Infrastructure Requirements for the Testing and Certification of Election Systems

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ABSTRACT

Infrastructure is the basic resources and organizational capabilities needed for the effective operation of an enterprise. Any proposed changes in the development and application of standards for voting systems or election systems must include the identification of the requisite federal, state and local infrastructure requirements to effectively implement those standards. This paper identifies core infrastructure requirements for the optimal voting and election system testing and certification environment.

Keywords


1. Introduction

Infrastructure: The basic physical and organizational structures and facilities needed for the operation of a society or enterprise.

Election System Testing Infrastructure: The basic physical and organizational resources and capabilities needed to provide services for election officials to facilitate the testing, certification and ongoing operation of election systems.

The importance that infrastructure plays in people’s everyday lives is often taken for granted even though it is perhaps the most pressing public policy issue facing Federal, State and local governments. Infrastructure investment in the development of communications, IT, roads and bridges, schools, ports and hospitals is important to both economic development and quality of life. With governments at all levels under budgetary pressure, infrastructure investment is often cut back or postponed. Much like conventional infrastructure requirements, the infrastructure requirements for testing and certifying election systems are a vitally important part of the election process but are often insufficiently addressed by election officials and too often given short shrift in appropriations by legislative bodies or other funding sources. This paper will define election system testing infrastructure and discuss both the organizational and physical properties of organizations conducting this work.

This paper will serve as an outline to enable election officials at all levels of government to have informed discussions regarding the infrastructure needs of election technology testing and certification efforts as increasingly complex technological solutions are being introduced to the field of election administration.

2. Information Technology Management

In the last decade election technology has become increasingly complex. Election officials at all levels are now being asked to be complex Information Technology (IT) system managers. One of the core responsibilities of any IT manager is to assess the appropriateness of technology for the organization, both operationally and strategically. This means evaluating the possible purchase of a new system or upgrading of an existing system against the
opportunities, threats and challenges the new technology poses to the organization. A properly configure testing and certification infrastructure not only permits the effective evaluation of the system to be purchased but may also be used to assesses the contextual need for that system in the current and future operating environments.

The core mission of a testing and certification process for election jurisdictions is to minimize the risk presented by new election/voting technology by assessing the system(s) against a set of jurisdictionally (federal, state or local) defined and validated requirements to determine the appropriateness of their use for that jurisdiction.

Infrastructure requirements are subdivided into sublevels. The framework that encompasses all levels is the organization infrastructure. It serves to link goals, activities and people through planned processes and systems. The organization infrastructure assumes the existence of validated planning principles:

- The Testing and Certification (T&C) organization operates with a clearly defined purpose and mission
- Within and without the organization there is no ambiguity about its scope and mission
- The T&C organization demonstrates a deliberate attitude of professionalism
- The T&C organization must be adaptive to scheduling and skill-set demands
- The T&C organization must balance principle with pragmatism.

3. Organizational Infrastructure and Capabilities

People

As in all human enterprises, the centrality of properly selected, trained, supervised and motivated personnel is all-important. The human resources required to design and manage a T&C program can be divided into two general domains: managerial and technical.

People -Managerial

- Organizational
  - Global understanding of the organizational IT infrastructure
  - Identify program goals, constraints and needed resources
  - Recruit, train and evaluate technical and administrative program personnel
  - Manage and facilitate complex communication lines between and among stakeholders
  - Ability to translate “tech speak” into “election speak” and vice versa
  - Translate program goals into implementable projects
  - IT management capabilities – manage IT staff effectively, providing leadership within the domain of the core technologies
  - The T&C organization must embrace its role as archivist. It must organize and preserve the artifacts of testing and certification, including reports, test protocols, and data sets
  - Demonstrate effective project management (PM) capabilities. Every test campaign is a project – with its own time line, resource requirements and deliverables. Managing concurrent projects as well as the overall operations of the T&C organization is required.

- Networking
  - The elections community is made up of a diverse and sometimes loosely connected set of stakeholders. Much of the communication is episodic and cross-disciplinary
  - The T&C organization must be capable of fostering, maintaining and utilizing multiple formal and informal networks of stakeholders. These partnerships are part of leveraging resources behind the limits of the organization
  - The T&C organizational leadership must become and remain an active and engaged participant and facilitator of these networks of users, manufacturers,
testers, labs, policy makers and other stakeholders.

- **Communications**
  - Must be able to communicate in technical and non technical terms to technical and non-technical audiences.
  - Report writing
  - Presentations
  - White papers, with requisite research
  - Documentation for funding justification
  - Ability to make and explain tough certification decisions to policy makers and stakeholders.

- **Commitment to continuous improvement of process and outcomes**
  - Leadership must set a tone of willingness to adapt and modify processes to improve throughput and outcomes
  - Management and staff must make the collection of feedback and its integration into organizational planning, a priority.

**People-Technical**

- Understand the core functionality of voting systems and related/interfacing election systems
- Understand the data constructs contained within the election environment and the various methods needed to extract that data in a useable format
- Understand mechanics and best practices of election administration to provide a contextual framework for testing systems
- Understand test design and test administration, especially within the elections domain
- Needs educational preparation consistent with job responsibilities
- Should possess a positive attitude regarding scientific methods and their application
- Understand the advantages and limits of technology outsourcing and contract management
- Sufficient legal knowledge to evaluate Non-Disclosure Agreements and contracts and ensure their compliance within the organization
- Develop budgets and implement accurate accounting practices.

**4. Organizational Infrastructure**

The organization itself must also have some intrinsic characteristics that enable it to function in a consistent and competent manner during periods of staff turnover as well as political change and instability, regardless of whether these challenges are internal, or come at the legislative or executive level.

**Program Continuity**

- Testing and certification programs require political, organizational and financial commitment that extends beyond the immediate need for a system within the jurisdiction
- Deployed systems must be retested (after modifications or discovered anomalies)
- Institutional knowledge must be preserved
- Skill sets must be grown and preserved
- Capacity must be grown and preserved as new challenges emerge and new technologies are implemented
- Relevance and value of the T&C program must be frequently justified
- The T&C organization will typically exist within a hierarchy of organizations, each engaged in some aspect of election administration – policy or operations. The T&C organization must maintain its relevance by adjusting its mission and capabilities within the context of the jurisdiction’s (federal, state or local) overall election administration efforts. The T&C organization does not exist, or work, in a political or operational vacuum.

**Organizational memory**

- The life span of voting systems requires a preservation of the information about their testing and the testing of their ancestors and cousins
- Maintaining a repository of information and experiences is valuable in assessing current threats and mitigations
- Being able to answer why, how, when and where, things have been done in the past
Precedent is an important justification and defense to challenges of certification processes

- Knowledge vs. Information - Effective administration of a T&C program requires a knowledge management system that preserves the contextual implications of information collected. Knowledge management systems preserve the rationale behind decisions so that future applications of the information can benefit from past experiences.

Technical Competence

- The T&C organization must demonstrate internal technical competence – it must be able to select, design and deploy technologies in support of their communication, testing, research, and administrative responsibilities
- The T&C organization should be a peer to the most technologically advanced elections office in the U.S.
- Flexibility – the ability to reconfigure, and if necessary, reinvent its own internal technical infrastructure to support new testing methods
- The T&C organization must be able to scale up research and testing efforts to meet episodic demands
- Cross-training staff, loaner staff, and contractor management strategies must be a part of the scope and scale decisions
- The technical staff must be able to “smooth” its supply and demand curves so that there is always sufficient capacity. This requires concurrent planning and a matrix approach to managing skill sets of the technology staff.

5. Physical Infrastructure & Capacities

Testing must be done in physical space. The T&C organization requires specialized facilities to conduct its work and meet its mission. Space and technology, organizational independence, research capability, training and various auditing functions are all examples of tasks with specific physical infrastructure and capacity requirements. These infrastructure components tend to be, at least initially, high-cost investments, however, they are critical to the organizations ability to develop and be optimally useful to the election administration community.

Space Requirements (laboratory/office space)

- T&C facilities should maintain working installs of election offices and precincts of each certified system (approximately100 sq. ft per election system). This is especially important since the T&C organization will need to set up and maintain configurations/simulations of election systems in order to recreate and isolate errors and anomalies in deployed systems
- Laboratory space should be both physically and cyber-secure
- T&C facilities should have closed and open networking capabilities, capable of replicating the production environment of each voting system. Additionally, virtual environments must be constructed to simulate production environments when testing live systems is prohibited. Optimal capabilities should include secure internal networks and/or secure web portals to facilitate testing and test review
- Testing facilities have specialized power and cooling requirements, beyond those of typical commercial office space
- Access to a loading dock and dedicated shipping and receiving capabilities will facilitate the movement of test systems to and from the facility
- Training space for both hands-on training of staff and election officials as well as production capabilities for on-line training
- Secure storage for records and archived system components.
Research & Investigation Capabilities

Manuals, procedures and other tools that guide the design and implementation of testing can only be created and validated through research. In many cases, T&C organizations are testing one-of-a-kind systems, with no precedent. Organizations must foster a culture and capacity for research.

- Organizations must be capable of designing and managing research projects that support the testing of voting systems
- Organizations must be able to leverage and utilize existing research
- Staff should be capable of executing or facilitating short-term, mission critical research to identify anomalies and mitigations within election cycles
- The senior staff and leadership of the organization must be effective at interfacing with academic and research organizations as peers
- Experienced researchers should be available to the organization as loans or contractors
- The T&C organization should have internal and externally expandable capabilities for forensic investigations. This includes the ability to design and direct/execute forensic investigations that are needed as a result of insufficient testing and review. The scope of the investigational capabilities must be expandable to meet the needs of the investigation, including cyber-forensics.

6. Training

Training and continuing education are critical components to any profession. T&C organizations must embrace their own continuing education requirements and ensure that all staff and all stakeholders who support and engage in the testing of systems are properly prepared and current.

The organization must have the ability to design and deliver education and training on the internal processes and utilization of work products of the T&C program to a variety of audiences, technical and non-technical.

7. Organizational Independence

All organizations exist within some political space. The relative positioning of the T&C organization with or within the political structure of the jurisdiction can produce both distractions and potential conflicts of interest.

- The administration of the T&C program should be free from political interference – testing authority and staff should be able to design and conduct testing programs without undue interference from local, state or other political bodies.
- T&C programs should not be susceptible to undue pressure from vendors/manufacturers
- T&C programs should not be susceptible to undue pressure from activists or advocacy groups
- The T&C organization should have a validated code of ethics that not only guides its own staff on issues of conflict of interest, but also informs other stakeholders of the ethical constraints within which the program functions.

8. Overview of Federal, State and Local Infrastructure

The testing and certification of voting systems is handled at all three levels of government. That is to say that federal, state and local governments all have a critical role to play in the assessment of voting technology prior to its deployment in the field. While the federal certification process and infrastructure are stable and consistent, state and local testing infrastructure depends on many variables including changing laws, resources, and expertise at those offices.

- Federal Infrastructure – The federal testing and certification process is primarily run by the Election Assistance Commission (EAC). According to recent research conducted by the National Conference of State Legislators (NCSL) and the Bipartisan Policy Center (BPC) 47 out of 50 states rely on some or all of the EAC’s federal certification process. This makes the EAC’s process a critical foundation for the testing and
certification infrastructure at the state and local level\(^1\). Currently the EAC has an infrastructure that consists of four full-time staff dedicated completely to the testing and certification program. In addition the EAC has two part-time senior level employees used to provide a technical review of both the test plans and test reports from the Voting System Test Labs (VSTLs). The EAC is also responsible for the accreditation of the three VSTLs. The VSTLs are the primary testers of the systems with the EAC serving as the certification authority. In addition to the EAC, the National Institute of Standards and Technology (NIST) is the other federal agency involved in the testing and certification process. NIST receives funding from the U.S. Congress via the EAC’s annual budget. NIST is tasked with providing technical support to the EAC via its Technical Guidelines Development Committee (TGDC). Additionally, NIST recommends VSTLs for possible accreditation to the EAC after NIST conducts a lab assessment via its National Voluntary Laboratory Accreditation Program (NVLAP).\(^2\) Approximately three million dollars is spent annually on running the federal testing and certification process.

- **State Infrastructure** - Some states have very clear statutory requirements for the testing and certification of voting technology. In those jurisdictions the infrastructure is generally consistent and supported with resources. A good example is Florida where the state has its own division for the testing and certification of voting technology. Georgia manages its certification testing through the Center for Election Systems at Kennesaw State University and Indiana through its VSTOP program at Ball State University.\(^3\) \(^4\) However, in many states the requirements for the assessment of voting technology is either not addressed or is vague. In many of these jurisdictions the infrastructure varies based on the priorities of the administration and the resources available. For most states one or two staff people are given the responsibility of administering the required process for certifying the election equipment. In some cases this task is only a small portion of their job. Because of this variability the vast majority of states have chosen to use some portion of the federal certification process with thirteen states specifically requiring full EAC certification of a system before it can be used in that state.\(^5\) Because the EAC’s program only covers the testing and certification of the voting systems states must determine how to assess other voting technology that falls outside the scope of the voting system. Because of this challenge some states have begun to work together, along with the EAC and NIST to develop processes and requirements for the assessment of this other voting technology. As an example the states of Indiana, Ohio and Pennsylvania implemented requirements for the testing and certification of electronic pollbooks. Several other states are now looking to duplicate these states efforts.

- **Local Infrastructure** – With limited exceptions (Travis County, TX and Los Angeles County, CA being the primary examples) local officials do not have the resources available to dedicate staff to voting technology requirements development and the assessment of systems. The “certification” of systems at the local level is largely done through the acceptance testing process. Generally, local officials are given a list of certified products from the state that can be used in their jurisdiction. From there the local officials create request for proposals (RFP). This RFP serves as the ad-hoc standards by which the local jurisdiction will evaluate the system’s compatibility with the needs of the jurisdiction. In most cases a local election official will have themselves and perhaps the local IT department to help them both craft the RFP and assess the system to those requirements (acceptance test). In some jurisdictions the local official will have their own IT department to conduct this testing.

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\(^2\) [http://www.eac.gov/testing_and_certification/laboratory_accreditation.aspx](http://www.eac.gov/testing_and_certification/laboratory_accreditation.aspx)

\(^3\) [http://elections.kennesaw.edu/](http://elections.kennesaw.edu/)

\(^4\) [http://bowencenterforpublicaffairs.org/institutes/policy-research/election-admin/vstop](http://bowencenterforpublicaffairs.org/institutes/policy-research/election-admin/vstop)

Additionally, in most cases the RFP and corresponding contract documents are written by the local official and sent to the local legal authority (i.e. county prosecutor or county attorney).

9. Laboratory Supervision/Auditing Capabilities

If a testing and certification body chooses to use contracted laboratories to assist in any part of the election system testing effort, the organization should have some ability to insist on and to verify that the laboratories abide by a “conflict of interest and prohibited practice program.”

At least some of the testing and certification organization personnel should be trained in auditing techniques in order to be able to ensure that neither the laboratory, its parent corporation, other contracted third party laboratories, nor any individual staff member involved in the testing of election systems have any vested interest in the outcome of the test process.

In addition, personnel should have at minimum a working knowledge of ISO standards and auditing techniques in order to be able to perform a review of the laboratories information and documentation and to conduct on site reviews to verify that the laboratories policies, procedures and practices meet the requirements of the testing and certification organization and international standards. Particular focus should be placed on familiarization and understanding of ISO/IEC 17025:2005 which specifies the general requirements for the competence to carry out testing and covers testing performed using standard methods, non-standard methods, and laboratory-developed methods.

10. Vendor/ Manufacturing Facility Quality Auditing Capabilities

Testing and certification entities will continually be concerned with the initial and ongoing quality of their election systems. Systems manufacturers should be required to demonstrate their ability to consistently provide products that meet the needs of election officials as well as applicable statutory and regulatory requirements. One proven way of doing this is through the conduct of quality audits of both the system manufacturer and, when appropriate, third party assembly facilities.

Using ISO 9001-2008 standards, is one way of ensuring and documenting that system vendors use an appropriate and effective quality management system. Auditors can use numerous techniques to verify that audit program requirements have been addressed in the quality management system. They can evaluate documents and verify records; interview document users to verify the process described by the document has been established, implemented and maintained; and trace the process forward or backward to verify activities are being performed.

Because ISO 9001 certifications are very expensive propositions, testing and certification bodies may allow for the vendor to use non-certified internally developed quality standards as long as they are based on the premises outlined in ISO 9001-2008.

Auditing is both a learned and acquired skill set although auditors do need certain generic pieces of knowledge. For example, knowledge of the subject matter and the criteria for the audit, knowledge of the organization products and its processes and knowledge of applicable legal and regulatory requirements. Auditors will also need general skills in planning and preparing for audits, conducting on-site audits, verbal and written reporting and follow-up activities. These skills are usually based on the subject matter of the audit.

11. Conclusion

In 2013, the American Society of Civil Engineers (ASCE) issued a wake-up call to local, state, and federal governments regarding the decline of infrastructure in the U.S. In that report, the ASCE, gave the U.S. a D+ on its report card for the condition of its roads, dams, bridges, and other infrastructure components. It issued a clarion call for action – to plan, to reinvest, and revitalize the infrastructure.

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6 http://www.iso.org/iso/catalogue_detail.htm?csnumber=39883

7 http://www.iso.org/iso/catalogue_detail?csnumber=46486

8 http://www.infrastructurereportcard.org/
needed for safety and economic prosperity. In 2014, The Presidential Commission on Election Administration issued their report, “The American Voting Experience: Report and Recommendations of the Presidential Commission on Election Administration” 9. This was a wake-up call to election officials, legislatures, and policy makers regarding the “impending crisis in voting technology”. Elections, like cars, trucks, boats, and planes, require well designed, well constructed and well maintained infrastructure. Among the most important, and ironically sometimes the most invisible infrastructure of democracy, is that needed to test and certify the new voting and elections systems that America needs.

As the EAC, states, and local jurisdictions, identify and evaluate their respective roles in testing and certifying voting/election systems, they will do well to evaluate the infrastructure required to affirm that the systems we use to conduct elections can attain the goal of safe, secure, accessible, transparent and affordable elections.