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***CONSULTING AND TESTING SERVICES  
RISK ASSESSMENT STUDY OF  
OHIO VOTING SYSTEMS***

**EXECUTIVE SUMMARY**

Developed for:

***STATE OF OHIO  
SECRETARY OF STATE***

Document Number SL-OH-EXSUM-FRPT-01,

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## 1. INTRODUCTION: EVEREST PROJECT

The Ohio Voting System Risk Assessment was intended to independently assess the risk that the State of Ohio electronic voting processes and systems will operate reliably and produce accurate results. SysTest Labs' areas of assessment on each of the three (3) State of Ohio certified voting systems were:

- a. Configuration Management
- b. Election Operations and Internal Controls
- c. Performance Testing

These systems include Election Management software, Direct Recording Electronic systems (DRE), Optical Scan systems, and Ballot Marking systems with trusted software builds, as noted below.

<u>Vendor</u>	<u>System</u>	<u>Description</u>	<u>Model #</u>	<u>Software/ Firmware Version</u>
ES&S	Unity	Election Management software		3.0.1.1
	Automark	Ballot Marking System	87000	1.1.2258
	iVotronic	Voter Dre	90998-BL	9.1.6.4
	iVotronic	Supervisor DRE	91057-BL	9.1.6.4
	iVotronic	ADA DRE	93038-BL	9.1.6.4
	Model 100	Tabletop Opt Scan Counter	76102B	5.2.1.0
	Model 650	High Speed Opt Scan Counter	50650	2.1.0.0
Premier	GEMS	Election Mangement software		1.18.24
	TSX	Voter DRE	TSx	4.64
	Accu-Vote 2000	Tabletop Optical Scan Unit	AVOS	1.96.6
	AccuVote OS Central Count	High Speed Optical Scan Unit	AVOS	2.0.12
	VC Programmer	Hardware for programming key cards	ST100	4.6.1
	Key Card Tool	Software for programming key cards		4.6.1
Hart	Ballot Origination, Tally, Rally & Servo	Election Management Software Components		

<u>Vendor</u>	<u>System</u>	<u>Description</u>	<u>Model #</u>	<u>Software/ Firmware Version</u>
		BOSS		4.3.13
		Tally		4.1.10
		SERVO		2.3.7
		Ballot Now		3.3.11
		eCM Manager		1.1.7
	e-slate	DRE	e-slate 3000	4.2.13
	e-scan	Precinct Opt Scan Counter	e-scan	1.3.14
		Judges Booth Controller		4.3.1
		Verifiable Ballot Option (VVPAT)		1.8.3

## 1.1. General Assessment Information

### 1.1.1. Configuration Management

The SysTest Labs Risk Assessment Team performed a Physical Configuration Audit and reviewed supporting documentation for each of the manufacturer's voting systems installed at the State of Ohio Computing Center in Columbus, Ohio. The purpose of the audit was to verify that the configurations of the sample systems, as defined by the hardware, firmware and software revision levels, was on the State of Ohio's list of certified systems.

In addition, the SysTest Labs team assessed the processes and procedures used by the State of Ohio to manage the equipment configuration in the field. Of particular interest were the configuration management practices for ensuring that the equipment was at the proper certified level and how updates and upgrades are managed and controlled.

SysTest Labs also conducted a review of the Logic and Accuracy (L&A) procedures in use by a select set of eleven (11) counties (specific counties were selected by the Secretary of State). We particularly looked for consistency across the State of Ohio certified and deployed vendors' equipment and if the procedures included steps for the verification, both before and after an election, of the hardware, firmware and software versions in use by the counties.

### 1.1.2. Elections Operations and Internal Control Assessment

The objective of the Election Operations & Internal Control Assessment was to determine whether existing or proposed policies, procedures, internal controls established in existing Vendor documentation and County practices are sufficient to ensure secure and accurate elections based upon software, hardware and operational vulnerabilities identified during previous and current testing phases. Our approach to this aspect of the risk assessment activity is much broader than may be used in other

phases of the project. Risks to elections operations and internal controls, in our view, includes any action (or inaction) that has the potential to adversely impact the accuracy, timeliness and transparency of an election beginning at candidate filing through recounts, but with emphasis on voting systems.

SysTest Labs team took a holistic approach to this assessment, addressing the entire election process of which voting systems are one singular component, albeit the most visible one. The research effort has included on-site interviews and assessments that have focused on internal control operational policies, procedures and processes which a representative sample of Ohio counties employ and the impact they have overall on security. Additionally we have included a review of Vendor documentation provided in support of the various voting platforms in use throughout Ohio.

SysTest Labs supports the understanding that a voting system is part of a larger process, and that well implemented security and operational policies, procedures and processes can significantly reduce any level of risk, much of which must be developed locally to reflect not only the specific voting system platform, but the unique nature of the environment in which the system is used. This is consistent with our view that the greatest risks to the voting process and the integrity of elections are not created by voting technology but rather by management practices, operational constraints, inadequate funding and resources, regulatory frameworks as well as less than helpful/useful Vendor documentation.

It is important to note that many risks to elections originate from poor management practices, inadequate training, complex and voluminous Vendor documentation, human error, unnecessarily complex and cumbersome laws and regulations, inadequate funding and resources, and partisan advantage. Many of these effect the ability of the election community, i.e., local election officials, state election officials and legislative bodies, to be effective in preparing for and running an election..

Other assessments have focused, and continue to focus on external threats to voting technology which may or may not have merit. The solutions to election administration issues, voter confidence and the security and integrity of elections are not to be found solely in the technology. Regardless of the thoughtfulness and thoroughness of a design, the complexities and cost associated with creating systems that are 100% secure solely on their own is unrealistic. True security is a combination of technology related security techniques and security measures found in thoughtful, well documented policies, procedures and processes for internal controls that are reflective of both a specific locality and a specific voting system.

### **1.1.3. Performance Testing**

The purpose of the Performance Testing portion of the risk assessment was to determine if there were any risks to the integrity of an election and accuracy of the vote counts when using each of the certified voting systems as defined by the Vendor documentation for normal usage. SysTest Labs developed a Performance Test Plan and associated Test Cases that defined the approach the Test Team used to provide the State of Ohio Secretary of State (SOS) with performance testing on the Unity, GEMS, and Ballot Origination, Tally, Rally & Servo Voting Systems developed by ES&S, Premier, and Hart InterCivic respectively. .

SysTest Labs performed:

1. Usability tests as defined in the EAC guidelines; however, these did not include ballot layout and disability testing
2. Volume testing to verify that at capacity a warning or error message alerted the poll worker to ensure the system does not overwrite existing data
3. Performance testing to ensure that votes are counted accurately and completely
4. Compatibility testing to verify that PCMCIA cards and the EMP card reader failure is discovered and mitigated
5. Verification testing to ensure VVPAT mechanisms are in place to assure a valid paper record is produced for privacy, auditing, verification, and recording accuracy of the ballot casts.

## 1.2. Purpose

This document is the EVEREST Project Executive Summary Report. This report was developed as a summary overview of the project's significant or critical findings, without specific technical details, for a broad audience.

## 1.3. Statement of Independence

SysTest Labs Incorporated is technically, managerially, and financially independent from all electronic voting systems vendors as specified in *IEEE 1012-2004 Annex C*. SysTest Labs has established a policy to ensure independence from companies whose projects are under analysis or assessments by SysTest Labs. The policy is as follows:

*The management and staff of SysTest Labs shall maintain an independent decisional relationship between SysTest Labs and its clients, affiliates, or other organizations so that SysTest Labs' capacity to perform risk assessment services objectively and without bias is not adversely affected.*

*SysTest Labs shall maintain independence in fact and in appearance from clients whose projects are or are scheduled to be under analysis or assessments by SysTest Labs. Control of the project budget shall be vested in an organization independent to all parties. The risk assessment environment, whether on-site at SysTest Labs or at a client's site, shall be organized so that staff members are not subjected to undue pressure or inducement that might influence their judgment or the results of their work.*

## 1.4. References

1. Election Assistance Commission Voting System Standards (EAC VSS), 2002 Version 1.0. Volume I and II.
2. Election Assistance Commission Voluntary Voting System Guidelines (EAC VVSG), 2005 Version 1.0. Volume I and II.
3. Draft Election Assistance Commission Voluntary Voting System Guidelines, 2007 Version 1.0. Volume I and II.
4. SysTest Labs Quality System Manual, Revision 01, prepared by SysTest Labs

5. NIST Special Publications 800-30, Risk Management Guide for Information Technology Systems, July 2002
6. See also section 1.6 for a list of vendor deliverables.

## 1.5. Systems Information

Items identified in Table 1 - Matrix of Required Software reflect all software required for configuration management assessments and for execution of all performance tests.

**Table 1 - Matrix of Required Software**

<u>Vendor</u>	<u>System</u>	<u>Description</u>	<u>Software/ Firmware Version</u>
ES&S	Unity	Election Management software	3.0.1.1
	EDM	EMS Database	7.4
	AM	Security and User Tracking for EDM	7.3.0.0
	ESSIM	Publishing tool for printing ES&S paper ballots	7.4
	iVIM	Publishing tool for graphic ballots for iVotronic Precinct Voting Systems	2.0
	HPM	Export the election definition for use in the voting terminals and scanners and reporting module.	5.2
	ERM	Results Reporting Program	7.1.2.0
	DAM	Transfers results to central collection location	6.0
Premier	GEMS	Election Management software	1.18.24
	Key Card Tool	Software for programming key cards	4.6.1
Hart InterCivic	Ballot Origination, Tally, Rally & Servo	Election Management Software Components	
	BOSS	Ballot Creation	4.3.13
	Tally	Tabulation and Reporting	4.1.10
	SERVO	Equipment and Data Mangement	2.3.7
	Ballot Now	Ballot Printing and Central Scanning	3.3.11



<u>Vendor</u>	<u>System</u>	<u>Description</u>	<u>Software/ Firmware Version</u>
	ECM Manager	ECM Manager	1.1.7

Equipment identified in Table 2, Table 3, and Table 4 reflects all hardware required for configuration management assessments and execution of all performance tests.

**Table 2 - Matrix of Required Hardware, Premier**

<u>Premier System</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Hdwe Version</u>	<u>Software Version</u>
GEMS Server PC	PC (Personal Computer)	DELL	1800, 2800, 2900	N/A	N/A
TSX DRE	Voter Terminal	Premier	AVTSx	00-103380-000B	4.6.4
TSX printer	VVPAT thermal printer		AVPMX	00-105514-000A	3.0.3
TSX PCMCIA Cards	128MB card	COTS			N/A
Accuvote Precinct Scanner	Table Top Ballot Scanner	Premier	AVOS 79811-04	00-103384-000D	1.96.6
Accuvote Central Scanner	Table Top Ballot Scanner	Premier	AVOS 79811-04	00-103384-000D	2.0.12
Accuvote Memory Card	128KB memory card				N/A
Ethernet Switch Or Hub	Connectivity device	COTS (3Com)		N/A	N/A
Port Server	Connects serial port to RJ45 ports	COTS (DIGI)	Port Server II 16	N/A	N/A
EMP Server PC	PC (Personal Computer)	DELL	3100		Windows XP SP2
Election Media Processor (EMP)		Premier	A, B, C, D EMPD-GS	111141-200D	4.6.2.0
Key Card Reader/Writer	Smart card terminal	COTS (SmartTech)	ST-100	N/A	N/A
Label Printer	COTS (Dymo)	Dymo	93089	N/A	7.5.0.9

<u>Premier System</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Hdwe Version</u>	<u>Software Version</u>
Express PollBook 5000	Voter registration terminal	Premier	2000	1.0500.207	2.1.1
Voter Access Card	Voter access memory smart card		VCG, SCG, ACG	DESI1642-1123 vCG SU004KC0/T=0B	N/A
Voter Card Encoder		Premier			1.3.2

**Table 3 - Matrix of Required Hardware, Hart InterCivic**

<u>HART System</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Hdwe Version</u>	<u>Software Version</u>
BOSS Server	PC (Personal Computer)	DELL (software must be installed by vendor)			Windows 2000 SP4
Optional SERVO Laptop	PC (Personal Computer)	DELL (software must be installed by vendor)			
eSlate (DRE)	Voter Terminal	HART	3000		4.2.13
eScan	Table Top Ballot Scanner	HART			
Judges Booth Controller (JBC)	Supervisor Terminal	HART	JBC 1000B		4.3.1
Audio card	Disabled Access Unit (DAU) card for audio recording				N/A
PCMCIA Cards (MBB)					N/A
Verifiable Ballot Option (VBO) Printer	Voter Verifiable Paper Audit Trail (VVPAT) Printer	HART	VBO		1.8.3
Syprus USB Removable Media Key (eCM)	USB	SYPRUS		N/A	
ATA Card Reader/Writer	Used To Read Flash To Read/Write PCMCIA Cards	Flash Reader	UISA2SE		

<u>HART System</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Hdwe Version</u>	<u>Software Version</u>
Ballot Box	Holding device for scanned ballots from the eScan unit	HART		N/A	N/A

**Table 4 - Matrix of Required Hardware, ES&S**

<u>ES&amp;S System</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Hdwe Version</u>	<u>Software Version</u>
iVotronic (DRE)	Voter DRE	ES&S	iVotronic DRE	1.1	9.1.6.4
iVotronic (DRE)	Supervisor DRE	ES&S	iVotronic DRE	1.1	9.1.6.4
iVotronic Compact Flash	CF Memory Card	COTS (SanDisk)	SDCFJ	N/A	N/A
Precinct Ballot Counter	Table Top Optical Scanner	ES&S	M100	N/A	5.2.1.0 BIOS 2.02
Central Ballot Scanner	High Speed Optical Scanner	ES&S	M650	N/A	
Line Printer		COTS (Okidata)	Microline 520	N/A	N/A
Automark Voter Assist Terminal (VAT)	Ballot Marking System	Automark	A100-00	N/A	
Automark Compact Flash	CF Memory Card	COTS			N/A
Real-Time Audit (RTAL) Log Printer	Voter Verifiable Paper Audit Trail (VVPAT) Printer	ES&S	PSA-80H-DRE	N/A	011
Personalized Electronic Ballot (PEB)		ES&S	91747-iV1.7c-PEB-S	N/A	N/A
Communication Pack	Printer And Communication Modem	ES&S	91756 iV1.2-CP	N/A	N/A
Printer	Seiko printer used for printing zero tapes etc.	Seiko	SII DPU-3445	N/A	N/A
Ballot Box	Holding device for scanned ballots from the M100	ES&S		N/A	N/A

## 1.6. Deliverable Materials

In addition to the hardware and software identified in section 1.5, ES&S, Premier, and Hart InterCivic delivered the following documents as a part of the Unity, GEMS, and Ballot Origination, Tally, Rally & Servo Voting System respectively.

### 1. ES&S

- Unity Data Flow Process
- Unity Overview Table
  - EDM Data Sheet
  - BIM Data Sheet
  - iVIM Data Sheet
  - HPM Data Sheet
  - DAM Data Sheet
  - ERM Data Sheet
- ES-AM Software spec 7.3.0.0
- ES-DAM 6.0
- ES-DAM functional spec 6.0 \_11-9-05\_
- ES-EDM 7.4 ed for Unity 3.0.1.0
- ES-EDM functional spec 7.3
- ERM 7.1.0.0 for Unity 3.0 final FOR CERT
- ERM Software Specifications 7.1.0.0
- ES-ESSIM 7.4 ed cm
- ITA ESSIM 7.3.0.0 Functional spec
- HPM 5.2.3.0 for Unity 3.0.1.0
- HPM Software Specifications 5.2.0.0
- Ivim install doc
- iVotronic Image Manager 2.0
- System 3.0.1.1 TDP

### 2. Hart InterCivic

- Operations Manuals
  - BalNow6100-067\_Rev33-62A
  - BOSS6100-019\_Rev43-62A
  - Rally6100-114\_Rev23-62A
  - SERVO6100-102\_REV42-62A
  - Tally6100-049\_43-62A
- Technical Specs
  - Ballot Now Functional Specification
  - BOSS Functional Specification
  - eCM Manager Functional Specification
  - eScan Functional Specification
  - eSlate\_FuncSpec
  - JBCFuncSpecB
  - ServoFunctionalSpec
  - Tally Functional Specification
  - VBO Functional Specification
  - System 6.2.1 TDP

### 3. Premier

- AccuView\_Printer\_Module\_Hardware\_Guide\_Revision\_3.0
- AccuVote-OS\_Central\_Count\_2.00\_Users\_Guide\_Revision\_4.0
- AccuVote-OS\_Hardware\_Guide\_Revision\_10.0
- AccuVote-OS\_Pollworkers\_Guide\_Revision\_3.0
- AccuVote-OS\_Precinct\_Count\_1.96\_Users\_Guide\_Revision\_4.0

- AccuVote-OS\_Service\_Guide\_Revision\_1.0
- AccuVote-TSX\_Hardware\_Guide\_Revision\_11.0
- AccuVote-TSX\_Pollworkers\_Guide\_Revision\_6.0
- AVPM\_Service\_Guide\_Revision\_1.0
- AVPM\_Single\_Roll\_Opening\_and\_Closing\_Procedures\_Revision\_3.0
- Ballot\_Specifications\_Revision\_3.0
- Ballot\_Station\_4.6\_System\_Administrators\_Guide\_Revision\_3.0
- Ballot\_Station\_4.6\_Users\_Guide\_Revision\_2.0
- Client\_Security\_Policy\_Revision\_6.0
- Election\_Media\_Processor\_4.6\_Users\_Guide\_Revision\_2.0
- Election\_Media\_Processor\_Hardware\_Guide\_Revision\_3.0
- Express\_Poll\_Administrators\_Guide\_for\_Versions\_2.0\_and\_2.1\_Revision\_1.2
- Express\_Poll\_Emulator\_and\_Resource\_Guide\_for\_Versions\_2.0\_and\_2.1\_Revision\_2.0
- Express\_Poll\_Users\_Guide\_for\_Version\_2.0\_and\_Higher\_Revision\_2.0
- GEMS\_1.18\_Election\_Administrators\_Guide\_Revision\_10.0
- GEMS\_1.18\_Product\_Overview\_Guide\_Revision\_6.0
- GEMS\_1.18\_Reference\_Guide\_Revision\_8.0
- GEMS\_1.18\_Results\_Server\_File\_Format\_1.1\_Revision\_1.0
- GEMS\_1.18\_System\_Administrators\_Guide\_Revision\_6.0
- GEMS\_1.18\_Users\_Guide\_Revision\_12
- GEMS\_Ohio\_Results\_Export\_Format\_1.0\_Revision\_1.0
- GEMS\_Server\_Configuration\_Guide\_Revision\_10.0
- JResult\_Client\_1.1\_Users\_Guide\_Revision\_2.0
- Key\_Card\_Tool\_4.6\_Users\_Guide\_Revision\_4.0
- TSText\_4.1\_Reference\_Guide\_Revision\_2.0
- VCProgrammer\_4.6\_System\_Administrators\_Guide\_Revision\_1.0
- VCProgrammer\_4.6\_Users\_Guide\_Revision\_1.0
- Voter Card Encoder Installation Guide Revision 1.0
- Voter\_Card\_Encoder\_1.3\_Users\_Guide\_Revision\_2.0
- System 1.18 TDP

## 1.7. Methodology Overview

SysTest Labs' ATOM™ Methodology is a systematic quality assurance and assessment approach that has been audited and approved as the methodology to be used when conducting Voting System Test Lab Certification Testing of electronic voting systems for the Election Assistance Commission (EAC). In addition, SysTest Labs uses ATOM™ in all QA, IV&V, Risk Assessment, and software test engineering efforts for commercial clients, as well as state and Federal agencies.

The EVEREST Risk Assessment effort by SysTest Labs focused primarily on the tasks of analyzing the following:

- Election Process Workflows
- Election Training plans and materials
- Electronic Voting systems deployment plans
- Electronic Voting systems security plans
- Configuration Management of systems Hardware
- Configuration Management of systems Software
- Configuration Management of systems Firmware

- Voting System Performance, i.e., functionality, reliability, usability, security, and accuracy, of the three deployed electronic voting systems

SysTest Labs has observed, monitored, and reviewed pertinent county and vendor activities throughout the project. To facilitate the accomplishments of the risk assessment objectives, SysTest Labs required support from the Secretary of State's staff, county BOEs, and the vendors to gain a sufficient understanding of the election systems as delineated in the State of Ohio Election Statues.

### **1.7.1. Election Operations and Internal Controls**

The information required to evaluate the effectiveness of Operational Procedures and Election Controls for voting systems in a potentially high risk environment was collected using three research techniques: surveys, site visits and document review. Eleven counties were selected as a representative sample of Ohio jurisdictions based upon size, demographics and voting systems to participate in the survey and site visit phases of the project. The counties selected were: Allen, Belmont, Cuyahoga, Fairfield, Franklin, Hamilton, Jackson, Licking, Lorain, Montgomery and Warren.

#### **1.7.1.1. Surveys**

Written surveys, instructions and an introductory letter from the Secretary of State were hand delivered to each of the participating counties. Every county responded to the survey and the responses have been reviewed and incorporated into this analysis.

#### **1.7.1.2. Site Visits**

Each of the selected counties was visited and interviewed by the SysTest Labs team to assess facilities, access controls and physical security. Additionally, election setup, programming and testing processes were reviewed for paper and electronic voting systems. Ballot security, accountability, tabulation, reporting and reconciliation processes were reviewed during the interviews. Election Day procedures for detecting and resolving machine security and operational issues and the corresponding poll worker training and procedures were discussed and assessed.

Each site visit consisted of a tour of the facilities and a discussion on the relevant items on an interview outline. As the purpose of the site visits and interviews was not to evaluate each county but rather to determine the type, scope, scale, consistency and adequacy of internal controls and operational practices at a statewide level, notes were not made specific to each county's practices to protect the integrity and effectiveness of security measures and controls each county has in place.

#### **1.7.1.3. Vendor Documentation**

A review of Vendor documentation (i.e., user manuals), was conducted to assess: 1) the level of thoroughness and usability of the documents relative to voting system operations with specific focus on security and election accuracy; and 2) how well county instituted policies, procedures and processes reflected the recommendations of vendors for such activities as identified in their documentation.

### 1.7.2. Configuration Management

The SysTest Labs Configuration Management Risk Assessment Team reviewed available documentation and performed a Physical Configuration Audit of a voting system installed at the State of Ohio Computing Center in Columbus, Ohio. In addition, the SysTest Labs team assessed the processes and procedures used by the State of Ohio to manage the equipment configuration in the field, as well as, conducting a review of the Logic and Accuracy (L&A) procedures in use by these select counties. We particularly looked for consistency across the State of Ohio certified and deployed vendors' equipment and if the procedures included steps for the verification of the hardware, firmware and software versions in use by the counties.

### 1.7.3. Performance Testing

As a separate deliverable to the SOS, SysTest Labs' Performance Test Team developed a voting system specific Performance Test Plan. This Performance Test Plan outlined the approach SysTest Labs implemented to provide the SOS with effective performance testing on the Unity, GEMS, and Ballot Origination, Tally, Rally & Servo Voting Systems developed by ES&S, Premier, and Hart InterCivic respectively. The purpose of the plan was to provide a clear and precise outline of the test elements required to ensure effective Performance Testing. The test plan:

- Identified items that need to be tested;
- Defined the test approach;
- Identified required hardware, support software, and tools to be used for testing; and
- Identified the types of tests to be performed;

The following list of performance test cases were used to confirm the required functionality, accuracy, and reliability of the voting systems.

**Table 5 - Matrix of System Level Testing:**

Test Cases	Description
TC0010 - Election Creation	The object of this test case is to observe the difficulty or ease of creating an election.
TC1010 - Set-Up and Closure of the Polling Place	The object of this test case is to observe the difficulty or ease of conducting the 'Set up' of the election system at the County and polling station, loading the election, opening the polls and closing the polls.
TC2010 - Configuration Management	The object of this test case is to verify SW and HW versions of the Election system used in testing
TC3010 - DRE Functionality	Verify core functionality of DRE to perform administrative duties
TC4010 - Election Vote Consolidation (Primary & General)	The objective of the Election Vote Consolidation (Primary & General) test case is to verify that vote totals obtained from each type of supported voting device (optical scan or DRE) can be

Test Cases	Description
	accurately consolidated into a central count vote total that all required reports and audit records can be viewed and/or produced.
TC4050 - VVPAT Accuracy	The objective of this test is to test and verify both the functionality and accuracy of the VVPAT printer device associated with a DRE polling place device. The test will confirm that all vote selections are accurately captured on the printer paper, that they are readable, that they can be canceled and changed, and that all changes are accurately reflected on the VVPAT.
TC5010 - Load Test Early Voting	The objective of this test case is to verify votes are not lost due to memory leak while casting ballots in Early Voting Mode on the DRE and exceed its memory capacity via the vendor's automated process or manual input. In addition, verify the Accuracy and integrity of the tally and a warning message is given to the user.
TC5020 - Load Test DRE	The objective of this test case is to verify votes are not lost due to insufficient memory capacity while casting ballots on Election Day Mode on the DRE devices .
TC5030 - Load Test Optical Scan	The objective of this test case is to verify votes are not lost due to insufficient memory capacity while casting ballots on Election Day Mode on the optical scan devices .
TC5040 - Load Test Storage Components	The objective of this test case is to verify a warning message is given to the user when user attempts to load an election definition that exceeds the memory capacity of the external memory device.
TC6010 – Security	The objective of this test case is to verify the Election System will log any unknown external devices that were inserted in any open port of the Election System.
TC7010 - PCMCIA Card Batch testing	The objective of this test case is to verify all PCIMIA cards provided for testing will function according to system specifications. Test case is a result recent problems with Card formatting using the incorrect FAT files.
TC8010 - Audit Tape	The objective of this test case is to verify the Election System will log all activities on each component of the System (Server, DRE, Scanner etc...)



## **2. RESULTS OF THE REVIEW**

The purpose of SysTest Labs' efforts in the Ohio Voting Systems Risk Assessment for the EVEREST Project was to identify risks to the accuracy of election results due to error or fraud; determine if any significant risks of accidental or intentional catastrophic machine failure or unrecoverable error exists; identify risks that cannot be sufficiently mitigated, indicating inherent system inadequacy; and discuss improvements that are required to maximize election integrity. SysTest Labs has developed a comprehensive set of all risks identified as a result of this assessment and have documented these in the Technical Final Report. However, in this Executive Summary, we are discussing only those critical risks that have been identified in the assessment.

### **2.1. Election Operations and Internal Controls**

Based upon the written surveys, site visits and documentation review, significant internal controls, security measures and operational procedures are in-place in each of the counties reviewed. There is a high level of commitment to protecting the voting systems and voting processes in use in each county from real and perceived threats to the integrity of elections. In our view, the policies, procedures and processes in place deter, delay, detect and deny most threats to voting systems specifically and the election environment in general. However, our assessment did identify vulnerabilities that are independent of any voting system vendor, voting system or class of voting technology.

The major vulnerabilities identified are:

1. The inadequacy of BOE facilities to provide appropriate levels of physical security, secure storage and access controls, particularly after-hours, for ballots, voting machines and election systems.
2. A general lack of documented local policies and procedures reflecting how elections are conducted, voting systems employed and sensitive items secured.
3. Statutes, regulations and directives based upon legacy voting technology, voting methods and election timelines that create unnecessary constraints, fail to provide relevant guidance or impose unreasonable timelines.
4. Ineffective staffing, organizational and management structures created or exacerbated as a by-product of the partisan bifurcation of Boards of Election.

### **2.2. Configuration Management Assessment**

#### **2.2.1. General Overview**

A physical configuration audit of the Ohio certified voting systems from each of the three deployed system vendors and assessment of the configuration management procedures identified various risks that must be addressed. A summary of general, non-voting system specific, configuration management risks are as follows:

1. We researched the ability to provide a procedure for verification that the firmware/software installed in a polling place device or ballot marking unit is equivalent to the certified version and has not been changed before, during or after an election. We found that any procedure to perform this operation before and after an election would be impractical for current ES&S and Premier systems. They require the disassembly of the unit, physical extraction of the memory device and utilization of specialized equipment to read the data. Hart InterCivic is currently the only manufacturer who has implemented a software routine that uses hash codes for verification of their firmware/software.
2. The 2006 directive states that L&A procedures will be provided to the counties by the SOS office. Although there are references to a state level L&A procedure, none could be found on the Secretary of State web site. The vendors have documented a procedure for their equipment but SysTest Labs could not determine if this procedure was available to or used by the county BOE personnel. The dissemination of information to the counties including L&A procedures is not consistent and should be centrally controlled by the SOS office.
3. The revision levels of all systems in the counties are unknown and not tracked. During the risk assessment, a unit was found to have down level firmware installed and required attention by the vendor's representative. A procedure to collect and maintain the configuration information (hardware, firmware and software revision levels) in a database would provide the opportunity to identify down level units and address the situation prior to an election.

#### **2.2.2. Premier Election Systems Specifics**

Premier Election Systems has certified or specified certain thermal printer paper, ballot paper stock and PCMCIA memory devices to work with their system. The use of materials other than those specified has been found to result in significant problems.

#### **2.2.3. ES&S Specifics**

ES&S has specified certain compact flash storage devices, ballot paper stock and thermal printer paper to be used for elections. The use of materials other than those specified has been found to result in significant problems.

#### **2.2.4. Hart InterCivic Specifics**

Hart InterCivic has specified certain PCMCIA memory devices and thermal printer paper to be used for elections. The use of materials other than those specified has been shown to result in significant problems.

### **2.3. Performance Testing**

As part of the Performance Test Plan, SysTest Labs' Performance Test Team created test cases intended not to pass or fail any component of the voting system, but to observe the result and any possible deficiencies in an election process. Testing emphasized:

- Preparing for an Election - Considering the number of personnel and polling locations needed to conduct an election, creating an election and setting up the equipment can be very daunting. SysTest Labs created and set up an election in accordance with the vendor documentation that was supplied to SysTest Labs in order to observe if any risks can arise due to lack of appropriate documents.
- Accuracy and Integrity of the Voting Process - As is with all elections, electronic or non-electronic, the accuracy of an election and the confidence of every vote being counted is of the utmost importance. SysTest Labs' accuracy and integrity testing included:
  - Creating election definitions, in accordance with the EAC guidelines and vendor procedures, voting the elections on the DREs and Optical Scanners, and observing if every vote was accurately accounted for in each polling device and in the final tally after consolidation
  - Accuracy testing of the VVPAT tapes from the DREs as well as the optical scanners
  - Volume testing on each system and verifying that votes were not be lost due to memory capacity or potential memory leaks.
- Accuracy of Audit Logs - In the event of any discrepancies in the election process, Audit logs are examined to resolve or investigate any issues. Tests of the Audit logs were executed to see if any risks exist due to the lack of logging specific events in the EMS, DRE, Optical Scan, Ballot Marking Device, and Central Count systems which would hamper the State of Ohio in investigating election related issues and/or recreating any voting day scenarios.

### **2.3.1. Summary Risks**

#### **2.3.1.1. Premier Risks**

SysTest Labs' Performance Test Team identified one significant risk to election integrity when using the Premier voting system. The risk was identified during a load test on the Accuvote TSX. The Accuvote TSX records the votes on the PCMCIA card. Once the number of votes recorded on the PCMCIA card reaches the limit of its memory, the TSX unit will purge the card to make more room for additional votes. However, in the process, the system purges necessary files on the PCMCIA card. This results in the system no longer being able to record new votes and the PCMCIA card will not be able to upload results into the Central Count server.

#### **2.3.1.2. ES&S Risks**

SysTest Labs' Performance Test Team identified one significant risk to election integrity when using the ES&S voting system. It is possible for the Audit Log feature on the Unity Election Management System to be turned off by an administrator in Administration Mode and not be required to be turned back on for Operational Mode resulting in an election being created without an Audit Log.

### **2.3.1.3. Hart InterCivic Risks**

SysTest Labs' Performance Test Team did not identify any significant or critical risks to election integrity when using the Hart InterCivic voting system.

### **3. SUGGESTIONS FOR IMPROVEMENT**

SysTest Labs have developed a comprehensive set of recommendations for mitigating all risks identified as a result of this assessment in the Technical Final Report. However, in this Executive Summary, we are addressing only those critical risks that have been identified. Mitigation of these risks is not to be found solely in the voting system technology certified by the state, but can be found also in changes in poll worker education, management practices, organizational structures, workflows, budgetary appropriations, election official processes, and legislation and directives at both the state and county level.

#### **3.1. Election Operations and Internal Controls**

The operational vulnerabilities identified by the Election Operations and Internal Controls team can be addressed and mitigated by the following suggestions. These suggestions are general in nature and more detailed countermeasures and mitigation strategies will be offered directly to the Secretary of State so as to not compromise existing security within counties.

1. A physical security assessment of each BOE facility should be conducted by a Physical Security and Crime Prevention Specialist from a local law enforcement agency. Suggestions, upgrades, security systems resulting from the assessment should be implemented.
2. An outline and standards for local procedures covering all election operations should be developed at the state level. Standards should also address inclusion of standardized, efficient and effective workflows for each voting technology and/or voting system. Counties should be required to develop resulting written procedures which should be reviewed and approved by peers and/or the Secretary of State. Periodic audits should be conducted to ensure counties comply with the procedures and that the procedures are updated to reflect changes.
3. Statutes, regulations and directives should be formally reviewed and revised with an emphasis on bringing them in line with current technologies and their new constraints and timelines. Specific area to examine include: timelines for inclusion of candidates, offices, measures and local options on the ballot; chain of custody and security of certified software and firmware changes, patches and upgrades; absentee ballot processing timelines and disqualifying criteria; and canvassing procedures and timelines.
4. Testing processes and protocols (e.g., Logic & Accuracy Testing) for each class of voting technology should be developed at the state level and monitored and enforced. A provision for external review of testing by the state or formal internal certification of the tests by the Board members should be part of the protocol.
5. Standardized job descriptions, merit based hiring/firing practices, minimum qualifications and on-going professional training should be developed at a state level and implemented at the local level. Such reforms can be made without sacrificing the partisan structure of the appointed local boards.

## **3.2. Configuration Management**

1. Clear communication with the BOE personnel to ensure that they understand that using something other than specified materials may result in significant failures during an election.
2. Develop a centralized source for dissemination of information (L&A procedures, hardware/software compatibility information and user documentation).
3. Provide a means for creating and maintaining a centralized database of the field inventory by county containing manufacturer, model, serial number and revision level information of certified systems. The database would be readily accessible by county BOE personnel for verifying the revision levels of their equipment.

## **3.3. Performance Testing**

### **3.3.1. Premier**

SysTest Labs recommends that Premier provide a fix to the Accuvote TSX system that would preclude it from purging required files when the limit of the PCMCIA Card memory is reached. A workaround for this risk, until a code fixed can be implemented, is for Premier to determine what the fixed number of allowable votes per minimum PCMCIA Card memory allocation is and to provide this number to each County using the Accuvote TSX system. The County would then be able to ascertain if the number of voters and maximum number of potential votes would exceed to allowable limit for their PCMCIA Cards.

### **3.3.2. ES&S**

Programmatic mechanisms should be developed and implemented in the unity Software that ensure that audit logging is always turned on by default during the election creation and editing process and operation. A workaround for this risk is to enforce policies for ensuring that the Audit Logging capability has not been disabled during election creation and editing process and operation.

## 4. Terms and Abbreviations

These terms and abbreviations will be used throughout this document:

**Table 6 - Matrix of Terms & Abbreviations**

Terms or Abbreviation	Description
EAC	Election Assistance Commission
ITA	Independent Test Authority
NASED	National Association of State Election Directors
SOCC	State of Ohio Computer Center
SOS	Secretary of State
VSS	Voting System Standards
VVSG	Voluntary Voting System Guidelines
VSTL	Voting System Test Lab
CF and PCMCIA Memory Cards:	Flash memory devices; also referred to as PC Cards
COTS	Commercial off the shelf
Software	Interpreted instructions
Firmware	Embedded instructions
Hardware	Physical components of a voting system
L&A	Logic and Accuracy
SHA-1 Hash Codes	Unique identifier derived through mathematical algorithm
Voting System Components	The units of equipment (server platform, voting terminal, ballot scan device) when used together create a voting system
DRE	Direct-Recording Electronic touch screen
Scanner	Electronic scanner used to scan paper ballots
Central Count	Scanner configuration for batch processing of paper ballots where one or more scanners are directly linked to GEMS server and results are loaded in real time.
Precinct Count	Scanner configuration for processing of paper ballots where results are recorded on the AccuVote Memory card.
VVPAT	Voter Verified Paper Audit Trail.
EMS	Election Management System
BOE	Board of Elections

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End of Report

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