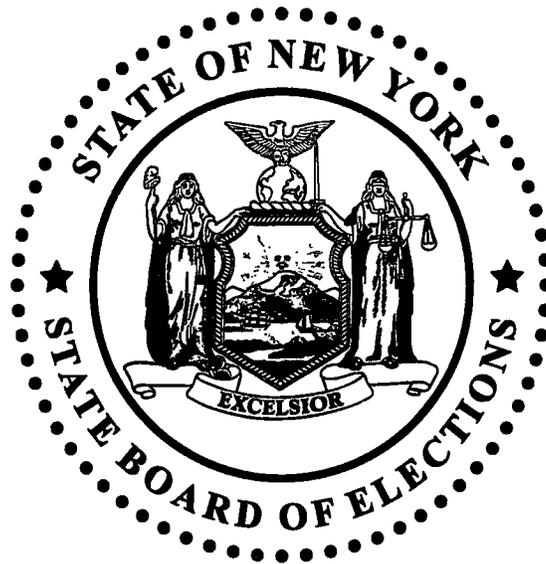**REPORT IN RESPONSE TO THE OPPORTUNITY PROVIDED FOR**

IN A GRANT FROM THE U.S. ELECTION ASSISTANCE COMMISSION

Develop and Document Processes and Best Practices for Coordinating

QUALITY AND COST-EFFECTIVE POST-ELECTION AUDITS

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September 10, 2013

DEVELOPING QUALITY AND COST-EFFECTIVE POST-ELECTION AUDITS

The New York State Board of Elections (referred to herein as NYSBOE) was awarded a grant from the US Election Assistance Commission (EAC), for the purpose of assessing innovative methodologies for the conduct of post-election audits. While there has been and continues to be debate nationwide among election administrators, statisticians, and other election stakeholders concerning, inter alia, the basis and size of any post-election audit, the issue of the need to validate the accuracy of any voting system is a settled one. It is of critical importance for all election administrators to take every step possible to restore the public's faith in the voting process and most importantly, the voting system on which votes are actually cast. The concept of auditing elections and thus ensuring the voting public's highest level of confidence possible in any election, has swung from one extreme - wherein there existed no paper trail of votes cast and no post-election audit requirements for legacy voting systems - to the other, in which extensive and exhaustive statistical-based and risk-limiting post-election audit options have been proposed and/or adopted. The intent of this research effort and the information it produces is to help ensure that common sense be brought to the all-important post-election audit conversation. The New York State Board of Elections, with the assistance of the grant awarded to us by the US Election Assistance Commission, hopes to achieve that goal in this report.

Post-election audits in New York are not election recounts – audits are intended to confirm a voting system's performance, without regard for the closeness of any single contest on a ballot. Post--election audits should be conducted not only on precinct-based voting systems, but on central count systems, as well. The ensuing report concerns itself not with the merits of the various audit options available to election administrators, but rather with the primary intent of the grant as awarded: the manner in which a post election audit can be more effectively accomplished.

It is important to note, in the context of ensuring the accuracy of a voting system, that in tandem with requiring post-election audits, election administrators should also require robust, full-measured pre-election logic and accuracy tests. When considered with the actual configuration of ballots within election management systems and the attendant 'proofing' of that work (prior to the production of ballots and the creation of voting system memory cards or other similar election-specific programming devices), a full-

throated pre-election confirmation of end results of ballot configuration and production processes and the implementation of post-election audit requirements will do much to help ensure the highest possible levels of confidence of not only election administrators, but of voters, candidates, and other stakeholders.

Manual post-election audits consist of the hand-counting of ballots cast, comparing the audit results to voting system results tapes/reports. If the voting system being audited is a precinct-based system, election officials should hand-count cast ballots from a pre-determined number of voting systems used in a particular election (for example, a subset of the number of scanners used in any given election), primarily because of the significant time and effort involved in sorting ballots by political subdivision from a voting system that was configured to count ballots from more than a single precinct or political subdivision. Administrators should adopt written procedures which direct the conduct of any audit, and further, should include escalation thresholds which are clearly defined so that unresolved discrepancies in the vote counts can be further evaluated and/or resolved. If the voting system being audited is a central-count system, election officials should hand-count the cast ballots from a pre-determined number of precincts counted by that system, again with escalation provisions. A copy of New York's audit procedure and sample forms for use during an audit appear in Appendix 2 of this report.

The search for options to consider in the development of quality and cost-effective audits revealed an important distinction in the use of the term 'automated' audit:

- Automated Audit - relies solely on the use of independent software to tabulate subsets of ballots (or all ballots, if required or desired), which are then compared to the tabulated results of ballots cast on voting systems.
- Machine-assisted Audit – is similar to the independent process of an automated audit, however a machine-assisted audit is augmented by the additional requirement that within the subsets of ballots audited, a manual comparison of some subset of actual ballots and audited ballot images be made.

For purposes of clarity, the two audit options most election administrators have heard and read about are described herein:

- Risk-limiting Audit – is based on statistical principles which require that subsets of ballots based on margins of victory, be audited and compared to the vote totals (machine counts) for the same subset of ballots on a contest basis, and further

includes a process which assesses evidence that the outcome of a contest is still correct, even when errors have been identified in the hand-counted results. In a risk-limiting audit, as contest results get closer, the sample size grows exponentially. The audit escalates when differences between audit results and voting system results are significant. Risk-limiting audits concern themselves not with the performance of a system, but rather that the winner of the election was actually the winner.

- Statistical-based Audit – begins with a statistical threshold sampling of ballots which will be audited. The results of the audit counts are then compared with vote results tapes/reports produced by the voting system. By way of example, in the State of New York, county election administrators are responsible for conducting elections, and as such they are required to comply with the State's Election Law which provides for a statutory 3% post-election statistical-based audit. (A copy of New York's statute and regulations appear in this report as Appendix 1.) The statute further directs the State Board of Elections to promulgate rules for the conduct of the audit, and for the process to be followed by county boards of elections for the expansion of the audit when discrepancies are encountered.

There are many published reports and white papers which discuss the types of post-election audits election administrators may consider adopting for statutory, regulatory, or procedural purposes. These reports, and those which discuss the merits of automated vs. machine-assisted audits can and should be assessed by administrators prior to making decisions relating to post-election audits. A bibliography identifying a sampling of audit-related reports can be found in Appendix 6.

When considering the implementation of a post-election audit, and regardless of the type of audit a jurisdiction may choose to conduct (manual, automated, or machine-assisted), election administrators should consider the instances which will require an escalation of the audit, and incorporate same into written procedures. Uniform escalation processes required to be implemented throughout a state will help ensure that in contests which incorporate more than a single political subdivision, uniform audit rules will apply.

In any audit, discrepancies must be resolved to the satisfaction of the audit team and the rules governing the audit. When discrepancies cannot be resolved, an escalation in

the number of systems or ballots to be audited must be provided for. In New York, such guidelines for escalation have been adopted for use in existing manual audits, and are recommended to jurisdictions, as follows:

- Any one or more discrepancies between the confirming manual counts and the original voting system counts which, when taken together would alter the vote share of any candidate, question or proposal by one tenth of one percent (0.1%) or more of the hand counted votes for respective contests, questions or proposals in the entire sample; or
- If discrepancies of any amount are detected between the confirming manual count and the original voting system count from at least 10% of the systems initially audited, the audit team will manually count the votes recorded on all the ballots from no less than an additional 5% of each type of the same type of voting machine or system which contains any such discrepancy or discrepancies.

Any audit escalations, regardless of the increment scale adopted by a jurisdiction, should be well-documented and include each stage of the audit as performed, any discrepancies and reconciliations, if any. The audit stages currently in place in New York, beyond the initial 3% required by statute, include escalations occurring at 5% and 12%, after which a complete manual audit is required. See Appendix 1 for New York's audit statute and regulation, and Appendix 2 for the accompanying procedure.

As with the topic of types of audits a jurisdiction may require, those same reports referenced in the bibliography in Appendix 6 also discuss the parameters of audits, as well as escalation thresholds. The positions presented in these and other published reports can and should be evaluated by administrators prior to making decisions and drafting procedures relating to the conduct of post-election audits.

In addressing the mandate of the EAC's grant award, the NYSBOE sought to evaluate innovative methodologies which would result in quality and cost-effective post-election audits. New York's own experiences with post-election audits reflect the Election Law's statutory requirement that such an audit be a manual one. The grant's objectives prompted research into options available to automate or otherwise machine-assist the post-election audit process.

Internet searches and conversations with election administrators provided little in the way of solid approaches to improving or expediting the actual post-election audit process, regardless of the audit option adopted by any jurisdiction. The NYSBOE then took steps to issue a Request for Proposal, so that a broader and more consistent effort to identify projects that spoke to the purpose of the EAC grant could be evaluated. A single response was filed with the State's procurement office, and upon the successful evaluation of that response, NYSBOE entered into an agreement with ClearBallot Group of Boston, Massachusetts. For the purposes of this report, it was required of ClearBallot Group to:

- demonstrate the ability to independently interpret ballot configurations;
- accurately recognize and tabulate votes cast;
- provide options for the comparison of tabulated voting system results and tabulated audit results;
- easily accommodate the escalation of an audit; and
- generate a variety of reports that would assist election administrators in comparing and evaluating votes cast.

To help election administrators better understand the process of automating or machine-assisting a post-election audit, we further arranged with the ClearBallot Group to create a DVD which would help readers make better understand the discussions presented in this report. That DVD is provided in Appendix 7.

MANUAL POST-ELECTION AUDIT

New York's Election Law provides for a manual audit of subsets of ballots cast in any given election, thus serving the public interest by enabling election administrators to independently confirm the ability of a voting system to properly interpret and award votes marked on ballots cast by voters.

This report considered concerns that:

- Due to the human element involved in a manual audit, the process is a subjective one. There is a natural temptation for audit teams to want to make audit results match voting system results.

- The manual evaluation of votes cast can be inaccurate and unreliable, as each audit team member may differently interpret marks made on ballots by voters and associated voter intent.

- The manual audit process is a time-consuming one and requires considerable staff resources.

- Costs associated with the conduct of manual audits are difficult to anticipate, and may exceed the financial resources available to election offices.

- Manual audits produce no data beyond the record of votes which audit team members consider cast. Therefore, no information is available to election administrators that could be evaluated and used for improving voter and/or poll worker educational materials.

- The manual audit process challenges the ability of election administrators to create and maintain a more transparent audit process, as it is nearly impossible to schedule manual audits by jurisdiction, and no ability to select or identify a time certain for the completion of such audits.

- Also by way of compromising the intent of transparency, the stakeholder participation in a manual audit requires numerous 'observers', the end result being that in many, if not most instances, candidates do not have sufficient

advocates to witness a multi-point manual audit when the ballots to be audited involve broad-based contests which were counted on multiple voting systems.

AUTOMATED POST-ELECTION AUDIT

The automated audit of subsets of ballots cast serves the public interest in much the same way that a manual post-election audit does, however an automated approach provides election administrators with more options and better solutions:

- Automated post-election audit systems and processes must be independent of voting system vendor software and hardware, and as such are able to independently confirm the ability of a voting system to properly interpret and award votes marked on ballots cast by voters.

- Automated audit tools make the audit process less subjective, as the manual interpretation of votes cast is completely bypassed. By removing the human factor from this equation, the audit process becomes much more transparent and completely unbiased.

- The actual processing of ballots to be audited when using an automated audit tool involves considerably less time and considerably fewer staff resources, both of which have a direct and positive impact on election offices and their respective budgets.

- The economies of time and staff resources resulting from an automated approach to audits will enable staff to be redeployed to other post-election tasks, ensuring that the time it takes to canvass, audit, and certify election results can be shorter and the tasks associated with those goals can be better managed.

- The economies of time saved via the use of an automated post-election audit tool will, in a more timely way, assure the public and candidates that vote counts are accurate and that winning candidates are indeed the winners of their particular contests.

- An automated audit process helps to ensure the basic intent of a post-election audit and the goals of transparency. The methodology lends itself to the more efficient scheduling of audits, and the inclusion of candidates, attorneys, and others in same. In addition, stakeholders would no longer need to have a cadre of supporters serving as audit monitors.

- The availability of audit results is much more immediate, and the accuracy of those results is much greater and more consistent than those obtained via manual audits.

- In the event that a subset-based audit requires escalation, there is no significant impact, by way of staff resources, budget or time concerns, as any escalation is easily facilitated. The exponential increased speed with which audited ballots can be processed could allow for a broader expansion of the audit without waiting for anomalies in vote counts to trigger a multi-tiered escalation process. An additional benefit when utilizing an automated audit tool is the ability for election administrators to audit all ballots cast in an election, if the jurisdiction's election administrators were either inclined or required by regulation or statute, to do so. Public faith in the accuracy of election results is more efficiently restored through the use of an independent automated audit tool.

BEST PRACTICES FOR PREPARING AND CONDUCTING A POST-ELECTION AUDIT

New York's sixty-two counties have been conducting manual post-election audits since 2009, when voting migrated from lever machines to optical scan voting systems. A number of best practices have resulted from experiences associated with the conduct of these audits, and have been incorporated into statewide procedures, which are presented in Appendix 2. Audits are required to be performed on precinct-based and central count voting systems, however compliance with the latter provision (in those counties which use central count systems) has been lacking. An additional component in New York's newly-upgraded monitoring program of voting system use is to reinforce awareness of the inclusion of all systems in the post-election audit, including central count systems.

The following are best practices and recommendations resulting from audit experiences:

Preliminary Organizational Work

- Prepare all necessary audit tally sheets for each voting system or batch of ballots that may be subject to an audit, reflecting political subdivisions and in a primary election, those political parties reflected on systems/ballots to be audited.

- Evaluate the audit work to be completed and assign an appropriate number of audit teams and supervisors to the task, taking into consideration the number of voting systems/ballots to be audited and the number of corresponding ballot styles constituting those groupings to be audited. Consider utilizing four-person audit teams, with assigned duties as herein described.

- In staffing an audit, consider bipartisan or other staffing measures that will help ensure appropriate checks and balances, as well as transparency. For example, do not permit a poll site inspector to serve on an audit team that will audit the same contests which were on that poll site inspector's Election Day ballot. Be sure the audit team has adequate supervision, in the event assistance is required.

- In addition to providing written procedures for audit team members to follow, which can be also be referred to during the audit, have each member of the team

including any supervisor or manager, sign an Oath of Office (see sample in Appendix 2).

Organizing the Audit Site

It is critical that the decorum of the audit site is conducive to the important work to be conducted in it. An organized and orderly work space, and as quiet an atmosphere as possible will help ensure the audit teams have an appropriate environment in which they can concentrate and accurately log their findings.

- Work stations (tables) should be placed at distances from each other sufficient to allow for an adequate path of travel for audit team members, supervisors and observers. Observers should be able to hear and see the activity of the audit team, but should not be so close to the team as to hover over them or distract them.

- Sufficient and comfortable seating should be provided.

- Audit team members and supervisors should wear name tags.

- Observers should sign in, and identify whom they represent.   Consider identifying observers with a "Guest Pass" name tag, so that security can be maintained in a crowded and/or active audit site.

Conducting the Audit

It is important that audit team members are not provided with voting system results prior to or during the audit. This will help avoid the opportunity or instance of audit team members' inclination to have audit results match election results.

- The 'read and mark method' has proven to be the most practical method for actually conducting a manual audit. Once ballots have been sorted for audit, an audit team member reads aloud the votes appearing on each ballot to be

audited. A different audit team member should observe the votes being read, to ensure that they have been accurately announced.

- As the votes are read and verified, an audit tram member will mark the vote(s) on a tally sheet, with an additional audit team member observing the marks posted to the tally sheet to ensure that they have accurately been recorded.

- Audit team members should complete and sign all documentation required by their jurisdiction before closing an audit session, then re-package and secure ballots and documents as directed.

Security at Audit Sites

Be sure that when rest breaks are taken, support staff is assigned to guard the ballots and audit documents until the audit team returns, or is replaced.

Adequate supplies to ensure a chain of custody for ballots and audit documents are imperative. Be sure to provide audit teams with:

- Numbered, tamper-evident seals for securing containers into which audited ballots will be placed;
- log sheets to identify to whom ballots have been delivered for auditing;
- a copy of the audit procedures and any additional guidance materials provided by election officials, for reference as well as for demonstration to observers who may question some aspect of the audit process;
- binder clips (no paper clips) and security envelopes or pouches for managing and securing batches of ballots to be audited;
- red pens or pencils, highlighters, post-it notes; and
- containers (boxes, bins, etc) of an appropriate size, into which batches of audited and unaudited ballots can be labeled and placed, to keep them separate and secure.

INTRODUCTION TO THE ClearBallot AUTOMATED

POST-ELECTION AUDIT

ClearBallot Group is one of several vendors that have developed software that can assist election administrators in facilitating post-election audits. ClearBallot's automated audit tool has been developed to serve the election process and election administrators as an independent and automated audit system, and does so by combining modern software architecture and commercial, off-the-shelf (COTS) scanners. In our introductory meeting with the developers of the ClearBallot audit tool to discuss the goals of this grant's directives and how their system might address those directives, we learned that ClearBallot Group shares the mutual goals of validating the accurate performance of voting systems and the accurate reporting of those results.

The intended result of any automated or machine-assisted audit of voted ballots is an increased level of confidence resulting from the ability to derive audit vote totals from ballots and/or ballot images that can then be used to validate Election Day vote totals.

A major requirement of any audit tool is the need for absolute independence from the software used for the original tabulation of ballots cast. Via interviews with the audit system developer, and in the subsequent demonstration of the system, we learned that:

- The developer has no access to voting system proprietary election management system software, which is the nexus of all ballot configuration and production tasks;

- The developer uses no proprietary hardware, and has designed their system to use unmodified, commercial off-the-shelf (COTS) scanners;

- Election administrators provide to ClearBallot the same ballot PDFs which will be provided to a print vendor for ballot production;

- ClearBallot independently converts those PDFs into unique ballot definition files, and readies the audit system to scan, read and report on ballots cast by voters from whatever audit groups the election jurisdiction has identified, or indeed for the scanning of all ballots cast in any given election;

- At no point in the post-election audit process is there any interaction between the voting system proprietary software and the audit system's software, thus maintaining the foundation and premise of any automated audit - complete independence;

- The ClearBallot system, through the use of software, generates reports which provide election administrators with data which they can use to identify and/or evaluate anomalies, trends, or other aspects of the voting process. A sampling of the system's reports can be found in Appendix 4;

- The system uses a high volume batch feed scanner in conjunction with a laptop computer to tabulate votes cast. Tabulation is in real time, and is limited only by the processing speed of the computer. A multi-scanner array is possible, each with its own laptop which can be networked for aggregating votes;

- The system is designed to scan and compare data against Election Day results thus providing an automatic gauge of the accuracy of the election using 'match points', as developed by ClearBallot and defined as a single point of comparison that can be computed by both the voting system and the audit software. Match points for the audit system include the number of ballots cast on the voting system compared to the number scanned by the ClearBallot system, along with a comparison of the number of votes cast by candidate for each system. The audit software includes two types of match points:

   Ballot points – are computed by multiplying the number of precincts by the number of "counter groups" (e.g. Election Day voters, Absentee, Early, etc.). For example, in a jurisdiction with 100 precincts/districts and 4 counter groups – Election Day, Absentee, Early voters and other – there will be 400 ballot match points. The maximum number of ballots cast by absentee voters in Precinct 1 constitutes one match point. The actual number of ballot points reported by the audit software eliminates ballot points where no ballots were cast.

   Vote points – are computed by multiplying the number of candidates/choices in the election by the number of ballot match points. By way of example and staying with the scenario described for ballot points, if the jurisdiction has 100 candidates/choices across all ballot styles, the number of vote points would be 40,000 (i.e. 100 candidates x 400 ballot points). The

number of votes cast for Candidate Jones in the contest for State Senator in Precinct 1 on Election Day constitutes one match point, and just as described above, the actual number of vote points are computed only for actual ballot points.

- The system provides statistical analysis via the comparison of the results output file from the voting system's election management system (EMS) to the results obtained after the scanning of ballots using the ClearBallot software. Analysis could also be performed independent of the system on an administrative level as well, by visually comparing the results reports from the voting system's EMS to those generated by the ClearBallot system;

- The technology has the capability to "electronically scissor out" vote targets for each voting position and to sort ballots by the density of marks made by voters. This functionality refers to the process of extracting a subsection or subsections of a ballot image and displaying the 'scissored' images in a report such as ClearBallot's *Vote Visualization* report (see Appendix 4). This step can be employed to evaluate vote targets or the area around a candidate's name. Hovering over the image's oval in the ClearBallot software application will calculate density and thus assess whether or not the vote will count;

- The system is also capable of providing a list of marginal votes. A sequence of up to 100 of the most marginal votes is displayed in a report, assisting election administrators in determining how those marks and associated ballots were viewed by the system. By hovering over a mark, the system provides the density information of the oval in question; and

- Value-added considerations for election administrators considering the use of automated audit tools include using any software component which can identify 'outside the oval' voter intent.

As mentioned earlier in this report, there is a school of thought among advocates of post-election audits, which maintains that no audit can be considered complete without a manual verification of actual ballots cast. In such a machine-assisted audit, this additional component of an audit process would occur after the automated audit tool has completed the audit tasks required by a jurisdiction's statutes or regulations.

When audit teams maintain the order of ballots as they are scanned during the automated audit, election administrators can match the digital image of any one ballot to that very same physical ballot. In meeting a statutory or regulatory audit requirement for this additional step, the jurisdiction is now conducting a machine-assisted audit. Once the automated audit has been completed pursuant to the jurisdiction's specifications, ballots for this step of the audit may then be randomly selected by audit team members, election administrators, or by any candidate or other stakeholder present at the audit, as the jurisdiction's rules or statutes permit. Ballot images in the audit system are sequentially numbered and labeled, therefore the random selection is made using these unique ballot identifiers. As the audited ballots are required to be maintained in the order in which they were scanned, the audit system will identify exactly where the original ballot which corresponds to the selected ballot image identifier can be found, and a visual comparison can occur. This particular step can be accomplished manually, or the group of audited ballots can be rescanned so that the audit software will stop when the selected ballot has been reached.

In instances when election administrators chose to or may be required to, the tabulation of votes cast from the images of audited ballots may be compared to the tabulation of the images stored by the voting system. The value of this functionality does presume a high level of confidence in the images available from the voting system itself. Election administrators should use future voting system software upgrade or development projects to improve the quality of ballot images captured by the voting system, making them as useful as possible.

PREPARING FOR AND PROCESSING AUTOMATED AUDIT PROJECTS

In the NYSBOE project, and in the application of this tool in an audit, preparations include:

- From the jurisdiction's official ballot PDFs, conversion via the utilization of ClearBallot's software, those same PDFs into unique ballot definition files. Through the use of converter software, the system assimilates the contests and voting options on each PDF, along with political party affiliation, precinct ID, ballot style, and vote target.

- Test the audit system prior to use, to ensure its accuracy. The ClearBallot system can produce its' own logic and accuracy testing data images as a means to confirm the accuracy and readiness of the audit software.

- Create a "target card" (or header card) which contains voter group and sequence group information which tells the system how to categorize the ballots to be audited, and can be subsequently used to help identify a single ballot.

- Download the independently-created ballot definition files to a specifically-designated computer which is connected to the jurisdiction's COTS audit scanner. The audit software resides on a PC/server, to which multiple scanners/workstations can be attached (increasing the ability to conduct multiple audits, or audit significantly large sets or subsets of ballots.

- Scan ballots to be audited, maintaining them in order, not only by the unit to be audited (by scanner, by precinct, by political subdivision, etc.), but also maintaining the order in which the ballots were scanned.

Among the various issues election administrators and staff may encounter in the automated audit environment is an un-scannable ballot. In these instances, ballots in this category should be manually audited, and audit vote results adjusted accordingly. While a process of manual key entry could be developed, and a written procedure to be followed when this instance presents itself could be adopted, the concept of re-

interpreting a voter's choices now becomes a labor-intensive and subjective step in the process, and lends itself to unfavorable audit session scenarios.

There may be instances (albeit infrequently) where blank ballot recognition by the audit system software takes more time than anticipated. This recognition process is the step through which the automated audit software uses the election jurisdiction's official blank ballot PDFs to programmatically identify and map the appropriate contest, candidate, and other data on the ballot, including vote targets and relevant zones of interest (such as the space on each ballot wherein a voter may write-in an alternate choice). This situation can potentially slow down the efficiency of the system, therefore forewarned is forearmed and election administrators should consider this eventuality when creating schedules for the conduct of preparatory tasks required before the audit can occur.

Additionally, ballots to be audited are required to be sorted by precincts - called 'batching' - and are then placed behind target cards, readied for scanning. This preparation is a manual process, and the requisite amount of time to accomplish this task should be allowed for. Clearly this pre-audit preparation time will decrease as staff becomes more familiar with and adept at using an automated audit tool.

For any jurisdiction contemplating the use of automated tools when conducting post-election audits, administrators should be aware of the possibility that some inefficiency might be encountered, relating to any new system or process start-up. This orientation period should be reflected in audit schedules and work plans when first incorporation automation in the post-election audit process. It takes time to understand, learn, and actually implement the various features of an automated audit system, and there is an initial learning curve for staff using the system. Adequate time should be dedicated to hands-on training programs for audit team members and other appropriate staff, before a system is to be used.

FUNCTIONAL TESTING OF AUTOMATED POST-ELECTION AUDIT

Prior to conducting any functional testing of ClearBallot's automated audit system, Voting Equipment Specialists from the New York State Board of Elections (NYSBOE) met with the developers on several occasions, to become more familiar with the basics of the system and to review the impact of changes the developer had made subsequent to our introductory meetings and prior to the commencement of functional testing. Additionally, NYSBOE staff visited the ClearBallot offices and workshops located in Boston, Massachusetts, to better understand and evaluate the audit system in action.

In order to be able to speak to issue of conducting an efficient and cost-effective audit, it was essential that conversations with system developers be frank, and that hands-on demonstrations of the audit system needed to be augmented by the actual deployment of the system in a live-election scenario. To that end, NYSBOE staff scheduled pilot projects in two counties: Saratoga and Schenectady (conducted on October 17 and 18 of 2012), in which an audit was conducted for primary election ballots as cast on both of the voting systems currently certified in New York State. The Schenectady County Board of Elections has selected the Election System and Software (ES & S) DS 200 for use in their county, and the Saratoga County Board of Elections has selected the Dominion Voting System's ImageCast for use by their voters.

To better grasp the operation of the system and the throughput such a system might encounter in a general election, NYSBOE staff revisited Schenectady and Saratoga counties to audit ballots from the 2012 general election, and added an additional visit, to Monroe County to expand the functional overview of the system's use in a larger jurisdiction. (These additional pilot visits were conducted on December 18, 2012 and January 14, 2013).

Aspects of the pilot projects which were considered in the selection process were:

- Adaptability for multiple voting systems (In New York, the two voting systems certified for use are the Election System and Software – referred to herein as ES & S, model DS 200 and the Dominion Voting System's ImageCast model. Version numbers and voting system information can be found in Appendix 3).
- Jurisdictions of varying sizes – in New York the jurisdictions having the responsibility to prepare for, conduct, and audit elections are its counties: In

2012 Monroe County, with 827 election districts (precincts), had 489,615 voters on file, with Schenectady at 120 election districts and 100,859 voters and Saratoga at 196 election districts and 163,782 voters.

- Dynamics of ballot complexity: Six constituted political parties are recognized in New York, and New York conducts closed primaries. Further, New York has unique general election ballot requirements, in that candidate names may appear on multiple party lines in any given general election contest.

The ClearBallot automated audit pilot projects conducted for the 2012 Primary Election, as well as the 2012 General Election were extremely successful. No anomalies in vote count comparisons were encountered. The administrators in the host county boards of elections had very positive experiences and provided helpful feedback:

- The audit teams in the pilot project counties experienced significant time savings, which administrators noted would translate into financial savings. Also, the pilot project hosts recognized that by using an audit tool, they would be able to refine the scheduling of audits, and better reflect when ballots cast in specific political subdivisions might be audited. This value was recognized by the pilot project hosts as helpful not only to them as election administrators, but also to candidates and other stakeholders participating in the audit.

- The election administrators acknowledged that they would be able to re-deploy manual audit team staff members to other post-election tasks, thus increasing each board's ability to better serve their voters (more timely collection of voter history, delivery of notifications of name or address changes occurring on election day, more timely notice of provisional ballot status, etc.).

- The election administrators were able to better serve candidates by providing in a non-subjective or arbitrary way an increased assurance that the voting system performed as intended and votes cast were counted as intended.

- The election administrators noted they were able to have in their own right, a higher level of confidence in the outcomes of the elections they had conducted, and in the accurate performance of their voting systems.

By way of feedback for the State Board's staff and the representatives from ClearBallot to consider, the election administrators made several helpful on-site suggestions, and recommended the following modifications to the automated audit tool:

- that the automated audit system be able to provide more granular reporting, including at the election district (precinct) level, which will result in enhanced reporting capabilities and will generate more data to be utilized for comparison and evaluation;

- that the automated audit system software be reviewed by developers such that the time required to map a ballot style which is not readily recognized by the audit software can be reduced; and

- that the various elements in the user interface be streamlined/adjusted, as the reporting application contains vast amounts of data which may result in confusion for the user/audit team, owing to the number of open tabs within a single viewing.

CONCLUSION

The use of an automated audit tool adds significant improvements to the post-election process of confirming voting system accuracy and the validation of vote results. Apart from cost and time savings, the true purpose of a post-election audit is best served via the use of automation. The functionality of the system we reviewed adds much to an election administrator's desire or obligation to evaluate election results from many viewpoints not possible in a manual audit.

This research paper is intended to be an exploration of how the quality of a post-election audit can be improved, and how such a process can be more cost-effective. Election administrators are encouraged to adopt requirements for and a process to implement post-election audits, and then to review this report and others, to identify methodologies and/or tools which best serve a particular election jurisdiction and its' respective statutes and regulations.

Automated audit tools afford new approaches to the concepts of audits, including the ability to audit all ballots cast in an election in a time- and cost-effective way, producing extensive data sets that can be evaluated by election officials, candidates, voting system vendors, and other stakeholders.

The New York State Board of Elections has used this grant opportunity to consider the value and feasibility of potential changes to its current audit requirements. Open discussions of such changes and of the evaluation of audit processes and tools will further reinforce for all election administrators, voters, and candidates, the highest degree of confidence in voting system performance and election outcomes.

NOTE: Samples of ballots used in New York State (see Appendix 5), and forms provided in this report have been reduced for ease of publication. If you would like to obtain full-size samples of any of the forms or ballots referenced herein, please contact the Election Operations Unit at the New York State Board of Elections.

ACKNOWLEDGEMENTS

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REPORT IN RESPONSE TO THE MISSION AND OPPORTUNITY PROVIDED FOR

IN A GRANT FROM THE U.S. ELECTION ASSISTANCE COMMISSION:

Develop and Document Processes and Best Practices for

Coordinating Quality and Cost-effective

POST-ELECTION AUDITS

New York State

Board of Elections

Post-Election Audit

Statute and Regulation

APPENDIX 1