NECESSARY: Do you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree?

N =		468	100%
Strongly agree	1	127	27%
Agree	2	167	36%
Neither	3	13	3%
Disagree	4	73	16%
Strongly disagree	5	77	16%
Don't know / Uncertain	8	10	2%
Refused	9	1	0%

Q19:
Did you need to call the command center at any time during the Primary Election Day?

N =		519	100%
Yes	1	254	49%
No	2	258	50%
Don't know / Uncertain	8	7	1%
Refused	9	0	0%

Q19A:
Generally speaking, when you called the command center...

N =		254	100%
Did you speak to someone on the first try	1	90	35%
Did you have to call back to speak to someone, or	2	93	37%
Were you unable to speak to someone	3	45	18%
Don't know / Uncertain (DO NOT READ)	8	26	10%
Refused (DO NOT READ)	9	0	0%

Q20:
Did your polling location have all the workers it needed?

N =		519	100%
Yes	1	328	63%
No	2	187	36%
Don't know / Uncertain	8	4	1%
Refused	9	0	0%

Q21:
Were you missing any supplies at your polling location?

N =		519	100%
Yes	1	148	29%
No	2	366	71%
Don't know / Uncertain	8	5	1%
Refused	9	0	0%

Q22:
How often did you ask voters to present identification before allowing them to vote...

N =		519	100%
All of the time	1	49	9%
Most of the time	2	33	6%
Only some of the time	3	68	13%
Hardly at all, or	4	127	24%
Never	5	222	43%
Don't know / Uncertain (DO NOT READ)	8	18	3%
Refused (DO NOT READ)	9	2	0%

Q23 Introduction:
I'm going to read you a list of possible problems that you may have experienced with the new voting machines. For each one please answer yes or no about whether or not you experienced the possible problem with the touch screen voting machines at your polling place...

Q23A:
Did you have any difficulty setting up the machine? Please answer yes or no about whether or not you experienced this possible problem with the touch screen voting machines at your polling place.

N =		519	100%
Yes	1	165	32%
No	2	351	68%
Don't know / Uncertain	8	2	0%
Refused	9	1	0%

Q23B:
Did you have any difficulty connecting the machine to a power source? Please answer yes or no about whether or not you experienced this possible problem with the touch screen voting machines at your polling place.

N =		519	100%
Yes	1	30	6%
No	2	486	94%
Don't know / Uncertain	8	3	1%
Refused	9	0	0%

Q23C:
Did you have any difficulty with the printer spools or loading paper in the printer? PROMPT IF NECESSARY: Please answer yes or no about whether or not you experienced this possible problem with the touch screen voting machines at your polling place.

N =		519	100%
Yes	1	196	38%
No	2	322	62%
Don't know / Uncertain	8	1	0%
Refused	9	0	0%

Q23D:
Did you have any difficulty attaching the security seal to the paper roll?
PROMPT IF NECESSARY: Please answer yes or no about whether or not you experienced this possible problem with the touch screen voting machines at your polling place.

N =		519	100%
Yes	1	108	21%
No	2	404	78%
Don't know / Uncertain	8	6	1%
Refused	9	1	0%

Q23E:

Did you have any difficulty with a printer jam?

PROMPT IF NECESSARY: Please answer yes or no about whether or not you experienced this possible problem with the touch screen voting machines at your polling place.

N =		519	100%
Yes	1	133	26%
No	2	377	73%
Don't know / Uncertain	8	9	2%
Refused	9	0	0%

Q23F:

Did you have any difficulty inserting the memory card into the machine?

PROMPT IF NECESSARY: Please answer yes or no about whether or not you experienced this possible problem with the touch screen voting machines at your polling place.

N =		519	100%
Yes	1	35	7%
No	2	481	93%
Don't know / Uncertain	8	3	1%
Refused	9	0	0%

Q23G:

Did you have any difficulty with the security tape on the memory card?

PROMPT IF NECESSARY: Please answer yes or no about whether or not you experienced this possible problem with the touch screen voting machines at your polling place.

N =		519	100%
Yes	1	42	8%
No	2	467	90%
Don't know / Uncertain	8	10	2%
Refused	9	0	0%

Q23H:

Did you have any difficulty with the card encoder?

PROMPT IF NECESSARY: Please answer yes or no about whether or not you experienced this possible problem with the touch screen voting machines at your polling place.

N =		519	100%
Yes	1	70	13%
No	2	439	85%
Don't know / Uncertain	8	9	2%
Refused	9	1	0%

Q23I:

Did you have any difficulty closing out the machines at the end of the day?
PROMPT IF NECESSARY: Please answer yes or no about whether or not you experienced this possible problem with the touch screen voting machines at your polling place.

N =		519	100%
Yes	1	234	45%
No	2	277	53%
Don't know / Uncertain	8	8	2%
Refused	9	0	0%

Q24II:

I'm going to read you a few statements about the polling place location and equipment for the May 2nd primary. Please rate each one of the following polling place conditions on a scale of 1 to 10, where 1 is "very poor" and 10 is "excellent"...

Q24A:

The overall condition of the polling place location where you worked on election day. On a scale of 1 to 10, where 1 is "very poor" and 10 is "excellent," please rate this polling place condition.

N =		519	100%
One (Very poor)	01	4	1%
Two	02	3	1%
Three	03	4	1%
Four	04	6	1%
Five	05	22	4%
Six	06	18	3%
Seven	07	40	8%
Eight	08	92	18%
Nine	09	56	11%
Ten (Excellent)	10	274	53%
Don't know / Uncertain	88	0	0%
Refused	99	0	0%

Q24B:

The accessibility of the polling place location for people with disabilities. On a scale of 1 to 10, where 1 is "very poor" and 10 is "excellent," please rate this polling place condition.

N =		519	100%
One (Very poor)	01	17	3%
Two	02	3	1%
Three	03	8	2%
Four	04	4	1%
Five	05	24	5%
Six	06	8	2%
Seven	07	24	5%
Eight	08	62	12%
Nine	09	66	13%
Ten (Excellent)	10	299	58%
Don't know / Uncertain	88	4	1%
Refused	99	0	0%

Q24C:

The availability of parking at the polling place.
PROMPT IF NECESSARY: On a scale of 1 to 10, where 1 is "very poor" and 10 is "excellent," please rate this polling place condition.

N =		519	100%
One (Very poor)	01	7	1%
Two	02	6	1%
Three	03	6	1%
Four	04	4	1%
Five	05	18	3%
Six	06	14	3%
Seven	07	23	4%
Eight	08	56	11%
Nine	09	49	9%
Ten (Excellent)	10	333	64%
Don't know / Uncertain	88	3	1%
Refused	99	0	0%

Q24D:

Adequate space to operate the equipment at the polling place.
PROMPT IF NECESSARY: On a scale of 1 to 10, where 1 is "very poor" and 10 is "excellent," please rate this polling place condition.

N =		519	100%
One (Very poor)	01	4	1%
Two	02	0	0%
Three	03	3	1%
Four	04	4	1%
Five	05	15	3%
Six	06	6	1%
Seven	07	22	4%
Eight	08	42	8%
Nine	09	55	11%
Ten (Excellent)	10	367	71%
Don't know / Uncertain	88	0	0%
Refused	99	1	0%

Q24E: Electrical outlets to plug in touch screen voting machines.

PROMPT IF NECESSARY: On a scale of 1 to 10, where 1 is "very poor" and 10 is "excellent," please rate this polling place condition.

N =		519	100%
One (Very poor)	01	6	1%
Two	02	5	1%
Three	03	5	1%
Four	04	2	0%
Five	05	11	2%
Six	06	7	1%
Seven	07	18	3%
Eight	08	64	12%
Nine	09	45	9%
Ten (Excellent)	10	354	68%
Don't know / Uncertain	88	1	0%
Refused	99	1	0%

Appendix 3 - Polling Place Incident Report Analysis

3.1 Precincts that Reported Opening Late

MAYFIELD HEIGHTS 00 U
CLEVELAND 03 M
CLEVELAND 04 M
CLEVELAND 06 S
CLEVELAND 20 J
CLEVELAND 20 M
GARFIELD HEIGHTS 06 B
MAYFIELD HEIGHTS 00 R
PARMA 09 H
SEVEN HILLS 01 A
SEVEN HILLS 01 B
SOLON 01 C
WALTON HILLS 00 A

3.2 Precincts With Long Waiting Times

BEACHWOOD 00 C	INDEPENDENCE 00 B
BEDFORD HGHTS 03 B	LAKEWOOD 03 E
BEDFORD HGHTS 03 C	MIDDLEBURG HTS 03 B
BEREA 02 D	NORTH OLMSTED 01 E
BEREA 02 E	NORTH OLMSTED 01 H
BEREA 03 A	NORTH OLMSTED 01 I
BEREA 04 D	NORTH OLMSTED 03 E
BRATENAHL 00 A	NORTH OLMSTED 03 G
BRECKSVILLE 00 D	NORTH ROYALTON 06 A
BROOK PARK 02 E	OAKWOOD 05 A
CLEVELAND 05 M	OLMSTED TWP 00 A
CLEVELAND 06 E	OLMSTED TWP 00 A
CLEVELAND 06 F	PARMA 05 B
CLEVELAND 06 T	PARMA 09 H
CLEVELAND 10 G	SEVEN HILLS 02 C
CLEVELAND 18 Q	SHAKER HEIGHTS 00 L
CLEVELAND HGHTS 02 K	SOLON 02 C
EUCLID 03 J	STRONGSVILLE 01 K
FAIRVIEW PARK 05 C	UNIVERSITY HTS 00 G
GARFIELD HEIGHTS 04 A	

3.3 High Priority Machine-Related Incidents

Precinct	Incident Report (Taken Verbatim from Precinct Report)
BEREA 04 C	#0239463 MACHINE WAS EXTREMELY SLOW WORKIN
BEREA 04 C	254265 MACHINE CARD READS DOES NOT WORK ALL THE TIME,
BEREA 05 C	DIEBOLD REP FROM ZONE 6 ADVISED US TO SHUT DOWN MACHINE #10 AND REBOOT IT, AS IT LOCKED UP WHILE VOTER WAS VOTING, WE HAD TO BREAK SEAL AND THEN WE RESEALED IT WITH SAME SEAL
BRATENAHL 00 A	SERIAL #245306 WAS FIXED ONLINE
BRECKSVILLE 00 I	VOTE CAST-0 VOTES CASTEL -MACHINE #5-MACHINE DID NOT ABORT-SUCCES CARD MISPROGRAMED.
BROOKLYN 00 E	GERI FROM DIEBOLD CAME TO CHECK OUT MACHINE DOWN, SHE CALED HER SUPERVISOR, WE WERE TOLD TO USE THE MACHINE AS IS
CLEVELAND 01 E	MACHINE POWERED OFF @ END OF VOTE, PATRICIA MYERS-216 663 1366, MACHINE #245942 OLD SEAL #277271, NEW SEAL #277267, BROKE SEAL TURNED BACK ON MACHINE, RESEALED MRS MYERS VOTE NEVER CAST
CLEVELAND 01 I	MACHINE NO 0248503 HAD TO BE RESTARTED WORKING OK AT 7.25 AM
CLEVELAND 01 Q	WHEN IT ARRIVED I FIX MACHINE #255036 AND IT WAORKED FOR THE VOTER
CLEVELAND 01 U	SHUT ALL MACHINE DOWN AND STARED OVER
CLEVELAND 04 Q	SOME OF THE MEMORY CARDS HAD TO BE REPROGRAMMED SO THE CARDS NIGHT BE SLIGHTLY OFF
CLEVELAND 06 G	#250190 UNFROZE AND I (JUDGE WAS ABLE TO CAST A BLANMK BALLOT)
CLEVELAND 06 G	MACHINES 236660 CANCELLED DOROTHY HAMBRICK'S VOTE, DOROTHY HAMBRICK THEN VOTED ON #0257732
CLEVELAND 06 O	241486-0607101 GETS JAMED-FROZE
CLEVELAND 10 B	UNIT #254538 STARTED ROLLING ON ITS OWN, BROKE SEAL 0607819 FIXED IT-WILL PUT BACK AT END OF DAY
CLEVELAND 10 R	MACHINE #237210 NEVER RECORDED ANY VOTES IT SAID TEST WAS PASSED AT BEGINNING OF SHIFT.
CLEVELAND 13 H	, BALLOTS 2-8 DELETED,
CLEVELAND 17 C	247834 (NUMBER 1) DOESN'T WORK BUT FURTHER TINKERING BY THE TECHNICIAN GOT IT TO WORK
CLEVELAND 17 P	UNITS MEMORY CARD 4 DIDNOT TALLY ALL THE WAY EDT WAS HERE

Precinct	Incident Report (Taken Verbatim from Precinct Report)
	AND SHE TOLD ME TO GIVE WHAT IS THERE
CLEVELAND 19 K	VOTING MACH #240828 ADJUSTED BY CHRIS
CLEVELAND 19 Q	COULDN'T DOWNLOAD THE ACCUMULATOR TOTALS THEY WERE INCOMPLETE THE SYSTEM DEPT SHUTTING DOWN
CLEVELAND 19 S	AT THE END NIGHT WE COULD NOT DOWN LOAD ON THE ACCUMULATOR MACHINE, BOTH PRECINCT COULD NOT GET RESULTS, THE TECHNICIAN MARY ELLEN DID NOT HAVE ANY IDEA OF WHAT TO DO EITHER
CLEVELAND 21 Q	COULD NOT DOWNLOAD THE ACCUMULATOR TOTALS, THEY WERE INCOMPLETE THE SEPTEM KEPT SHUTTING DOWN
CLEVELAND HGHTS 02 H	ERROR MESSAGE ON MACHINE 240921-MACHINE SHUT DOWN MAY BE NO RECORDED VOTES ON PAPER ROLL
CLEVELAND HGHTS 02 I	THE VOTER MACHINES ARE NOW OPERATING PROPERTY IT WAS A HECTIC AND THE FIRST SET OF PEOPLE VOTES WERE NOT COUNTED
CLEVELAND HGHTS 03 B	MACHINE BROKEN SERIAL #241161 ACCUMULATION MACHINE BROKEN SER #247969
CLEVELAND HGHTS 03 H	MACHINE 257252 MEMORY CARD NOT PROPERLY INSERTED
CLEVELAND HGHTS 03 H	257252 REPAIRED
CLEVELAND HGHTS 04 J	SUPERVISOR CAME RESTARTED MACH SIGNED PAPER AGAIN TOUCHED SCREEN/TAPE POLLED BEFORE ALL SIGNED
CLEVELAND HGHTS 05 D	BAD MEMORY CARD-MACHINE DOWN TX UNIT 273917 MEM CD #32773AA REPORTED TO TECH HELP 6:35
CLEVELAND HGHTS 05 H	MACHINE #241471 BLACK OUT AND VOTE INVALID
EAST CLEVELAND 02 C	MACHINE SN #254892 WENT OUT
EAST CLEVELAND 03 D	MACHINE CORRECTED ITSELF
EAST CLEVELAND 04 B	TROUBLE WITH MACHINES REPRESENTATIVE FROM DIEBOLD CME OUT AND REPAIRED MACHINES AND WE HAD NO MORE TROUBLE WE HAD TO USE PAPER BALLOTS
EUCLID 03 D	ACCUMULATER TXS SHUT OFF WHEN ATTEMPTING TO READ CARD #2 BUT WAS ABLE TO UPLOAD CARD ON SYSTEM UNABLE TO TOTAL ON RECEIPT
FAIRVIEW PARK 03 B	JACK STILLMAN TECH SUPPORT WITH ROGER BUSCHER OK'D USE OF #251393 AND 250054 RESUMED VOTING ON UNIT
FAIRVIEW PARK 05 C	JEFF HALLMARK FROM DIEBOLD SAYS MACHINE NEEDS TO BE SHUT DOWN AND NEW MEMORY CARD INSERTED WE ASKED JACK (EDT) TO GET A NEW CARD, MACHINE SHUT DOWN FROM 12.15 TO (END OF DAY), JACK CALLED BOR BAKER FROM BALLOT DEPT 216-780-4195 BOB SAID TO RUN MEMORY CARD THROUGH ACCUMULATOR AT

Precinct	Incident Report (Taken Verbatim from Precinct Report)
	END OF DAY, BUT ISOLATE THAT CARD WITH AN EXPLANATION OF PROBLEM
GATES MILLS 00 C	252448-INOPERABLE MACHINE #11-ONLY SHOWING 99% POWER WOULD NOT PERFORM FUNCTIONS SCREEN SHOWS INSERT CARD TO BEGIN VOTING, BUT INSERTING A CARD DID NOT REGISTER, TECH PEOPLE (3) WERE UNABLE TO DO 'TEST PRINTER' STEP
LAKEWOOD 01 M	TERMINAL #247790 MISCODED & HAD TO BE SHUT DOWN & RESTART
LAKEWOOD 02 H	THE 1ST BALLOT VOTED WAS A BLANK BALLOT ON VOTING MACHINE #236456
NORTH OLMSTED 01 A	SHUT DOWN USE OF MACHINE CALLED BOARD OF ELECTIONS-WAITING FOR CALL BACK-10.00-REBOOTED MACHINE-OK THERE WERE ALREADY 14 BALLOTS CAST"
NORTH OLMSTED 01 B	0245211 FIRST BALLOT ENCODED WRONG ECW
NORTH OLMSTED 01 D	NON-FUNCTIONAL UNIT (255482)
NORTH OLMSTED 01 G	B OF E, OUT TO FIX 2 MACHINES PLUS ACCUMULATING DEVICE, 1 REMAINS W/ BROKEN LOCK NEVER USED
NORTH OLMSTED 01 H	BALLOT #8-250401 CAST BLANK REPRINTED BALLOT
NORTH OLMSTED 01 H	BALLOT #9-248505 CAST BLANK REPRINTED BALLOT
NORTH OLMSTED 03 G	257058 AND 254732 ON THOSE TWO MACHINE THE PAPER JAM ON THE WAY TO THE CANISTER WE HAD TO UNJAM THEM USING SUPERVISOR CARD TO OPEN AND ROLL THE PAPER BY HAND
NORTH OLMSTED 03 H	VOTE MACHINE DOWN #239712-TECHNICIAN CALLED HOTLINE
NORTH ROYALTON 04 D	HAD TO SHUT MACHINE DOWN DUE TO ERROR-2ND BROKE SEAL 278794
NORTH ROYALTON 04 E	THE COMPUTER #244010 OR (5790 MACHINE 4) WILL HAVE ONE BLACK R BALLOT-I DID THAT TO GET THE COMPUTER RESTARTED, BECAUSE IT WASN'T WORKING SO WE HAD TO SUT IT DOWN&START AGAIN ELIZABETH ROMANO
NORTH ROYALTON 05 D	MS DUFFER & I APPROVED MACHINE#249976 FOR SECOND TIME BECAUSE IT WOULD NOT STAY RUNNING BALLOT WAS RESERVED
OLMSTED TWP 00 J	WE HAD TO DELETE 3VOTES-HOWEVER- THOSE (3) VOTES STILL RECORDED AT THE BOOTHS-AS NEW VOTES, THERE WILL BE A DIFFERENCE OF (3) VOTES AS A FINAL TALLY AT J""
PARMA 08 E	REBOOTED & IT'S RESET.
SOUTH EUCLID 02 F	VOTING AMCHINE 251338 DID NOT WORJ APPROPRIATELY DURING VOTING
WESTLAKE 06 B	TECH NOTIFIED US ALL 4 OF OUR MACHINES WERE NOT RECORDING

Precinct	Incident Report (Taken Verbatim from Precinct Report)
	VOTES, SECOND ZERO REPORT WOULDNOT PRINT OUT

3.4 All Incident Codes

Incident Description	Incident Category	Original Code
No incidents reported at this precinct	no incident	0
record showed voter received absentee ballot, but came to vote at poll (provisional)	Provisional	406
voters name not in book ---- (provisional ballot)	Provisional	408
voters turned away because polls opened late	Administration	83
poll opened late	Administration	85
no place to record whether provisional voter is D or R, so can't total and record figures for certificate #1	Administration	1
conflicting instructions regarding payroll envelope	Administration	2
confusion over payroll cards	Administration	4
did not have additional list of electors	Administration	6
more voter access cards needed to enhance traffic flow, reduce waiting time	Administration	9
not enough working machines, voters having to wait, or vote paper or provisional ballots	Administration	10
voter given provisional ballot, name later found in the book	Administration	17
electors worksheet incident	Administration	18
voter direction cards missing	administration	20
did not receive headphones for VBIS system	administration	23
votes not totaling up correctly	administration	35
lines long, voters asking to cast paper or provisional ballots	administration	36
equipment arrived late	administration	42
loaned access card or encoder or memory card to another precinct	administration	46
ballot deleted	administration	52
request to remove a specific ballot	administration	53
voter lines, voters unhappy about waiting	administration	70
took too long to set up equipment	administration	75
complicated procedures, too many numbers to keep track of	administration	78
BOE not responsive to calls	administration	80
problem conducting end-of-night ballot reconciliation	administration	81
Called the BOE	administration	82

Incident Description	Incident Category	Original Code
polls need to have more workers	administration	86
polling place owner did not show up on time to let workers in the building	administration	90
when busy, did not make all voters sign in the book	administration	93
booth worker wrote voters in the book for the wrong party	administration	97
trainer machines left at precinct	administration	98
no key or combination for lock	administration	161
machine setup incident	administration	162
serial numbers of opened seals recorded in wrong place or improperly recorded	administration	209
failed to make required signatures	administration	210
received memory cards for other precinct's machines	administration	225
not enough access cards sent	administration	241
batteries ran out, machine turned off because power strip was not turned on or building power issue	administration	251
power level in battery going down	administration	252
concern that screens are visible to incoming voters – should be set up differently	administration	260
concern that machines & printers should have been tested on Monday evening	administration	270
supervisor card needed to be changed	administration	281
supervisor card lost	administration	282
worker let a Dem vote in Republican primary	administration	313
judge wrote wrong voter information in book	administration	490
voter signed in wrong space	administration	602
voter voted but did not sign the book	administration	682
all machines down at opening and had voters leave and come back later	critical ballot incident	92
deleted three votes from machine intentionally.	critical ballot problem	99
voters not allowed to vote because machine down	critical ballot problem	294
did not have voter sign provisional ballot	critical ballot problem	31
no machines set up to accommodate blind voters, missing VBIS equipment	critical ballot problem	41
EDT accidentally cast ballot	critical ballot problem	50

Incident Description	Incident Category	Original Code
first ballot cast did not register correctly	critical ballot problem	192
machine canceled vote, or cast blank vote, and voter re-voted	critical ballot problem	193
voter did not vote because the card could not be enabled	critical ballot problem	291
voter forgot to cast vote on some races, was allowed to vote again	critical ballot problem	659
no "I voted today" stickers	supply	8
supplies missing	supply	40
no power cords for one or more machines	supply	87
ran out of paper	supply	212
no reel of paper sent for machine	supply	218
not enough memory cards sent, or arrived late	supply	223
concern over having no spare batteries for encoder	supply	250
poor directions as to what to do with provisional ballots	training	30
more training needed; instructions confusing, hard to follow, too much complication	training	200
confusion over where signatures should be placed	training	206
instructor book, quick reference guide, or manual unclear, uninformative, or in conflict with each other	training	207
broken or defective seal/lock on canister; seals break too easily	seals	60
machine security seal broken or missing	seals	61
not enough locks	seals	62
not enough canister seals sent	seals	63
had to break tag to put item in bag	seals	64
seals taken or otherwise missing from supply bag	seals	65
red bag & canister bag broken upon arrival at precinct	seals	66
put memory cards in the wrong bag (chain of custody problem)	seals	67
Missing or problem with red seal	seals	68
broke machine seal to address problem	seals	69
needed to break security seal to restart machine	seals	107
bag seal problem	seals	208
various seal problems	seals	211
delivery man opened bag without permission	seals	235
bag or pouch not sealed	seals	236

Incident Description	Incident Category	Original Code
blue tape seal accidentally thrown away	seals	242
had to use extra memory card seal, making us short on such seals	seals	243
no place on "security event log" to record seal numbers as seals are broken	seals	275
forgot to record ballot totals on security event log	seals	276
drunk VFW member kept rushing us to leave polling place	voter problem	76
voter balked after completing provisional ballot	voter problem	601
voter called someone to find out how to vote	voter problem	619
voter balked, refused to vote, thought too much personal info was being required	voter problem	620
voter had moved, but still wanted to vote at old precinct	voter problem	640
voter had already voted, but came back later to vote again	voter problem	641
voter wanted to vote in other party's primary after starting to vote	voter problem	647
voter wanted to alter or cancel vote as VVPAD was printing	voter problem	648
voter wanted to alter ballot, but could not find the contest again when going back	voter problem	650
voter wanted to revote in party primary after casting "issues only" ballot	voter problem	651
voter signed in, then did not to vote, usually because they couldn't wait that long	voter problem	654
voter shouted, yelled, was belligerent, threatening, or disruptive	voter problem	660
voter wanted "issues only" ballot, but no issues on ballot in that locale	voter problem	663
voter walked out, deciding not to vote instead of casting a provisional ballot	voter problem	665
voter became angry, damaged machine, police called	voter problem	666
voter became angry, left machine in card intentionally	voter problem	679
voter not in book and then refused provisional ballot when offered	voter problem	683
voter refused to sign provisional ballot envelope	voter problem	684
voter broke plastic cover trying to get to paper vote record	voter problem	685
voter did not have ID became belligerent when asked and had to be escorted out	voter problem	687
voter refused to sign provisional ballot, or fill out envelope completely	voter problem	688
voter walked out with access card	voter problem	689

Incident Description	Incident Category	Original Code
voter lost access card	voter problem	690
machine failed to record any votes	machine	108
machine powered down, failed to register previous vote	machine	109
machine didn't work	machine	100
difficulties getting machines started	machine	101
machine quit working	machine	102
could not get machine started	machine	103
Diebold rep came to "repair machines" & get them going	machine	104
machine down, but fixed and restarted by EDT, student helper (or "corrected" itself)	machine	105
Diebold rep could not get machine to work	machine	106
could not read card correctly to tabulate vote	machine	110
machine could not be set up	machine	121
no zero machine, zero machine not working	machine	124
sound not working	machine	129
motor on machines would not stop running	machine	159
used supervisor card to reset machine	machine	185
machine would not shut down	machine	187
broken parts on computer (screen, magnifier, etc)	machine	190
booth worker used supervisor card to start or restart machine	machine	279
booth worker used supervision card to shut down machine before 8:00 PM	machine	280
paper tape jammed, or would not advance or too low to print	printer	112
VVPAT did not print for voter	printer	117
printer not working	printer	122
paper too old and dry for printer to handle	printer	113
paper loose in canister	printer	114
paper tore in canister	printer	115
false error message indicating low paper supply	printer	116
needed to break seal on canister to "unjam" printer and get paper going	printer	118
problem with canister	printer	119

Incident Description	Incident Category	Original Code
machine had no canister tape or canister	printer	120
printer missing	printer	123
difficulty getting printer to work correctly	printer	125
paper tape kept advancing	printer	130
machine not working – used other precinct's machines	printer	137
low on paper	printer	194
could not print total report for the canister	printing reports/closeout	111
machine would not print zero report	printing reports/closeout	126
machine would not print totals report at end of day	printing reports/closeout	127
machine did not print second copy of report	printing reports/closeout	128
pressed "no" on response to long report query, but got long report anyway	printing reports/closeout	180
unable to run totals at end of night because machine detected "invalid" supervisor card	printing reports/closeout	197
could not download data or reconcile votes at the end of night because of machine problems	printing reports/closeout	198
printer didn't do what instruction book said it would	printing reports/closeout	216
forgot to put zero balance report in memory card bag	printing reports/closeout	230
failed to record canister bag number	printing reports/closeout	231
did not or could not print copy of zero report	printing reports/closeout	232
forgot to do the zero report, or didn't have enough time to do it	printing reports/closeout	233
failed to tear off zero total report, still in canister	printing reports/closeout	234
did not run final report on ballot totals	printing reports/closeout	274
set up accumulator machine incorrectly or accumulator problem	printing reports/closeout	290

Incident Description	Incident Category	Original Code
discrepancy between stub numbers in book and encoder's numbers	printing reports/closeout	293
failed to sign zero form	printing reports/closeout	296
encoders not working	encoder/access card	141
problem clearing Encoder	encoder/access card	135
encoder produces card that generates wrong party ballot	encoder/access card	140
machine would not read some access cards	encoder/access card	142
machine spits out some access cards	encoder/access card	143
access card could not be programmed (voter given new one)	encoder/access card	144
access card reprogrammed	encoder/access card	145
access card not accepted, voter given new one or a paper ballot	encoder/access card	146
access card stuck	encoder/access card	147
voter's access card said he had already voted	encoder/access card	148
hard to keep access cards in machine	encoder/access card	149
bad or "dead" access cards	encoder/access card	150
machine brought up wrong party ballot, voter didn't notice until after casting ballot	encoder/access card	151
low battery on encoder	encoder/access card	153
Encoder from Diebold person only encodes democrat ballots!	encoder/access card	155
missing or lost access card	encoder/access card	156
machine would not bring up issues only ballot	encoder/access card	160
voter access codes difficult to remove from encoder	encoder/access card	240
voters are getting access cards dirty, greasy, other voters don't' want to touch them	encoder/access card	630
bad memory card	memory cards	138
unable to download totals from memory card	memory cards	139
machine missing memory card	memory cards	191
memory card failed, was replaced	memory cards	196
removed card before ran totals, or returned machines with cards inside	memory cards	215
received more memory cards than machines	memory cards	219
confusion regarding memory card	memory cards	220
unaware that memory card designated to specific machine -- may have	memory cards	221

Incident Description	Incident Category	Original Code
put cards in wrong units		
placed memory card in wrong machine; may have screwed up votes	memory cards	222
voter claims issue measures would not come back on the screen for verification	voter-machine	163
voter claims issue measures did not come up on screen	voter-machine	164
write-in keys hard to punch	voter-machine	170
words hard to read	voter-machine	171
printer was not visible to a disabled voter in wheelchair	voter-machine	283
voter pulled card out before finishing ballot (isn't this impossible?)	voter-machine	673
voter took too long and was timed out by machine (allowed to try again)	voter-machine	675
voter missed race on ballot	voter-machine	677
voter put access card in backwards or upside down	voter-machine	678
voter left card in machine by mistake	voter-machine	680
voters having problem seeing where to insert access card	voter-machine	693
voter could not see entire printed ballot	voter-machine	695
incorrectly closed canister	booth worker machine	201
confusion over canister seal info.	booth worker machine	202
paper put in backwards or upside down	booth worker machine	205
mistakenly replaced working canister with another	booth worker machine	213
forgot to write down seal information or wrote down wrong information	booth worker machine	214
memory card inserted incorrectly	booth worker machine	224
accidentally shut down machine while removing memory card	booth worker machine	297
missing zero card or zero machine	zero card/machine	204
zero machine accidentally turned off, would not produce totals	zero card/machine	277
absent, tardy, or missing booth worker(s)	booth worker problems	301

Incident Description	Incident Category	Original Code
presiding judge absent	booth worker problems	302
presiding judge injured	booth worker problems	303
booth worker left	booth worker problems	304
EDT technician absent	booth worker problems	305
didn't have student helpers	booth worker problems	306
booth worker not able, not willing, or too lazy to perform job	booth worker problems	310
technician knew nothing	booth worker problems	311
booth worker stole phone and surge protector	booth worker problems	314
booth worker was rude to voters and/or other booth workers	booth worker problems	320
presiding judge high on crack, had to leave	booth worker problems	330
Relative of presiding judge signed payroll card but did no work	booth worker problems	331
voter not at listed address; moved to new address, or address error	VR	401
duplicate voter record	VR	402
voter in book is dead	VR	403
voter listed with wrong party	VR	404
voter name spelled wrong	VR	405
voter in book has moved and is gone	VR	407
voter is on absentee voter list, but not in poll book?	VR	409
voter in book but in wrong precinct	VR	410
voter married or divorced, has new last name	VR	411
mismatch between name & signature, or lack of signature	VR	412
voters signature has changed to point it no longer matches book	VR	413
date of birth mis-entered	VR	414

Incident Description	Incident Category	Original Code
voter not listed in correct alphabetical order (probably a Mc vs. Mac problem)	VR	415
voter added to book	VR	440
voter lives in nursing home, or has Alzheimer's (request for removal from someone)	VR	460
voter listed on pink sheet and did not vote	VR	470
voter wanted to change partisan information (neutral of all other actions)	partisan change	480
voter changed mind after declaring partisanship, but before access card was coded	partisan change	604
voter changed mind from party to issues only, or vice versa, while waiting to vote	partisan change	605
voter changed his mind about party affiliation after completing provisional ballot	partisan change	606
voter wanted to vote on offices but not declare party affiliation	partisan change	608
voter changed partisanship	partisan change	611
voter changed party but did not sign book	partisan change	656
voter decided not to vote because he didn't want to declare party	partisan change	667
voter wanted to change partisanship	partisan change	676
voter wanted to split ticket vote in primary, unhappy he could not	partisan change	681
no heat	polling place	501
phones out or not working well, or no cell phone service	polling place	502
too many school stickers?	polling place	503
lack of parking	polling place	504
unable to contact or get answer back from Board of Elections	polling place	505
site locked when workers arrived, either Monday PM or Tuesday AM	polling place	506
no flags	polling place	507
some activist within 100 feet of polling place (one threatened voter's life)	polling place	508
parking lot not well lit	polling place	509
no water in building	polling place	511
poor lighting in voting area	polling place	520
polling place was noisy	polling place	521

Incident Description	Incident Category	Original Code
voters, precinct workers smelled gas or some other bad smell	polling place	522
had to leave Monday night before getting everything ready	polling place	523
couldn't get flags in concrete-like ground	polling place	524
too much power demand—blew fuse/circuit breaker	polling place	525
power strip not working	polling place	526
polling place located on street that is dangerous to cross	polling place	530
polling place in very loud school	polling place	540
polling place reeked of chlorine bleach	polling place	550
voter wanted "issues only" ballot but got party ballot, or vice versa, or got ballot for wrong party	ballot problem not critical	5
provisional ballot was for one party, voter wanted ballot for the other	ballot problem not critical	11
voter wrongly given provisional ballot	ballot problem not critical	12
voter never received absentee ballot, or received it too late	ballot problem not critical	13
voter should have received provisional ballot but voted on machine	ballot problem not critical	14
voter issued wrong type of access card, or card for wrong precinct	ballot problem not critical	15
voter given wrong provisional ballot	ballot problem not critical	16
voter not in book, allowed to vote anyway	ballot problem not critical	19
did not send back voted absentee ballot	ballot problem not critical	22
some races missing on provisional ballot for this precinct	ballot problem not critical	32
voters from other precinct used our machines because theirs weren't working	ballot problem not critical	43
voter voted on zero machine	ballot problem not critical	44
voter voted on wrong precinct's machine	ballot problem not critical	45
voter recorded as having voted, booth worker knows they haven't	ballot problem not	77

Incident Description	Incident Category	Original Code
	critical	
had voter CAST BALLOT and THEN issued a new ballot	ballot problem not critical	91
voter signed in (or voted) as Rep, should have been Dem (or vice versa)	ballot problem not critical	603
voter wanted to cancel vote	ballot problem not critical	653
voter listed as casting absentee ballot voted on machine	ballot problem not critical	655
voter cast blank ballot by mistake (given new one)	ballot problem not critical	657
voter voted on machine assigned to a different precinct	ballot problem not critical	658
17yr. old voted	ballot problem not critical	691
Ken called to explain zero memory card	Non-critical Event	701
replacement booth worker arrived	Non-critical Event	702
Ken called or came over to straighten things out	Non-critical Event	703
reporter from Plain Dealer visited precinct	Non-critical Event	704
visit by inspector, or official	Non-critical Event	705
call from BOE	Non-critical Event	706
replacement EDT arrived	Non-critical Event	707
EDTs came to fix problems or explain procedures	Non-critical Event	711
judge arrived	Non-critical Event	712
tech came and fixed machine or got it running	Non-critical Event	714
seals arrived	Non-critical Event	715
access cards delivered	Non-critical Event	716
student workers were excellent	Non-critical Event	720
booth worker was excellent	Non-critical Event	721
Diebold rep was excellent	Non-critical Event	722
EDT (tech), either original or replacement, was excellent	Non-critical Event	723
report of a task being performed, no indication of any problem	Non-critical Event	750
voter fixed machine (is this a positive event?)	Non-critical Event	760
booth worker thought themselves qualified to be EDT in November	Non-critical Event	770

Incident Description	Incident Category	Original Code
(dream on)		
voter or voters liked the new system	Non-critical Event	780
visually impaired voter liked the large text	Non-critical Event	781
8th grade students impressed by the TS machines	Non-critical Event	782
voter or voters disliked the new system, or liked older system better	Non-critical Event	785
exit pollster from ESI on scene—what could be better?	Non-critical Event	786
loaned canister, or stuff, to another precinct	Non-critical Event	795
possible problem, unable to discern what it was	Non-critical Event	901
no or not enough working ink pens, pens wouldn't write on seals	Non-critical Event	3
tape (Scotch) not good	Non-critical Event	7
no rubber bands	Non-critical Event	21
need white out	Non-critical Event	51
ordered Plain Dealer photographer out of the polling place	Non-critical Event	94
allowed Plain Dealer photographer to take pictures at polling place	Non-critical Event	95
took long time to close down poll	Non-critical Event	278
dropped machine key into machine	Non-critical Event	292
booth workers complained about low wages	Non-critical Event	321
booth workers were arguing with each other	Non-critical Event	323
booth workers disliked new system	Non-critical Event	324
voter could not find name of candidate he believed to be on ballot	Non-critical Event	607
voter wanted to cast vote on behalf of family member	Non-critical Event	610
voter concerned about accuracy of vote	Non-critical Event	652
voter believed electronic machine unreliable, requested and given paper ballot	Non-critical Event	661
voter didn't want to declare part, but eventually did and voted	Non-critical Event	668
voter wanted paper receipt of ballot, unhappy they couldn't get it	Non-critical Event	670
voter wanted paper copy deleted	Non-critical Event	671
voter doubled paper print out was legible enough	Non-critical Event	672
voter said machine too complicated, had friend help him	Non-critical Event	674
voter grabbed poll book	Non-critical Event	692
voter voted provisionally because afraid of e-voting	Non-critical Event	694

3.5 Draft Incident Reporting Form

Directions: please use this form to record all problems or incidents that arise in your polling site. Please provide as much detail as possible for the type of problem you encounter and how it was (or was not) resolved.

<precinct identifying information>
<election date>

Presiding Judge Name
Election Officer 1
Election Officer 2
Election Officer 3
Election Officer 4

Average wait throughout day _____ minutes
Longest wait during busy period _____ minutes

Problem	Time	Type of Problem (check all that apply)	Nature of Problem	Problem Resolution
1	____	☐ Voting Machine ☐ Voting Machine Printer ☐ Voter Registration ☐ Supplies ☐ Access Cards ☐ Encoders ☐ Seals ☐ End of Election Closeout ☐ Ballot Handling ☐ Polling Place ☐ Poll Workers ☐ Voters ☐ Other		
2	____	☐ Voting Machine ☐ Voting Machine Printer ☐ Voter Registration ☐ Supplies ☐ Access Cards ☐ Encoders ☐ Seals ☐ End of Election Closeout ☐ Ballot Handling ☐ Polling Place ☐ Poll Workers ☐ Voters ☐ Other		
3	____	☐ Voting Machine ☐ Voting Machine Printer ☐ Voter Registration ☐ Supplies ☐ Access Cards ☐ Encoders ☐ Seals ☐ End of Election Closeout ☐ Ballot Handling ☐ Polling Place ☐ Poll Workers ☐ Voters		

Appendix 4 - Optimal Voting Machine Allocation Analysis

4.1 No. of Registered Voters per Allocated DRE Machine: May 2nd 2006 Primary

(ordered alphabetically)

* Ratio = Registered Voters/No of DRE Machines Deployed to Voting Polling Location

Polling Location	# Reg. Voters	# of DRE Machines Deployed	Ratio*	SAG # = 5226	SAG # = 6978	# in Precincts	"Cleveland"
A.J. RICKOFF SCHOOL	3045	16	190.3	16	23	2	No
ABINGTON ARMS APARTMENTS	456	2	228	3	5	1	Yes
ADDISON BRANCH LIBRARY	1105	6	184.2	7	9	2	Yes
ADDISON SQUARE APARTMENTS	834	4	208.5	5	7	1	Yes
ADLAI STEVENSON ELEM. SCHOOL	1511	8	188.9	8	11	2	Yes
ADRIAN ELEMENTARY SCHOOL	1421	7	203	7	9	2	No
ADVENT LUTHERAN CHURCH – HARPER	2618	14	187	13	17	4	No
ADVENT LUTHERAN CHURCH – HARVARD	2201	12	183.4	12	16	3	Yes
ALBERT W. HENN MANSION	1520	8	190	8	10	2	No
ALBION ELEMENTARY SCHOOL	3423	17	201.4	16	20	5	No
ALBION MIDDLE SCHOOL	1385	10	138.5	7	8	2	No
ALEXANDER G. BELL ELEM. SCHOOL	979	5	195.8	6	8	3	Yes
ALEXANDER HAMILTON REC. CENTER	1371	7	195.9	8	11	2	Yes
ALEXIA MANOR	1261	6	210.2	8	10	2	Yes
ALL SAINTS LUTHERAN CHURCH	1097	5	219.4	6	8	2	No
ALMIRA ELEMENTARY SCHOOL	3102	15	206.8	16	22	4	Yes
ALTA SOCIAL SETTLEMENT	1626	8	203.3	10	12	3	No
AMBLESIDE TOWERS APARTMENTS	622	3	207.3	4	6	1	Yes
AMERICAN LEGION POST	1761	9	195.7	10	13	2	Yes
ANNUNCIATION CHURCH	791	4	197.8	5	7	3	No
ANTIOCH TOWERS	520	3	173.3	4	5	1	Yes
ANTON GRDINA ELEMENTARY SCHOOL	1349	8	168.6	8	11	2	Yes
APPLEWOOD CENTER INC	445	2	222.5	3	5	2	Yes
APTHORP TOWERS APARTMENTS	703	5	140.6	5	6	1	Yes
AURORA UPPER INTERMED. SCHOOL	1753	9	194.8	9	12	3	Yes
BALDWIN WALLACE REC. CENTER	1793	9	199.2	8	11	3	No
BAPTIST MID-MISSIONS	2026	9	225.1	10	13	3	No
BAY HIGH SCHOOL	2473	12	206.1	12	15	4	No
BAY PRESBYTERIAN CHURCH	3633	19	191.2	16	21	5	No
BAY VILLAGE MIDDLE SCHOOL	2448	12	204	12	15	4	No
BEACHLAND PRESBYTERIAN CHURCH	2413	12	201.1	14	18	4	No
BEACHWOOD HIGH SCHOOL	3228	15	215.2	15	19	3	No
BEDFORD CITY HALL	1469	7	209.9	7	9	3	No
BEDFORD HEIGHTS SERVICE BUILDING	1677	9	186.3	8	11	2	No
BEDFORD HIGH SCHOOL	1590	8	198.8	8	10	2	No

Polling Location	# Reg. Voters	# of DRE Machines Deployed	Ratio*	SAG # = 5226	SAG # = 6978	# in Precincts	"Cleveland"
BEIT HANNA SOCIAL CLUB	1950	10	195	11	15	2	Yes
BELLAIRE GARDEN APARTMENTS	793	4	198.3	5	7	1	Yes
BELLAIRE-PURITAS DEVELOPMENT CORP	684	3	228	4	6	1	Yes
BENTLEYVILLE VILLAGE HALL	835	4	208.8	4	6	1	No
BEREA BAPTIST CHURCH	2052	11	186.5	9	13	3	No
BERTRAM WOODS LIBRARY	1454	6	242.3	7	10	2	No
BESSIE KINSNER ELEM. SCHOOL	1848	10	184.8	8	12	2	No
BETHANY CHRISTIAN CHURCH	2366	12	197.2	13	18	3	Yes
BETHEL LUTHERAN CHURCH	1790	12	149.2	9	11	3	No
BETHLEHEM LUTHERAN CHURCH	1788	9	198.7	8	12	1	No
BIG CREEK ELEMENTARY SCHOOL	529	3	176.3	3	4	1	No
BLOSSOM PROPERTY	3489	18	193.8	16	21	4	No
BOLTON ELEMENTARY SCHOOL	1507	8	188.4	9	12	3	No
BOULEVARD ELEMENTARY SCHOOL – D	1040	6	173.3	5	7	2	No
BOULEVARD ELEMENTARY SCHOOL - L	2163	11	196.6	12	16	3	Yes
BOULEVARD PRESBYTERIAN CHURCH	1287	6	214.5	6	9	1	No
BOYS & GIRLS CLUB OF CLEVELAND	1356	7	193.7	8	11	2	Yes
BRATENAHL COMMUNITY CENTER	1247	6	207.8	6	8	2	No
BRECKSVILLE CITY HALL	2907	16	181.7	13	17	4	No
BRECKSVILLE COMMUNITY CENTER	2078	10	207.8	10	13	3	No
BRECKSVILLE UNITED METH. CHURCH	1400	7	200	7	9	2	No
BROADVIEW HTS. COMMUNITY BLDG.	3650	18	202.8	17	21	3	No
BROOK PARK COUNCIL CHAMBERS	1269	7	181.3	6	8	1	Yes
BROOK PARK RECREATION CENTER	6821	33	206.7	30	40	9	No
BROOK PARK UNITED METH. CHURCH	2837	14	202.6	14	17	4	No
BROOKLAWN ELEMENTARY SCHOOL	1452	8	181.5	8	12	2	Yes
BROOKLYN ACRES MUTUAL HOMES	1946	10	194.6	11	15	2	Yes
BROOKLYN COMMUNITY CENTER	2469	13	189.9	11	15	4	Yes
BROOKLYN HIGH SCHOOL	2516	13	193.5	12	16	3	No
BROOKLYN HTS. COMMUNITY CENTER	1175	6	195.8	6	8	1	Yes
BROOKLYN HTS.UN.CH. OF CHRIST	1739	9	193.2	11	13	2	Yes
BROOKRIDGE ELEMENTARY SCHOOL	649	3	216.3	4	6	1	No
BROOKVIEW ELEMENTARY SCHOOL	2513	13	193.3	12	15	4	No
BRYDEN ELEMENTARY SCHOOL	2472	13	190.2	11	15	5	No
BUTTERNUT ELEMENTARY SCHOOL	1531	7	218.7	7	10	2	No
CALEDONIA ELEMENTARY SCHOOL	1445	8	180.6	8	11	2	Yes
CANAAN MISSIONARY BAPTIST CHURCH	1472	7	210.3	9	11	2	Yes
CANTERBURY ELEMENTARY SCHOOL	1286	7	183.7	7	10	2	Yes
CAPTAIN ARTHUR ROTH SCHOOL	2400	12	200	13	17	3	Yes
CARLYLE CONDOMINIUMS	645	4	161.3	4	5	1	No

Polling Location	# Reg. Voters	# of DRE Machines Deployed	Ratio*	SAG # = 5226	SAG # = 6978	# in Precincts	"Cleveland"
CHAGRIN FALLS HIGH SCHOOL	3772	18	209.6	17	22	2	Yes
CHAMBERS ELEMENTARY SCHOOL	2341	12	195.1	13	17	2	No
CHARLES A. MOONEY MIDDLE SCHOOL	1089	6	181.5	6	9	2	Yes
CHARLES H. LAKE ELEM. SCHOOL	3064	15	204.3	17	22	2	Yes
CHARLES ORR ELEMENTARY SCHOOL	537	3	179	4	5	1	Yes
CHESTER C. BOLTON SCHOOL	2326	11	211.5	11	14	1	Yes
CHRISTIAN ASSEMBLY	1937	9	215.2	9	12	5	No
CHRISTIAN FELLOWSHIP CHURCH	2105	11	191.4	12	16	2	No
CHRISTIAN REFORMED CHURCH	1334	6	222.3	7	9	2	No
CHURCH OF GOD OF CLEVELAND	1650	8	206.3	9	13	1	No
CHURCH OF ST. CLARENCE	3257	17	191.6	14	19	4	No
CHURCH OF THE LIVING GOD	2535	13	195	11	16	4	No
CHURCH OF THE SAVIOUR	1958	10	195.8	11	14	5	No
CIRCLE VISTA APARTMENTS	1953	9	217	11	14	2	Yes
CLAGUE RD. UN. CHURCH OF CHRIST	2200	13	169.2	11	13	3	No
CLARA E. WESTROPP MIDDLE SCHOOL	2704	14	193.1	15	19	4	Yes
CLEVELAND HEIGHTS HIGH SCHOOL	1551	8	193.9	9	12	3	No
CLEVELAND KOREAN PRESB. CHURCH	2949	15	196.6	16	21	3	Yes
COFFINBERRY SCHOOL	1238	6	206.3	6	8	2	Yes
COLLINWOOD BRANCH LIBRARY	1139	6	189.8	7	9	2	Yes
COLUMBIA MOBILE HOME PARK	1607	9	178.6	8	10	3	No
COLUMBUS INTERMEDIATE SCHOOL	2960	16	185	14	18	4	No
CONGREGATION BETHAYNU	1435	8	179.4	7	10	2	No
CORNERSTONE COMMUNITY CHURCH	3222	16	201.4	15	20	5	No
CORY UNITED METHODIST CHURCH	2001	10	200.1	11	15	3	No
COVE CHURCH	1289	7	184.1	6	9	2	No
COVENTRY ELEMENTARY SCHOOL	2325	12	193.8	13	18	4	No
CUDELL RECREATION CENTER	4114	22	187	21	29	5	Yes
CUYAHOGA CO. LIBRARY ADMIN. BLDG.	1230	6	205	6	9	2	No
CUYAHOGA HEIGHTS VILLAGE HALL	579	4	144.8	4	6	1	Yes
CUYAHOGA VALLEY CAREER CENTER	1556	9	172.9	7	10	3	No
DAG HAMMARSKJOLD ELEM. SCHOOL	2564	14	183.1	12	15	3	No
DAMASCUS BAPTIST CHURCH	831	4	207.8	5	7	1	Yes
DANIEL E. MORGAN ELEM. SCHOOL	832	4	208	5	7	1	Yes
DENISON ELEMENTARY SCHOOL	2586	13	198.9	14	19	3	Yes
DENTZLER ELEMENTARY SCHOOL	2369	13	182.2	11	14	4	No
DIVINITY LUTHERAN CHURCH	1764	8	220.5	8	12	3	No
DR.MARTIN LUTHER EV.LUTH. CHURCH	1033	5	206.6	5	7	2	No
DRAKE ELEMENTARY SCHOOL	2261	10	226.1	11	14	3	No
DUNHAM ELEMENTARY SCHOOL	2498	12	208.2	11	15	4	No
DWYER MEMORIAL SENIOR CENTER	2120	11	192.7	10	13	3	No
EARLE B. TURNER RECREATION	752	4	188	5	7	1	Yes

Polling Location	# Reg. Voters	# of DRE Machines Deployed	Ratio*	SAG # = 5226	SAG # = 6978	# in Precincts	"Cleveland"
CENTER							
EAST 131ST BRANCH LIBRARY	978	5	195.6	6	8	2	Yes
EAST CLEVELAND PUBLIC LIBRARY	1019	5	203.8	6	8	2	Yes
EAST HIGH SCHOOL	3104	16	194	17	22	4	Yes
EASTMAN BRANCH LIBRARY	1929	10	192.9	10	15	2	Yes
EASTWOOD ELEMENTARY SCHOOL	738	4	184.5	4	6	5	No
EDITH WHITNEY ELEM. SCHOOL	3202	15	213.5	14	19	5	No
EDNA SURRARRER ELEM. SCHOOL	3580	19	188.4	16	21	5	No
ELKS HALL	1696	9	188.4	8	10	2	Yes
ELLENWOOD CENTER	1674	9	186	8	11	2	No
ELMWOOD ELEMENTARY SCHOOL	2691	13	207	12	16	4	No
ELMWOOD RECREATION CENTER	2000	10	200	10	13	3	No
EMERSON MIDDLE SCHOOL	601	3	200.3	3	5	1	No
EMILE B. DESAUZE ELEM. SCHOOL	2290	12	190.8	12	17	3	Yes
EMPIRE COMPUTECH SCHOOL	1682	8	210.3	9	12	1	No
ERNEST BOHN TOWER	1130	6	188.3	7	10	2	Yes
ESTABROOK RECREATION CENTER	1123	5	224.6	7	9	1	Yes
EUCLID BEACH CLUB RESIDENCE	773	4	193.3	5	7	3	No
EUCLID BEACH VILLA	1088	6	181.3	7	9	3	No
EUCLID CHILD DEVELOPMENT CENTER	2189	10	218.9	10	14	3	No
EUCLID HIGH SCHOOL	660	3	220	4	5	1	No
EUCLID PUBLIC LIBRARY	1579	8	197.4	8	10	2	No
EUCLID SENIOR CENTER	3042	16	190.1	13	18	4	No
EUCLID SQUARE MALL (EUCLIDIAN ROOM)	2244	11	204	11	14	3	No
EUCLID VILLA APARTMENTS	973	5	194.6	5	7	1	No
EVERLASTING BAPTIST CH. ANNEX	1538	8	192.3	9	12	2	Yes
FAIRFAX ELEMENTARY SCHOOL	1920	10	192	11	14	3	Yes
FAIRFAX RECREATION CENTER	1770	9	196.7	10	13	2	Yes
FAIRHILL CENTER FOR AGING	2981	16	186.3	16	22	2	No
FAIRVIEW PARK CITY HALL	2257	12	188.1	11	14	3	No
FAIRVIEW PARK REGIONAL LIBRARY	2044	10	204.4	10	13	3	No
FAIRVIEW VILLAGE APARTMENTS	1522	7	217.4	7	10	2	No
FAIRWOOD ELEMENTARY SCHOOL	2729	15	181.9	13	17	4	No
FAITH UNITED METHODIST CHURCH	2010	10	201	12	15	3	Yes
FALLS SCHOOL GYM	4399	22	200	20	26	1	No
FAMICO TOWERS	420	2	210	3	4	1	Yes
FATIMA FAMILY CENTER	759	4	189.8	5	7	4	Yes
FERNWAY ELEMENTARY SCHOOL	1500	9	166.7	7	9	2	No
FIFTH CHRISTIAN CHURCH	2338	12	194.8	13	17	3	No
FIRE STATION NO. 1	1551	8	193.9	7	10	4	No
FIRE STATION NO. 2 - RUPLE	1408	7	201.1	7	9	3	Yes
FIRE STATION NO.2 - TAYLOR	435	2	217.5	3	4	1	No

Polling Location	# Reg. Voters	# of DRE Machines Deployed	Ratio*	SAG # = 5226	SAG # = 6978	# in Precincts	"Cleveland"
FIRST ASSEMBLY OF GOD	1897	11	172.5	9	12	3	No
FIRST BAPTIST CHURCH OF BEDFORD	723	4	180.8	4	6	1	No
FITCH INTERMEDIATE SCHOOL	2408	9	267.6	10	15	3	No
FLEET BRANCH LIBRARY	1456	7	208	8	12	2	Yes
FOREST HILL PARKWAY SCHOOL	1565	8	195.6	8	12	1	Yes
FOREST HILL TERRACE APARTMENTS	673	3	224.3	4	6	1	Yes
FOREST HILLS PRESB. CHURCH	2303	11	209.4	13	17	2	No
FOREST PARK ELEMENTARY SCHOOL	1650	8	206.3	7	11	6	No
FRANKLIN ELEMENTARY SCHOOL	2640	13	203.1	12	16	4	No
FRIEDENS UN D CHURCH OF CHRIST	310	2	155	2	4	1	Yes
FUCHS MIZRACHI SCHOOL	2450	14	175	11	15	4	No
FULTON BRANCH LIBRARY	1831	9	203.4	10	14	3	Yes
FUNDAMENTAL EDUCATION CENTER	902	5	180.4	5	8	2	Yes
GARDEN VALLEY NEIGHBOR D HOUSE	1029	5	205.8	6	8	1	Yes
GARFIELD HEIGHTS HIGH SCHOOL	2948	15	196.5	14	18	3	No
GARFIELD HEIGHTS JUSTICE CENTER	2270	11	206.4	11	14	3	No
GARFIELD HEIGHTS MIDDLE SCHOOL	1315	6	219.2	7	9	1	Yes
GARFIELD HTS COMMUNITY CENTER	1615	8	201.9	8	10	3	No
GARFIELD MEM. UN. METH. CHURCH	2179	11	198.1	10	14	3	No
GARNETT PRIMARY SCHOOL	1149	5	229.8	6	8	2	No
GATES MILLS COMMUNITY HOUSE	2257	13	173.6	11	14	3	No
GATEWAY MANOR	1040	5	208	5	7	2	No
GEARITY ELEMENTARY SCHOOL	1364	7	194.9	6	9	2	No
GEORGE W.CARVER ELEM. SCHOOL	727	4	181.8	5	7	1	Yes
GEORGETOWN CONDOMINIUMS	278	1	278	2	3	1	No
GIDDINGS ELEMENTARY SCHOOL	1637	8	204.6	10	13	2	Yes
GLENBROOK ELEMENTARY SCHOOL	1312	6	218.7	7	8	2	No
GLENDALE PRIMARY SCHOOL	1371	7	195.9	7	9	2	No
GLENVILLE HIGH SCHOOL	827	4	206.8	5	7	1	Yes
GLENVILLE LIBRARY	771	4	192.8	5	8	1	No
GLENWILLOW VILLAGE HALL	527	3	175.7	3	4	4	Yes
GLORIA DEI EVANG. LUTH. CHURCH	1513	8	189.1	9	12	2	Yes
GOLDWOOD PRIMARY SCHOOL	1372	7	196	7	9	2	No
GRACE CHRISITIAN MISSIONARY ALLIANCE CH	1220	6	203.3	6	9	2	Yes
GRACE CHURCH OF NORTH OLMSTED	1561	8	195.1	8	10	3	Yes
GRACE L. ROXBURY ELEM. SCHOOL	2331	12	194.3	11	15	2	No
GRACE LUTHERAN CHURCH	1971	10	197.1	11	15	2	No
GRACEMOUNT ELEMENTARY SCHOOL	2228	13	171.4	12	17	3	Yes
GRANGER ROAD ADMIN. BUILDING	1219	6	203.2	6	8	2	No
GRANT ELEMENTARY SCHOOL	2579	12	214.9	12	16	4	No
GRANTWOOD GOLF COURSE	2852	13	219.4	13	17	3	No
GREATER ABYSSINIA TOWERS	1261	7	180.1	7	10	2	Yes

Polling Location	# Reg. Voters	# of DRE Machines Deployed	Ratio*	SAG # = 5226	SAG # = 6978	# in Precincts	"Cleveland"
GREEN VALLEY ELEMENTARY SCHOOL	1463	7	209	8	9	3	No
GREENBRIAR MIDDLE SCHOOL ANNEX	2066	9	229.6	10	13	3	No
GREENVIEW UPPER ELEM. SCHOOL	1067	5	213.4	6	7	2	No
GUNNING PARK RECREATION CENTER	2837	14	202.6	15	19	3	Yes
HALLORAN SKATING RINK	2987	17	175.7	16	21	3	No
HANNA ELEMENTARY SCHOOL	1644	9	182.7	8	11	3	No
HARBOR CREST APARTMENTS	1170	6	195	6	8	1	No
HARDING MIDDLE SCHOOL	3841	19	202.2	17	23	6	No
HARRY E. DAVIS MIDDLE SCHOOL	1577	8	197.1	9	12	2	Yes
HARVARD COMMUNITY CENTER	1297	7	185.3	8	10	2	Yes
HEALTH CAREERS CTR. HIGH SCHOOL	3116	15	207.7	17	22	2	Yes
HEIGHTS CHRISTIAN CHURCH	806	4	201.5	4	6	1	No
HELEN S. BROWN SENIOR CENTER	1570	9	174.4	9	12	2	Yes
HENRY LONGFELLOW ELEM. SCHOOL	1227	6	204.5	7	10	2	Yes
HERITAGE CONGREGATIONAL CHURCH	1375	7	196.4	7	9	2	No
HERITAGE MIDDLE SCHOOL	528	3	176	4	5	1	Yes
HIGH POINT RECREATION CENTER	4163	21	198.2	18	24	6	No
HIGHLAND HILLS VILLAGE HALL	769	5	153.8	4	6	1	No
HIGHLAND HTS. COMMUNITY CENTER	3007	18	167.1	14	18	4	No
HILLIARD ELEMENTARY SCHOOL	3741	19	196.9	17	23	5	No
HILLSIDE MIDDLE SCHOOL	2318	12	193.2	11	14	3	No
HILLTOP ELEMENTARY SCHOOL	1842	9	204.7	9	12	3	No
HILLTOP VILLAGE	431	2	215.5	3	4	1	No
HOLLY LANE ELEMENTARY SCHOOL	3121	15	208.1	14	18	2	No
HOLY CROSS CHURCH	2779	13	213.8	13	16	3	No
HOLY NAME ELEMENTARY SCHOOL	1944	10	194.4	11	15	3	Yes
HOLY REDEEMER SCHOOL	2855	14	203.9	16	21	3	Yes
HOLY TRINITY BAPTIST CHURCH	3372	17	198.4	18	24	4	Yes
HOPE EVANG. LUTHERAN CHURCH	1290	6	215	8	10	2	Yes
HORACE MANN MIDDLE SCHOOL	1993	10	199.3	9	13	2	Yes
HORIZONS ACTIVITY CENTER	2560	14	182.9	12	16	3	Yes
HOUGH MULTI-SERVICE CENTER	1404	7	200.6	8	11	2	Yes
HOWARD CHAPMAN ELEM. SCHOOL	3250	17	191.2	15	19	5	No
HOWARD ROBBINS TOWERS	1353	6	225.5	7	9	2	No
HUNTING VALLEY VILLAGE HALL	537	4	134.3	3	5	1	No
HUNTINGTON GREEN	1250	6	208.3	6	9	2	No
HURON PLACE APARTMENTS	1599	9	177.7	9	12	2	Yes
IMMACULATE HEART OF MARY	2265	11	205.9	12	16	3	Yes
INDEPENDENCE MIDDLE SCHOOL	2332	11	212	11	15	3	No
INDEPENDENCE OLD TOWN HALL	1457	7	208.1	7	9	4	No
INDIAN HILLS EMERITUS HOUSE	1249	6	208.2	6	8	1	No
IOWA MAPLE ELEMENTARY SCHOOL	1627	8	203.4	9	12	3	No

Polling Location	# Reg. Voters	# of DRE Machines Deployed	Ratio*	SAG # = 5226	SAG # = 6978	# in Precincts	"Cleveland"
JAELOT APARTMENTS	1088	5	217.6	7	9	2	Yes
JIMMY DIMORA COMMUNITY CENTER	1823	10	182.3	9	12	3	No
JOHN DEWEY ELEMENTARY SCHOOL	1081	5	216.2	6	7	2	No
JOHN F. KENNEDY HIGH SCHOOL	1495	8	186.9	9	12	5	Yes
JOHN KNOX PRESBYTERIAN CHURCH	2606	14	186.1	12	16	4	No
JOHN MARSHALL HIGH SCHOOL	2172	11	197.5	13	16	3	No
JOHN MUIR ELEMENTARY SCHOOL	2183	11	198.5	10	13	3	No
JOSEPH F. LANDIS ELEM. SCHOOL	1077	6	179.5	7	9	1	Yes
JOSEPH GALLAGHER MIDDLE SCHOOL	2499	12	208.3	13	19	3	Yes
JUDSON PARK	755	4	188.8	5	7	1	Yes
KENNETH L. JOHNSON REC, CENTER	618	3	206	4	6	1	Yes
KENSINGTON INITERMEDIATE SCHOOL	1159	6	193.2	6	8	2	No
KING KENNEDY HIGH RISE	747	3	249	5	7	1	Yes
KIRBY MANOR APARTMENTS	2462	15	164.1	13	18	3	Yes
KIWANIS LODGE	5872	29	202.5	26	34	9	No
KNICKERBOCKER APARTMENTS	687	3	229	4	5	1	No
LAKE SHORE CHRISTIAN CHURCH	768	4	192	4	6	1	No
LAKE SHORE GOLDEN AGE CENTER	648	4	162	4	6	1	Yes
LAKE SHORE TOWERS	1473	7	210.4	7	9	2	No
LAKESIDE BAPTIST CHURCH	720	4	180	5	6	1	Yes
LAKEVIEW TOWERS APARTMENTS	1121	6	186.8	6	8	3	Yes
LAKEWOOD CHRISTIAN CHURCH	2068	10	206.8	9	13	1	Yes
LAKEWOOD CITY HALL	4767	24	198.6	21	28	6	Yes
LAKEWOOD HIGH SCHOOL	1784	9	198.2	8	12	3	No
LAKEWOOD PRESBYTERIAN CHURCH	1218	7	174	6	8	2	No
LAKEWOOD UNITED METH. CHURCH	2202	12	183.5	11	13	3	No
LANDER ELEMENTARY SCHOOL	1739	8	217.4	8	11	3	No
LAWRENCE SCHOOL	1360	7	194.3	7	9	1	Yes
LEWIS F. MAYER MIDDLE SCHOOL	2822	16	176.4	14	17	4	No
LINCOLN ELEMENTARY SCHOOL	2688	13	206.8	13	16	5	No
LINCOLN POST 13 P.L.A.V	2291	11	208.3	13	16	3	Yes
LINCOLN WEST HIGH SCHOOL	2576	13	198.2	14	18	3	Yes
LINNDALE VILLAGE HALL	91	2	45.5	1	2	1	No
LOMOND ELEMENTARY SCHOOL	1744	12	145.3	9	11	3	No
LONNIE BURTON RECREATION CENTER	2631	12	219.3	15	18	3	Yes
LORAIN BRANCH LIBRARY	849	4	212.3	5	8	1	Yes
LORAIN SQUARE ESTATES	1517	8	189.6	8	12	2	Yes
LOUIS PASTUER ELEMENTARY SCHOOL	804	4	201	5	7	1	Yes
LOUISA MAY ALCOTT ELEM. SCHOOL	2859	13	219.9	15	21	3	Yes
LOWDEN ELEMENTARY SCHOOL	2048	10	204.8	10	12	3	No
LT. COLONEL JOHN GLENN SCHOOL	2223	13	171	10	14	3	No
LUIS MUNOZ MARIN MIDDLE SCHOOL	1695	8	211.9	9	13	2	Yes

Polling Location	# Reg. Voters	# of DRE Machines Deployed	Ratio*	SAG # = 5226	SAG # = 6978	# in Precincts	"Cleveland"
LUPICA TOWERS	1166	6	194.3	7	10	3	No
LUTHER MEMORIAL SCHOOL	2503	12	208.6	14	19	3	Yes
LYNDHURST BAPTIST CHURCH	481	2	240.5	3	4	1	No
LYNDHURST CITY HALL	1416	9	157.3	6	9	2	No
LYNDHURST COMM. PRESB. CHURCH	1102	5	220.4	6	7	2	No
MACINTOSH FARMS	1890	10	189	9	12	2	No
MADISON BRANCH PUBLIC LIBRARY	596	3	198.7	4	5	5	No
MAPLE ELEMENTARY SCHOOL	2302	11	209.3	10	14	3	No
MAPLE HEIGHTS HIGH SCHOOL	2767	14	197.6	13	17	4	No
MAPLE HTS. UN. METHODIST CHURCH	2149	10	214.9	11	14	3	No
MARION STERLING ELEM. SCHOOL	1890	10	189	11	14	2	Yes
MARTIN LUTHER KING CIVIC CENTER	1339	6	223.2	8	11	2	Yes
MARTIN LUTHER KING HIGH SCHOOL	774	5	154.8	5	7	1	Yes
MARTIN LUTHER KING LIBRARY	1149	6	191.5	7	10	3	Yes
MAX S. HAYES VOCATIONAL SCHOOL	1029	5	205.8	6	8	2	No
MAYFIELD HIGH SCHOOL	1458	8	182.3	7	9	2	Yes
MAYFIELD MIDDLE SCHOOL	1768	8	221	8	12	3	No
MAYFIELD VILL. COMMUNITY CENTER	1354	6	225.7	7	9	2	No
MCKINLEY ELEMENTARY SCHOOL	2471	17	145.4	12	15	3	No
MEMORIAL SCHOOL	2629	14	187.8	15	19	4	Yes
MENORAH PARK CTR. FOR SR. LIVING	862	4	215.5	5	6	1	No
MERCER ELEMENTARY SCHOOL	2242	12	186.8	10	14	3	No
MERIDIAN CONDOMINIUM COMPLEX	712	4	178	4	5	1	No
MICHAEL A.RIES RINK	3189	16	199.3	14	19	5	No
MICHAEL R. WHITE ELEM. SCHOOL	864	5	172.8	5	7	2	No
MICHAEL ZONE RECREATION CENTER	1823	9	202.6	11	14	2	Yes
MIDDLEBURG HEIGHTS COMM. CENTER	1001	5	200.2	5	7	1	No
MIDDLEBURG HEIGHTS LIBRARY	1911	10	191.1	9	12	2	No
MIDDLEBURG HTS. CHURCH OF GOD	1221	6	203.5	6	8	2	No
MILES ELEMENTARY SCHOOL	1714	8	214.3	9	13	2	Yes
MILES ELMARGE APARTMENTS	923	5	184.6	5	8	1	Yes
MILL CREEK COMMUNITY CENTER	1034	5	206.8	6	9	3	No
MILLIKEN EARLY CHILDHOOD CENTER	1598	8	199.8	9	12	4	No
MILLRIDGE SCHOOL	1763	4	440.8	8	11	2	No
MINISTERS MISS. BAPTIST CHURCH	686	4	171.5	4	6	1	Yes
MISTY LAKE VILLAGE	1185	7	169.3	6	8	1	No
MONTICELLO MIDDLE SCHOOL	2759	14	197.1	15	20	2	No
MORNING STAR BAPTIST CHURCH	1015	6	169.2	6	9	2	Yes
MORNING STAR TOWERS	1697	9	188.6	10	12	2	Yes
MT. AUBURN MANOR APARTMENTS	768	4	192	5	7	1	Yes
MT. HAVEN BAPTIST CHURCH	2012	10	201.2	12	15	2	Yes
MT. NEBO BAPTIST CHURCH ANNEX	679	3	226.3	5	6	1	Yes

Polling Location	# Reg. Voters	# of DRE Machines Deployed	Ratio*	SAG # = 5226	SAG # = 6978	# in Precincts	"Cleveland"
MT. OLIVE BAPTIST CHURCH	1634	15	108.9	9	13	2	Yes
MT. PLEASANT LIBRARY	1452	7	207.4	8	11	2	Yes
MT. SINAI BAPTIST CHURCH	1134	5	226.8	7	9	1	Yes
MUSICIANS TOWER	750	4	187.5	5	7	1	Yes
NEW AVENUES TO INDEPENDENCE	4766	24	198.6	26	34	3	No
NEW HAMPTON PARTY CENTER	1054	4	263.5	6	7	1	No
NEW JERUSALEM CHURCH OF GOD	1035	5	207	6	8	1	Yes
NEWBURGH HTS. SENIOR CENTER	1430	7	204.3	7	9	2	No
NEWTON D. BAKER ELEM. SCHOOL	828	4	207	5	7	1	Yes
NOBLE NEIGHBORHOOD LIBRARY	2869	15	191.3	16	20	4	Yes
NORMANDY ELEMENTARY SCHOOL	631	3	210.3	3	5	2	Yes
NORMANDY HIGH SCHOOL	2396	13	184.3	11	15	2	No
NORTH OLMSTED BRANCH LIBRARY	1351	6	225.2	7	9	2	No
NORTH OLMSTED CITY HALL	2497	15	166.5	12	15	3	No
NORTH OLMSTED COMMUNITY CABIN	3689	20	184.5	17	21	2	No
NORTH OLMSTED REC. COMPLEX	1047	5	209.4	5	7	3	Yes
NORTH POINTE APARTMENTS	<1000>	5	200	5	7	5	No
NORTH RANDALL VILLAGE HALL	914	5	182.8	5	7	2	No
NORTH ROYALTON CHRISTIAN CHURCH	1745	9	193.9	8	11	2	No
NORTH ROYALTON HIGH SCHOOL	2267	10	226.7	11	14	3	No
NORTH ROYALTON PUBLIC LIBRARY	2398	11	218	11	15	3	No
NOTTINGHAM UNITED METHODIST CHURCH	1623	9	180.3	9	12	2	Yes
OAKWOOD VILLAGE FIRE STATION	671	3	223.7	4	5	1	No
OAKWOOD VILLAGE HALL	681	4	170.3	4	5	2	No
OLD STONE CHURCH	1392	6	232	8	10	1	Yes
OLIVE B. ALLEN ELEMENTARY SCHOOL	2608	11	237.1	12	16	4	No
OLMSTED CHRISTIAN CHURCH	1558	9	173.1	7	10	2	No
OLMSTED COMMUNITY CHURCH	2283	11	207.5	11	14	3	No
OLMSTED FALLS HIGH SCHOOL	2133	13	164.1	10	14	2	No
ONAWAY ELEMENTARY SCHOOL	1182	7	168.9	6	8	2	No
OPEN DOOR BAPTIST CHURCH	1794	9	199.3	10	14	3	No
ORANGE VILLAGE HALL	2797	14	199.8	13	17	2	Yes
ORCHARD ELEMENTARY SCHOOL	846	4	211.5	5	7	3	No
OUR HOUSE (APARTMENTS)	981	5	196.2	5	7	1	No
OUR LADY OF ANGELS LINUS HALL	776	5	155.2	5	6	1	Yes
OUR LADY OF LOURDES SHRINE	4107	21	195.6	18	24	5	No
OUR LADY OF MT. CARMEL CHURCH	1559	9	173.2	9	13	2	Yes
OUR SAVIOR LUTHERAN CHURCH	1577	8	197.1	8	11	4	Yes
OXFORD ELEMENTARY SCHOOL	2659	14	189.9	14	18	4	No
PARKNOLL ELEMENTARY SCHOOL	1595	8	199.4	8	10	2	No
PARKVIEW ELEMENTARY SCHOOL	676	3	225.3	4	5	1	No

Polling Location	# Reg. Voters	# of DRE Machines Deployed	Ratio*	SAG # = 5226	SAG # = 6978	# in Precincts	"Cleveland"
PARKVIEW SCHOOL BUILDING	2138	10	213.8	10	14	4	No
PARMA CHRISTIAN CHURCH	1805	9	200.6	9	11	3	No
PARMA HEIGHTS BAPTIST CHURCH	1858	10	185.8	9	11	3	No
PARMA HEIGHTS SERVICE GARAGE	4922	25	196.9	22	28	7	No
PARMA LUTHERAN CHURCH	1876	9	208.4	9	12	3	No
PARMA MOOSE LODGE #1744	771	4	192.8	4	6	3	No
PARMA PARK ELEMENTARY SCHOOL	2413	12	201.1	11	15	2	No
PARMA REGIONAL LIBRARY	656	3	218.7	4	5	1	No
PARMA SENIOR CITIZENS CENTER	2839	15	189.3	13	17	4	No
PATRICK HENRY MIDDLE SCHOOL	1502	8	187.8	8	12	2	Yes
PAUL L. DUNBAR ELEM. SCHOOL	1536	10	153.6	9	12	4	Yes
PAUL REVERE ELEMENTARY SCHOOL	1620	9	180	9	12	2	Yes
PEARL RD. UN D METHODIST CHURCH	2030	11	184.5	11	15	1	No
PEARLBROOK CHURCH OF GOD	994	6	165.7	6	8	1	Yes
PEPPER PIKE LEARNING CENTER	3006	16	187.9	14	18	5	No
PILGRIM CONGREGATIONAL CHURCH	1364	7	194.9	8	10	2	Yes
PINZONE TOWER APARTMENTS	669	3	223	4	5	1	No
PLEASANT VALLEY ELEM. SCHOOL	3516	18	195.3	15	21	5	No
PLEASANTVIEW ELEMENTARY SCHOOL	3329	17	195.8	15	20	2	No
PLYMOUTH CHURCH OF SHAKER	1379	6	229.8	7	9	2	No
PRINCE OF PEACE LUTHERAN CHURCH	727	4	181.8	4	6	1	No
PROSPECT ELEMENTARY SCHOOL	1876	9	208.4	11	14	2	Yes
PURITAS LUTHERAN CHURCH	1499	7	214.1	9	12	2	Yes
QUARRY TOWN (CMHA)	1730	9	192.2	9	11	3	No
QUINN CHAPEL CHURCH	2361	11	214.6	12	17	3	Yes
RAINBOW PLACE	738	4	184.5	5	7	2	Yes
RANDALLWOOD SCHOOL	1597	8	199.6	8	11	2	No
RATNER DAY SCHOOL	1310	6	218.3	7	8	2	No
RAYMOND ELEMENTARY SCHOOL	2748	14	196.3	12	16	3	No
REGINA HIGH SCHOOL	1736	9	192.9	8	11	3	No
RENWOOD ELEMENTARY SCHOOL	2279	11	207.2	11	14	4	No
RESERVE SQUARE	1489	7	212.7	8	12	2	Yes
RICE BRANCH LIBRARY	2665	14	190.4	16	19	3	Yes
RIDGE ROAD UN. CHURCH OF CHRIST	1302	6	217	7	9	2	No
RIDGEBROOK ELEMENTARY SCHOOL	2629	12	219.1	12	16	4	No
RIDGEBURY ELEMENTARY SCHOOL	1166	6	194.3	6	8	2	No
RIDGEWOOD UN. METHODIST CHURCH	1142	6	190.3	6	8	4	Yes
RIVEREDGE ELEMENTARY SCHOOL	1294	6	215.7	6	9	2	No
RIVERSIDE CHURCH OF GOD IN CHRIST	1244	6	207.3	7	9	2	Yes
RIVERSIDE ELEMENTARY SCHOOL	1996	10	199.6	11	15	3	Yes
RIVERVIEW APARTMENTS	649	4	162.3	4	6	2	Yes

Polling Location	# Reg. Voters	# of DRE Machines Deployed	Ratio*	SAG # = 5226	SAG # = 6978	# in Precincts	"Cleveland"
ROADOAN ELEMENTARY SCHOOL	669	3	223	4	5	1	No
ROBERT FULTON ELEM. SCHOOL	1823	10	182.3	10	14	3	No
ROBERT H. JAMISON ELEM. SCHOOL	1367	7	195.3	8	10	1	No
ROCKPORT BRANCH LIBRARY	1324	7	189.1	8	10	3	Yes
ROCKPORT UNITED METH. CHURCH	1975	10	197.5	9	13	3	Yes
ROCKSIDE ELEMENTARY SCHOOL	597	3	199	3	5	1	No
ROCKY RIVER CIVIC CENTER	3058	15	203.9	14	19	5	No
ROCKY RIVER HIGH SCHOOL	619	3	206.3	4	5	2	No
ROCKY RIVER LIBRARY	2126	11	193.3	10	14	1	Yes
ROCKY RIVER MIDDLE SCHOOL	1421	7	203	7	9	2	No
ROCKY RIVER PRESBYTERIAN CHURCH	1688	10	168.8	8	11	3	No
ROCKY RIVER UNITED METH. CHURCH	686	4	171.5	4	5	1	No
ROOSEVELT ELEMENTARY SCHOOL	2820	14	201.4	14	17	4	No
ROSS C. DEJOHN COMM.CENTER	1900	9	211.1	9	12	3	No
ROWLAND ELEMENTARY SCHOOL	2604	13	200.3	12	16	4	No
ROXBORO ELEMENTARY SCHOOL	1907	10	190.7	11	14	3	Yes
ROYAL REDEEMER LUTH. CHURCH	5158	25	206.3	22	31	2	No
ROYAL VIEW ELEMENTARY SCHOOL	3218	16	201.1	15	19	4	No
ROZELLE ELEMENTARY SCHOOL	654	3	218	4	6	1	Yes
SACRED HEART OF JESUS CHURCH	765	4	191.3	5	7	1	Yes
SALVATION ARMY - CLARK	1540	8	192.5	9	13	2	Yes
SALVATION ARMY - EAST 93RD	2139	11	194.5	11	16	3	Yes
SALVATION ARMY - GROVEWOOD	2860	15	190.7	16	21	4	Yes
SCHAAF COMMUNITY CENTER	3179	16	198.7	15	20	2	No
SCHNURMANN HOUSE (SERVICE CTR)	816	4	204	4	6	1	No
SECOND CALVARY BAPTIST CHURCH	1071	7	153	6	9	3	Yes
SENIOR CITIZENS CENTER BLDG-G	1037	6	172.8	5	7	1	Yes
SENIOR CITIZENS CENTER BLDG-H	363	3	121	2	4	2	No
SEVEN HILLS RECREATION CENTER	2391	12	199.3	10	15	3	No
SEVERANCE TOWERS	1629	8	203.6	10	13	2	Yes
SHADOW CREEK	814	4	203.5	4	6	1	No
SHAKER COMMUNITY BUILDING	1880	10	188	9	12	3	No
SHAKER FAMILY CENTER	2101	12	175.1	10	13	3	No
SHAKER HEIGHTS LIBRARY	2185	11	198.6	10	13	6	No
SHAKER HEIGHTS MIDDLE SCHOOL	2653	13	204.1	12	16	4	No
SHERRI PARK APARTMENTS	1059	5	211.8	5	7	1	No
SHILOH MIDDLE SCHOOL	3597	17	211.6	16	21	6	No
SHORE CULTURAL CENTER	822	4	205.5	4	6	3	Yes
SIMPSON UN D METHODIST CHURCH	1738	8	217.3	10	13	2	Yes
SO.EUCLID/HILCREST UN.METH CH.	1252	6	208.7	6	8	2	No
SOLON CENTER FOR THE ARTS	2356	12	196.3	11	14	4	No
SOLON HIGH SCHOOL	2140	12	178.3	11	13	3	No

Polling Location	# Reg. Voters	# of DRE Machines Deployed	Ratio*	SAG # = 5226	SAG # = 6978	# in Precincts	"Cleveland"
SOLON PUBLIC LIBRARY	2907	14	207.6	14	17	4	No
SOLON UNITED METHODIST CHURCH	2434	12	202.8	12	15	5	No
SOUTH EUCLID CITY HALL	1408	7	201.1	7	9	2	No
SOUTH EUCLID COMMUNITY CENTER	1928	10	192.8	9	12	1	Yes
SOUTH WESTERLY APARTMENTS	586	3	195.3	3	5	2	Yes
SOUTHEAST BRANCH LIBRARY	1461	7	208.7	7	10	2	No
SPRING HILL VILLA APARTMENTS	1537	8	192.1	9	12	2	Yes
SPRINGBROOK APARTMENTS	825	4	206.3	5	7	1	Yes
SPRUCE ELEMENTARY SCHOOL	1790	9	198.9	9	12	2	No
ST. ALBANS EPISCOPAL CHURCH	1487	7	212.4	8	11	2	Yes
ST. ANDREW EASTERN ORTH. CHURCH	2521	13	193.9	11	16	2	Yes
ST. ANDREW TOWER	912	4	228	6	8	1	Yes
ST. ANTHONY S SCHOOL	1360	7	194.3	7	9	2	No
ST. BARNABAS EPISCOPAL CHURCH	1932	9	214.7	9	12	3	No
ST. BRIDGETS CATHOLIC SCHOOL	2033	9	225.9	10	13	3	No
ST. CHARLES SCHOOL	1380	7	197.1	7	9	3	Yes
ST. CLEMENT S CHURCH	2853	15	190.2	13	17	4	No
ST. DEMETRIOS GREEK ORTH.CHURCH	1230	6	205	6	8	2	No
ST. DOMINIC SCHOOL	1323	5	264.6	7	8	2	No
ST. HYACINTH S AUDITORIUM	1030	6	171.7	6	8	2	Yes
ST. JAMES LUTHERAN CHURCH – BROADVIEW	1623	8	202.9	10	12	2	Yes
ST. JAMES LUTHERAN CHURCH – HAYDEN	1453	8	181.6	8	12	2	Yes
ST. JOHN LUTHERAN CHURCH	2519	13	193.8	14	19	3	Yes
ST. JOHN NEPOMUCENE SCHOOL	1603	9	178.1	9	13	2	Yes
ST. JOSEPH COLLINWOOD SCHOOL	3835	20	191.8	21	27	4	Yes
ST. JOSEPH S ACADEMY	1452	7	207.4	9	11	2	Yes
ST. JUDE PARISH HALL	1723	9	191.4	8	11	3	Yes
ST. LADISLAS CHURCH	3863	18	214.6	17	23	5	No
ST. LEO PARISH COMMUNITY CENTER	1677	8	209.6	9	12	7	No
ST. LUKE LUTHERAN CHURCH	1300	6	216.7	7	10	2	Yes
ST. MARGARET MARY CHURCH HALL	2341	12	195.1	11	14	3	No
ST. MARTIN DEPORRES CENTER	3575	19	188.2	19	26	4	Yes
ST. MARTIN DEPORRES HIGH SCHOOL	2502	12	208.5	14	18	3	Yes
ST. MARY MAGDALENE	1983	9	220.3	9	12	3	No
ST. MARY'S CATHOLIC SCHOOL	489	2	244.5	3	4	1	No
ST. MARY'S ROMANIAN ORTH. CHURCH	2261	11	205.5	11	17	1	No
ST. MEL HALL	3226	17	189.8	18	23	1	Yes
ST. MICHAELS RUSS. ORTH. CHURCH	2349	12	195.8	11	14	3	No
ST. MONICA SCHOOL	3294	17	193.8	15	19	4	Yes
ST. PATRICK S CHURCH	2504	13	192.6	13	19	3	Yes

Polling Location	# Reg. Voters	# of DRE Machines Deployed	Ratio*	SAG # = 5226	SAG # = 6978	# in Precincts	"Cleveland"
ST. PAUL LUTHERAN CHURCH	4254	22	193.4	19	24	6	No
ST. PETER & PAUL CATHOLIC CHURCH	1531	8	191.4	8	10	3	No
ST. PETER UN D CHURCH OF CHRIST	2247	11	204.3	11	14	3	No
ST. PHILIP NERI SCHOOL	1805	9	200.6	10	14	2	Yes
ST. SAVA CHURCH HALL	3630	18	201.7	17	21	4	No
ST. THOMAS MORE CHURCH	728	4	182	4	6	1	No
ST. TIMOTHY MANOR	1348	6	224.7	7	9	2	No
ST. WENCESLAS SCHOOL	2044	10	204.4	10	13	3	No
ST. WILLIAMS SCHOOL	2518	13	193.7	12	15	3	No
STARLIGHT BAPTIST CHURCH	768	3	256	5	6	1	Yes
STATE ROAD COMMUNITY CHURCH	2440	12	203.3	11	15	2	No
STRONGSVILLE CITY HALL	1687	8	210.9	8	11	2	No
STRONGSVILLE COMMUNITY LIBRARY	2463	12	205.3	11	14	3	No
STRONGSVILLE CTR. MIDDLE SCHOOL	2134	16	133.4	10	13	3	No
STRONGSVILLE EARLY LEARNING PRE-SCHOOL	1720	9	191.1	8	11	3	No
STRONGSVILLE HIGH SCHOOL	3485	17	205	14	21	4	No
STS. PHILLIP & JAMES CATH. CHURCH	2493	13	191.8	14	18	5	Yes
SUNVIEW ELEMENTARY SCHOOL	1490	10	149	7	10	2	No
SUPERIOR ELEMENTARY SCHOOL	1440	8	180	8	11	2	Yes
TAFT ELEMENTARY SCHOOL	1235	6	205.8	6	9	1	Yes
TAYLOR ROAD ACADEMY	2959	14	211.4	16	22	4	Yes
TEMPLE EMANU EL	1889	9	209.9	9	12	3	No
TERRACE TOWERS	955	5	191	6	8	1	Yes
THE ALCAZAR HOTEL	705	4	176.3	4	6	1	Yes
THE CHURCH OF THE WEST. RESERVE	1521	8	190.1	8	10	3	No
THE HAMPTONS REC. BUILDING	1653	8	206.6	8	10	2	No
THE MARSOL APTS. CLUBHOUSE	1179	6	196.5	6	8	1	No
THE MASTER'S CHURCH	758	4	189.5	4	6	1	No
THE NORMANDY APARTMENTS	867	4	216.8	5	6	1	No
THE UNITY CHURCH OF GREATER CLEVELAND	535	4	133.8	3	5	1	No
THOMAS JEFFERSON MAGNET SCHOOL	2510	12	209.2	12	15	3	No
THOREAU PARK ELEMENTARY SCHOOL	2654	14	189.6	13	16	5	No
THORNTON PARK	1290	8	161.3	6	9	2	No
THURGOOD MARSHALL REC. CENTER	1288	7	184	8	10	2	Yes
TOWER IN THE PARK	470	2	235	3	4	1	No
TREMONT ELEMENTARY SCHOOL	2544	12	212	13	18	3	Yes
TRI-CITY SENIOR CENTER	1677	9	186.3	8	11	5	Yes
TRINITY COMMONS	963	5	192.6	6	8	1	Yes
UNION BRANCH LIBRARY	1096	5	219.2	7	9	2	No
UNION ELEMENTARY SCHOOL	1850	10	185	10	14	2	Yes
UNION SQUARE APARTMENTS	1571	8	196.4	9	12	2	Yes

Polling Location	# Reg. Voters	# of DRE Machines Deployed	Ratio*	SAG # = 5226	SAG # = 6978	# in Precincts	"Cleveland"
UNITED CHURCH OF CHRIST	888	4	222	5	8	1	Yes
UNIVERSITY CIRCLE PLACE APTS.	463	2	231.5	3	5	1	Yes
UNIVERSITY HTS. BRANCH LIBRARY	3152	15	210.1	14	18	5	No
UPSON ELEMENTARY SCHOOL	735	4	183.8	4	6	1	No
V. F. W. POST #2850	2378	13	182.9	13	18	4	No
V.F.W. HALL POST 1082	1832	10	183.2	9	12	3	No
V.F.W. POST #2533	1460	8	182.5	9	12	2	Yes
V.F.W. POST# 387	2184	12	182	12	16	3	Yes
VALLEY FORGE HIGH SCHOOL	1831	9	203.4	9	12	2	Yes
VALLEY ROAD VILLA	1826	9	202.9	10	14	2	Yes
VALLEY VIEW COMMUNITY CENTER	1801	9	200.1	9	12	3	Yes
VALLEY VISTA ELEMENTARY SCHOOL	1639	8	204.9	7	11	2	No
VILLA SERENA	535	3	178.3	3	4	1	No
WADE PARK APARTMENTS	1226	6	204.3	7	10	3	Yes
WADE PARK ELEMENTARY SCHOOL	709	4	177.3	5	7	1	Yes
WALTON ELEMENTARY SCHOOL	1862	9	206.9	11	15	2	Yes
WALTON HILLS COMMUNITY BUILDING	1978	10	197.8	9	12	1	Yes
WARRENSVILLE COMMUNITY APTS.	710	4	177.5	4	6	1	Yes
WARRENSVILLE COUNTY LIBRARY	1637	8	204.6	8	10	2	No
WARRENSVILLE HTS. MIDDLE SCHOOL	1107	6	184.5	6	8	1	Yes
WATERGATE APARTMENTS	963	<5>	192.6	5	7	<1>	<No>
WAVERLY ELEMENTARY SCHOOL	2893	15	192.9	17	20	3	Yes
WELLINGTON CATERING	1757	7	251	9	11	2	No
WERNER UNITED METHODIST CHURCH	1731	9	192.3	9	13	2	Yes
WEST PARK SLOVENIAN HOME	1627	8	203.4	9	13	2	Yes
WESTERLY APTS. (BARTON CTR)	713	4	178.3	4	5	1	No
WESTLAKE B.O.E. ADMIN. OFFICES	625	4	156.3	4	5	1	No
WESTLAKE CTR. FOR COMM. SERVICES	3247	15	216.5	14	19	4	No
WESTLAKE HIGH SCHOOL	623	3	207.7	4	5	1	No
WESTLAKE LOG CABIN	2192	11	199.3	10	14	3	No
WESTLAKE RETIREMENT COMMUNITY	905	4	226.3	5	6	1	No
WESTLAKE UNITED METH. CHURCH	2253	11	204.8	10	14	3	No
WESTSIDE HUNGARIAN REFORMED CHURCH	1639	8	204.9	9	12	2	Yes
WESTSIDE SACHSENHEIM HALL	838	5	167.6	5	7	2	Yes
WESTWOOD ELEMENTARY SCHOOL	861	4	215.3	5	6	1	No
WILEY MIDDLE SCHOOL	1106	6	184.3	6	8	4	No
WILLIAM FOSTER ELEM. SCHOOL	832	4	208	5	6	1	No
WILLOW ELEMENTARY SCHOOL	558	3	186	4	5	2	Yes
WILLSON TOWER APARTMENTS	1086	5	217.2	6	9	1	Yes
WINTON PLACE	581	3	193.7	3	5	1	No

Polling Location	# Reg. Voters	# of DRE Machines Deployed	Ratio*	SAG # = 5226	SAG # = 6978	# in Precincts	"Cleveland"
WOODBURY ELEMENTARY SCHOOL	3925	21	186.9	21	28	2	Yes
WOODLAND HILLS ELEM. SCHOOL	2147	11	195.2	12	15	3	Yes
WOODMERE TOWN HALL	565	4	141.3	3	5	1	No
Y. M. C. A.	1258	6	209.7	8	10	2	Yes
ZELLERS ELEMENTARY SCHOOL	1662	7	237.4	8	11	2	No
ZELMA GEORGE COMMUNITY CTR	3001	15	200.1	17	21	3	Yes
ZION CHAPEL(MISS BAPT ANNEX)	1483	8	185.4	8	12	2	Yes
ZION LUTHERAN PARISH HALL	705	4	176.3	4	6	1	No

4.2 Expected performance of different machine allocations on a given Election Day.[20]

Allocation	#Machines	Scenario	Max of Avg (min)	Avg of Avg (min)	#Centers waiting >30 mins	StDev	#Centers waiting >60 mins	StDev	#Centers waiting >180 mins	StDev
SAG (5.2k)	5226	1	20.7	2.0	0.0	0.0	0.0	0.0	0.0	0.0
		2	35.6	7.4	4.2	2.1	0.0	0.0	0.0	0.0
		3	209.9	42.7	261.0	7.0	169.3	7.2	5.1	2.0
Cuyahoga	5211	1	80.3	3.0	1.7	0.9	0.4	0.5	0.0	0.0
		2	116.0	9.7	35.8	4.8	6.2	2.4	0.2	0.4
		3	430.4	53.1	257.5	9.8	186.1	9.0	36.9	6.7
Cuyahoga (adjusted)	5216	1	43.9	2.9	1.2	1.1	0.1	0.3	0.0	0.0
		2	102.5	9.6	38.0	7.0	5.8	1.2	0.0	0.0
		3	344.8	52.6	256.5	6.1	188.6	8.4	36.0	6.2
SAG (7k)	6978	1	4.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0
		2	15.2	1.7	0.1	0.3	0.0	0.0	0.0	0.0
		3	51.6	10.0	30.8	3.6	0.0	0.0	0.0	0.0
SAG (4.5k)	4488	1	26.6	4.6	0.2	0.4	0.0	0.0	0.0	0.0
		2	91.7	14.5	92.3	6.4	9.3	2.2	0.0	0.0
		3	318.6	81.3	289.9	8.3	268.2	9.9	95.0	7.2

[20] Additional allocation simulations of voting machines per voting centers are available. If you cannot locate some of the allocations or would like to obtain optimal allocations and their evaluations for different numbers of machines and/or scenarios, please contact ESI.

Appendix 5 - Manual Count of Paper Ballots

5.1 Manual Count Summary Sheet

ELECTION SCIENCE INSTITUTE Improving the American Election Process

FORM RT-2-01

VVPAT Summary Data

Election: Cuyahoga May 2, 2006 Primary

Today's Date: _____

Reader: _____ Printout Date/Time _____

Reader Table: _____ Reader Seat No. _____

Vote Center: _____ Jurisdiction: _____

Machine ID: _____

Machine Serial No.: _____

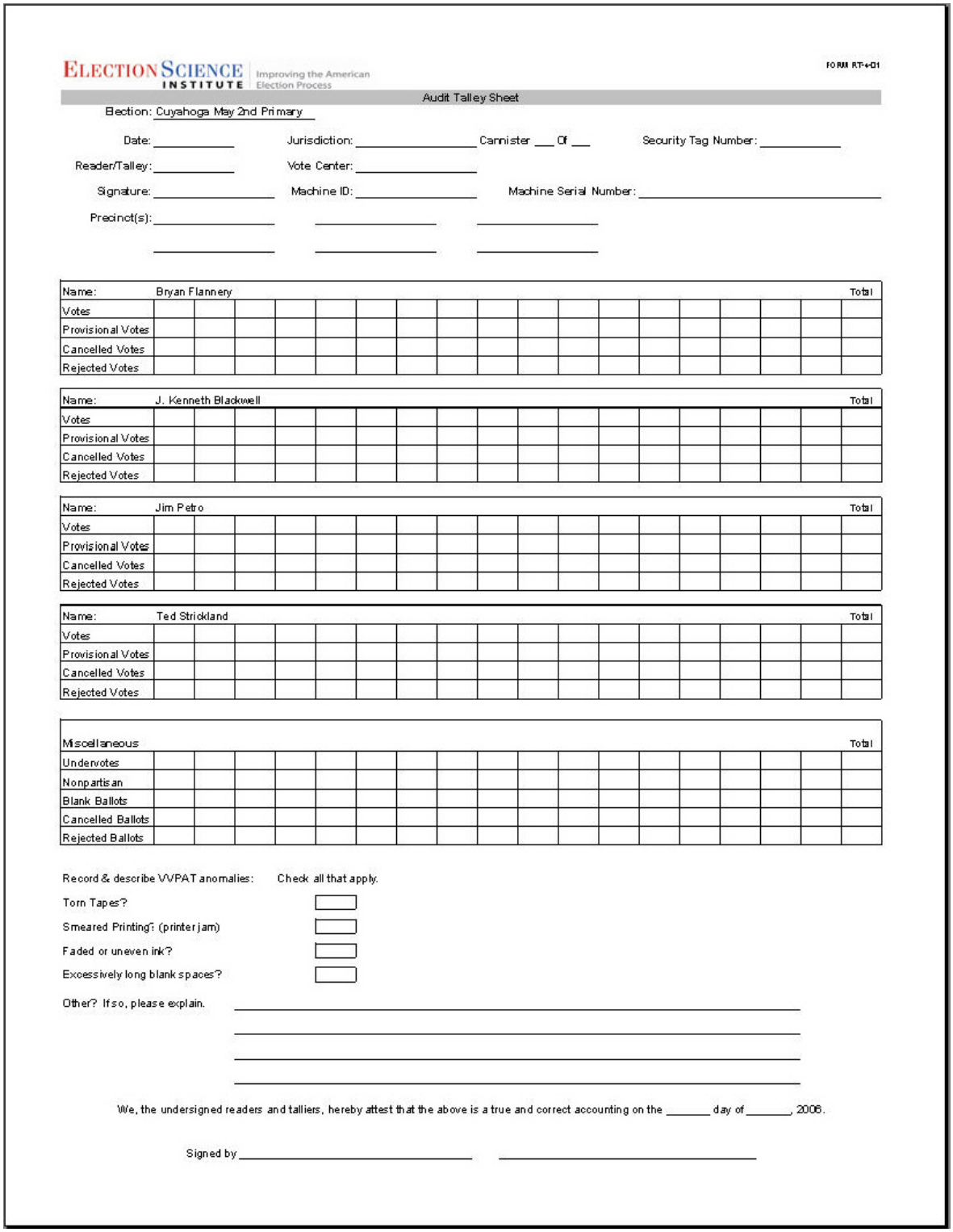
Canister: _____ (no.) of _____ (total)

Precinct Nos.						Total ballots cast across precints
Ballots Cast at each Precinct						

Count		Total Ballots
Flannery	FL	
Strickland	ST	
Blackwell	BL	
Petro	PT	
	Subtotal	

Subtotal +	
Issues Only +	
Undervotes =	
Total -	

5.2 Manual Count Tally Sheet



ELECTION SCIENCE INSTITUTE Improving the American Election Process

FORM RT-v.01

Audit Talley Sheet

Election: Cuyahoga May 2nd Primary

Date: _____ Jurisdiction: _____ Cannister ___ Of ___ Security Tag Number: _____

Reader/Talley: _____ Vote Center: _____

Signature: _____ Machine ID: _____ Machine Serial Number: _____

Precinct(s): _____ _____ _____

_____ _____ _____

Name:	Bryan Flannery																	Total
Votes																		
Provisional Votes																		
Cancelled Votes																		
Rejected Votes																		

Name:	J. Kenneth Blackwell																	Total
Votes																		
Provisional Votes																		
Cancelled Votes																		
Rejected Votes																		

Name:	Jim Petro																	Total
Votes																		
Provisional Votes																		
Cancelled Votes																		
Rejected Votes																		

Name:	Ted Strickland																	Total
Votes																		
Provisional Votes																		
Cancelled Votes																		
Rejected Votes																		

Miscellaneous																		Total
Undervotes																		
Nonpartisan																		
Blank Ballots																		
Cancelled Ballots																		
Rejected Ballots																		

Record & describe VVPAT anomalies: Check all that apply.

Torn Tapes? ☐

Smeared Printing? (printer jam) ☐

Faded or uneven ink? ☐

Excessively long blank spaces? ☐

Other? If so, please explain. _____

_____

_____

_____

We, the undersigned readers and talliers, hereby attest that the above is a true and correct accounting on the _____ day of _____, 2006.

Signed by _____ _____

5.3 Election Procedures Where Devices Are Used

BALDWIN'S OHIO REVISED CODE ANNOTATED
TITLE XXXV. ELECTIONS
CHAPTER 3506. VOTING AND TABULATING EQUIPMENT
ELECTION PROCEDURES WHERE DEVICES USED

➡3506.18 Recounts where direct recording electronic voting machine used

(A) **For any recount of an election in which ballots are cast using a direct recording electronic voting machine with a voter verified paper audit trail, the voter verified paper audit trail shall serve as the official ballot to be recounted.**

(B) Voter verified paper audit trails shall be preserved in the same manner and for the same time period as paper ballots are preserved under section 3505.31 of the Revised Code.

(C) A voter verified paper audit trail shall be treated as are other ballots for purposes of section 149.43 of the Revised Code and shall be retained in accordance with the county records retention schedule established under section 149.38 of the Revised Code after the relevant time period prescribed for its preservation in section 3505.31 of the Revised Code, or as ordered by the secretary of state or a court of competent jurisdiction.

(D) If a voter verified paper audit trail is made available to the public, any information on that voter verified paper audit trail that identifies the particular direct recording electronic voting machine that produced it shall be redacted.

The statutes and Constitution are current through 2006 File 142 of the 126th

GA (2005-2006), apv. by 7/27/06, and filed with the Secretary of State

by 7/27/06.

END OF DOCUMENT

5.4 Standards for VVPAT and Paper Record of Electronic Voting

BALDWIN'S OHIO ADMINISTRATIVE CODE ANNOTATED

111 SECRETARY OF STATE

111:5 STANDARDS FOR VOTER VERIFIED PAPER AUDIT TRAIL

CHAPTER 111:5-1. PAPER RECORD OF ELECTRONIC VOTING; INSPECTION BY VOTERS; RECOUNT

Rules are current through May 31, 2006;

Appendices are current through March 31, 2004

111:5-1-01 Standards for voter verified paper audit trail

(A) These standards have been developed by the secretary of state pursuant to Substitute House Bill 262, and shall regulate and govern the use of the voter verified paper audit trail system in direct recording electronic (DRE) voting machines in all elections governed by the Ohio Revised Code. These standards shall only apply to DRE systems for which an electronic record of the vote is created by the DRE. The standards in this document constitute a minimum standard of performance.

(B) Direct recording electronic voting machine means a voting machine that records votes by means of a ballot display provided with mechanical or electro-optical components that can be actuated by the voter, that processes the data by means of a computer program, and that records voting data and ballot images in internal or external memory components. Only for the purpose of complying with the accessibility requirements of section 3506.19 of the Revised Code, optical scan marking devices determined by the secretary of state to provide the same or substantially similar levels of accessibility, including non-visual accessibility, shall be considered direct recording electronic voting devices. A direct recording electronic voting machine produces a tabulation of the voting data stored in a removable memory component and a printed copy.

(C) "Voter verified paper audit trail" means a physical paper printout on which the voter's ballot choices, as registered by a direct recording electronic voting machine, are recorded. The voter shall be permitted to visually or audibly inspect the contents of the physical paper printout. The physical paper printout shall be securely retained at the polling place until the close of the polls on the day of the election; the secretary of state shall adopt rules under Chapter 119. of the Revised Code specifying the manner of storing the physical paper printout at the polling place. After the physical paper printout is produced, but before the voter's ballot is recorded, the voter shall have an opportunity to accept or reject the contents of the printout as matching the voter's ballot choices. If a voter rejects the contents of the physical paper printout, the system that

produces the voter verified paper audit trail shall invalidate the printout and permit the voter to recast the voter's ballot. On and after the first federal election that occurs after January 1, 2006, unless required sooner by the Help America Vote Act of 2002, any system that produces a voter verified paper audit trail shall be accessible to disabled voters, including visually impaired voters, in the same manner as the direct recording electronic voting machine that produces it.

(D) General description

(1) Components: the voter verified paper audit trail (VVPAT) system shall minimally consist of:

(a) A voter verified paper audit trail writer (VVPAT-W): a device attached, built into, or used in conjunction with a direct recording electronic (DRE) unit. Such a device must minimally consists of:

(i) Printer: a device that will duplicate a voter's selections on the DRE onto a paper record copy.

The system shall include one VVPAT printing device attached to or built into each DRE.

(ii) A paper record display unit: a unit that will allow a voter to view his or her paper record copy while preventing the voter from directly handling the paper record copy.

(iii) Paper: the paper used to produce the voter verified paper audit trail shall be sturdy, clean, and resistant to degradation.

(b) A voter verified paper audit trail record storage unit (VVPAT-S): a device that stores cast and spoiled paper record copies.

(c) These devices may be integrated as appropriate to their operation.

(d) A VVPAT may not be used with any voting equipment that contains any radio frequency (RF) transmit or receive capability or any other wireless communication device that transmits information point to point at a distance greater than one inch.

(e) A VVPAT may not be used with any voting equipment beyond the physical confines of the polling place, except when used outside a polling place in a self-contained manner to allow for curbside or functioning similar voting.

(2) Operation:

(a) VVPAT systems may be designed in various configurations. In all such devices, prior to casting the ballot, the voter shall have the ability to verify his or her selections on a paper record copy. Before final verification, the voter shall either accept or reject the choices represented on the paper record copy. Upon the completion of verification and casting the ballot, both the electronic record and the paper record copy shall be stored and retained.

(b) Any system that produces a voter verified paper audit trail shall be accessible to disabled voters, including visually impaired voters, in the same manner as the direct recording electronic voting machine that produces it.

(3) Maintenance: VVPAT system design shall permit routine maintenance in a manner that prevents the risk of undetected tampering or unauthorized altering of certified system components during routine system maintenance.

(E) Design requirements

(1) General

(a) Use of electronic and paper ballot records

(i) Every electronic record must have a corresponding paper ballot record copy.

(a) The paper ballot record copy must be printed and the voter must have the opportunity to verify that record prior to the final electronic record being recorded.

(b) A unique DRE identifier must appear on each individual paper ballot record produced, without revealing the identity of the voter who cast the ballot.

(ii) For any recount of an election in which ballots are cast using a direct recording electronic voting machine with a voter verified paper audit trail, the voter verified paper audit trail shall serve as the official ballot to be recounted.

(iii) In the case of a difference between the electronic record and the paper record copy, the paper record copy shall govern, unless there is clear evidence that the paper record copy is inaccurate, incomplete or unreadable as defined in the system procedures.

(iv) The voter verified paper audit trail shall be preserved in the same manner and for the same time period as paper ballots are preserved under section 3505.31 of the Revised Code.

(b) Privacy: The VVPAT system shall be designed to allow every voter to review, accept or reject his/her paper record copy privately and independently and shall comply with federal and state privacy requirements.

(c) Secrecy: The VVPAT system shall be designed to ensure secrecy of votes so that it is not possible to determine which voter cast which paper record copy and shall comply with federal and state secrecy requirements.

(d) Readability:

(i) The VVPAT system shall be designed to maximize the ease in which the voter may review, accept or reject his/her paper record copy and shall comply with federal and state readability requirements.

(a) The headline should be printed in no smaller than twenty-five point font, however, if the vendor cannot print the headline in at least twenty-five point font then they have the option of using a typeface of not less then nine point font and the VVPAT machine must include magnification capability to read the font as if it were thirty point font.

(b) The ballot language, explanation and arguments must be printed in no smaller than nine point font and no larger than eighteen point font and the machine must include a magnification capability read the font as if it were thirty point font.

(c) The ballot typeface must be times new roman, arial, myriad, or its equivalent.

(ii) On and after the first federal election that occurs after January 1, 2006, unless required sooner by the Help America Vote Act of 2002, the voter verified paper audit trail shall be capable of being optically scanned for the purpose of conducting a recount or other audit of the voting machine and shall be readable in a manner that makes the voter's ballot choices obvious to the voter without the use of computer or electronic codes.

(e) Accessibility: The VVPAT system shall be designed to allow access for disabled and limited literacy voters to privately and independently use the VVPAT and shall comply with federal and state accessibility requirements.

(f) Language accessibility: The VVPAT system shall be designed to allow each voter to verify their vote on a paper record copy in the same language they voted in on the DRE and shall comply with federal and state requirements.

(g) Security: The VVPAT system shall be designed to prevent tampering with either the VVPAT system or the paper record copy, and shall comply with federal and state security requirements.

(h) Capacity: The VVPAT system shall be designed with a combined capacity to ensure that an adequate amount of all the paper record, ink, toner, ribbon or other like supply units in a precinct will accommodate all voters using the DRE's with VVPAT-W within the precinct.

(i) The VVPAT system shall be designed to ensure that booth workers will not be required to add paper record, ink, toner, ribbon or other like supply units to the VVPAT-W, more than once, during the polling hours.

(i) Integrity:

(i) The VVPAT system must be designed to prohibit the production by any direct recording electronic voting machine of anything that legally could be removed by the voter from the polling place, such as a receipt or voter confirmation.

(ii) The VVPAT system must provide a low supply warning to provide a booth worker the opportunity to add paper, ink, toner, ribbon or other like supply before the supply item runs out.

(a) In the event a supply warning occurs as a voter is casting a ballot, the VVPAT must safeguard the secrecy of the ballot by preventing the booth worker from reading the VVPAT ballot.

(b) After the booth worker has filled the supply, the system shall allow the voter to review their VVPAT ballot without having to recast their ballot.

(j) Capability: The VVPAT device should draw its power from the DRE or the same electrical circuit the DRE draws its power from.

(i) When not plugged into an AC power source, the battery used to power the DRE must also power the VVPAT. However, a separate battery can be used to power the VVPAT as long as the voting process cannot continue if the VVPAT is not operational.

(ii) The battery must provide sufficient power to supply both the DRE and VVPAT device for at least two hours, or federal and state standards, which ever is more stringent.

(2) Paper record copy

(a) Security: Security protections shall be built into the paper record copy and/or VVPAT-S to prevent tampering. This provision shall apply to paper record copies before, during and after printing.

(b) Readability: The paper shall be designed so as to make the paper record copy readable by voters and election officials and shall comply with state readability requirements.

(c) Retention: The voter verified paper record copy shall be retained by the elections official for the same period of time as mandated by state law for the retention of paper ballots for that election.

(3) Printer

(a) Security: The printer shall be physically secure from tampering. The paper record copy and the image created by the VVPAT-W on the paper record copy shall be designed to withstand storage requirements as outlined in these standards and state requirements.

(b) Readability: The image created by the printer shall be designed to allow a voter to review his or her paper record copy privately and independently.

(i) The headline should be printed in no smaller than twenty-five point font, however, if the vendor cannot print the headline in at least twenty-five point font then they have the option of using a typeface of not less then nine point font and the VVPAT machine must include magnification capability to read the font as if it were thirty point font.

(ii) The ballot language, explanation and arguments must be printed in no smaller than nine point type and the machine must include a magnification

capability read the font as if it were thirty point.

(iii) The VVPAT must be printed using black ink, toner, or chemical agent on white paper.

(iv) The VVPAT must be printed using typeface/font of times new roman, arial, myriad, or its equivalent.

(v) The VVPAT must be printed using a paper weight of no less than fifteen pounds.

(c) Printed information

(i) Offices/issues: The image created by the VVPAT-W shall include every contest that is displayed to the voter on the DRE review screen including write-ins and undervotes.

(ii) Provisional ballot: The image created by the VVPAT-W shall be clearly identifiable in the case of a provisional ballot.

(iii) Spoiled ballot

(a) The image created by the VVPAT-W shall be clearly identifiable in the case of a spoiled paper record copy. The clearly identifiable spoiled paper record copy shall be shown in the paper record display unit to allow the voter to acknowledge the paper record copy has been spoiled. The VVPAT system shall be designed to prevent a paper record copy from being spoiled after the voter has verified that paper record copy and has cast his/her ballot.

(b) The voter shall have the opportunity to affirmatively spoil their paper record copy no more than two times. An error in recording or printing a paper record copy not caused by the voter shall not be counted as a spoiled paper record copy.

(c) Upon spoiling their paper record copy the voter shall be able to modify and verify selections on the DRE without having to reselect all of their choices.

(d) Before the voter causes a third and final paper record copy to be printed, the voter shall be presented with a warning notice that the selections made on screen will be final and the voter will see and verify a printout of their vote, but will not be given additional opportunities to change their vote.

(d) Language accessibility

(i) The VVPAT-W shall be capable of producing an image in all alternative languages for which the DRE is certified.

(ii) The paper record copy shall be printed in English and in the alternative language when used by a voter to cast their vote on the DRE.

(4) Paper record display unit

(a) Security: The paper record display unit shall allow the voter to inspect the paper record copy without physically handling the paper record copy and shall be physically secure from tampering.

(b) Readability: The paper record display unit shall provide adequate visual space to allow the voter to privately and independently inspect the paper record copy. A paper record copy shall be readable from the same position and posture used for voting on the DRE. The voter shall have the ability to view both the review screen on the DRE and the paper record copy in the display unit simultaneously. If the paper record copy cannot be viewed in its entirety in the paper record display unit at one time, then the voter shall have the opportunity to verify the entire paper record copy prior to either the electronic record or the paper record copy being stored and recorded.

(i) Covering: Any protective covering intended to be transparent shall be in such condition that it can be made transparent by ordinary cleaning of its exposed surface.

(c) Accessibility: The VVPAT components must conform to federal and state accessibility requirements.

(i) This shall include, but is not limited to, an audio component.

(a) The audio component must accurately relay the information printed on the paper record copy to the voter.

(5) Paper record storage unit

(a) Security: The paper record storage unit shall be designed to prevent tampering.

(b) Secrecy: The VVPAT system shall be designed and proper procedures put in place to ensure the printed ballot audit trail is stored in a manner to ensure secrecy of votes so that it is not possible to determine which voter cast which paper record copy.

(c) Capacity: The combined capacity of all the paper record storage units in a precinct must be enough to accommodate all voters using the DREs within the precinct.

(F) Procedure requirements

(1) Update: Testing and certification, pre-election, election and post-election procedures for each DRE voting system shall be updated to reflect the use of the VVPAT. These updates include, but are not limited to:

(a) Testing and certification

(i) Testing: The VVPAT system shall conform to federal and state testing requirements. Required testing shall include, but not be limited to, functionality, security, durability, longevity and accessibility testing.

(ii) Certification: The VVPAT system must be certified for use by the state of Ohio in conjunction with the rest of the voting system with which it is intended to be used.

(iii) Configuration: The VVPAT system shall not, at any time, contain or use undisclosed hardware or software. The only components that may be used in the system are components that have been tested and certified for use in the state of Ohio.

(b) Pre-election procedures: The VVPAT system components must be integrated into existing local logic and accuracy testing requirements.

(c) Election procedures

(i) Malfunctions

(a) The vendor shall provide written recommendations for how to investigate and resolve malfunctions including, but not limited to, misreporting votes, unreadable paper records, paper or ribbon jams, low-ink, low paper, misfeeds and power failures.

(b) The vendor shall include written recommendations for how to recover votes in the case of malfunction to assure a ballot is properly recorded and stored.

(ii) The vendor shall include written recommendations for if the voter does not complete the verification process for their paper record copy.

(iii) The system shall prevent any further attempt to cast a ballot until an election judge has reset the VVPAT/DRE after correcting a malfunction.

(d) Post election procedures

(i) Written procedures shall reflect the use of the paper record copies in the required full manual recount as defined under state requirements.

(ii) The vendor shall include written recommendations for how the secrecy of votes will be ensured.

(iii) The vendor shall include written recommendations for how a discrepancy between an electronic record and its corresponding paper record copy shall be identified, investigated and resolved.

(a) The vendor shall include written recommendations for determining what constitutes clear evidence that a paper record copy is inaccurate, incomplete or unreadable.

(G) In order to provide the secretary information pertinent to the implementation of the voting machines and the security of the voting machines, the individual voting machine vendors must meet the following requirements:

(1) Vendors shall produce all documentation describing materials, equipment, programs, and procedures, including source codes, scripts, and data files, required to develop, install or operate any software, firmware or hardware used in the voting system.

(2) Vendor shall produce the following documents submitted to or resulting from the federal testing and qualification or re-qualification process regarding voting systems:

(a) The technical data package as defined in voting systems standards 2002 (VSS-2002), Volume II, Section 2, or the current voting systems standards.

(b) Within thirty days of testing, Vendor shall furnish secretary with all test reports in the vendor's possession, both published final and intermediate statue reports showing discovered deficiencies and resolution

steps.

(3) Vendor shall produce the following documents relating to each hardware, software and firmware version for any component of the voting system: detailed change logs, hardware change records or logs, test records relating to the changed components, and documents describing the effects of the changes.

(4) Vendor shall execute and deliver to the secretary of state an authorization in a format reasonably acceptable to vendor and independent testing authorities, to enable the secretary of state to obtain information about the status of federal testing and qualifications of vendors voting systems proposed to be used in Ohio.

(5) Vendor shall notify, within two business days, the secretary of state of problems encountered in Ohio and other jurisdictions, whether upon completion of testing or in an actual election, which vendor concludes would reasonably create an impediment to obtaining certification.

(6) Vendor shall maintain in good working order, provided the following are subjected only to normal wear and tear and proper usage, one working version of vendor's voting system, a server containing election management system and peripherals proposed to be used in any Ohio election.

(7) Vendor shall provide the secretary a statement identifying the voting system supplied and affirming that each voting system is state certified at the time of vendor's statement.

(8) Vendors shall implement the following security measures:

(a) Replace hard-coded supervisor passwords with dynamic passwords, and provide directions and training to enable election officials to change these passwords if election officials choose to do so.

(b) Use secure data transmissions between touch screen terminals and the server.

(c) There shall not be vendor controlled security keys and the encryption code shall be programmable by county.

(9) Vendor shall notify secretary of state and the counties, where the vendors system is in use, of any security patches or other software upgrades that vendor recommends to be installed on the server. Vendor shall notify the secretary of any security patches which vendor recommends not be used.

HISTORY: 2004-05 OMR pam. #10 (E), eff. 4-28-05

RC 119.032 rule review date(s): 4-28-10

CROSS REFERENCES

RC 3501.05, Duties and powers of secretary of state

RC 3501.10, Offices of board

RC 3501.28, Compensation of election judges

RC 3506.01, Definitions

RC 3506.05, Certification of voting machines, marking devices, and tabulating equipment; board of voting machine examiners fund

RC 3506.06, Specifications for marking device

RC 3506.10, Requirements of voting machines

RC 3506.17, Voting machine maintenance fund

RC 3506.18, Recounts where direct recording electronic voting machine used

RC 3506.19, Availability of direct recording electronic voting machines to disabled persons

RC 3509.07, Rejection of absentee vote

RC 3513.052, Restrictions on seeking multiple offices

RC 3517.109, Disposal of excess funds and contributions; reports and declarations

RC 3517.1010, Disposal of excess funds

RC 3519.16, Protest against board's findings; establishing of sufficiency or insufficiency of signatures; supplementary petition

OH ADC 111:5-1-01

END OF DOCUMENT

Appendix 6 - Comparing the Count

6.1 Cuyahoga BOE email to ESI[21]

Figure 17: Cuyahoga Explanation for Discrepancy between DRE Memory Card and DRE Election Archive

Steven Hertzberg

From: Jia Wang [bejwx@cuyahogacounty.us]
Sent: Thursday, August 03, 2006 6:53 AM
To: steven@electionscience.org
Cc: Lou Irizarry; Robert Baker
Subject: List and Data for Missing Machines

Attachments: missing_list.xls; esi_missing_card_export.zip


missing_list.xls (29 KB)


esi_missing_card_export.zip (5...

Hi Steve,

I compared the data from the memory cards and the data from TSx units, and pulled out the precincts with non-matching data. There are 18 precincts in total.

With Tyrone's help, we look up those polling locations in the floppy statis report, and find out 10 of those non-matching precincts are results from ballots cast by 17 year-old voters and emergency voters.
These ballots are not cast on the regular TSx machine, the ballot department has to manually enter those ballot into the system after election. Thus, the regular TSx used on election night will not contain those votes, but the official memory cards would.

6 of the precincts are results of 3 machines we couldn't locate at the warehouse, 1 precinct are result of the corrupted official memory card, and 1 precinct are result of a mis-placed official memory card. I've reuploaded data for these 8 precincts to a separate database. The exported data is attached with this email.

I've looked up all the missing cards (both ESI's and the list I have) from the official floppy statis report, most of those machines were either not used on May 2nd, or we've retrieved its data from the accumulator machine (the zero machine). Only 3 machines were used and we could not locate at the warehouse, and it matches the missing machines from the precinct data comparison.

The "missing_list.xls" contains three worksheets, one for the list of missing machines I have, one for ESI's list, and one for the precinct comparison.

Let me know if you have any questions.

- Jia

[21] Due to the late arrival of this email, ESI has not incorporated this additional data into its analysis. However, upon cursory review ESI does not believe that the ballots reflected in this email, namely 17-year-old voters and emergency voters, were cast on the AccuVote-TS voting devices in question. This will require further investigation to determine how to treat the email referred to in this email.

6.2 Missing VVPAT Summaries

Poll Location	Jurisdiction	Vote Center	Machine ID	Machine Serial Number	Canister	Notes
	Cleveland	Salvation Army				No ballots. Bag contained one empty clamshell
1820	Cleveland	Salvation Army	4	251142	3 of 5	Creased paper, this tape had no canister. Was rolled up and thrown in bottom of bag - no summary report
1340	Cleveland	St Mel Hall	0	249896		This is a zero unit tape with a zero report and summary report only. All totals are 0.
2860I00	Euclid	Holy Cross Church	8	249144		No summary on tape. Tape began with ballot cancelled followed by another ballot cancelled. No reconciliation
2860G00	Euclid	Holy Cross Church	6	247817		No summary of tape. Canister blank, no totals on tape.
2860H00	Euclid	Holy Cross Church	7	239400		No summary of tape. Canister blank, no totals on tape.
	North Royalton	Royal Redeemer Luth. Church		257545		No ballots cast - reviewed by director. Tape missing info. Note attached stated It could not fix printer after prelim reports.
4110C00	North Royalton	Royal Redeemer Luth. Church	2	257124		No summary on tape. Paper jam
	North Royalton	Royal Redeemer Luth. Church	17	249976		No summary report, torn paper
	Olmsted Twp	Olmsted Christian Church			1 of 14	No summary on VVPAT to reconcile
4620	Parma	Renwood Elementary			1 of 6	No Summary on VVPAT
4560	Parma	St Anthony's School	6	254812		7 zero reports - 3 votes counted
	Shaker Heights	Fernway Elementary	3		3 of 3	Blank tape, paper in backwards

6.3 Missing VVPAT Cartridges

Jurisdiction	Vote Center (Physical Poll Location)	Machine ID (Memory Card ID)	Cards Cast on tsfloppystatusreport	*Machine Serial Number (from Observance File)*
Bay Village	BAY VILLAGE MIDDLE SCHOOL	1	47	255166
Bay Village	BAY VILLAGE MIDDLE SCHOOL	3	67	237281
Bedford Hts	BEDFORD HEIGHTS SERVICE BUILDING	0	38	240821
Bedford Hts	BEDFORD HEIGHTS SERVICE BUILDING	1	61	253396
Bedford Hts	BEDFORD HEIGHTS SERVICE BUILDING	2	0	*
Bedford Hts	BEDFORD HEIGHTS SERVICE BUILDING	3	53	244007
Bratenahl	BRATENAHL COMMUNITY CENTER *	1	1	238975
Bratenahl	BRATENAHL COMMUNITY CENTER *	2	0	*
Bratenahl	BRATENAHL COMMUNITY CENTER *	3	0	*
Bratenahl	BRATENAHL COMMUNITY CENTER *	4	72	245306
Brooklyn Hts	BROOKLYN HTS. COMMUNITY CENTER	4	63	245322
Cleveland	BROOKLYN HTS.UN. CHURCH OF CHRIST	0	62	259957
Cleveland	CAPTAIN ARTHUR ROTH SCHOOL *	6	0	*
Cleveland Hts	CLEVELAND HEIGHTS HIGH SCHOOL	0	30	258493
Cleveland Hts	CLEVELAND HEIGHTS HIGH SCHOOL	1	27	25115
Cleveland Hts	CLEVELAND HEIGHTS HIGH SCHOOL	2	26	255812
Cleveland Hts	CLEVELAND HEIGHTS HIGH SCHOOL	3	38	254764
Cleveland Hts	CLEVELAND HEIGHTS HIGH SCHOOL	5	36	zero machine
Cleveland	CUDELL RECREATION CENTER	21	1	
Strongsville	EDITH WHITNEY ELEM. SCHOOL	8	0	*
Strongsville	EDITH WHITNEY ELEM. SCHOOL	11	0	*
Strongsville	EDITH WHITNEY ELEM. SCHOOL	13	0	*
Euclid	EUCLID VILLA APARTMENTS	3	26	239372
Fairview Park	FAIRVIEW PARK CITY HALL	2	100	258429
Fairview Park	FAIRVIEW PARK CITY HALL	7	74	240940
Fairview Park	FAIRVIEW PARK CITY HALL	8	76	239451

Jurisdiction	Vote Center (Physical Poll Location)	Machine ID (Memory Card ID)	Cards Cast on tsfloppystatusreport	*Machine Serial Number (from Observance File)*
Fairview Park	FAIRVIEW PARK CITY HALL	10	74	253770
Shaker Hts	FERNWAY ELEMENTARY SCHOOL *	5	0	*
Shaker Hts	FERNWAY ELEMENTARY SCHOOL *	8	1	
Cleveland	HALLORAN SKATING RINK	2	15	248682
Cleveland	HALLORAN SKATING RINK	16	1	
Beechwood	HILLTOP ELEMENTARY SCHOOL	0	56	241120
Beechwood	HILLTOP ELEMENTARY SCHOOL	1	47	255998
Beechwood	HILLTOP ELEMENTARY SCHOOL	2	34	241135
Beechwood	HILLTOP ELEMENTARY SCHOOL	7	31	248716
Euclid	HOLY CROSS CHURCH	0	40	239516
East Cleveland	HURON PLACE APARTMENTS *	8	1	
Parma	JOHN MUIR ELEMENTARY SCHOOL	10	2	
Mayfield Hts	LANDER ELEMENTARY SCHOOL	2	57	241165
Mayfield Hts	LANDER ELEMENTARY SCHOOL	3	0	*
Mayfield Hts	LANDER ELEMENTARY SCHOOL	5	59	242499
Mayfield Hts	LANDER ELEMENTARY SCHOOL	6	55	249757
Mayfield Hts	LANDER ELEMENTARY SCHOOL	7	51	241163
North Olmsted	MAPLE ELEMENTARY SCHOOL	2	84	zero machine
North Olmsted	MAPLE ELEMENTARY SCHOOL	3	70	251047
Cleveland	MORNING STAR BAPTIST CHURCH *	2	15	241476
Strongsville	OLIVE B. ALLEN ELEMENTARY SCHOOL	9	0	*
Strongsville	OLIVE B. ALLEN ELEMENTARY SCHOOL	10	1	
Olmsted Twp	OLMSTED CHRISTIAN CHURCH	4	30	251141
Olmsted Twp	OLMSTED CHRISTIAN CHURCH	5	30	253237
Olmsted Twp	OLMSTED CHRISTIAN CHURCH	8	3	
Olmsted Twp	OLMSTED FALLS HIGH SCHOOL	5	14	235859
Olmsted Twp	OLMSTED FALLS HIGH SCHOOL	9	0	*

Jurisdiction	Vote Center (Physical Poll Location)	Machine ID (Memory Card ID)	Cards Cast on tsfloppystatusreport	*Machine Serial Number (from Observance File)*
Olmsted Twp	OLMSTED FALLS HIGH SCHOOL	11	0	*
Cleveland	PEARLBROOK CHURCH OF GOD	5	1	
Parma	RENWOOD ELEMENTARY SCHOOL	4	66	250142
Parma	RENWOOD ELEMENTARY SCHOOL	5	63	251100
Parma	RENWOOD ELEMENTARY SCHOOL	6	60	253247
Parma	RENWOOD ELEMENTARY SCHOOL	7	50	253248
Parma	RENWOOD ELEMENTARY SCHOOL	9	0	*
Rocky River	ROCKY RIVER LIBRARY	3	0	*
North Royalton	ROYAL REDEEMER LUTH. CHURCH	10	0	*
North Royalton	ROYAL REDEEMER LUTH. CHURCH	14	0	*
Cleveland	SALVATION ARMY – CLARK	6	0	*
Cleveland	SALVATION ARMY - GROVEWOOD	0	15	237548
Cleveland	SALVATION ARMY - GROVEWOOD	1	17	239471
Cleveland	SALVATION ARMY - GROVEWOOD	2	21	251909
Cleveland	SALVATION ARMY - GROVEWOOD	3	20	253833
Cleveland	SALVATION ARMY - GROVEWOOD	4	17	251212
Cleveland	SALVATION ARMY - GROVEWOOD	9	42	zero machine
Cleveland	SALVATION ARMY - GROVEWOOD	11	0	*
Cleveland	ST MEL HALL	15	0	*
Parma	ST. ANTHONY'S SCHOOL	1	3	253316
Bay Village	ST. BARNABAS EPISCOPAL CHURCH	4	0	*
East Cleveland	ST. JAMES LUTHERAN CHURCH *	0	31	251417
East Cleveland	ST. JAMES LUTHERAN CHURCH *	2	26	237231
East Cleveland	ST. JAMES LUTHERAN CHURCH *	3	37	257045
East Cleveland	ST. JAMES LUTHERAN CHURCH *	4	53	239663
East Cleveland	ST. JAMES LUTHERAN CHURCH *	6	35	*
Brooklyn Hts	ST. THOMAS MORE CHURCH	0	44	250482

Jurisdiction	Vote Center (Physical Poll Location)	Machine ID (Memory Card ID)	Cards Cast on tsfloppystatusreport	*Machine Serial Number (from Observance File)*
Brooklyn Hts	ST. THOMAS MORE CHURCH	1	69	243809
Brooklyn Hts	ST. THOMAS MORE CHURCH	2	40	253413
Brooklyn Hts	ST. THOMAS MORE CHURCH	3	0	242529
Maple Heights	ST. WENCESLAS SCHOOL	3	0	*
Maple Heights	ST. WENCESLAS SCHOOL	7	0	*
Strongsville	STRONGSVILLE CTR. MIDDLE SCHOOL	0	0	252290
Strongsville	STRONGSVILLE CTR. MIDDLE SCHOOL	15	1	

6.4 Missing or Corrupt Memory Cards

Vote Center (Precinct Number)	Machine ID (Memory Card ID)	Notes
McKinley Elementary School (3470)	14	Missing Memory Card
McKinley Elementary School (3470)	15	Missing Memory Card
St Wenseslas (3890)	7	Corrupted Memory Card

6.5 Vote Centers where abs(VVPAT Summary – VVPAT Ballot Count) > 10

Vote Center (Physical Poll Location)	Machine ID (Memory Card ID)	Machine Serial Number	Canister Number (on canister)
BOULEVARD ELEMENTARY SCHOOL *	4	248887	3 of 3
BOULEVARD ELEMENTARY SCHOOL *	1	241301	
BRATENAHL COMMUNITY CENTER *	0	253380	1 of 3
EDITH WHITNEY ELEM. SCHOOL	0	254883	1 of 2
HOLY CROSS CHURCH	6	247817	
HOLY CROSS CHURCH	7	239400	
HOLY CROSS CHURCH	8	249144	
JOHN MUIR ELEMENTARY SCHOOL	0	240870	
LUPICA TOWERS *			
OLMSTED CHRISTIAN CHURCH	3	253409	1 of 12
OLMSTED CHRISTIAN CHURCH			1 of 14
RENWOOD ELEMENTARY SCHOOL			1 of 6
ROYAL REDEEMER LUTH. CHURCH	2	257124	
SALVATION ARMY - CLARK	4	251142	3 of 5
ST. JAMES LUTHERAN CHURCH *	1	254690	1 of 1

6.6 Miscellaneous VVPAT Discrepencies

Jurisdiction	Vote Center	Machine ID	Machine Serial Number	ISSUES
Cleveland	Collinwood Branch Library	0	237490	All 3 VVPATs used the same machine serial number. Data is different in all data cells. No notes to explain why same machine was used.
Cleveland	Collinwood Branch Library	2	237490	All 3 VVPATs used the same machine serial number. Data is different in all data cells. No notes to explain why same machine was used.
Cleveland	Collinwood Branch Library	5	237490	All 3 VVPATs used the same machine serial number. Data is different in all data cells. No notes to explain why same machine was used.
Cleveland	Collinwood Branch Library	1	250428	All 3 VVPATs used same machine serial number. Data is different in all data cells. Location changed to Morning Star Baptist Church. Time stamp is not election night. These appear to be reprints after the fact.
Cleveland	Collinwood Branch Library	3	250428	All 3 VVPATs used same machine serial number. Data is different in all data cells. Location changed to Morning Star Baptist Church. Time stamp is not election night. These appear to be reprints after the fact.
Cleveland	Morning Star Baptist Church	5	250428	All 3 VVPATs used same machine serial number. Data is different in all data cells. Location changed to Collinwood Branch Library. Time stamp is not election night. These appear to be reprints after the fact.
Parma		5	251100	These two VVPATs are identical other than canister number, non partisan votes and 1 Flannery rejected vote. No recount was needed.
Parma		5	251100	These two VVPATs are identical other than canister number, non partisan votes and 1 Flannery rejected vote. No recount was needed.

6.7 VVPAT Cartridges that are Missing or Unaccounted for

Location of Cartridge	Quantity	Balance	Notes
Total Known & Unknown Missing VVPATs	≤ 87		No notes
VVPATs from DRE devices with no election day data	24	63	No notes
Known missing VVPATs	50	13	The missing VVPATs were discovered while conducting the manual count.
Unknown missing VVPATs	≤ 13	0	VVPATs from two vote centers were not provided to ESI during the manual count. ESI has been unable to determine the exact quantity of missing VVPATs from these two locations. In addition, ESI is unable to determine whether the VVPATs from these 2 location are missing or were simply not delivered during the manual count.

Section 9

Glossary of Terms

VOTE CENTER – A physical polling location, containing one or more voting devices. The results of ballots cast at a vote center are tallied to report precincts to which the vote center has been defined..

MACHINE ID – A one (1) or two (2) digit ID number of the memory card used to uniquely identify the machine's memory card to its corresponding vote center. This number is assigned according to the sequence in which the machines are opened.

MACHINE SERIAL NUMBER – The factory assigned six (6) digit number of the DRE that identifies the serial number printed on the VVPAT Summary as well as the exterior of the machine itself. We use this number to match the audit tally sheet with the VVPAT Summary. (e.g., 223219).

JURISDICTION – The geographical area over which legal authority extends for the vote center. Typically a city.

VVPAT CANISTER – The VVPAT paper ballots are stored in "clamshell" canisters. Booth workers were instructed to provide identifying information on the canister label, including, importantly, the sequence of VVPAT tapes contained in the canisters – e.g., 1 of 3; 2 of 3; 3 of 3.

PRECINCT NO's – The number of a report precinct, as printed on the ballots. The smallest jurisdictional division within the county. Under Ohio law, voters must cast their ballots in their precinct. Precinct numbers can range from three (3) to five (5) digits. Vote centers contain multiple precincts. Voters were allowed to cast their ballots on terminals outside their precinct; however, they were required to have their ballot access card activated using the card activator in their precinct.

BALLOTS CAST AT EACH PRECINCT – This identifies the total number of ballots cast by eligible voters at a particular precinct. Also called Cards Cast.

VVPAT – Voter Verified Paper Audit Trail.

SECURITY TAG NUMBER – This identifies the numbered label used to seal the canister after election day.

UNDERVOTE – The voter fails to make a choice in a particular contest.

NON-PARTISAN – In the primary, some voters chose to vote only on non-partisan issues. These "issues-only" votes are non-partisan votes.

BLANK BALLOTS (NO VOTE) – Voter did not vote on this particular issue and appears as a blank ballot.

PROVISIONAL – Votes cast on the machines that are not counted until after the Board of Elections has verified the voter's eligibility.

CANCELLED – Voter cancelled his/her vote for particular race or candidate prior to casting the ballot.

REJECTED – Voter changed his/her mind and opted out of original decision to cast ballot.

RECONCILED – In a comparison of the VVPAT summary and its correlating Audit tally sheet, the vote totals are considered "reconciled" if the vote totals match up.

SECONDARY COUNT – In conducting a comparison of the VVPAT summary and the Audit tally sheet, if the totals did not match the VVPAT ballots were subjected to a blind audit (also called second manual count).

POLL LOCATION – This code identifies the location in which a vote was cast.

VVPAT SUMMARY – This is the summary of vote activity on a particular machine. Booth workers were instructed to produce the VVPAT summary at the close of the election. Typically, the VVPAT summary was printed at the end of the ballot tape.

VVPAT BALLOT COUNT – This is the manual count of the each ballot printed on a VVPAT tape. Results of the individual count were recorded on the Audit Talley Sheet.

AccuVote-TS voting device -

SOVC – Statement of Votes Cast. This is typically provided in the form of a paper or electronic report, including the vote counts by race by precinct.

GEMS Server – A proprietary database utilized to accumulated and report the vote totals.

VVPAT Summary - The VVPAT Summary (see sample image to right) is a summary of results for all VVPAT Ballots on each VVPAT Cartridge . The summary is printed when each VVPAT Cartridge is full or at the end of Election Day.

VVPAT Ballots - VVPAT Ballots are the aggregate of all voter verified ballots on a single VVPAT Cartridge. A VVPAT Cartridge may contain over 100 VVPAT Ballots, with each VVPAT containing a record of the vote cast by an individual voter.

DRE Memory Card - The removable storage medium utilized by the AccuVote-TS voting devices to which election and ballot information are written, and from which election results are tallied. DRE Memory Cards are standard off-the-shelf PCMCIA Type II memory cards typically holding 512MB of data.

DRE Election Archive - A storage medium located inside the AccuVote-TS voting device in which election results are stored and election archives are stored. While ESI has not confirmed the nature of this storage device, it is believed to be a standard hard disk drive that stores backup of the data stored on the DRE Memory Card.