2010 Pre-Election Logic and Accuracy Testing and Post-Election Audit Initiative

Final Program Executive Summary

In our original concept for this grant project, we envisioned having a program director and two programmers working in tandem with Election department staff with the goal of enhancing our existing pre and post-election testing and auditing and developing programs that can be utilized by other jurisdictions. We feel that we have accomplished most of what we set out to do, however, there were issues with availability of staff to work on the project due to the fact that we the 2012 Presidential election primary and general elections followed very closely by local elections in February and April of this year. The project manager, Mr. Chew, had limited availability during the summers of 2011 and 2012 respectively due to prior business commitments.

Despite these obstacles, we were able to accomplish our major goals of this project: to document our existing testing and auditing procedures which we were able to achieve. With the help of our consultant group, Catalyst, we were able to develop software for Pre-Election L& A testing. Time constraints factored into some of the documentation, such as more elaborate step by step guides to Pre L&A and Post Auditing procedures before the grant period ended. The fact that we were not able to spend even 50% of the funds allocated for this project is indicative of the lack of unencumbered time that could be dedicated to this project and shows how our ambitions were scaled back by the realities of staff availability

What follows is a listing of major highlights of our project:

Major Features of This Project

1. Documentation of our existing high-quality Pre-election Logic & Accuracy (L&A) Testing procedures.
2. Documentation of existing high-quality Post-election Audit program procedures
3. Development of management database for L&A testing, with a toolkit of reports
    a. Commercial Off-the-Shelf technology developed to a downloadable format for use by other jurisdictions
    b. Diagnostic, user-friendly reports
4. Development of a management database for Post-election Auditing, with a toolkit of reports
    a. Commercial Off-the-Shelf technology developed to a downloadable format for use by other jurisdictions
    b. User friendly diagnostic reports helping staff find and investigate discrepancies
    c. Networking capabilities to allow multi-site real-time access for staff
    d. A Report on Election Discrepancies
        i. Categorizes the types of issues that were resolved
        ii. Allows administrative assessment – how well is the voting system working; are we improving;
5. The Voter's Guide to Accuracy of Voting Equipment (see powerpoint

E-VERIFY – Phase 1– Description of Existing Electronic Auditing Procedures
Electronic Verification of PreLAT

Executive Summary – Pre-election Logic & Accuracy Tests are designed to assure the election administrator and the public that votes will be counted properly and accurately. Most jurisdictions do conduct such tests. Yet in some cases, errors can slip through PreLAT undetected. Cook County believes that electronic verification of the results of PreLAT provides greater certainty than a visual check, no matter how conscientious and skilled the visual tester.

Electronic Verification of PreLAT is a method in which the administrator develops a database to predict the results of a well-designed & rigorous test election. The administrator can load actual results into the database and compare them to predicted results, identifying candidates, machines or ballot styles with discrepancies – lines with more or fewer ballots or votes than the predicted total.

Three key insights should be mentioned here.

1) There are many unremarkable causes of discrepancies - test ballots inaccurately marked by staff, staff who feed the wrong number of ballots through a ballot scanner; staff who lose track of where they are in the course of making manual test votes on touchscreens; rare, small flecks in ballot paper that are picked up by a scanner.

2) There are genuine underlying issues of logic and accuracy that turn up in PreLAT, including late court decisions on candidate listings that have been made less than systematically across programmed equipment; ballot design flaws that lead to machine-readable smudges at creases on absentee ballots; inaccurately assigned equipment; and incomplete implementation of late changes to ballot entitlement (assignment of ballot styles to different precincts). PreLAT is not a pointless exercise, so jurisdictions should follow procedures that give an extremely high degree of confidence that PreLAT is identifying all discrepancies.

    a. Here we would note that some of these examples come from the consulting work our staff have done with other counties. Errors in logic and accuracy are not unique to Cook County.

3) A visual check of results sometimes misses such discrepancies, whether because of mental fatigue, distraction, or in situations where the overlay of two ballot styles or different types of machines creates a vote-pattern that looks correct (i.e. – 2,4,6,2,4,6, 2,4,6) but isn't correct (should be 2,4,6,1,2,3,2,4,6)

    a. As in 2-a) our staff can confirm that the frailty of a visual check of results is not an issue unique to Cook County. Other counties fail to notice some discrepancies when "eyeballing" prelat results.

The goal of Electronic Verification of PreLAT is to find every single discrepancy and trace it back to its source. This allows the administrator to assess the nature of the error, either verifying that

machines accurately counted test votes that were cast (in cases where PreLAT testers made mistakes) or to correct any flaws in election database logic or in machine accuracy.

The E-Verify Project assumes a jurisdiction already completes some form of PreLAT, so we'll spend most attention on how to incorporate electronic verification into PreLAT, providing enough description of our own PreLAT policies so other jurisdictions can see where their distinct PreLAT policies may require different approaches to verification

Electronic Verification of PreLAT

– Preparation for Electronic Verification

In every PreLAT regime, administrators choose a desired vote pattern and then run a test set of votes cast in that pattern, checking the output to verify that the test pattern is met. In an Electronic Verification setting, you must choose a pattern that can be generated exactly by a database using normal mathematical operations to arrive at an output that mimics the results as provided by your tally system.

This may be more complicated than it seems, depending on what you are testing and how you receive those streams of data. You'll need to think about your different streams of votes, at which points in the process you want to test them and how you receive the test tallies. Are there reasons you use different vote patterns in those different streams? Do you need the same size test set for different streams of results? In most cases, it's recommended to look different tally sets separately, though there may also be reasons for aggregating votes from different streams.

We will walk through Cook County data streams to give examples of how this can work.

Cook County PreLAT

Cook County voters can vote early on touchscreens, by mail-in absentee on optical scan paper ballots, and they also have both touchscreen and optical scan paper options on Election Day. Thus, we have four different streams of votes to be verified. We do so at four different points.

Election Day Optical Scan Paper ballots for all 1673 precincts go through PreLAT on a small set of 10-12 scanners, using the memory device or cartridge ("Memory Pack" in Cook County) prepared for each precinct, to test the election and ballot composition logic on the cartridge (Accuracy, which is inherent in a machine, not a cartridge, is tested later, on the actual scanner assigned to each precinct.) Immediately after a cartridge's logic has been tested, the scanner cartridges are uploaded into our Tally System (WinEDS. We run the electronic verification after every 20-60 precincts have been tested. For this precinct optical scan vote stream we use a test pattern on every ballot style that would displaying a 1,2,3,1,2,3 results pattern for each contest on a ballot. Precincts can have multiple ballot styles that have contests overlapping in different ways which leads to a modified vote pattern when all testing is complete.

Thus, in Precinct A, with two ballot styles that share the first two districts (President & Senate) but have different districts lower down the ballot (House), and then they share a county office, we wind up with results like this:

President – 2, 4, 6, 2, 4, 6
Senate – 2, 4, 6, 2, 4, 6
House 1 – 1, 2, 3, 1, 2, 3
House 2 – 1, 2, 3, 1, 2, 3
County – 2, 4, 6, 2, 4, 6

Obviously, the above demonstrative pattern assumes six candidates or marking locations (we vote write in lines) per contest. If there were only five marking locations in Senate contest above, for example, the results would look this:

President – 2, 4, 6, 2, 4, 6
Senate – 2, 4, 6, 2, 4,
House 1 – 1, 2, 3, 1, 2, 3
House 2 – 1, 2, 3, 1, 2, 3
County – 2, 4, 6, 2, 4, 6

The salient point being that at each change in contest, the vote pattern begins again. Other election administrators may choose different patterns but this is ours.

Election Day Touchscreens are tested through manual voting and the use of a vote simulator program that automatically generates a pattern of 1, 2, and 3,1,2,3 for every contest on every ballot on each touchscreen. For the manual test voting staff cast a single vote for each of two candidates in the first contest on each touchscreen. Thus, if Precinct A from the above example is assigned three touchscreens, we would expect Precinct A to return results like these:

President - 6, 9, 9, 3, 6, 9
Senate – 3, 6, 9, 3, 6, 9
House 1 – 3, 6, 9, 3, 6, and 9
House 2 – 3, 6, 9, 3, 6, and 9
County – 3, 6, 9, 3, 6, 9

Because each machine is tested for all styles, like the optical scan testing, we expect any given touchscreen machine in a precinct to have the same pattern as the single optical scan cartridge in that same precinct. Because we assign and test three, you must use the multiplier of 3. Finally, because we asked testers to manually cast two ballots, each containing a vote for each of the first two candidates in the first contest, you would add three votes to each of those candidates' totals.

Mail-in Paper Ballots are counted on a high-speed ballot counter (400-c). We use test decks marked for Election Day Paper Ballot PreLAT. Because we have traditionally had relatively few mail-in ballots cast, we have chosen to do an abbreviated PreLAT, testing 10% of all ballot styles in a given election.

In the most recent election, this was 50 test decks of about 30 ballots each - 1,500 ballots, which were then on each of 3 ballot counters for a total run of 4,500 ballots. This approximates the number of ballots actually cast by mail this election. A run of all ballot sets on each machine would have required a 45,000 ballot run, which was deemed out of scale to the number of voters using this method of voting.

Early Vote Touchscreens use a vote simulator that produces a 1, 2, 3,1,2,3 pattern in each contest, countywide. In addition, staff cast two votes on each touchscreen – a single vote for each of the first two candidates in the first contest. A given precinct might have 0s in all contests except one. Many precincts would have no votes at all. In most contests that were voted, vote totals would equal 1, 2, 3 multiplied by the number of machines used, but in the first contest, each of the first candidates would have additional votes equal to the number of machines used. Thus, in an election with 10 machines used, the pattern in Precinct A might be:

President	20, 30, 30, 10, 20, 30
Senate	0, 0, 0, 0, 0, 0
House 1	10, 20, 30, 10, 20, 30
House 2	0, 0, 0, 0, 0, 0
County	0, 0, 0, 0, 0, 0

Thus, our different vote types generate very different patterns of results, which have to be assessed separately. In Election Day Paper results, contests 1, 2 and 5 share the same pattern, and 3 & 4 share a different pattern. In our Election Day touchscreen results, contest 1 has a unique pattern, and all other contests share a second pattern. In Early Vote touchscreens, results are different in different precincts, but all contests except the first have identical patterns. And in Mail Paper, the pattern is the same in every precinct with votes, but relatively few precincts have votes.

OUR E-Verify Guide

1) Identification of vote streams & their vote patterns
    a. Precinct Touchscreen, Precinct Optical Scan; Early Vote Touchscreen; Mail-in Optical Scan.
    b. Testing dates for each
    c. Test methodologies for each
        i. Number of ballots to be cast per style and/or overall
        ii. Selection of appropriate vote patterns
            1. Different patterns for TS vs.
            2. Special issues – vote for >1 contests.
            3. over vote, under vote and blank (and how verified)
            4. Over vote in multi-candidate contests?
    d. Staff selection & training
        i. Consider the amount of staff time required

2) Database Prep for Scanner Verification
    a. Gather tables
        i. Precincts to ballot styles
        ii. Ballot styles to district
        iii. District to contest (for instance, when multiple city offices are up for election)
        iv. Contest to candidate (and position)
        v. Ballot position to vote total
    b. Incorporate the new precinct table allowing for marking off completed precincts, updating status for both touch screen and scanner and saving comments for each machine.
        i. Key was that it allowed for a simple, easy-to-download and to-read report
3) Paper Ballot Marking –
    a. Special attention should be paid to over vote marking in multi-candidate contests.
    b. Likewise, proofers should at a minimum look at last contest on front and back, which are most often missed.
    c. An effort should be made to use the same color of pen throughout initial marking.

   d. This allows us to use a different colored pen for any re-marking during ballot running (i.e., any corrections done based on manual checks prior to the computer check). This way, it's easier to diagnose errors found by computer.
   e. Absolute accuracy is not necessary in ballot marking, since discrepancies from pattern allow us to verify that the vote was counted accurately. But a high degree of accuracy makes it easier to track down a small number of discrepancies thoroughly and without disruption to the ballot-running process.
4) Space & materials prep considerations
   a. Need at least 5 large tables for materials prep and final placement;
   b. Consider flow of envelopes and bins – from where to where.
   c. Each Scanner needs space for
      i. precincts awaiting processing;
      ii. the ballots that need to be run
      iii. The ballots that have just been run.
      iv. Providing sufficient space will help us keep ballot sets in numeric order.
   d. Need at least 20 bins
   e. Need a computer with WinEDS and Microsoft Access (can it be networked – if so, what network folders can be used
5) Ballot Runs on Scanners
   a. Cartridges are labeled with ballot styles that must be run
      i. Currently, staff use a chart to label them by hand on post-its.
      ii. We should use the envelopes instead of the charts to label the cartridges.
      iii. This means labels must be printed ahead of time – Yolanda mentioned that labels weren't available when she began running ballots this year.
      iv. Envelopes should be staged in mail-bins by township.
      v. Related note - the two unrelated precinct-numbering systems create many problems for temp staff, since they don't really understand either system. Eliminating code number would make organization of this process simpler.
   b. Scanner cartridges and ballots are given out more than 1 at a time, in sets that require the same groupings of ballot styles. Still, an effort should be made to run them in alpha numeric order, which allows for easier verification.
   c. Staff should try to keep ballots in order after running, because this facilitates faster discrepancy tracking.
   d. Ideally, ballot staff would mark each precinct that a given set of ballots is used for on either Ballot #1 or on the No Initials ballot. This too would allow for more rapid discrepancy tracking.
   e. Any re-marking should be done in a different color than the original color, to distinguish remarks for the purpose of tracking discrepancies in precincts already run.
6) Cartridge Loading
   a. A staffer in the scanner room should be set up to upload Scanner Cartridges as they are completed.
   b. This staffer should be responsible for creating labels for bins of 20 envelopes. We should almost always stick with 20/bin, and always have them labeled.
   c. The staffer is responsible for organizing the space and labeling space so it is clear where scanner staff should leave cartridges to be uploaded, etc.
   d. The staffer must have a WinEDS connected computer.
      i. Staffer needs appropriate passwords

e. Ideally, this computer would also have Microsoft Access and a printer connection to allow for printing of tracking items.
    i. This staffer might be responsible for helping organize the work. This staffer would probably not be involved in the database loading and analysis.

7) Scanner Verification
    a. Check WinEDS to see that a desired group of cartridges is loaded.
    b. Stop Tally
    c. Wait 30 seconds before Loading Data (in the reporting tool). This should allow recently uploaded cartridges to spool.
    d. Wait 30 seconds before running the batch job for the appropriate Block (the batch jobs reside on the WinEDS server)
    e. Check the results for the desired township to be sure that the latest data has spooled.
    f. Delete old records in the table "Prelat Results".
    g. Import new data
    h. Check the Scanner Verification Query
        i. In the "Prelat Status" Database, mark off precincts that are verified
        ii. Analyze data for precincts with discrepancies and summarize what needs to be checked in the Prelat Status Database.
    i. Run the Scanner Issues Query
        i. NEW – this should include ballot styles for each candidate if possible.
        ii. Give tasks to staff who can check discrepancies.

8) Touch screen Card Activator PreLAT
    a. Simple process
        i. Must be simple enough that floor leaders can run this without much thought, given the wide range of other things they need to track down
        ii. One critical issue – how quickly does tally spool when Mark's program is on Auto-Load?
            1. I'm wondering whether tally is delayed
            2. Auto-load is pretty crucial, since this eliminates a confusing three-step for floor leaders – cutting off tally, loading in the Reporting Tool, then reinstating tally
    b. Ensure that the envelopes indicate which candidates get the manual and auto votes
        i. Indicate selection code
        ii. Indicate proper totals for each to allow staff to proof their own work.
            1. It should say "5 votes on Card Activator tape" to avoid having someone cast 5 manual votes.
    c. Emphasize to setters the goal of putting precincts on the table in alpha-numeric order
        i. This isn't a rule.
        ii. But it's an important guideline – in the past, we've used the fact that a few precincts inevitably come out of order to cover for the fact that the setters really weren't trying to set precincts in order.
        iii. Keeping them in order does help us track what's going on and recognize quickly when a precinct is lost. It creates a smoother workflow for the unit testing scanners at the VSCs.
    d. Database Prep for touch screen PreLAT
        i. Is direct linkage with Nate's Prelat database possible
            1. Probably not b/c it needs to be on a different network

2. If coordination is possible, pull names of staff completing each precinct in order to make discrepancy follow-up simpler, quicker

ii. Import machine assignments

iii. Ensure that the table handles manual and auto votes properly

e. Verification of Touch Screen vote pattern

i. Follow the same routine as for Scanner prelat verification (section 6)

Ballot Marking
Step-by-step

Organizing Ballots & Space

Ballots are received from the printer by ballot style in the form of 'Test Decks' – usually 35-75 ballots depending on the number precincts using that ballot style.

- We get test decks for a lot of ballots – 546 styles in 2012 primary
  - 2 parties & a non-partisan ballot with referenda
  - federal ballots that are coded to each Congressional District
  - Specified precincts of Hindi/English and Chinese/English ballots (Spanish is included on the first run sets.)
- Though the primary use is for testing precinct scanners, some ballots will be used for mail-absentee testing (i.e., the 400-C).
- A staffer signs for them box-by-box
  - We've requested that they be shipped in alphanumeric order where possible (they're printed by size of press run, but this should allow for reasonable orderliness.)
  - We should <u>immediately</u> put them in labeled bins of about 20 ballot styles
    - A copy of the label is below
    - Labels should allow for
      - Missing precincts in a given township
      - Various stages of completion (1st mark, 2nd mark and proofing)
- Space required
  - Work Tables
    - 1 table per pair of ballot markers doing 1st mark
    - 1 table for "2nd mark"
    - 1 table for proofing
  - Shelving/tray storage
    - Shelving for unmarked ballots (up to 80 trays if all primary ballots come in at once.)
    - designated, signed space for ballots at each stage above (1st mark completed, 2nd mark completed, proof completed)
    - shelving for marked ballots (up to 800 ballot styles in a local election)

Marking the Ballots

The ballot sets will deteriorate after use, so we need additional sets for styles used in a greater number of precincts

1-6 precincts 1 ballot set
7-12 precincts 2 ballot sets

13-20 pcts. 3 ballot sets
21-30 pcts 4 ballot sets
31-40 pcts. 5 ballot sets

Develop voting pattern

- The standard is 1-2-3-1-2-3
- Large, vote-for-more-than-one contests may trigger large numbers of test ballots. It's possible to minimize ballots used by carefully voting a "2nd marking" for vote-for-multiple contests.
    - Use extreme care (only move 2nd marking candidates up to ballots that are run the same number of times – i.e., move a candidate 9 to a 3rd ballot, but not to a 1st ballot.

First Marking – Assign each townships ballots to a pair or group of 3

- This is key – so that you only have a limited set of townships in play at any one moment.
- If you have 15 people, all grabbing ballots from anywhere, you may have 10 townships active, and it's very difficult to figure out where something may be if it goes missing.
- In some cases, it may be preferable to have the two markers marking different portions of the ballot set. You could divvy work up by front and back of ballot; or by ballots 1-3 and 4-6; This helps reduce complexity for a given staffer and allows them to zero in on the idiosyncrasies' of a particular part of the ballot.
- Training emphasis: most mistakes are on one-person contests that disappear, or on contests that are "hidden" (the only one at the top of a column, or the only one on the back.
    - Show examples during training
- Ballots should be handled by township, not by individual precinct. A bin should be pulled, completed then put back in order and moved to its new status. (i.e., 1st mark completed)

2nd Marking

The idea of second marking is to mark races that have marks beyond the normal pattern, for reasons of convenience, simplicity and or time-effectiveness. For instance, we had two 12-person contests in March 2012 in an election that otherwise required only 6 ballots. We wanted to mark these two contests on Ballots 1-6, but having the primary markers do this would have created a huge potential for 'distraction errors' (i.e., errors where staff know what to do, but it requires closer attention, and they're apt to fail occasionally.)

- Assign a small number of people to this task, since it usually requires somewhat more close attention.
- On the other hand, usually 2nd marking will go quicker since relatively few contests require a 2nd mark.
- Create a special area for 2nd marking; near the area where 1st Mark Completed trays are kept;

Proofing

- The first ballot sets completed by any given staffer should be proofed immediately and VERY thoroughly. Pay special attention to lines that might not pop out:
    - Single-candidate contests
    - Contests that are the only one in their column
    - Contests on the back, particularly in series of ballots where most of them have nothing on the back

    - contests that have a #3-#6 ballot on the back in a series where there have been few such contests (i.e., where staff may have gotten in the habit of only looking at the back for the 1 and 2 ballots)
- Again, handle everything township by township, not precinct by precinct.

Final Shelving

- Proofed sets can be shelved by ballot style
- Extra ballots can be re-boxed and held
- "Bad Ballots" can be sorted and kept – may be possible to reuse one in a pinch.

Bin Label (adjust font sizes) #1

Township:

Missing Precincts: _____

_____

First Marking Complete: _____

Second Marking Complete: _____

Proofing Complete: _____

Bin Label #2 (for "Extra Ballots" – print on different color)

Township: ALL CAPS

Missing Precincts: _____

THIS SHELF FOR TRAYS WHERE

1ST MARK IS COMPLETE

THIS SHELF FOR TRAYS WHERE

2ND MARK IS COMPLETE

THIS SHELF FOR TRAYS WHERE

PROOFING IS COMPLETE

THIS TRAY HOLDS

BAD BALLOTS

Cook County Post-Election Auditing:
A Description of Existing Procedures

Executive Summary

The goal of the Post Election Audit is to assess whether votes were counted accurately. The components of this testing should include:

- the Canvass – testing whether aggregate results match the results generated by vote counting equipment in precincts;
- the Percent Recount – verifying in a random set of precincts (5% as determined by law in Illinois) that the results generated in precinct match the ballots as cast by voters.
- the Ballots Cast Audit – verifying that the number of votes counted matches the number of voters who signed in.

Canvass

The goal of the Canvass is to ensure that the results that the election judges (poll workers) in precinct have signed off on match the results returned to the election authority for publication. Precinct results have been transmitted from precinct to central office electronically, and while the possibility of error or tampering may be remote, the goal is to prove that that has not happened. In Cook County, this is done orally, with one staffer reading the results from the precinct results tape aloud while another staffer follows along on the report generated by our central tabulating system. Results for every precinct are check.

Percent Recount

The goal of the Percent Recount is to verify that the results generated in precinct and transmitted to the central office accurately reflect the votes cast by voters. This is done by recounting paper ballots, and by examining and recounting the Voter Verified Paper Trail for touchscreen votes. In Illinois, a touchscreen voter is given a chance to review those candidates he or she 'touched' via a receipt tape visible to the voter until they touch the 'cast ballot' button and the tape scrolls away. This tape is the legal vote.

Again, the procedure in Cook County is an oral count by two staff, one of whom examines the voters ballot and states each selection made, while the other tallies. At the end, the tallies are counted and compared to the official tabulation to ensure they are accurate. The theory behind the percent recount is that a small sampling is sufficient to identify major fraud, and that the risk of minor fraud deciding a close election is countered by the candidate's right to seek an examination of records and/or a complete recount. Illinois law sets 5% as the number of precincts that must be recounted to guard against major fraud.

The Ballots Cast Audit

The goal of the Ballots Cast Audit is to ensure that election judges (poll workers) counted ballots for every voter who voted, or determine why they may not have done so. Traditionally, election judges completed this task by reporting the number of votes and the number of applications for ballot, and where the numbers mismatched, the judges explained the discrepancy. As the complexity of elections has increased, judges have faced new difficulties – understanding how to count applications for ballot (Illinois law provides for provisional affidavit voters with a pre-printed application and those without, and election judges have misunderstood this in creating their count of

voters; and successfully adding up votes. (Touchscreens return the number of voters, but when the size of the ballot requires two ballot cards, paper ballot counters return the number of cards, so judges may have to create ballot totals using the formula a + b + c/2). While the majority of poll worker teams return accurate reports, some fail at the task, and their failure may hinder the ability of the election jurisdiction to identify other issues (for instance, the 'falloff' generated by voters who fail to finalize their touchscreen vote before existing the precinct; or the occasional failure of judges to notify the central office that some paper ballots weren't counted because of a machine failure.)