



**30th Annual National
Conference San Francisco,
CA**

2014 Professional Practices Program

The Benefits of Audit Log Analysis

Cuyahoga County Board of Elections

Submitted by:

**Pat McDonald, Director
Cuyahoga County Board of Elections
2925 Euclid Ave.
Cleveland, Oh 44115
216-443-6445
Pmcdonald@cuyahogacounty.us
443vote.com**

Background

The Cuyahoga County Board of Elections (CCBOE) is the largest election jurisdiction in the State of Ohio and is comprised of 1,047 election precincts and almost 900,000 registered voters. Optical scanners are deployed for all precincts at over 400 different polling locations on Election Day. Paper ballots are handed out to voters after their credentials are verified and voters are responsible for scanning their ballots using an optical scanning machine with the aid of trained poll workers. The paper ballots are collected in a sealed compartment underneath the scanner and votes are saved to a sealed USB flash drive. Additionally, as mandated by state law, an electronic audit log is constantly recording all events on the voting device. This audit log has provided invaluable insight into voting machine use on Election Day and has allowed for significant election improvements to be made.

Problem

It has been exceedingly difficult to gather high-quality information with regards to Election Day operations at polling locations, specifically regarding voting machine use. In the past, the CCBOE has relied on anecdotal feedback from poll workers, observers, and voters in the form of memos, notes, and phone calls. This feedback included some complaints of error messages being encountered while attempting to scan ballots. Much of this information would be relayed through temporary staff unfamiliar with the proper procedures and nuances of the voting machines. Unfortunately, it was difficult to ascertain the accuracy of these criticisms as there was no hard evidence to substantiate many concerns. The CCBOE would receive grievances about malfunctioning units, but the same units successfully underwent extensive logic and accuracy testing before election use and they would operate without incident after election use when tested by board employees. Reliable information regarding the interaction of the voting machines and the voters needed to be examined to find any problems that existed and work toward a solution.

Example: The CCBOE received copious feedback regarding ballot jams occurring at polling locations, but very rarely would ballots actually become stuck in a voting unit during in-house testing. Hours were spent trying to recreate the issues with no success.

Solution

In efforts to accomplish this, the CCBOE decided to turn its attention to the audit logs that are present on all flash drives in the voting machines. The log files were found and copied from the flash drives, but their format prevented practicable application as they consisted of huge amounts of data points.

- A single precinct contains over 6,000 unique data points for an election. This means when assessing the county as a whole, there are close to 6.5 million unique data points for an election.
- Because all events must be recorded to the log, it was comprised of Election Day information as well as all previous testing. The relevant information needed to be parsed and the data modified into a more usable format.

The CCBOE created a computer program internally that seamlessly extracts, compiles, and summarizes audit log information while also allowing the option to choose a date range to use, e.g. Election Day only. This program allows for the copying of log files in a simple way and without any chance of modifying or deleting any other files on the flash drive. It finds and compiles all requested audit log data into a spreadsheet organized by municipality. Lastly, it creates a summary sheet that shows the quantity of each type of log item and in which precincts the items occurred. This

summary has been crucial and has revolutionized the way the CCBOE examines Election Day voting machine use.

Election Improvements

The Ballot Department initially scrutinizes the data to determine if there were any incidents that should be specially reviewed when conducting our Official Canvass. All anomalies recorded in the log on Election Day are investigated to determine the possibility of any ballots not being counted and any ballots being counted more than one time. All messages that involve ballot jams are investigated, as past experience has shown that this is a source of confusion for both voters and poll workers.

After each election, the audit log data is evaluated to help provide insight and troubleshoot problems. The CCBOE had been studying ballot jams for numerous elections based on feedback provided by poll workers and had been hard-pressed to improve. When audit logs became available to examine, it became evident that ballots jams were being documented by poll workers for many machine incidents that did not involve actual ballot jams. The voting machines provide feedback to voters for many different and legitimate reasons. For example, a ballot with a stub would be returned to a voter while indicating the ballot is too long or a ballot would not be accepted because the voter does not insert the ballot all the way into the machine or fails to release the ballot. These examples would be noted by poll workers as a ballot jam, but the log would indicate the reality of the occurrence. In this case, the data prompted to the CCBOE to define the term “ballot jam” for poll workers and allowed it to refocus its efforts on genuine problems.

The audit log data also helps determine what can be improved upon for future elections. This process has demonstrated great successes, which can be evidenced by improvements in the number of voters attempting to scan their ballot into the wrong precinct’s machine. The CCBOE had a notion this was an issue, but we did not know how prevalent it was until we had quantifiable data. Following the discovery, much more emphasis on voters using the correct precinct’s machine was conveyed during poll worker training and a voter education campaign was implemented. The polling locations and precincts where this problem was most prevalent were pinpointed, which allowed for the concentration of the voter education program in the areas most necessary. Furthermore, colored signs listing the precinct were adorned to each voting machine via large pole to allow voters to more easily identify the correct machine for their use. The fruition of our efforts can be shown in the numbers.

- In the November 4, 2012 General Election voters attempted to scan their ballot on the wrong precinct’s optical scanner 1.30% of the time.
- In the May 6, 2014 Primary Election the number of voters who attempted to scan their ballot on the wrong precinct’s optical scanner dropped to 0.36% of the time, which is over a 70% drop from when the problem was first identified.

Conclusion

The CCBOE has been collecting and utilizing audit log data since 2012 and has continually refined the program and the subsequent use of its information. The statistics provide a critical insight into the interaction between voting machines and voters at polling locations on Election Day. This awareness provides the necessary details to continually improve upon the Election Day experience for the constituents of Cuyahoga County and allow for a more accurate canvass of votes.

AUDIT LOG COMPILER

The screenshot shows the 'Audit Log Compiler' application window. It is divided into two main sections: 'Copy' and 'Compile'.

Copy Section:

- Select Data Source:** F:\
- Select Data Destination Path:** \\desktop\Log Files
- Last copied:** STRONGSVILLE -01-A, DS200, May 6, 2014 Primary Election
- Copy Stick** button

Compile Section:

- Select Data Source:** \\Log Files
- Select Spreadsheet Destination Path:** \\desktop\Log Files\Compiled Spreadsheet\Audit Log Data.xlsx
- Use Filter
- Date Range Begin:** Tuesday, May 06, 2014 5:00:00 AM
- Date Range Ends:** Tuesday, May 06, 2014 10:00:00 PM
- Election Logs
- System Logs
- Compile Data** button

The Cuyahoga County Board of Elections' Audit Log Compiler is comprised of two sections: the Copy section provides for an efficient way to duplicate log files from election media used on Election Day; the Compile section assembles the log files into a spreadsheet that displays all events recorded as separate line items, and summarizes the quantity of each type of event.

AUDIT LOG

Election Title	Precinct Id	Precinct Name	Election Date	Date / Time	Category	Event Code	Description
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:18:28 05/06/2014	P_LOG	1004115	Vote Session Started
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:18:31 05/06/2014	P_LOG	3004101	IMR Log Characteristic Point Status Init 24 New 24
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:18:32 05/06/2014	P_LOG	1004107	Ballot images stored
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:18:32 05/06/2014	P_LOG	1004022	Voting session complete
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:27:30 05/06/2014	P_LOG	1004115	Vote Session Started
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:27:35 05/06/2014	P_ERROR	3003336	Ballot Could Not Be Read. Please remove your ballot and re-insert the opposite end first.
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:29:09 05/06/2014	P_LOG	1004115	Vote Session Started
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:29:14 05/06/2014	P_ERROR	3003335	Ballot Could Not Be Read. Please remove your ballot and re-insert the opposite end first.
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:29:17 05/06/2014	P_ERROR	3013004	Ballot Jam. Please check the paper path.
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:30:05 05/06/2014	P_LOG	1004327	Entered poll worker instructions for ballot jam
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:34:15 05/06/2014	P_LOG	1004328	Ballot jam cleared
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:34:17 05/06/2014	P_LOG	1004123	Voter selected language es
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:34:22 05/06/2014	P_LOG	1004123	Voter selected language en
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:34:41 05/06/2014	P_LOG	1004115	Vote Session Started
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:34:46 05/06/2014	P_ERROR	3003335	Ballot Could Not Be Read. Please remove your ballot and re-insert the opposite end first.
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:34:49 05/06/2014	P_ERROR	3013004	Ballot Jam. Please check the paper path.
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:35:10 05/06/2014	P_LOG	1004327	Entered poll worker instructions for ballot jam
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:35:57 05/06/2014	P_LOG	1004328	Ballot jam cleared
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:36:02 05/06/2014	P_LOG	1004123	Voter selected language es
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:36:29 05/06/2014	P_LOG	1004123	Voter selected language en
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:36:41 05/06/2014	P_LOG	1004115	Vote Session Started
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:36:44 05/06/2014	P_LOG	3004101	IMR Log Characteristic Point Status Init 24 New 24
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:36:46 05/06/2014	P_LOG	1004107	Ballot images stored
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:36:47 05/06/2014	P_LOG	1004022	Voting session complete
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:36:56 05/06/2014	P_LOG	1004115	Vote Session Started
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:36:59 05/06/2014	P_LOG	3004101	IMR Log Characteristic Point Status Init 24 New 24
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:37:00 05/06/2014	P_LOG	1004107	Ballot images stored
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:37:01 05/06/2014	P_LOG	1004022	Voting session complete
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:37:33 05/06/2014	P_LOG	1004115	Vote Session Started
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:37:36 05/06/2014	P_LOG	3004101	IMR Log Characteristic Point Status Init 24 New 24
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:37:37 05/06/2014	P_LOG	1004107	Ballot images stored
May 6, 2014 Primary Election	2002	BAY VILLAGE -01-C	03/22/2014	14:37:38 05/06/2014	P_LOG	1004022	Voting session complete

The audit log displays all events occurring on election media along with date and time. Errors are automatically highlighted red.

AUDIT LOG ANALYSIS

DS200 Occurrence	NOV12GEN Occurrences	Percentage of Total Ballot Pages Cast	Percentage of Total Attempts to Feed a Ballot Page Into Scanner	MAY13PRI Occurrences	Percentage of Total Ballot Pages Cast	Percentage of Total Attempts to Feed a Ballot Page Into Scanner
Ballot Pages Cast	203,554	100.00%	93.74%	16,660	100.00%	94.63%
Blank Ballot Accepted (Part of Ballots Cast)	16,601	8.16%		7	0.04%	
Over Voted Ballot Accepted (Part of Ballots Cast)	841	0.41%		9	0.05%	
Ballot Jam - Ballot Counted (Part of Ballots Cast)	132	0.06%		4	0.02%	
Blank Ballot Returned to Voter	569		0.26%	17		0.10%
Over Voted Ballot Returned to Voter	623		0.29%	22		0.12%
Marginal Mark Ballot Returned	193		0.09%	2		0.01%
Ballot Too Short	39		0.02%	0		0.00%
Ballot Too Long	1,030		0.47%	124		0.70%
Invalid Sequence Type Split for Election	2,451		1.13%	16		0.09%
Multiple Ballots Detected	677		0.31%	3		0.02%
Ballot Not Inserted Far Enough	7,040		3.24%	714		4.06%
Ballot Removed During Scan	0		0.00%	0		0.00%
Ballot Dragged	65		0.03%	1		0.01%
Missed Orientation Mark	854		0.39%	40		0.23%
Ballot Jam During Entry - Not Counted	50		0.02%	6		0.03%
Ballot Jam During Return - Not Counted	272		0.13%	5		0.03%
Total Attempts to Feed Ballot Into Scanner:	217,145			17,605		

Note: The November 6, 2012 data includes the same 181 precincts involved in the May 7, 2013 Primary Election; all other precincts in the County have been omitted for this comparison.

An audit log analysis is completed after every election. Comparisons to previous elections allow for improvements to be seen and quantified.

PRECINCT SIGN ATTACHED TO VOTING MACHINE



The audit logs revealed that in past elections many voters attempted to scan their precinct ballot using an incorrect precinct-specific machine. A large easy-to-see sign was adorned to each voting machine to help direct voters to the correct machine for their precinct ballot. Improvements in poll worker training coupled with the signs helped reduce the number of ballots attempted scanned on the wrong machine by 70% in less than two years.