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ELECTIONS

States, Territories, and the District Are Taking a Range of Important Steps to Manage Their Varied Voting System Environments

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GAO-08-874

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Highlights

Highlights of GAO-08-874, a report to the Chairman, Committee on Rules and Administration, U.S. Senate

ELECTIONS

States, Territories, and the District Are Taking a Range of Important Steps to Manage Their Varied Voting System Environments

Why GAO Did This Study

Our Nation's overall election system depends on all levels of government and the interplay of people, processes, and technology, which includes the voting systems that are used during an election. GAO has previously reported on issues and challenges associated with ensuring that voting systems are secure and reliable. The states, territories, and the District of Columbia (District) each play a pivotal role in managing voting systems to ensure that they perform as intended.

In light of this role, GAO was asked to answer the following questions relative to states, territories, and the District: (1) what voting methods and systems are these entities using in federal elections and what changes are underway; (2) how do they certify or otherwise approve voting systems; (3) what other steps do they take to ensure the accuracy, reliability, and security of voting systems; (4) how do they identify, evaluate, and respond to voting system problems; and (5) how do they view federal voting system-related resources and services.

To accomplish this, GAO conducted a Web-based survey of election officials in all 50 states, the four U.S. territories, and the District and received responses from all but three states; contacted the officials to better understand their approaches and issues; and reviewed documentation provided by survey respondents and other contacts.

To view the full product, including the scope and methodology, click on GAO-08-874. To view GAO's survey of election officials, click on GAO-08-1147SP.For more information, contact Randolph C. Hite at (202) 512-3439 or hiter@gao.gov.

What GAO Found

The mix of voting methods and systems that were used in the 2006 general election varied across states, territories, and the District, and this mix is not expected to change substantially for the 2008 general election. This variety is due to several factors, but particularly the degree of influence that these governments have exerted over local jurisdictions in selecting systems.

In establishing their voting environments, states, territories, and the District reported approving or otherwise certifying their systems against requirements and described largely similar approaches in doing so. Further, they reported facing some of the same challenges, such as ensuring that vendors meet requirements and completing the approval process on time; and identified steps they have taken to address these challenges.

To further ensure that their approved systems performed as intended, these entities also reported conducting one or more types of postapproval voting system testing—acceptance, readiness, Election Day parallel, postelection audit, and security. Certain types of tests—such as acceptance and readiness—were reported as being conducted by many states, territories, and the District, while others—such as parallel—were reported as being employed by only a handful. The manner of performing the tests also varied.

Notwithstanding their system approval and testing efforts, most states, territories, and the District nevertheless have reported experiencing problems on Election Day. While these entities largely described the problems as isolated and having minimal impact, a few reported that they experienced problems that were more widespread and significant. However, the full scope of the problems that may have been experienced is not clear because states and others reported that local jurisdictions were generally not required to report problems. To address this, a few states and territories reported that they are becoming more active in identifying and resolving problems, for instance, by developing policies and procedures to address them. However, election officials also cited related challenges, such as determining the cause of the problems and appropriate corrective actions.

To aid states, territories, and the District in managing their voting system environments, the federal government, through the Election Assistance Commission, provides a number of services and resources, such as federal certification of systems and guidance. With the exception of the timing of the certification process, most entities reported that they are largely satisfied with these services and resources, although some are not satisfied.

While following similar approval and testing approaches and resolving voting system problems, differences in how each entity executes these approaches offer important opportunities for these governments to share knowledge and experience. To the extent that this occurs, the manner in which systems perform on Election Day can only improve.

United States Government Accountability Office

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Abbreviations

District	District of Columbia
DRE	direct recording electronic
EAC	Election Assistance Commission
FEC	Federal Election Commission
HAVA	Help America Vote Act of 2002
NASED	National Association of State Election Directors
NIST	National Institute of Standards and Technology

G A O

Accountability * Integrity * Reliability

United States Government Accountability Office
Washington, DC 20548

September 25, 2008

The Honorable Dianne Feinstein
Chairman
Committee on Rules and Administration
United States Senate

Dear Madam Chairman:

Following the 2000 and 2004 general elections, we issued a series of reports and testified on virtually every aspect of our nation's overall election system, including the many challenges and opportunities associated with various types of voting systems.[1] In this regard, we emphasized that voting systems alone were neither the sole contributor nor the solution to the problems that were experienced during the 2000 and 2004 elections, and that the overall election system as a whole depended on the effective interplay of people, processes, and technology and involved all levels of government. During this period, the Congress passed the Help America Vote Act of 2002 (HAVA),[2] which authorized funding for local and state governments to make improvements in election administration, including upgrading antiquated voting systems. In addition, HAVA created the Election Assistance Commission (EAC) to, among other things, provide resources and services that states and localities can use to acquire and manage voting systems.

State, territory, and the District of Columbia (the District) governments play a key role in ensuring that the mix of voting systems used during an election is accurate, secure, and reliable and that any problems with these systems are addressed. Accordingly, you asked us to answer the following

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[1]See, for example, GAO, *Elections: Perspectives on Activities and Challenges Across the Nation*, GAO-02-3 (Washington, D.C.: Oct. 15, 2001); *Elections: Status and Use of Federal Voting Equipment Standards*, GAO-02-52 (Washington, D.C.: Oct. 15, 2001); *Elections: A Framework for Evaluating Reform Proposals*, GAO-02-90 (Washington, D.C.: Oct. 15, 2001); *Elections: Federal Efforts to Improve Security and Reliability of Electronic Voting Systems Are Under Way, but Key Activities Need to Be Completed*, GAO-05-956 (Washington, D.C.: Sept. 21, 2005); *Elections: The Nation's Evolving Election System as Reflected in the November 2004 General Election*, GAO-06-450 (Washington, D.C.: June 6, 2006); and *Elections: All Levels of Government Are Needed to Address Electronic Voting System Challenges*, GAO-07-741T (Washington, D.C.: April 18, 2007).

[2]Pub. L. No. 107-252, 116 Stat. 1666 (2002).

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questions relative to the 50 states, 4 U.S. territories, and the District: (1) what voting methods and systems they are using in federal elections and what changes are underway; (2) how they certify or otherwise approve voting systems for use in federal elections; (3) what other steps they take to ensure that voting systems are accurate, reliable, and secure; (4) how they identify, evaluate, and respond to voting system problems; and (5) how they view federal voting system-related resources and services.

To accomplish this, we conducted a Web-based survey (GAO-08-1147SP) of election officials in all 50 states, 4 territories, and the District regarding their respective requirements, activities, experiences, changes, and views relative to: voting methods and systems used; voting system approval, testing, and problem management; and federal resources and services.[3] Three U.S. territories and one commonwealth were selected for this review—American Samoa, Guam, the Commonwealth of Puerto Rico, and the U.S. Virgin Islands—based on their federally mandated requirement to comply with the provisions of HAVA. We obtained responses from 47 states, all 4 territories, and the District.[4] Three states (Michigan, New Jersey, and Utah) chose not to respond to our survey.[5] We also contacted election officials in almost every state and territory, and the District, to better understand and illustrate their respective approaches and issues, and obtained and reviewed relevant documentation from these officials and their Web sites. The scope of this work did not include contacting election officials from local jurisdictions to verify survey responses or other information provided by state officials.

We conducted this performance audit from October 2007 to September 2008 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings

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[3]GAO, *Elections: 2007 Survey of State Voting System Programs*, GAO-08-1147SP (Washington, D.C.: Sept. 25, 2008).

[4]For the purpose of this report, the term "survey respondent" refers to all entities who responded to a survey question and "territory" refers to the three territories and one commonwealth. The term "states and others" refers to some portion of the 50 states and at least one territory or the District.

[5]For the three states that did not respond to our survey, we obtained and reviewed relevant statutes to determine their respective requirements and where appropriate, we reported on these requirements.

and conclusions based on our audit objectives. Further details of our objectives, scope, and methodology are included in appendix I.

Results in Brief

The mix of voting methods and systems that were used in the 2006 general election, and the mix that is expected to be used in the upcoming 2008 general election, vary across states, territories, and the District. These mixes were due largely to several factors, particularly the degree of influence that the states, territories, and the District have exerted over local jurisdictions in selecting systems.

In establishing their voting system environments, states, territories, and the District reported approving or otherwise certifying their systems against their respective requirements. Moreover, they reported that they employed similar basic approval approaches, and they have faced some of the same challenges. To further ensure that their approved mixes of systems performed as intended during an election, most of these entities also reported conducting one or more types of postapproval tests. While some of these tests were conducted by almost all states, territories, and the District, others were confined to only a handful of these entities. Notwithstanding their efforts to approve and subsequently test their systems, they reported experiencing problems on Election Day. Most states and territories, and the District, described these problems as isolated and as having minimal impact on elections, although a few states reported more widespread and significant problems. Overall, however, the full scope of voting system problems that have been experienced is unclear because local jurisdictions generally do not have to report problems. To address this, a few states and territories have become more active in identifying and resolving problems, and a number have reported taking actions to overcome a range of challenges that many states and territories share.

To aid states, territories, and the District in managing their respective voting system environments, the federal government, through EAC, provides voting system-related services and resources, such as federal certification of systems and guidance pertaining to systems. With the exception of the timing of federal certification of systems, most states, the territories, and the District reported that they are largely satisfied with these services and resources.

Multiple Voting Methods and Systems Continue to Be Used in Elections, with the Mix Being Heavily Influenced by the Roles States, Territories, and the District Play in Selecting Systems

States, territories, and the District reported using a mix of voting methods and systems for the 2006 general election, and few changes to this mix are expected for the 2008 general election. For most states and one territory, this mix will typically consist of using at least two different methods across the election stages,[6] with the most common number being four. Moreover, the mix of systems planned for the 2008 elections continues to mostly include direct recording electronic (DRE), precinct count optical scan, and central count optical scan, although ballot marking devices and vote-by-phone systems are becoming more prevalent.

A key factor that has influenced each mix of systems is the level of state, territory, and District involvement in the selection of voting systems for their local jurisdictions. For the 2008 general election, most states and all four territories reported that they will either select voting systems for jurisdictions or provide jurisdictions with a list of approved voting systems from which to select. Moreover, states and territories that select voting systems for local jurisdictions generally plan to use fewer voting systems for the 2008 general election than do states that use other approaches. Other factors that have influenced selection of voting methods and systems for 2008 and may continue to do so are compliance with state and federal requirements, availability of funding to purchase voting equipment, and voter concerns with existing systems.

Approval of Voting Systems Is Governed by Largely Similar Approaches and Generally Affected by the Same Challenges

State, territory, and District statutes largely specify requirements and responsibility for approving voting systems to be used in an election. Specifically, 43 states, 2 territories, and the District reported having requirements for approving or otherwise certifying voting systems, and their respective requirements are mostly captured in statute. The remaining states and territories have requirements that have been administratively established.

Regardless of the basis for their approval requirements, states, territories, and the District largely follow a similar series of basic steps in approving voting systems. These steps are (1) establishing standards or criteria; (2) evaluating documentation; (3) testing systems to state standards and examining test results; and (4) making an approval decision; all in conjunction with involving the public in the process and resolving system

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[6]These stages provide vote casting opportunities through absentee voting, early voting, and Election Day voting at polling places.

problems during the process. However, the nature and extent of the specific approval activities conducted as part of these broad steps varies. For example, the testing performed by some states ranges from system demonstrations using mock elections to source code reviews.

In addition, responsibility for performing approval activities varies across states, territories, and the District. For example, the approval authorities for 12 states and 1 territory rely solely on their election staff to perform the various approval activities, while the approval authorities in 28 states, 1 territory, and the District rely on two or more stakeholders. The approval authority is typically the state's secretary of state or the state's election board or committee, although the approval authority may delegate responsibility for performing certain approval steps to other stakeholders, such as the state chief information officer or chief technology officer.

States and territories also face similar challenges in approving voting systems. The most frequently cited challenges are ensuring that vendors meet system requirements; ensuring that voters' concerns are considered; having sufficient qualified staff and facilities to conduct tests; and ensuring that the approval process is timely.

A Range of Tests Were Required and Performed after Voting System Approval, and the Scope and Approach to Performing Them Varied

For the 2006 general election, most states and others reported that they required more than one type of postapproval voting system testing to be performed. Of the five types of testing—acceptance, readiness (logic and accuracy), parallel, postelection audit, and security—about one-third of the states, territories, and the District reported requirements for at least four types, in addition to the testing required as part of system approval. In contrast, a small number of states reported that they required only readiness testing, which was the most frequently cited type of testing performed, as it is intended to determine a system's readiness just prior to use in an election. Moreover, those entities that required readiness testing typically reported similar testing approaches (i.e., using test ballots to exercise system recording, tabulation, and reporting functions; verifying the completeness and accuracy of test results; and sealing the systems until they were activated on Election Day).

With respect to the other four types of testing, many states, one territory, and the District reported employing acceptance testing, which determines whether the delivered voting equipment meets state or local requirements. Further, many states, territories, and the District reported that they conducted security tests. Relatively few states reported performing

parallel testing during elections, primarily because they were not statutorily required to do so, or they did not have sufficient voting units or funding. Several states and the District also reported requirements for postelection audit testing, which largely consisted of verifying election totals by recounting the recorded votes. For example, one state manually recounted a random sample of at least one percent of the precincts, while another state used voter-verified paper audit trails to verify election totals.

Across all types of testing, the states, territories, and the District varied as to the timing, scope, and activities performed, as well as the personnel involved. For instance, several states reported that their security testing focused on assessing the physical security of the systems and the facilities in which they were stored, while a few others also performed a wide range of security reviews, such as risk assessments, source code reviews, and penetration tests.[7] Also, while some states and territories reported testing all voting system units, others tested only selected units. Moreover, while most testing was performed by local jurisdictions with guidance from the states, several states also performed these tests using state staff, vendors, or contractors.

States, territories, and the District generally reported minor challenges related to having sufficient testing resources and executing testing activities in a timely manner. Nevertheless, roughly half of respondents reported experiencing such challenges and a handful of states viewed them as major.

Nature and Extent of Reported Voting System Problems Were Not Viewed as Significant, Although Related Challenges Suggest Complete Information May Not Be Available

States, territories, and the District reported experiencing a variety of problems with their voting systems during the 2006 general election, but identified few instances of problems occurring at multiple locations and largely characterized the problems as occurring to little extent and with little impact. The most frequently reported problems were systems where paper jammed or was improperly fed or imprinted; systems that stopped operating or would not operate at all during the election; systems with slow response time; and systems that did not tabulate votes correctly. Furthermore, 12 states reported that they had experienced these problems and one other to a moderate or great extent.

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[7]Penetration testing is where evaluators attempt to circumvent the security features of a system, using common tools and techniques, and based on their understanding of the system design and implementation, in order to identify methods of gaining access to a system.

The extent to which states and others are aware of system problems is unclear because less than one-half of them required local jurisdictions to report problems that arose during the 2006 election, relying instead on voluntary reporting by local jurisdictions, voters, and voting system vendors. Nevertheless, many respondents reported that they and their local jurisdictions evaluated problems after the election, for example, through reviews of system logs and reports, audits, investigations, recounts of election results, and system retests. They also reported that both levels of government were involved in implementing corrective actions, and that many respondents developed new policies and procedures to address and correct the problems.

About one-half of the states and the District reported facing multiple challenges in managing voting system problems that arose in the 2006 election. The most-reported challenges were determining the causes of problems and identifying, evaluating, and selecting corrective actions, but challenges with adequate funding, staffing, and training to correct problems were also reported. State officials also described various actions they have taken to overcome these challenges.

Federal Voting System Services and Resources Generally Are Viewed Favorably

The federal government, through EAC, has made available various products and services available to our nation's elections community, including federal certification of voting systems, voluntary voting system guidelines, accredited voting system testing laboratories, and election administration and voting system management guidance. Among these services, approximately one-third of the states reported plans to purchase new systems for use in the 2008 election, thus requiring federal system certification. Because none of these systems have been certified by EAC as of May 2008, these states reported that they intend to either forego planned system replacements and upgrades for the 2008 general election or seek other ways to satisfy state statutes or directives that require federal certification.

Except for the timing of EAC's certification of systems, most states, territories, and the District reported that they were generally satisfied with EAC services and resources to the extent that they expressed any view on them. For example, over one-half reported satisfaction with the comprehensiveness, clarity, or ease of use of the voluntary voting system guidelines, although one state noted that the guidelines may be too demanding to allow any voting systems to be certified within a reasonable time frame. Most respondents reported that they were also satisfied with EAC's quick start management guides, which provide recommended

practices for state and local election officials in areas such as voting system certification, acceptance testing, ballot preparation and printing and pre-election testing, and voting system security. With respect to accredited test laboratories, two states reported that they were using them in support of their respective voting system approval processes.

The role that states, territories, and the District play in ensuring that unique voting system environments perform as intended on Election Day is significant. While the general approaches that each follows to carry out this role relative to approving and testing systems and resolving system problems are largely similar, the details surrounding how these approaches are executed show differences. These differences offer important opportunities for states, territories, and the District to leverage shared knowledge and experience in evolving their respective approaches. Other opportunities exist to learn from and address state, territory, and the District views and perspectives on federal services and resources. To the extent that this occurs, then the manner in which voting systems perform on Election Day can only improve.

Background

The fairness and accuracy of the U.S. election system is a foundation of our democracy. Within this system, each of the 50 states, 4 territories, and the District plays a pivotal role and has a somewhat distinct approach to accomplishing these goals. The U.S. election system also involves the interaction of people at all levels of government, year-round preparation and planning, and a range of technologies, such as electronic voting systems.

Following the 2000 general election, we issued a series of reports addressing a range of issues and challenges associated with voting systems.[8] These reports also identified challenges that election officials reported facing in major stages of the election process. Subsequently, the Congress passed the Help America Vote Act of 2002 (HAVA) to help states upgrade antiquated voting equipment and technologies and support them in making federally mandated improvements to their voting systems. Since the 2004 general election, we have issued voting system-related reports on system security and reliability and on evolving voting system methods, technologies, and management practices.

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[8]See the Related GAO Products page at the end of this report for a list of GAO reports on voting systems since 2001. These products can be found on our Web site at www.gao.gov.

The Overall U.S. Election System Relies on All Levels of Government and the Interplay of People, Processes, and Technology

Election Authority and Responsibility Spans All Levels of Government

All levels of government—federal, state, and local—share responsibilities for elections and voting systems. Regardless of the level of government, election administration is a year-round activity, involving varying groups of people and a range of technologies performing activities within each stage of the election process.

Election authority and responsibility in the United States is shared by federal, state, and local governments. At the federal level, the Congress has authority under the Constitution to regulate the administration of presidential and congressional elections. In this regard, it has passed legislation affecting the administration of state elections in several major areas of the voting process, such as HAVA. However, the Congress does not have general constitutional authority over the administration of state and local elections.

Individual states, territories, and the District are responsible for the administration of both their own elections and federal elections. Each regulates its respective elections through legislation, administrative codes, executive directives, or other mechanisms, which establish requirements, policies, and procedures for adopting voting system standards, testing voting systems, ensuring ballot access, establishing registration procedures, determining absentee voting requirements, establishing voting locations, providing Election Day workers, and counting and certifying the vote. Thus, the U.S. election process can be seen as an assemblage of 55 somewhat distinct election systems—one for each of the 50 states, the 4 territories, and the District.

Further, although election policy and procedures are legislated primarily at the state level, states typically have decentralized election administration so that the details are carried out at the city or county levels. This is important because there are more than 10,000 local election jurisdictions and their sizes vary enormously—from a rural county with about 200 voters to a large urban county, such as Los Angeles County, where the total number of registered voters for the 2000 elections exceeded the registered voter totals in 41 states.[9]

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[9]GAO-02-3.

| Election Administration Is a Multi-step Process | Election administration is a year-round process, involving key activities that are performed within four stages of the election process.[10] These stages, and the activities that comprise them, are as follows: |

- *Voter registration.* Among other things, local election officials register eligible voters and maintain voter registration lists, including updates to registrants' information and deletions of the names of registrants who are no longer eligible to vote.

- *Absentee and early voting.* This type of voting allows eligible persons to vote in person or by mail before Election Day. Election officials must design ballots and other systems to permit this type of voting and educate voters on how to vote by these methods.

- *Election Day voting.* In preparation for Election Day, a range of activities are performed, such as arranging locations for polling places, recruiting and training poll workers, designing ballots, and preparing and testing voting equipment for use in casting and tabulating votes. On Election Day, key activities include opening and closing polling places and assisting voters in casting votes.

- *Vote counting and certification.* Once polls are closed, the cast ballots are tabulated, decisions are made whether and how to count ballots that cannot be read by the vote-counting equipment, the final vote counts are certified, and recounts or audits are performed, if required.

Voting systems are primarily involved in the last three of these stages, during which votes are recorded, cast, and counted.

Electronic Voting Systems Support Vote Casting and Counting

The technology used to cast and count votes is one essential part of the multifaceted U.S. election process. In the United States today, votes are cast, and in some instances counted, by electronic voting methods: optical scan, direct recording electronic, ballot marking device, and vote-by-phone.[11] In addition, some jurisdictions use election management systems to integrate vote casting and tabulating functions for a given election with

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[10]Provisional voting is also generally used by states to address certain voter eligibility issues encountered at the polling place on Election Day. A provisional ballot cast by an individual with an eligibility issue would not typically be counted until the individual's eligibility to vote under state law has been verified.

[11]Two older voting methods—lever machine and punch card—are no longer widely used.

other election management functions. Table 1 shows the critical vote casting and tabulating functions offered by different systems.

Table 1: Capabilities Provided by Prevalent Voting Methods and Systems

Voting method or system	Marks ballot	Casts ballot	Tabulates ballot
Direct recording electronic	x	x	x
Optical scan	—	x	x
Ballot marking device	x	—	—
Vote-by-phone	x	—	—
Election management system	—	—	x

Source: GAO.

Before voting equipment can be used in any given election to perform these functions, it must be programmed to accommodate the specific characteristics of that election, including preparing a ballot that is unique to that election and, depending on the voting equipment, programming the equipment to present the ballot to the voter and read the ballot as voted. Software then downloads the election-specific ballot configuration through the use of memory cartridges or other media to produce either a digital or paper ballot that lists the names of the candidates and the issues to be voted on. On or before Election Day, voters record their choices. Some ballots may include a space for write-in choices. When voters have finished marking their ballot selections, how the ballot is cast and counted varies by voting method.

A description of four electronic voting methods and election management systems follows.

Direct recording electronic (DRE). These devices capture votes electronically, without the use of paper ballots. DREs come in two basic models: pushbutton or touchscreen. DRE ballots are marked by a voter pressing a button or touching a screen that highlights the selected candidate's name or an issue. Voters can change their selections until they hit the final "vote" button or screen, which casts their vote (see fig. 1). Although these systems do not use paper ballots, they can retain permanent electronic images of all the ballots, which can be stored on various media, including internal hard disk drives, flash cards, or memory cartridges.

DREs require the use of software to program the various ballot styles and tabulate the votes, which is generally done through the use of memory cartridges or other media. For pushbutton models, the software assigns

the buttons to particular candidates, while for touchscreen models; the software defines the size and location on the screen where the voter makes the selection. DREs offer various configurations for tabulating the votes. Some contain removable storage media that can be taken from the voting device and transported to a central location to be tallied. Others can be configured to electronically transmit the vote totals from the polling place to a central tally location. Vote tally software often is used to tabulate the vote totals from one or more units. These systems also are designed not to allow overvotes (i.e., where the voter votes for two candidates for one office, invalidating the vote).

Figure 1: DRE System
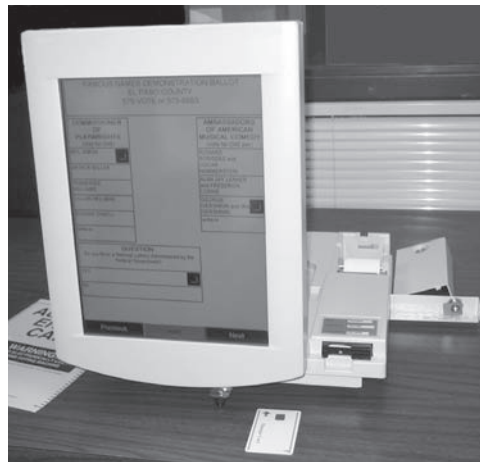
Source: GAO.

Optical scan. This method uses electronic technology to tabulate paper ballots. An optical scan system is made up of computer-readable paper ballots, appropriate marking devices, privacy booths, and a computerized tabulation device. Optical scan ballots are marked using an appropriate writing instrument to fill in boxes or ovals, or to complete an arrow next to a candidate's name or an issue. To cast the ballot, voters deposit their ballots into a sealed box to be counted either at the polling place—a

precinct count optical scan[12]—or at a central location—a central count optical scan. The ballots are tabulated by optical-mark-recognition equipment (see fig. 2), which counts votes by sensing or reading the marks on the ballot. Software instructs the tabulation equipment how to assign each vote (i.e., to assign valid marks on the ballot to the proper candidate or issue).

Figure 2: Precinct Count Optical Scan Tabulator and Central Count Optical Scan Tabulator

Source: GAO.

If ballots are counted at the polling place, voters or election officials put the ballots into the tabulation equipment, which tallies the votes; these tallies can be captured in removable storage media that are transported to a central tally location, or they can be electronically transmitted from the polling place to the central tally location. Some precinct-based optical scanners also now include a digital ballot imaging component that digitally reads a voter's ballot selection, tabulates the results, and saves a digital image of the marked ballot on a memory card for auditing purposes. In addition, precinct-based optical scanners can be programmed to detect overvotes and undervotes (where the voter does not vote for all contests or issues on the ballot) and to take some action in response (such as rejecting the ballot). If election officials program precinct-based optical scan systems to detect and reject overvotes and undervotes, voters can fix their mistakes before leaving the polling place.

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[12]Precinct count optical scan equipment sits on a ballot box with two compartments for scanned ballots—one for accepted ballots (i.e., those that are properly filled out) and one for rejected ballots (i.e., blank ballots, ballots with write-ins, or those accepted because of a forced override). In addition, an auxiliary compartment in the ballot box is used for storing ballots if an emergency arises (e.g., loss of power or machine failure) that prevents the ballots from being scanned.

By contrast, if ballots are centrally counted, election officials transfer the sealed ballot boxes to the central location after the polls close, where election officials run the ballots through the tabulation equipment in the presence of observers. Central count optical scanners thus do not allow voters to correct any mistakes that may have been made.

Ballot marking devices. These devices use electronic technology to mark an optical scan ballot at voter direction, interpret the ballot selections, communicate the interpretation for voter verification, and then print a voter-verified ballot. A ballot marking device integrates components such as an optical scanner, printer, touch-screen monitor, and a navigational keypad (see fig. 3).

Figure 3: Ballot Marking Device

Source: ES&S (Election Systems & Software).

Voters use the device's accessible interface to record their choices on a paper or digital ballot. For example, voters with visual impairments will use an audio interface as well as a Braille keypad to make a selection. Voters who prefer to vote in an alternate language can also utilize the audio interface. Voters with disabilities can make their selection using a foot-pedal or a sip-puff device. These devices do not store or tabulate votes electronically. When votes have been recorded and verified, they are printed on a standard optical scan ballot that must be read, recorded, and tabulated by a precinct-based or central count optical scanner. This technology includes functionality to prevent overvotes and undervotes.

Vote-by-phone. Vote-by-phone systems use electronic technology to mark paper ballots. This system is made up of a standard touch-tone telephone and a printer. Unlike the other electronic voting systems, programming of

ballots is done manually by an election official at a secured location. When voters call from a polling place to connect to the system, the ballot is read to the voters who then make choices using the telephone keypad. The system then prints out a paper ballot at either a central location (central print) or a polling site (fax print). Central print ballots are read back to the voter over the phone for verification, after which the voter can decide to cast the ballot or discard it and revote. Fax print ballots produce a physical ballot at the polling place for the voter to review, verify, and cast in a ballot box. The system also informs voters of undervotes.

Election management systems. These systems, which are used in conjunction with one of the other types of voting systems, integrate the functions associated with preparing vote-casting and tabulating equipment for a given election with other election management functions. Election management systems run on jurisdictions' existing personal computers or vendor-provided election management system computers and generally consist of one or more interactive databases containing information about a jurisdiction's precincts, the election contest, the candidates, and the issues being decided. They can then be used to design and generate various ballots, program vote-casting and tabulating equipment, and centrally tally and generate reports on election progress and results.

HAVA Was Enacted to Strengthen the Overall U.S. Election Process

In October 2002, the Congress passed HAVA to provide states, territories, and the District with organizations, processes, and resources for improving the administration of future federal elections. One of the primary HAVA provisions relates to encouraging states and others to upgrade antiquated voting systems and technologies and authorizing $3.86 billion over several fiscal years to support states in making federally mandated improvements to their voting systems. HAVA also includes minimum requirements for such systems, to include providing voters with the ability to verify their votes before casting their ballot, producing permanent paper records for manual auditing of voting systems, and complying with ballot counting error rates set out in specified federal voting system standards. HAVA also requires that such systems provide individuals with disabilities the same opportunity for access and participation by providing for the use of at least one DRE or other voting system equipped for individuals with disabilities at each polling place. The deadline for states and jurisdictions to comply with specific minimum requirements for voting systems, such as producing a paper record for audit purposes, was January 1, 2006.

In addition, HAVA established EAC and assigned it wide-ranging duties to help improve state and local administration of federal elections. To assist EAC in establishing voting system standards and performing its responsibilities, HAVA established three organizations and levied new requirements on a fourth. Specifically, it established a technical guidelines committee to develop and recommend voting system standards to EAC. To assist in an independent review of these standards, EAC chartered, as required by HAVA, a Standards Board, comprised of 110 state, territory, District, and local election officials, and established the Board of Advisors to review the voluntary guidelines developed by EAC's guidelines committee and provide comments and recommendations to EAC. Finally, the act assigned the National Institute of Standards and Technology (NIST) responsibility for providing technical support to EAC's guidelines committee and making the Director of NIST the committee chair.

Among other things, EAC is responsible for (1) providing voluntary guidance to states implementing certain HAVA provisions, (2) serving as a national clearinghouse for election-related information and a resource for information with respect to the administration of federal elections, (3) conducting studies, (4) administering programs that provide federal funds for states to make improvements to some aspects of election administration, (5) accrediting independent voting system test laboratories, and (6) certifying voting systems. EAC is led by four commissioners who are to be appointed by the president and confirmed by the Senate. The services and resources that EAC provides in discharging its responsibilities are discussed below.

- *Providing voluntary guidance.* HAVA requires EAC to adopt a set of federal voting system standards. In December 2005, EAC adopted the voluntary guidelines, which define a set of specifications and requirements against which voting systems are to be designed, developed, and tested to determine whether they provide the functionality, accessibility, and security capabilities required to help ensure the integrity of voting systems. As such, the voluntary guidelines specify the functional requirements, performance characteristics, documentation requirements, and test evaluation criteria for the federal certification of voting systems. In 2007, the EAC's guidelines committee submitted to EAC the next update to the voluntary guidelines.

- *Serving as an information clearinghouse.* HAVA requires EAC to maintain a clearinghouse of information on the experiences of state and local governments relative to, among other things, implementing the voluntary voting system guidelines and operating voting systems. As part

of this responsibility, EAC has created a space on its Web site to post or link to voting system reports and studies that have been conducted or commissioned by a state or local government that reflect its experience in operating a voting system or implementing the voluntary guidelines. EAC does not review the information for quality and does not endorse the reports and studies.

- *Administering provision of federal funds*. HAVA requires EAC to administer a program to disburse funding to states for the replacement of older voting equipment and election administration improvements under Title III of HAVA. EAC began distributing funds in 2004 for (1) helping states meet HAVA's Title III requirements for uniform and nondiscriminatory election technology and administration, including the act's requirements pertaining to voting system standards; (2) provisional voting; (3) voting information; (4) a computerized statewide voter registration list; and (5) identification of first-time voters who register to vote by mail.

- *Accrediting independent test laboratories*. HAVA assigned responsibilities for laboratory accreditation to both EAC and NIST. In general, NIST focuses on assessing laboratory technical qualifications and recommends laboratories to EAC for accreditation. EAC uses NIST's assessment results and recommendations, and augments them with its own review of related laboratory testing documentation to reach an accreditation decision.

- *Certifying voting systems*. HAVA requires EAC to provide for the testing, certification, decertification, and recertification of voting system hardware and software. According to EAC's Testing and Certification Program Manual, EAC certification means that a voting system has been successfully tested by an accredited, independent testing laboratory; meets requirements set forth in a specific set of federal voting system standards; and performs according to the vendor's specifications.[13]

For fiscal year 2007, EAC's appropriation totaled $16.2 million. EAC reported that this included $6.7 million (48.4 percent) for activities related to improving voting technology, such as accrediting voting system laboratories and managing the voting system certification process; $2.7

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[13]Prior to HAVA, no federal agency was assigned or assumed responsibility for testing and certifying voting systems against the federal standards. Instead, the National Association of State Election Directors (NASED), through its Voting Systems Committee, assumed this responsibility by accrediting independent test authorities, which in turn tested equipment against the standards. This program was discontinued in July 2006.

million (19.5 percent) for EAC administration activities and Federal Register notices; $2.4 million (17.1 percent) for HAVA funds management activities; and $1.8 million (13.3 percent) for the production and distribution of election management guidelines and related quick start management guides. The remaining funds went toward meetings for the Standards Board and Board of Advisors. EAC's budget for fiscal year 2008 is $16.53 million and its budget request for fiscal year 2009 is around $16.7 million.

Management of Voting System Performance Is a Continuous Process

As we previously reported,[14] the effective management of voting systems extends beyond Election Day activities and is a continuous process that involves the interplay of people, processes, and technology during the entire life of a system. The performance of these systems is heavily influenced by a number of factors, including how well the system is defined, developed, acquired, tested, operated, and managed.

The development of a voting system starts with an explicit definition of what the system is to do and how well it is to do it. These requirements are then translated into design specifications that are used to develop the system. Electronic voting systems are typically developed by vendors, then purchased as commercial, off-the-shelf products and operated by state and local election administrators. During the three phases of a system (development, acquisition, and operations), a range of tests is performed and the process is managed to ensure that performance expectations are met. Together, these activities form a voting system life cycle (see fig. 4).

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[14]GAO-07-741T.

Figure 4: Conceptual Depiction of a Voting System Life Cycle Model

Requirements/standards		
Development	Acquisition	Operations
Testing		
Management		
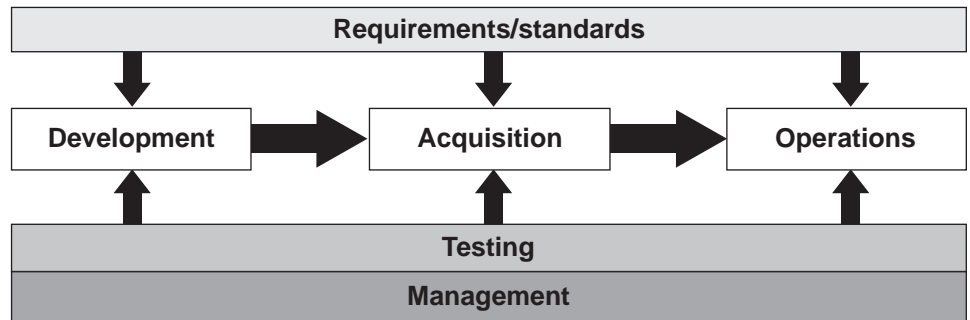
Sources: GAO analysis of NIST, IEEE, and EAC publications.

Successful implementation of the three key phases of a voting system's life cycle requires the coordinated efforts of vendors, state officials, and local governments:

- *Requirements/standards.* Voting system standards define the functional and performance requirements that must be met, and thus provide the baseline against which systems are developed, acquired, and tested. They also specify how the systems should be operated and managed. Voting system standards apply to system hardware, software, firmware, and documentation, and they span prevoting, voting, and postvoting activities. In addition to national standards, some states and local jurisdictions have specified their own voting system requirements. They include the functional and performance requirements that are contained in state statutes, administrative codes, policies, procedures, and best practices. These requirements also provide the baseline against which voting systems are developed, approved, acquired, tested, operated, and managed.

- *Development.* Product development is performed by the voting system vendor and includes defining more detailed system requirements, designing the system specifications, developing software, integrating hardware and software components, and testing the integrated system.

- *Acquisition.* Voting system acquisition activities are performed by state and local governments and include publishing a solicitation, evaluating offers, choosing a voting system method, choosing a vendor, awarding and administering contracts, and testing the acquired system.

- *Operations.* Operation of voting systems is typically the responsibility of local jurisdictions, whose officials may, in turn, rely on or obtain

assistance from system vendors. These activities include ballot design and programming, setting up systems before voting, pre-election testing, vote capture and counting during elections, recounts and system audits after elections, and storage of systems between elections. Among other things, this phase includes activities associated with the physical environments in which the system operates. These include ensuring the physical security of the polling place and voting equipment and controlling the chain of custody for voting system components and supplies. The operations phase also includes monitoring the election process by use of system audit logs and backups, and the collection, analysis, reporting, and resolution of election problems.

- *Testing*. Testing is conducted by multiple entities throughout the system life cycle. Vendors conduct testing during system development, for example. National testing of systems is conducted by the EAC- and NIST-accredited voting system testing laboratories. As described in depth later in this report, states perform a range of tests prior to approving or otherwise certifying a system, as well as after system approval but prior to the system's use in an election. Types of voting system testing include: certification testing (federal level), certification/approval testing (state level), acceptance testing, readiness (logic and accuracy) testing, security testing, Election Day parallel testing, and postelection voting system audits. Table 2 summarizes these types of tests.

Table 2: Types of Voting System Testing

Type	Purpose
Certification (federal)[a]	To verify compliance of voting equipment with federal standards prior to or as a condition of system acceptance
Certification/approval (state)	To validate compliance of voting equipment with state specific requirements before an election
Acceptance	To verify that voting equipment delivered by a vendor meets state or local requirements before an election
Readiness (logic and accuracy)	To verify that voting equipment is functioning properly, usually by confirming that predictable outputs are produced from predefined inputs before an election
Security	To verify that technical security controls embedded in voting equipment operate as intended, as well as ensure that security policies and procedures governing the testing, operation, and use of the systems are properly defined and implemented by the responsible officials before an election
Election Day parallel	To verify accurate performance of voting equipment through random selection and systematic evaluation of operational equipment during an election
Postelection audit	To review and reconcile election records to confirm correct conduct of an election or uncover evidence of problems with voting equipment or election processes after an election

Source: GAO.

- *Management.* Voting system vendors manage the development of the system, while states and/or local jurisdictions manage the acquisition, operation, and maintenance of the system. Management activities include test management, configuration management, requirements management, and risk management.

GAO Has Previously Identified Voting System Related Issues and Challenges

Since 2000, we have reported on a range of issues and challenges associated with voting systems.[15]

- In 2001, we reported[16] that the challenges confronting local jurisdictions in using voting technologies include having reliable measures and objective data to know whether the technology being used is meeting the needs of the jurisdiction's user communities; ensuring that necessary security, testing, and maintenance activities are performed; ensuring that the technology will provide benefits over its useful life commensurate with life cycle costs (acquisition as well as operations and maintenance) and that these collective costs are affordable and sustainable; and ensuring that the three elements of people, process, and technology are managed as interrelated and interdependent parts of the total voting system.

- Also in 2001, we reported[17] that no federal agency had been assigned explicit statutory responsibility for developing voting equipment standards, but that the Federal Election Commission (FEC) had assumed this role by developing voluntary standards in 1990 for computer-based systems. We found that those standards described most—but not all—types of system requirements and that the FEC planned to issue revised standards in 2002. Accordingly, we recommended, among other things, that the FEC accelerate the development of requirements for equipment usability, including considerations for human capabilities and limitations.

- Later that same year, we provided perspective on the challenges inherent in our election system, including the difficulty of accurately diagnosing and correcting election system problems in an environment where people

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[15]See the Related GAO Products page at the end of the report for a list of these reports.

[16]GAO-02-3.

[17]GAO-02-52.

and processes can be more significant factors than voting technology. We went on to suggest four criteria[18] against which proposals could be evaluated: (1) appropriate federal role in election reform; (2) balance between accessibility and integrity; (3) integration of people, process, and technology; and (4) affordability and sustainability of election reforms.

- Our final report in the series reported[19] that funding constraints at the local level hindered the acquisition of voting equipment that is more accessible to persons with disabilities. In addition, we found that expanding the availability of alternative voting methods or accommodations can provide voters with additional options, but implementing these changes can present election officials with legal, administrative, and operational challenges.

- In 2005, we reported[20] that numerous entities had raised concerns about voting systems' security and reliability, citing instances of weak security controls, system design flaws, inadequate system version control, inadequate security testing, incorrect system configuration, poor security management, and vague or incomplete voting system standards. We recommended that EAC define specific tasks, processes, and time frames for improving the nation's voting systems standards, testing capabilities, and management support available to state and local election officials.

- Our nationwide study of the 2004-2006 election cycles reported[21] that larger local election jurisdictions may be replacing older equipment with technology-based voting methods to a greater extent than small jurisdictions, which continue to use paper ballots extensively and are the majority of jurisdictions. We concluded that as the elections technology environment evolves, voting system performance management, security, and testing will continue to be important to ensuring the integrity of the overall elections process.

- In our 2007 testimony, we explained[22] how challenges confronting all levels of government in acquiring and operating voting systems for future

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[18]GAO-02-90.

[19]GAO-02-107.

[20]GAO-05-956.

[21]GAO-06-450.

[22]GAO-07-741T.

elections are not unlike some of those faced by any technology user: adoption and consistent application of standards for system capabilities and performance; successful management and integration of the people, process, and technology components; rigorous and disciplined performance of testing and security activities; and reliable measurement to determine whether the systems are performing as intended.

States', Territories', and the District's Voting Environments Largely Consist of Multiple Methods and Systems, and Have Been Influenced by Various Factors

States, territories, and the District report that they plan to rely on a variety of voting methods and systems for the 2008 general election. For most states and two territories, at least two different methods are planned for use across several election stages, with four methods being most frequently planned. Moreover, they intend to rely on multiple types of voting methods, with the most prevalent types being precinct count optical scan, central count optical scan, and DRE. Ballot marking devices are also to be commonly used; vote-by-phone is expected to be in very limited use.

A key factor that has influenced the number of system types used is the level of state involvement in the selection of voting systems, which has increased since the 2004 election. For the 2008 general election, the majority of states and territories reported that they will either select the voting systems that jurisdictions use or provide jurisdictions with a list of approved voting systems from which to select. However, a few respondents reported that they will continue to use approaches that were more widely used in 2004, such as approving local jurisdictions' selections. In general, states and territories that select voting systems for local jurisdictions reported that they will employ fewer voting systems in the 2008 general election than those states that allow local jurisdictions to select their systems.

Several other factors have influenced the selection of voting methods and systems for the 2008 general election or may affect their selection in the future. According to election officials, these include meeting state or federal requirements, funding availability, and voter concerns with existing systems. These are similar to factors that we have previously reported as affecting voting system investment decisions.

States, Territories, and the District to Rely Largely on Several Voting Methods and Systems for the 2008 Election

For the 2008 general election, most states, territories, and the District reported that they will rely on more than one voting method to conduct the three election stages of vote casting, counting, and certification (absentee, early, and Election Day polling place voting). For example, 9 states, 1 territory, and the District plan to use two methods; 16 states plan to use four methods (the most common number); and 9 states plan to use

the maximum number of reported methods—five. For those states, territories, and the District that plan to use two or more methods, the mix of methods consistently includes either DRE or optical scan (precinct or central count) methods, or both. Furthermore, many states also intend to use the more emergent voting methods (ballot marking devices and vote by phone), while others expect to use older methods (e.g., lever machines, punch card, and paper ballot). The voting method used, as well as the size and demographics of a voting jurisdiction, significantly affects the complexity of planning and conducting an election, as we previously reported.[23] Figure 5 illustrates the number of methods that respondents plan to use for the 2008 election.

Figure 5: Number of Voting Methods That Survey Respondents Plan to Use for the 2008 General Election
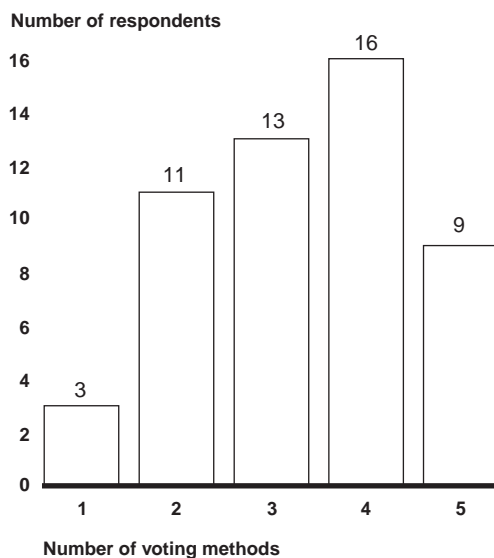
Source: GAO 2008 survey of state, territory, and the District of Columbia election officials.

This mix of methods planned for the 2008 general election included few changes from the mix of methods that states, territories, and the District reported for the 2006 general election. For example, 8 states, 1 territory, and the District used two methods; 19 states used four methods (the most common number); and 8 states used five methods, which was also the maximum number of reported methods. The mix of methods for the 2006

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[23]GAO-07-741T.

general election also consistently included either DRE, precinct count optical scan, or central count optical scan methods, and many states used emergent methods like ballot marking devices.

According to survey respondents, some voting methods are to be more widely used for multiple vote casting and counting stages, or in a particular stage, than others. Specifically, most states, two territories, and the District reported that they plan to use precinct or central count optical scan systems in at least one stage. Many states and the District also plan to use DRE or ballot marking devices, and 2 states plan to use vote-by-phone, in more than one stage. Only one state plans to use lever machines, while only one other state plans to use punch cards. In addition, survey respondents reported that precinct count optical scan and DRE systems will be the most widely used method for two election stages (polling places on Election Day and early voting), while central count optical scan will be the most widely used method for absentee voting. The numbers of states, territories, and the District that plan to rely on specific voting methods for the voting stages is similar to numbers reported for the 2006 general election, although ballot marking devices are becoming more prevalent. Table 3 shows the number of respondents planning to use specific voting methods for each voting stage.

Table 3: Voting Methods that Survey Respondents Plan to Use by Voting Stage for the 2008 General Election

	Voting stage[a]		
Voting method	**Election Day polling place voting**	**Early voting[b]**	**Absentee voting[c]**
DRE	31	17	9
Precinct count optical scan	38	18	24
Central count optical scan	17	10	40
Ballot marking device	26	10	14
Vote-by-phone	6	2	—
Lever machine	1	—	—
Punch card	1	1	1
Paper (hand-counted) ballot	18	7	21

Source: GAO 2008 survey of state, territory, and the District of Columbia election officials.

[a]Our survey question asked about each of these voting options separately. There may be some overlapping responses for early voting and absentee voting, due in part to how these voting stages are defined within states' and others' statutory frameworks.

[b]Early voting is voting generally in-person in advance of Election Day at specific polling place locations, separate from absentee voting.

In addition to a variety of voting methods, most states also will rely on a mix of voting systems for the 2008 general election. For example, 30 states reported that they plan to use 2 to 5 systems, 9 states plan to use 6 to 10 systems, and 3 states plan to use 11 to 15 systems. A few states and the majority of territories plan to rely on a single voting system. In contrast, one state plans to use five different system models from two different vendors in some counties. Table 4 provides an example of one state's planned use of systems for the 2008 general election to illustrate the range and variation in voting system models that can be used within a state.

Table 4: Example of Voting Methods, Manufacturers, and Voting System Models Planned for Use in One State for the 2008 General Election

Voting method	Manufacturer	System model	Number of counties planning to use
Optical scan	Premier	ACV-OS	51
Optical scan	Premier	ACV-OSX (Digital Scan)	20
Optical scan	ES&S	M100	28
Ballot marking device	Premier	A300	71
Ballot marking device	ES&S	A100	28

Source: GAO analysis of state-provided data.

State Involvement in System Selection Has Increased Since 2004 and Is Reflected in the Number of Voting Systems Planned for Use in 2008

State involvement in local jurisdictions' selection of voting systems has increased since the 2004 general election. Moreover, the level of involvement in system selection by states, territories, and the District has influenced the number of voting systems planned for use in the 2008 election. For the 2004 general election, 29 states and the District had selected the voting systems to be used by local jurisdictions or provided a list of approved systems from which jurisdictions could make selections. The remaining 21 states either allowed local jurisdictions to select voting equipment without state involvement or allowed the jurisdiction to obtain state approval for selecting a system.

For the 2008 general election, most states and territories exercise control over the selection of voting systems in one of two ways. First, the majority of states reported that they would be involved in voting system selection by providing a list of approved systems from which local election officials

could select. Second, most of the remaining states and all of the territories reported that they would actually select the systems for local jurisdictions to use. The remaining three states and the District reported different approaches for the upcoming election, such as requiring that systems selected by local jurisdictions be approved by the state, providing a list of systems for local jurisdictions to chose from but selecting all the accessible systems, or allowing jurisdictions to purchase any system that meets state requirements. Figure 6 summarizes the role of each state, territory, and the District in selecting voting systems for jurisdictions for the 2004 and 2008 elections.

Figure 6: Reported Involvement by States and Others in the Selection of Voting Systems for the 2004 and 2008 General Elections

2004

Washington, D.C.

Alaska   Hawaii

☐ State was not involved in equipment selection

☐ State required equipment chosen by local jurisdictions to be approved by the state

☐ State provided list of equipment from which local jurisdictions were required to choose

■ State required local jurisdictions to use specific method

2008

American Samoa

Guam

Washington, D.C.

Puerto Rico

Alaska   Hawaii

U.S. Virgin Islands

☐ State was not involved in equipment selection/No response

▨ Other

☐ State required that voting systems selected by local jurisdictions then be approved by the state

☐ State provided a list of approved voting systems from which local jurisdictions were required to select

■ State selected voting system(s) for local jurisdictions

Sources: GAO 2005 and 2008 surveys of states, territories, and the District of Columbia election officials, MapArt (map).

Note: Territories were not included in GAO's 2005 survey of state election officials. Two states and the District reported individual approaches for involvement in local jurisdictions' selection of systems; they are listed as Other in the figure.

State officials that we interviewed cited various reasons for why states have become more involved in voting system selection. For example, officials from one state told us that providing a list of systems to local jurisdictions was a statutory requirement. Officials from another state said that, as a result of HAVA, the state purchased systems for jurisdictions, which facilitated control over its expenditures of HAVA funding. In addition, another state's officials stated that it provided a mechanism to ensure local jurisdictions were using the appropriate systems.

The number of voting systems planned for use in the 2008 election is a function of the level of state-, territory-, and District-level involvement in system selection. Based on survey data, states and territories that selected systems for local jurisdictions plan to use fewer systems in the upcoming election than states that required jurisdictions to choose systems from an approved list. Figure 7 shows the number of systems planned for use in the 2008 election with respect to two main approaches of survey respondents to voting system selection.

Figure 7: Number of Voting Systems Planned for Use in the 2008 General Election in Relation to the Reported Type of Involvement by States and Others in Voting System Selection
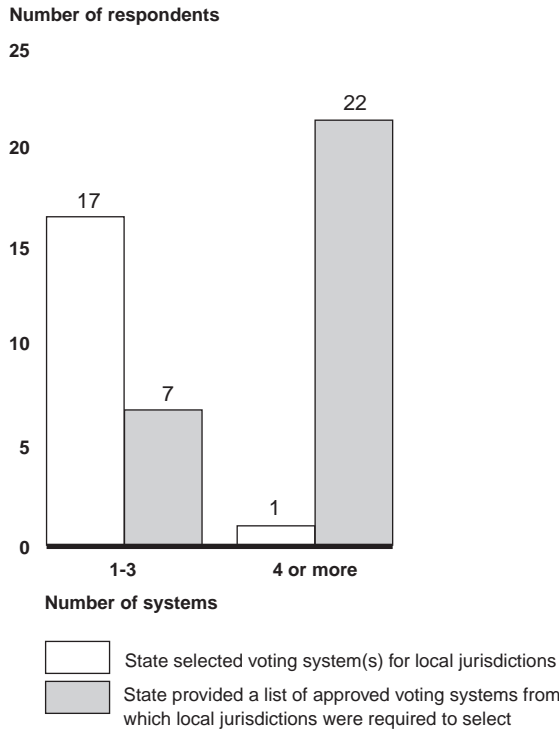
Number of respondents

State selected voting system(s) for local jurisdictions

State provided a list of approved voting systems from which local jurisdictions were required to select

Source: GAO 2008 survey of state, territory, and the District of Columbia election officials.

Note: Two states that use alternate approaches to involvement in voting system selection and the District plan to use from one to three systems. The remaining state plans to use five systems.

Several Additional Factors Influence Selection of Voting Methods and Systems

Officials in the states and territories that we interviewed identified one or more factors beyond the states' involvement in voting system selection that have influenced their selection of voting methods and systems for the 2008 general election or may affect their solution in the future. These factors, which are similar to some of the voting system investment considerations that we have previously identified, are (1) meeting state and federal requirements, (2) availability of funding, and (3) voter concerns with existing systems.

Meeting state and federal requirements. Election officials from 2 states and 1 territory told us that they had adopted ballot marking devices and vote-by-phone systems for the 2008 general election in order to comply with state and federal accessibility requirements. Conversely, officials from other states told us that potential changes to federal

requirements may influence them to postpone selecting any new systems. For example, officials with 2 states told us that their decision to upgrade their systems or purchase new systems in the future could be influenced, in part, by potential new federal voting system requirements that are included in bills before the Congress. In addition, election officials from one state and one territory told us that the anticipated 2007 federal voluntary voting system guidelines could necessitate system changes, and thus, in one case, they would postpone the selection of new voting systems until the 2007 guidelines were finalized.

Availability of funding. Based on survey responses, 37 states, 1 territory, and the District reported using all available HAVA funds to purchase voting systems. Election officials from two of these and other states told us that without additional funding, further investment in new or upgraded systems may not be possible. Specifically, officials from one state said they are applying for additional HAVA funds to replace may of their voting systems except for their optical scan equipment. Election officials in another state told us they would like to adopt optical scan systems but simply do not have the funds needed to purchase the systems. These and other election officials expressed concern that any future changes to voting methods and systems will be hard to undertake unless they receive additional funding for purchasing the systems.

Concerns of voters. State and other election officials that we interviewed reported voter concerns with existing systems as a factor in the selection of new systems. For example, election officials from 2 states and 1 territory told us that because of voter concerns regarding DREs, they may either eliminate or limit the systems' use for the upcoming election. Instead, they planned to rely more on their other voting methods. In contrast, officials from another state that use DREs said that because of high voter confidence in and satisfaction with these systems and their reliability, stability, and predictability, they had no plans to purchase other systems. Election officials from 2 other states also reported that they were not planning to acquire new systems for the upcoming election because their voters are satisfied with their current systems.

These factors influencing states' selection of voting methods and systems are similar to the factors that we previously reported in 2006[24] as influencing local jurisdictions' purchase of new systems. In particular,

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[24]GAO-06-450.

meeting state requirements was one of the most frequent factors cited by local jurisdictions in determining which systems to purchase. Other widely influential factors cited by local jurisdictions included ease of use and affordability. Meeting HAVA requirements and state funding were also cited as factors in the purchase of systems.

States, Territories, and the District Have Largely Defined Similar Approaches and Face Common Challenges in Approving Voting Systems

Most states, territories, and the District approve or otherwise certify voting systems for use in elections, and in doing so, follow a similar series of basic steps. The majority of these states also have processes in place to qualify an initial approval, and to reapprove or revoke a prior approval if certain conditions are met. However, the nature and extent of the activities that comprise the basic approval steps, and who performs these activities, vary. For example, some states' election staff conduct mock elections or system demonstrations while other states rely on academic institutions, external experts, or consultants to perform a range of system tests and establish a basis for approval. States, territories, and the District also reported facing similar challenges in approving systems, including ensuring that vendors meet requirements, having sufficient qualified staff and facilities to conduct testing, and completing the approval process in a timely fashion.

Most States, Territories, and the District Approve Voting Systems, but Fewer Provide for Approvals to Be Qualified, Reapproved, or Revoked

Most states, two territories, and the District approve or otherwise certify voting systems, but fewer provide for qualifying approval, or for renewing or revoking a prior system approval.[25] System approval processes are largely governed by statutory requirements, but the specificity of these requirements varies by state. Most states' statutes include a detailed list of requirements that voting systems must meet for approval to be granted, and a few state and territory statutes include specific approval activities that must be performed. Similarly, most states that provide for approval revocation also specify circumstances for doing so in statute; a few of these also identify specific revocation steps.

[25]Qualifying approval is either approving a voting system due to special circumstances or adding additional conditions or procedures that must be met to fully comply with state requirements and to permit the system's use.

System Approval Processes Are Largely in Place and Governed by Requirements, but Specific Requirements and Approval Activities Vary

Most states, 2 of the territories, and the District approve or certify voting systems for use in elections to ensure they meet specific state requirements and standards. Based on responses to our survey and a review of statutes, 43 of 50 states, 2 of 4 territories, and the District currently have a requirement to approve or certify voting systems (see fig. 8), and many have statutory frameworks. The 7 states and 1 territory that do not have an approval requirement have reported alternative approval approaches that are mostly based on nonstatutory requirements, according to election officials. The other territory does not use electronic voting systems. The number of states with approval requirements is similar to the numbers that were previously reported relative to the 2000 and 2004 elections.[26]

Figure 8: 2008 Voting System Approval Requirements Reported by States and Others for 2008
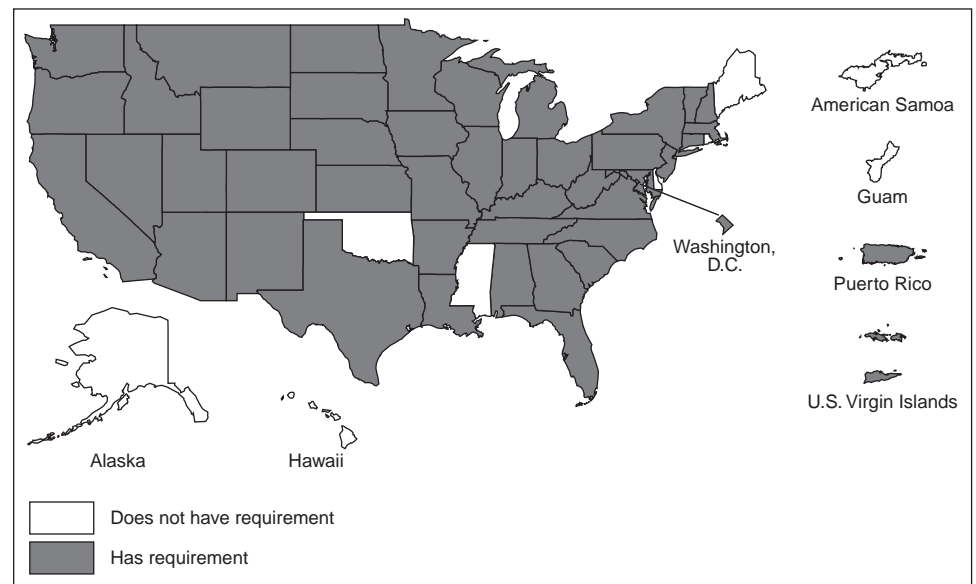
Sources: GAO 2008 survey of state, territory, and the District of Columbia election officials and GAO analysis of state statutes for Michigan, New Jersey, and Utah; MapArt (map).

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[26]We previously reported that 45 states and the District, and 42 states and the District, had certification programs for the 2000 (see GAO-02-3) and 2004 general elections (see GAO-06-450), respectively. Our previous reports did not collect information on territory requirements for voting system certification.

Based on our review of state and territory statutes, the requirements that voting systems must meet, and the activities to be performed, vary as to their specificity. Most statutes include a detailed list of requirements that must be met for approval to be granted, such as permitting voters to cast ballots for all offices that they are entitled to, ensuring secrecy in casting a ballot, and including a mechanism to record and tabulate the votes cast. However, a few state statutes do not cite detailed requirements, but rather state that an approval authority is to specify the appropriate technical standards or criteria for approval. Further, few state and territory statutes include specific activities to be performed. Rather, the statutes typically include such general activities as: (1) testing of voting system functions, (2) examining previous testing laboratory results, (3) involving the public in the approval process through public hearings or periods for public comment, (4) reviewing vendor financial information and system maintenance manuals by an approval authority, and (5) placing system source code in escrow.

While 7 states and 1 territory do not have a statutory framework that governs approval, they do have statutory voting system requirements, and they have defined approaches to selecting systems. More specifically, the 7 states' statutes require certain system functions or authorize specific voting methods, but they do not have statutory requirements that assign responsibility for approving systems to a specific entity. To select systems, election officials in the majority of the 7 states and 1 territory told us that they develop detailed administrative requirements that the voting system must meet and processes that govern how systems are selected. To illustrate, one state uses a combination of mechanisms and acceptance testing procedures to ensure that systems meet state requirements. The remaining states and the territory require certain vendor documentation that they evaluate to ensure that the system complies with state requirements or federal standards.

State officials that we interviewed cited various reasons for not having a statutory framework governing voting system approval. Officials in one state said that because the state historically had not been involved in local jurisdictions' selection of systems, its legislature did not see a need for state approval. Officials for another state indicated that the state's current statutes on voting systems make a statutory approval process unnecessary because, by law, only the state is allowed to purchase systems for local jurisdictions to use. Officials with one other state said that an approval process was not necessary because of the limited number of voting system units in the state and that it was not feasible given resource limitations.

Qualified Approval Is Permitted in Many States, but Conditions Vary

Survey responses from many states identified the use of qualified approvals to either approve a voting system due to special circumstances or to add conditions or procedures that must be met to fully comply with state requirements and to permit the system's use. Specifically, 23 of the states with an approval requirement reported at least one of four types of qualified approval—exemption, emergency, conditional, or provisional. Of these, 2 states' statutes address qualified approvals. Neither the territories nor the District have qualified approvals (see table 5).

Table 5: Types, Purposes, and Circumstances of Qualified Approval with Number of States that Have Provisions for Each Type

Type	Purpose	Circumstances for use	Number of states with provisions
Exception	Allow system to be used in an election without undergoing state approval process	Approve legacy system; system with limited functionality	7
Emergency	Grant approval to voting system when standard approval process cannot be completed before the election	Approve system upgrades or modifications within limited time frame	12
Conditional	Grant approval to voting system contingent on taking additional actions before the system can be used in an election	Approve system with required administrative procedures; approval expires at predetermined time	6
Provisional	Grant approval to voting system contingent on additional actions while the system is in use for an election	Approve system for use in certain capacity (maximum number of voters, specific jurisdictions, pilot projects)	12

Source: GAO 2008 survey of state, territory, and District of Columbia election officials.

Note: The total number of respondents to this question was 45. Of these, 2 states and 1 territory reported "Don't know." The rest of the territories and the District reported that they did not have any qualified approval processes. Although survey respondents that did not have a requirement for approval of voting systems were excluded from this survey question, 1 state and 1 territory that did not have an approval requirement provided responses to this question.

As shown in table 5, certain types of qualified approval are more prevalent than others, and several states have multiple types in place. Specifically, emergency and provisional approvals are more prevalent than exception or conditional approvals. In addition, approximately one-third of the 23 states have multiple types of qualified approvals, with the most frequent combination being emergency and provisional.

While almost one-half of the states have a qualified approval process in place, only 12 states reported that they have used these processes since December 2004; however, most of these states reported that they have done so repeatedly. For example, 2 states used provisional approval almost every time they granted approval to a voting system because the approval decision also outlined specific conditions for local jurisdictions to follow to use the system in an election. In another case, a state repeatedly used conditional approval because adding the condition allowed for (1) addressing any residual system concerns or (2) operating the system for a limited time before requiring re-examination. A few other states reported utilizing qualified approvals only once to address specific circumstances. In 2 states, a form of qualified approval was used because there was insufficient time to provide an unqualified approval. In another state, an exception approval was used because the system was to be used in a limited capacity, and thus certain functionality did not need to be approved.

Reapproval Is Largely Required, but Circumstances Vary

Almost all states, territories, and the District that require system approval also require system reapproval under certain circumstances to ensure that systems continue to meet the requirements under which they were initially approved, according to state-identified approval statutes and other survey responses. The circumstances that prompt reapproval and the activities to be performed are typically established in state statutes, or in administrative procedures that are set by the approval authority, but these circumstances vary. According to survey respondents, most require reapproval of a system when system hardware or software is modified. In addition, more than one-half also require reapproval when examination or testing show that the system no longer meets the requirements under which it was originally approved, or when state requirements change. States also responded that other circumstances could lead to reapproval, such as state or local jurisdiction requests for reapproval or expiration of a prior approval (see fig. 9).

Figure 9: Circumstances for Reapproving Voting Systems as Reported by States and Others

Number of respondents

Circumstances that lead to reapproval

Source: GAO 2008 survey of state, territory, and the District of Columbia election officials.

Note: The total number of survey respondents to this question was 45. Although respondents that do not have a requirement for approval were excluded from this survey question, 1 state and 1 territory that did not have an approval requirement provided responses to this question.
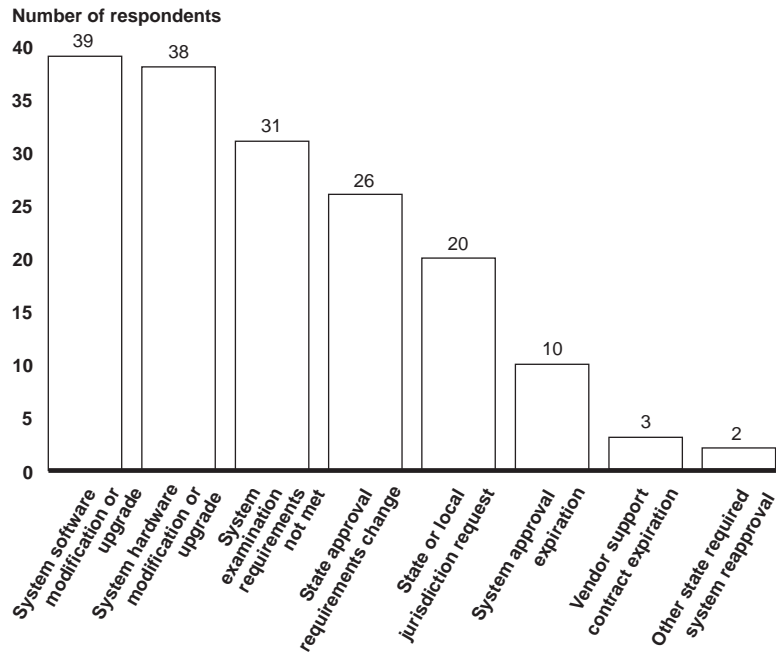
A few statutes also allow an approval authority to determine the circumstances for reviewing existing approval. Typically, approval authorities could require reapproval if they: (1) determine changes to the system affect its accuracy, efficiency, or capacity; (2) receive a request for system re-examination by state electors; or (3) otherwise deem it appropriate. In addition, two states require reapproval every 4 or 8 years, respectively.

Since December 2004, almost one-half of the respondents reported that they have reapproved from one-fourth to all of their voting systems to introduce upgrades, make a system accessible to voters with disabilities, or incorporate software or firmware changes. Officials from one state told us that when any voting system changes are made, the approval for any previous version of that system is automatically revoked.

Prior Approval Generally Can Be Revoked, but Specific Requirements Vary

The majority of states and one territory have a process to rescind an existing voting system approval if the system fails to fulfill requirements, but the circumstances that prompt it, and the process followed to justify it, vary. Specifically, 31 states and 1 territory with an approval requirement reported they have a revocation process,[27] and for the majority of these states, the process is established by statute, though a few states and one territory specify their respective processes in administrative procedures. Based on our review of state statutes and survey responses, most of these states and the one territory specify that any unapproved modifications or changes that cause a system to no longer comply with state requirements could lead to revocation. Other circumstances, such as changes in state requirements, irregularities discovered as a result of postelection audits, and federal decertification also could lead to revocation, based on survey responses (see table 6).

Table 6: Circumstances Reported by States and Others for Revoking Voting System Approval

Circumstance	Number of respondents
Software modification or upgrade that causes noncompliance with state requirements	29
Testing reveals system requirements not met	29
Hardware modification or upgrade causes noncompliance with state requirements	28
Postelection audit irregularities	26
Federal decertification	26
State requirement changes	25
State or local requests	16
System approval expiration	14
Another state or jurisdiction approval revoked	13
Other[a]	6

Source: GAO 2008 survey of state, territory, and District of Columbia election officials and GAO review of relevant statutes.

Note: Respondents that did not report a requirement for revoking approval were excluded from this survey question. In addition, 1 or 2 states responded "Don't know" for some of the options in this question.

[a]Other circumstances included vendor contract expiration, system misrepresentation in the approval application, and system not used after initial approval.

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[27]Respondents that do not report a requirement for voting system approval were excluded from this survey question.

Although the statutes that we reviewed typically specify when a revocation is effective, few specify the steps to be followed. With respect to effective dates, several statutes specify that systems are to be withdrawn immediately following the revocation, although two states allow local jurisdictions anywhere from 6 to 24 months to withdraw a nonapproved system from use and implement or purchase a new system. For a small number of states, the statutory steps are broadly defined, such as (1) holding public hearings; (2) requiring vendors to provide written responses on corrective measures or other system documentation; and (3) providing written notice to vendors, state or local election officials, and the public when revocation is being considered. In addition, one state's statute specifies that a revocation that occurs 6 months or less before an election will not go into effect until after the election.

States, Territories, and the District Generally Have Defined Similar Approaches, but Specific Approval and Revocation Activities and Stakeholders Involved Vary

Notwithstanding the variability in voting system approval requirements, most states, territories, and the District follow a similar series of general steps in approving voting systems and revoking a prior approval. However, the specific activities that comprise these steps vary. For example, based on discussions with election officials, approval-related testing can include mock election testing, source code review, or function testing. In addition, the stakeholders that perform the approval steps vary across states, territories, and the District. For example, the approval authorities in 12 states and 1 territory rely solely on their election board, committee, or secretary of state to perform approval activities, while the approval authorities in 28 states, 1 territory, and the District rely on two or more stakeholders. In addition, the majority of approval authorities also engage state or local officials and external experts or consultants (e.g. academic institutions) in the approval process in order to augment technical expertise, and a few states collaborate with either the state chief information officer or chief technology officer. Several states and one territory also reported making recent improvements to the approval process activities that they had in place for the 2006 election, such as adding additional testing requirements and changing who performs certain approval activities.

Basic Steps Governing Approval of Voting Systems Are Largely Similar

The primary steps that govern how states, territories, and the District are to approve voting systems are generally similar. Based on survey responses, approval can be viewed in terms of four steps: (1) establishing standards or criteria, (2) evaluating documentation, (3) testing systems to state standards and examining test results, (4) making an approval decision. Two other activities may interact with these steps: involving the public in aspects of the approval, and resolving problems that surface

during the approval process. Each of the general approval process steps and activities, and their relative timing, are depicted in figure 10 and described in the following sections.

Figure 10: General Steps that States and Others Follow in Approving Voting System

Approval timeline

Involve public

Members of the public are kept informed of voting system approval activities through one or more mechanisms, including public notices, public hearings, invitations to view or participate in approval activities, or periods for public comment.

1. Establish standards or criteria	2. Evaluate documentation	3. Test and examine results	4. Make approval decision
Minimum system requirements (functional or performance) are established that must be met for a voting system to be approved.	Voting system documentation is evaluated to determine whether the system meets the standards or criteria. Documentation may include technical documentation, vendor business information, and test plans and results from accredited testing laboratories.	Voting systems are tested to determine whether they meet the standards or criteria. The results are examined to confirm whether the system successfully passed testing.	The results of voting system testing and documentation evaluation, including any recommendations, are reviewed and a decision is made regarding system approval.

Resolve problems

Problems that arise as a result of the documentation evaluation or testing are resolved with the vendor.

Source: GAO analysis.

1. Establish standards or criteria. Based on survey responses and contacts with election officials, the majority of states, one territory, and the District have established standards or criteria that a voting system must satisfy to be approved. For the most part, these standards or criteria address system performance; physical, design, or environmental characteristics; system security; system audibility; and information privacy. A small number of survey respondents also reported approval requirements for long-term system sustainability, life cycle costs, and system use by other states.

Election officials described a variety of approaches and resources for developing these requirements. For example, several states and a territory have committees or focus groups composed of major stakeholders—such as state executives, knowledgeable technical experts or consults, and advocacy groups—to determine system approval standards or criteria. Other states engage state and local election officials. Resources that states and other officials cited as contributing to the development of standards

were other state requirements, the federal voluntary voting system guidelines, industry technology standards, and studies of voting systems.

In developing the specific standards, election officials told us that a few factors guided the process, including: (1) compliance with state or federal requirements, as appropriate; (2) satisfaction of voters' needs; and (3) appropriate technical specificity. As noted earlier, officials for some states told us that their respective state statutes have detailed requirements, thus the statutes provided a solid basis for developing approval requirements. Officials for other states said that their legislatures had vested its approval authority with responsibility for developing the appropriate technical standards. According to these officials, this provides flexibility for changing requirements because it does not require legislative action. Officials for some states also noted that having many groups involved in the process helps ensure that the standards are comprehensive.

2. Evaluate documentation. In this step, the approval authority or designated staff evaluates vendor-provided system documentation against the standards or criteria for approval. Such documentation is submitted as part of the approval application. State and other election officials told us that they evaluate a range of vendor documentation and other sources to assess a system. On the basis of our interviews with state officials, and analysis of survey responses and state-provided statutes and documentation, the most common types of documents include test plans and test results from independent testing laboratories, operations manuals, vendor financial and performance information, and vendor contracts. Some states also collect other documentation, such as software source code, training materials, photographs, and other states' approval reports.

3. Test and examine results. Testing is intended to determine whether the system meets specified standards or criteria. As part of testing, test plans, procedures, or checklists are developed and executed, and test results are examined to confirm whether the system successfully passed testing. Based on survey responses, the majority of states and territories perform system testing as part of their approval process, and the testing generally covers major system functions. Specifically, 34 states and 3 territories perform approval testing,[28] and in doing so test a range of

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[28]Although survey respondents that did not report a requirement for system approval were excluded from this survey question, one state and one territory that did not have approval requirements nevertheless reported performing testing as part of approval.

functions, such as ballot definition or layout, ballot marking, vote casting, tabulation, transmission of results, and the election management system. In addition, a few states reported testing the integration of the electronic poll book.[29]

The type of testing and examination of results performed varies among states and territories to support system approval decision making. These include mock elections, accessibility, source code review, and volume testing. See table 7 for the types of tests and the purpose of each.

Table 7: Types and Purposes of Approval-Related Testing

Type	Purpose
Accessibility	Determine whether the system's accessibility functions (e.g., audio ballot volume and system interfaces) meet requirements and perform as intended.
Function	Determine whether system functions (e.g., ballot definition, processing ballots, tabulating results) meet requirements and perform as intended.
Software comparison	Determine whether the certified version of system software has been installed on a voting system by comparing the vendor-provided version with the certified version.
Mock election	Determine whether tabulation software is accurate by tabulating marked ballot test decks and comparing the results with original paper ballots; confirm the correct ballot presentation and vote casting.
Regression testing	Determine whether software or firmware upgrades did not adversely affect other system features that were not part of the upgrade.
Security testing	Determine whether system components or configurations include access controls, and whether system configurations, network communications logs, and removable media have security vulnerabilities.
Source code review	Determine whether software code is constructed correctly and contains no malicious code or security vulnerabilities.
Volume testing	Determine whether the system will operate in conditions approximating normal use by voters on Election Day.

Source: GAO analysis of state-provided documentation.

[29]Such testing was not applicable for the majority of these states because they do not use an electronic poll book as part of their voting system. An electronic poll book is an electronic mechanism, including stand-alone software, by which an election official at a polling place, at the time an individual seeks to vote, may obtain information on the individual's eligibility to vote, whether the mechanism is operated by integration with a voting system or independently.

Depending on the type of testing performed, election officials or their designees develop test plans that list specific test activities to be performed for each type of test. In general, these plans are developed by looking at technical documentation provided by the vendor to determine how the systems should be tested, although officials with one state noted that their staff used the testing protocols from an independent testing laboratory when developing its test plan. After testing is completed, election officials told us that they review the results to ensure that the system successfully passed the testing.

4. Make approval decision. Approval authorities typically base their approval decision on the results of the documentation evaluation and the testing performed, as well as stakeholder recommendations. Once a decision is reached, a letter is sent to the vendor notifying it of the decision. The approval results also are provided to local jurisdictions so that they may acquire systems. Voting system approval results also may be posted on state Web sites as an information resource for local jurisdictions or the public.

All states, territories, and the District reported that they make an approval decision as part of their approval process, though the processes for dissemination of the results vary. For example, officials from one state reported that the final approval decision is a multiday process where examiners meet with the approval authority to review all test results and determine whether or not the system will be approved, or if it will receive a form of qualified approval. Officials from another state told us that the approval authority reviews the testing reports and the recommendations from technical experts to make the approval decisions. According to state statutes, some states require the approval authority to notify local jurisdictions about the specific systems that are approved, while other states also require that the basis for the approval be made available to local jurisdictions and the public. Several of the election officials that we interviewed confirmed that they notify local jurisdictions of the approval decision by providing a list of approved voting systems to jurisdictions or placing a copy of the list on the state's Web site. A few officials told us that the basis for system approval is also posted on the state's Web site.

Involve Public. Involving the public in some manner in the approval process was cited by 29 of 47 states, 3 of 4 territories, and the District as a related aspect of the approval process. More specifically, these respondents reported that they hold public hearings or seek public comments during the approval process. Further, election officials that we interviewed told us that the public is either invited to hearings where a

vendor demonstrates the system or is invited to participate in some aspect of the testing process. In addition, some officials said that the public is involved in developing voting system standards or criteria.

Resolve problems. All but 2 states that had an approval requirement identified problem resolution as a part of the approval process. During our interviews with state officials, they identified four factors that they said facilitate problem resolution: (1) sufficient time, (2) effective relationships and communication with vendors, (3) thorough documentation and understanding of the problems, and (4) vendor understanding of the state's practices and requirements.

Activities for Revoking Prior System Approval Generally Are Similar

As with system approval, there are generally similar activities performed by the 31 approving states and 1 territory that have processes to revoke a prior voting system approval. Based on survey responses and election official interviews, these activities can be grouped into four general steps—re-evaluation, decision, withdrawal, and reconsideration.

Re-evaluate the system. These state and territory officials reported that they will re-examine a system to determine if it still meets approval standards when they receive complaints or information from such sources as local jurisdiction reports, postelection audits, or other states. Several states also hold a public hearing as part of this reevaluation.

Decide on revocation. Most of these states reported that the decision on whether to revoke a prior approval is made by the approval authority. However, for one state, a judge makes the decision based on a review of the system evaluation report and complaints. Once a decision is made, the approval authority provides written notification to the vendor that the system's approval has been revoked.

Withdraw revoked system. As noted earlier, the majority of these states and one territory with a revocation process reported that once a revocation decision has been made, a system generally is to be withdrawn immediately from use, although some states allow more time. Local jurisdictions are informed of the withdrawal of approval and its effective date.

Reconsideration decision. The majority of these states reported that they allow the vendor to request reconsideration of revocation, but the methods for doing so vary. Vendors can submit written requests, provide testimony at public hearings, or submit documentation for reconsideration.

States, Territories, and the District Involve Varying Stakeholders in Their Approval Processes

Overall responsibility for approving the voting system normally rests with an approval authority that is established by statute. Typically, the approval authority also determines the stakeholders that participate in the approval process. In doing so, the approval authority may delegate responsibility to one or more other stakeholders for performing certain approval steps, depending on statutory requirements and available resources. These stakeholders can include other state, territory, or local jurisdiction staff, subject matter experts or consultants, and the state's chief information officer or chief technology officer.

Based on survey responses and review of state-provided election statutes, the approval authority is typically the state's secretary of state or the state's election board or committee. Approximately one-half of state statutes designate the secretary of state as the approval authority, while almost all of the remaining states, as well as the territories and the District, require a state election board or commission to be the approval authority. For 2 states, the state election director is the approval authority.

The approval authorities' delegation of responsibility for performing the approval steps varies in terms of the stakeholders involved and their assigned roles and responsibilities. Based on survey responses, the approval authorities for 12 states and 1 territory rely solely on their election staff to perform the approval steps and activities, while the approval authorities in 28 states, 1 territory, and the District rely on two or more stakeholders to conduct these steps and activities. Election officials for the states and territories that we interviewed told us that these stakeholders include other state or local officials, experts or consultants who provide technical expertise on voting systems, or election and program management. In addition, officials for some states stated that these stakeholders assisted the approval authority in making the approval decisions. For example:

- Election officials from one state told us that the state's cyber security office, along with experts from state universities, helps develop the approval process requirements, particularly in the areas of security, telecommunications, and audit capabilities. According to state officials, this assistance allows the state to develop more comprehensive requirements in these areas.

- Election officials from another state explained that staff from the office of the chief information officer is involved in all aspects of the approval process. They said that the staff provides technical expertise for system acquisition management and evaluations of voting systems. These office

staff members also help evaluate requests for proposals and participated in reviews of system source code.

- Another state's election officials told us that they work with county clerks and information technology staff to perform system testing. According to officials, county clerks provide needed expertise in election management processes because they administer the voting systems during elections, while county information technology staff provide expertise and resources to conduct software comparisons and address potential system problems.

In addition, officials for several states told us they use external experts or consultants in performing certain approval process steps. These include universities, consulting groups or firms, and technical or subject matter experts. For example:

- Election officials from one state told us they use the staff and resources from a state university to evaluate documentation and test the systems. More specifically, university staff review technical documentation, develops test plans, conducts testing and examines testing results, serves as the state escrow agent for voting system source code, and provides system training and technical support to local election officials.

- Officials from another state told us they use a private, nonprofit company as a technology advisor and to develop testing requirements, review laboratory test plans, and develop suggested practices for county boards.

- Another state's election officials told us they contract with technical consultants to evaluate technical documentation, review system source code, ask vendors questions during system demonstrations, and conduct testing and examination of results.

State officials emphasized that experts and consultants are important stakeholders in the process because they provide needed technical expertise and resources that are not otherwise available. They also said that using the external experts and consultants provides a measure of impartiality and independence in the reviews because they are viewed as independent of the election office.

Several States and a Territory Have Made Recent Improvements to Their Approval Process Activities

Several states and one territory have made improvements to approval process activities since the 2006 general election relative to establishing standards or criteria, evaluating documentation, and testing and examining of results. In selected cases, states have made improvements to

a range of approval steps and activities, while other states have made improvements to one process step. For example:

- Officials from 2 states told us they have developed new or additional approval requirements and processes to either accommodate a new voting system or add additional security controls for their systems.

- Officials from one state stated they have begun to review additional technical documentation, such as system configurations, security specifications, and operations and maintenance procedures, as well as the vendor's configuration management plan and quality assurance program.

- Officials from 2 states said they have expanded the types of testing performed to include volume testing, reviews of source code, penetration testing, and accessibility testing for voters with disabilities. Officials from another state said that staff members from their secretary of state's office have begun participating in setting up the mock elections testing.

States and Others Largely Reported Facing Similar Challenges in Approving Systems

According to survey responses, many states, several territories, and the District faced similar challenges in approving voting systems for the 2006 general election. Of the thirteen challenges identified in our survey, the most prevalent challenges reported by respondents were: ensuring that vendors meet requirements, ensuring that voters' concerns are considered, having sufficient qualified staff and facilities to conduct tests, and ensuring that the approval process is completed in time for the election (at least 25 responses for each). The thirteen challenges can be grouped into three categories: (1) system management, (2) resource availability, and (3) stakeholder coordination (see fig. 11).

Figure 11: Voting System Approval Challenges Reported by States and Others
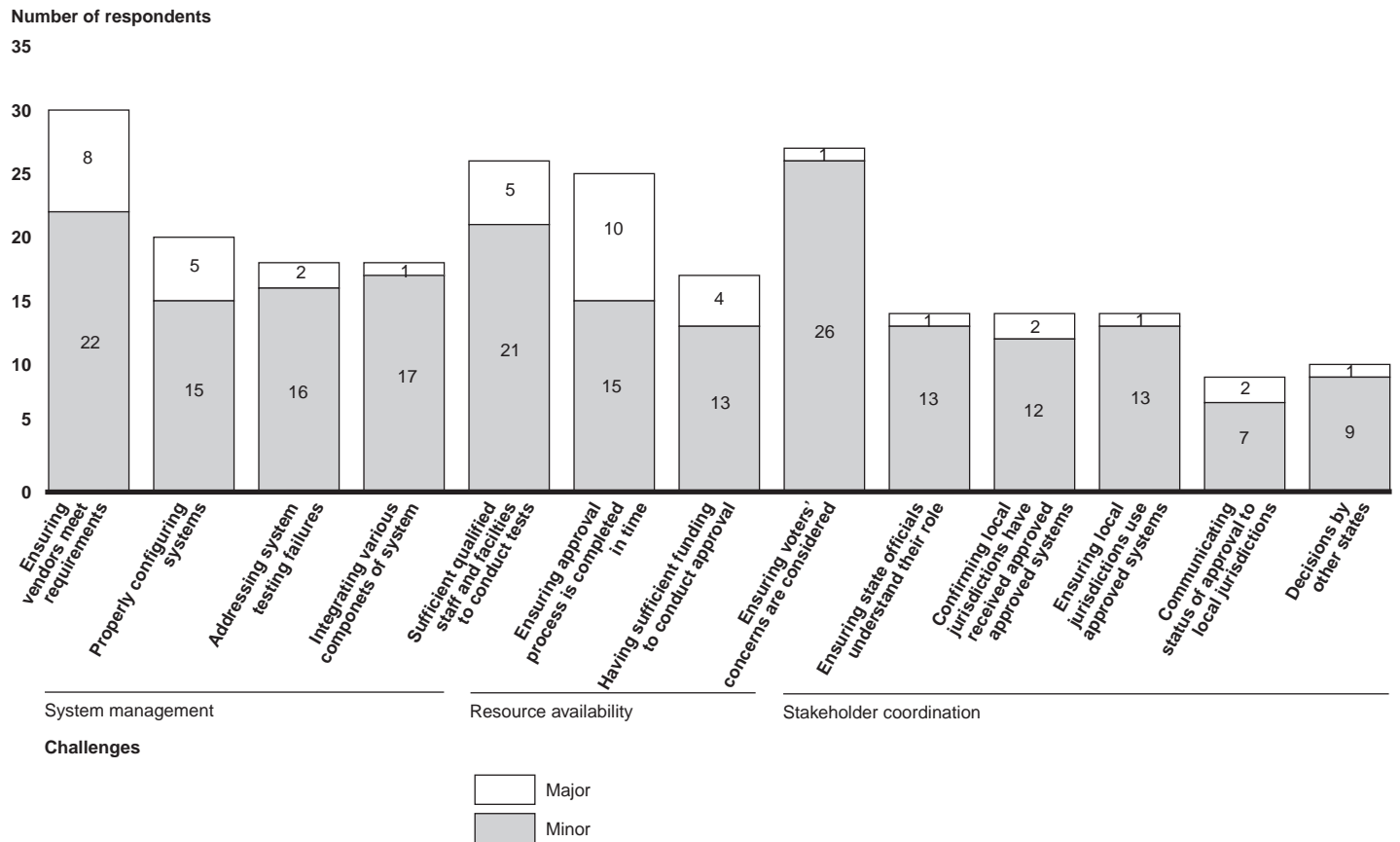
Number of respondents

Source: GAO 2008 survey of state, territory and the District of Columbia election officials.

States, territories, and the District typically reported experiencing multiple challenges. Of the 46 respondents with approval processes, 41 reported at least one challenge and most had more than one. The majority of respondents reported five or more challenges.

Although most respondents considered their challenges to be minor, each of the thirteen challenges was identified as a major challenge by at least one respondent. Further, five of the challenges were reported to be major by four or more respondents. These five are (1) ensuring that vendors meet requirements, (2) properly configuring systems, (3) having sufficient qualified staff and facilities, (4) ensuring that approval is completed in time for the election, and (5) having sufficient funding to conduct approval. These major challenges were confined to 16 of the respondents.

Election officials that we interviewed also provided their views on the root causes of some of the challenges and shared their approaches for addressing them. These approaches included facilitating working relationships with vendors, collaborating with university and other state or local officials to leverage their expertise and resources, and utilizing technological solutions.

System Management Challenges

System management-related challenges include ensuring vendors meet requirements, addressing system testing failures, properly configuring systems, and integrating system components. More than one-third of the respondents reported that they faced at least three of these challenges, and nine reported all four challenges.

The most frequently cited system management challenge was ensuring that vendors met requirements (29 states and 1 territory). Moreover, 8 states considered this to be a major challenge. Election officials from several states told us that this challenge stems from the fact that vendors have not always provided complete approval applications or successfully met testing requirements. For the most part, these officials attributed this challenge to vendors' insufficient knowledge of state approval requirements, inexperienced vendor staff, or lack of commitment to complying with approval requirements. The significance of this challenge is evident by the fact that 12 states reported that they have denied approval to voting systems because state requirements could not be met.

Many of the respondents reported challenges related to properly configuring systems or integrating system components, but more respondents considered system configuration as a major challenge (5 respondents) than system integration (1 respondent). Election officials from one state attributed challenges with system configuration to varying degrees of responsibility for local jurisdiction officials in handling various county systems.

Over one-third of respondents reported having faced the remaining challenge of addressing system testing failures, but just 2 respondents considered this challenge to be major. According to election officials that we interviewed, when vendors did not provide needed documentation or other technical information, or when system failures occurred during vendor demonstrations or system testing, approval delays have resulted.

Officials from the states that have experienced system management-related challenges described various steps to deal with them, but generally identified one important step as establishing effective working

relationships with vendors to facilitate access to needed information. In addition, officials from one state said that they have thoroughly documented testing failures so that vendors would be better positioned to address the problems. Officials from one state told us that they have revoked an existing system approval, in part, to make the vendor more responsive to meeting state requirements.

Resource Availability Challenges

Many of the commonly identified approval-related challenges relate to insufficient resources, to include lack of qualified staff and facilities, inadequate funding, and limited time. Specifically the majority of respondents reported facing at least two of these three challenges, and about one-third of the respondents reported having faced all three. Collectively, these challenges were also identified as major by more respondents than any other category of challenges.

Over one-half of respondents reported that having an adequate number of staff, including staff with the requisite technical expertise, was a challenge, as was having sufficient test facilities with adequate space or equipment to efficiently or effectively complete such approval activities as source code reviews, volume testing, and functional testing. Further, more than one-third of respondents cited funding limitations as a challenge. However, election officials that we interviewed cited different reasons for these challenges. For example, officials said that their funding challenge was largely due to lean state budgets. In contrast, officials from another state attributed their staffing challenge to statutory limitations on what they can pay technical experts. According to these officials, this results in experts working on their own time.

The third resource-related challenge is ensuring that the approval process is timely. This challenge was cited by 25 respondents and was also the most frequently cited major challenge (10 respondents). According to election officials from several states, they have not always had sufficient time to perform such approval activities as testing and problem resolution. Further, officials from a few states identified demanding approval time frames that are set in statute or administrative requirements as the source of this challenge.

To overcome staffing and facility challenges, officials from some states told us they have relied on EAC certification or voting system testing laboratory results. Officials from some other states told us that they have formed partnerships with universities to leverage their expertise, used staff from other state or local jurisdiction offices, or requested additional funding from state legislatures to expand staff and facilities. One state

official stated that he is considering partnering with other states to conduct testing for similar requirements.

Stakeholder Coordination Challenges

The stakeholder coordination-related challenges include ensuring that voters' concerns are considered and that state officials understand their role, confirming that local jurisdictions have received and used approved systems, and communicating approval status to local jurisdictions and revocation decisions made by other states. Overall, 8 respondents reported that they have experienced more than three of the challenges in this category, with one state reporting that it has experienced all six. For the most part, these challenges were not as widely reported as challenges in the other two categories. Nevertheless, ensuring that voters' concerns were addressed was the second most frequently reported approval challenge.

Of the 27 respondents that were challenged in ensuring that voters' concerns were considered, all but one considered it a minor challenge. Statements by election officials in several states help to explain why it was so widely viewed as minor. According to these officials, questions and concerns raised by voters regarding the reliability, security, or accuracy of the state's voting systems were often not relevant to their state. Further, they said that voting system problems described in media reports or other states' revocation decisions were also not always relevant to them, which may be why only 10 respondents reported other states' revocation decisions as a challenge. To address voter concerns, state officials explained that they listen to voters' concerns and provide information on state systems and processes, as appropriate, to alleviate the concerns. However, they added that doing so requires time and resources.

The remaining five challenges in this category were cited by 9 to 14 respondents and relate to coordination with local jurisdictions or considering approval results from other states. For the most part, election officials attributed these challenges to inexperienced vendor staff, system complexity, or local jurisdiction staff changes. More specifically, officials from one state told us that vendors did not always install the approved system configurations on local jurisdiction systems, while officials from one state told us that it was a challenge to keep local jurisdictions fully informed on the status of the approval phases and to ensure that the local jurisdictions installed the changes to system components. Further, officials from one territory told us that local election officials did not always follow the territory's administrative procedures.

To address these challenges, election officials that we interviewed described a range of steps that they take. For example, officials from a few states told us that they assisted counties by using software escrow to save copies of approved voting system configurations and compared these against the version used by local jurisdictions, thereby ensuring use of the approved system configuration. Officials from two states said that either state or local officials periodically perform system inspections to ensure that the systems are accurate and meet state requirements. Officials from one state said that they have instituted new approval policies and procedures that help to address the approval coordination issues.

States, Territories, and the District Required and Conducted a Range of Tests after System Approval and Faced a Variety of Testing Challenges

Beyond the testing performed in support of voting system approval, states, territories, and the District required and conducted other types of testing to ensure that systems perform as intended during elections. While each type of testing was required and conducted to some degree, the extent and content of the tests varied considerably for the 2006 general election. Most states employed testing prior to accepting new, changed, or upgraded systems, as well as readiness testing prior to Election Day use. Many states also performed security testing at different times and conducted postelection audits. In contrast, relatively few states conducted Election Day parallel testing. Although states, territories, and the District varied as to the personnel that were involved in the various types of testing, they reported that most types of testing were conducted by the local jurisdictions—sometimes in conjunction with state election officials. Several states also used vendors, consultants, or contractors to conduct testing.

The challenges that states faced in testing voting systems varied. Overall, about two-thirds of the survey respondents identified at least one testing challenge, while 16 states identified five or more challenges, with one reporting that it faced eight challenges. Among the challenges concerning all types of postapproval testing, roughly two-fifths cited limited staffing, funding, and time to complete testing before the election. They also cited approaches being taken to address the challenges.

Most States, Territories, and the District Required and Performed Postapproval Testing, but Approaches Varied

All but one state and two territories augment their approval of voting systems with postapproval testing that provides opportunities to anticipate and address potential voting system problems before they affect election results. As we have previously reported,[30] rigorous testing at multiple points in the voting system life cycle provides important assurance that a system conforms to state and local requirements, functions correctly, and is secure and reliable. Five types of tests that states or local jurisdictions typically conduct when acquiring and operating voting systems are

- acceptance testing,

- readiness testing,

- parallel testing,

- postelection audits, and

- security testing.[31]

Most states, two territories, and the District reported that they required two or more types of postapproval tests. Specifically, 42 of the 52 respondents required two or more types of tests, and approximately one-third of those respondents required at least four types. Many of these states and territories, as well as the District, also required approval of voting systems. On the other hand, 7 respondents required just one type of test, and 3 reported no requirements for voting system testing. The types of tests that were required were largely specified in statute. In addition, some had regulations or directives for specific types of tests and time frames for conducting them (see fig. 12).

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[30]GAO-05-956.

[31]GAO-06-450.

Figure 12: Number of Required Test Types Reported by States and Others for the 2006 General Election
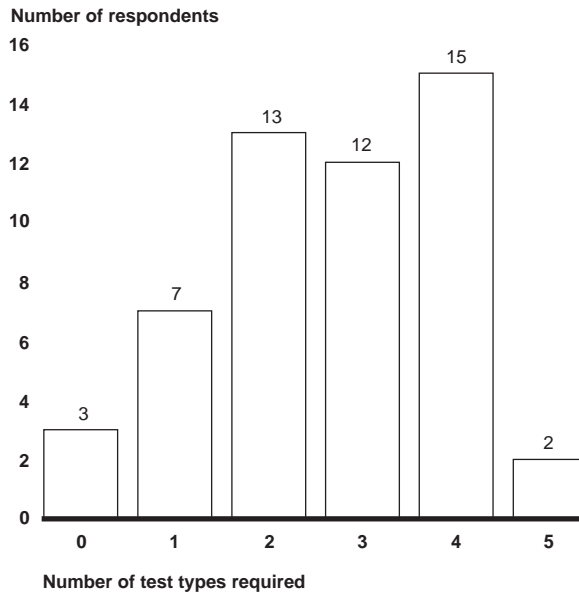
Number of respondents

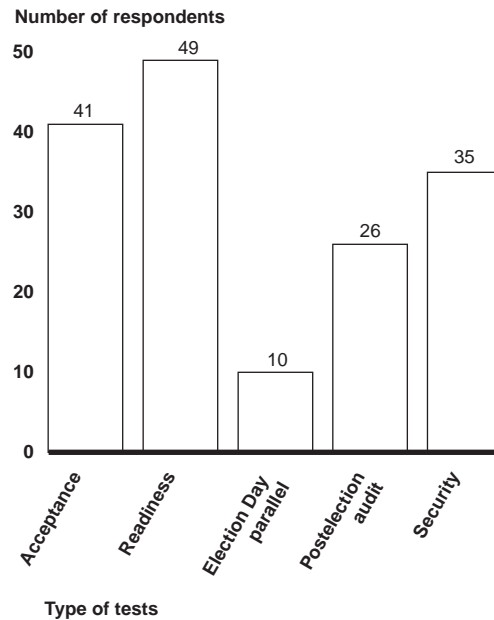**Number of test types required**

Source: GAO 2008 survey and interviews of state, territory, and the District of Columbia election officials.

For the 2006 general election, survey responses show that some of these tests were more widely performed than others. For instance, almost all states performed readiness testing, making it the most widely used type of test. Acceptance testing was the next most widely used, followed by security testing, postelection audits, and Election Day parallel testing (see fig. 13). Except for acceptance and security testing, the relative prevalence of these tests was consistent with our previously reported findings relative to the 2004 election.[32] Reasons respondents gave for performing or not performing particular test types are discussed in the following sections.

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[32]GAO-06-450. For the 2004 general election, states and the District reported performing each of the following tests: acceptance (26 states and the District); readiness (49 states and the District); Election Day parallel (13 states); postelection audit (22 states and the district); and security (24 states and the District). Our results included responses from all 50 states and the District. We did not include the territories in that survey.

Figure 13: Types of Postapproval Testing Performed for the 2006 General Election as Reported by States and Others

Number of respondents

Type of tests	Number of respondents
Acceptance	41
Readiness	49
Election Day parallel	10
Postelection audit	26
Security	35

Type of tests

Source: GAO 2008 survey and interviews of state, territory, and the District of Columbia election officials.

Requirements and responsibility for performing testing are largely specified in statute or directives, based on: responses to our survey; contacts with state, territory, and District election officials; and our analysis of materials they provided. Further, responsibility for postapproval testing was typically assigned to local jurisdictions, although many state election officials told us that they provided testing guidance to local jurisdictions and that they sometimes required the jurisdictions to file test documentation with them. Furthermore, our work showed considerable variation in the nature and scope of testing for the 2006 general election.

The following sections provide an overview of the five types of postapproval testing and the range of reported approaches.
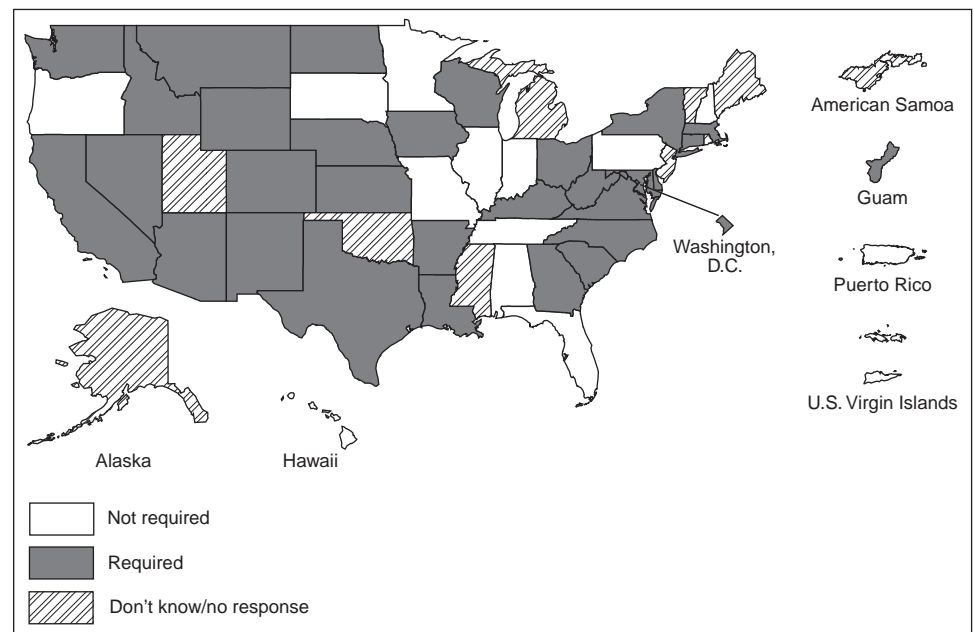
Acceptance Testing

Acceptance testing validates that the units delivered by the vendor perform in accordance with specifications[33] and related contract

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[33]The specifications may reference a system configuration previously approved or certified by the state and may include capabilities or configurations required for a particular election.

provisions. According to EAC guidance, it includes: (1) physical analysis to ensure that the system is intact and physical components, such as locks and doors, operate properly; (2) diagnostic analysis to test and calibrate mechanical and electronic components, such as a memory card or other device, printers, readers, and touch screens; and (3) functional analysis to test the operation of hardware, firmware, and software for election functions, such as voting, ballot marking, tabulation, and reporting.[34] EAC guidance also recommends conducting a mock election as part of acceptance testing.

Based on our survey, almost two-thirds of states, territories, and the District (31 of 52 respondents) required acceptance testing for the 2006 general election to verify that voting systems delivered by the vendor met state requirements (see fig. 14). According to most respondents, these requirements are contained in state statutes, codes, or regulations.

Figure 14: Acceptance Testing Requirements Reported by States and Others for the 2006 General Election

Sources: GAO 2008 survey of state, territory, and the District of Columbia election officials; MapArt (map).

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[34]U.S. Election Assistance Commission, *Acceptance Testing*, undated. http://www.eac.gov/election/quick-start-management-guides/.

Statutory testing provisions range in content from high-level requirements to more detailed specifications governing testing timing, scope, policies, and responsibilities. In general, states and others require acceptance testing for each type of system and required testing for both new and modified systems. One state also required that their systems operate successfully in an actual election to be accepted. A few state statutes address the entire acceptance testing process, from initial delivery by the vendor through decision making by election officials. For example, one state's statute required the following:

- After the system has been delivered:
  "…the local board shall test the system to confirm that the system, including all hardware, software, and other components:

  (a) Is identical to the system certified by the State Board;

  (b) Is fully functional and capable of satisfying the needs of the board; and

  (c) Satisfies all requirements, terms, and conditions of the contract."

- The acceptance test shall demonstrate the system's ability to:

  "(1) Process simulated ballots for each precinct or polling place in the county;

  (2) Accept valid votes in every ballot position enabled by the ballot format;

  (3) Reject over-votes and votes in invalid ballot positions;

  (4) Generate system status and error messages;

  (5) Generate system audit records;

  (6) Comply with all applicable statutes, regulations, and procedures; etc."

- After the acceptance test has been performed:

  "If the system fails the test required of this regulation, the local board may not accept the contract."

- In performing the acceptance test:

  "… the local board may enlist the assistance of State Board personnel or independent consultants."

  Several states that did not identify current statutory or regulatory requirements for acceptance testing nevertheless indicated that they performed such testing for the 2006 general election. In addition to the 29 states, 1 territory, and the District, that reported that they required and performed acceptance tests, 9 states and a territory reported that they also performed these tests, even though no requirements existed for doing so. Officials from one of these states told us that their local jurisdictions performed the tests, and that they assisted them by providing guidance.

  In most of the states that reported performing acceptance testing, local election officials were identified as either solely or partly responsible for conducting the tests. Specifically, in 21 states, local officials were the only level of government involved in performing the tests.[35] In 14 states, responsibility was shared between local and state election officials. For example, state officials from one state were responsible for providing testing oversight, finalizing timetables, coordinating with the counties, and keeping records of the test. In another state, each piece of voting equipment was tested multiple times at both state and local levels. For 2 states, 1 territory, and the District, acceptance testing was performed solely at the state level (see fig. 15).

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[35]This included one state that identified acceptance testing responsibilities for the county auditor, rather than local election officials.

Figure 15: Responsibilities for Performing Acceptance Testing Reported by States and Others for the 2006 General Election
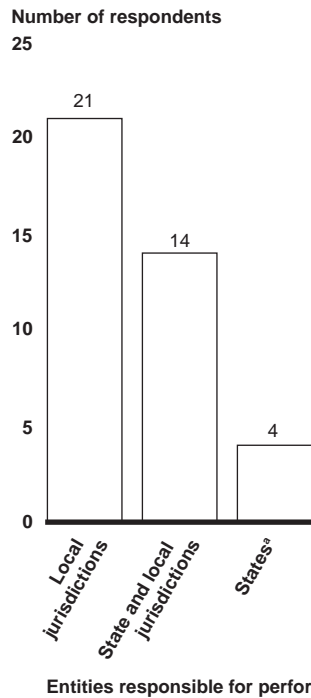
Number of respondents

Entities responsible for performing testing

Source: GAO 2008 survey and interviews of state, territory, and the District of Columbia election officials.

Note: One state reported responsibilities as "Other" and another territory reported responsibilities for experts, consultants, and contractors.

[a]Includes responses from one territory and the District.

Other parties frequently assisted state and local officials in performing acceptance testing. Of the 41 respondents who reported performing acceptance testing, 26 indicated that vendors, contractors, and consultants assisted them. In fact, officials with several states told us that vendors played a significant role in test planning and execution. For example, officials in one state said that vendors performed these tests under contracts with local jurisdictions. Officials in another state said that vendors helped state officials develop the acceptance test and that local election officials were invited, but not required, to attend the tests. Officials from another state said that their local jurisdictions did not have the technical expertise or equipment to do any tests of their own so they used consultants to help them. In another state, local jurisdictions developed testing criteria and were assisted by state election officials who helped to perform the tests, while another state official leveraged existing relationships with technical experts or vendors to address any problems.

Election officials we interviewed generally described similar activities as part of acceptance testing:

- Checklists were used to guide election officials through the test steps and application of criteria. For instance, one state election official told us that a checklist was completed for each voting system and individual unit. The list included instructions for inspecting mechanical, electronic, and optical components and identified qualities to evaluate.

- Physical and mechanical aspects of voting units were inspected to ensure that system components were working properly. For instance, one state official told us that they inspect paper feed paths to ensure proper operation.

- Diagnostic tests were executed to detect malfunctions or failures and to ensure proper functionality. One state election official told us that these diagnostic tests were run on each voting unit and its components. For instance, touch screens were calibrated to accept voter selections correctly.

- Ballot generation, voting, and tabulation were conducted with test data to ensure that the system and its components could accurately and reliably accept, record, and tabulate the votes. Such testing sometimes included large volumes of ballots and votes and involved generating vote totals and reconciling them within and among voting units.

- The accepted configuration of the system was documented and electronically captured to establish a baseline for future comparison. Furthermore, the voting system's software configuration was verified against the state-approved configuration.

- An acceptance test report was prepared and submitted for review and approval by a higher authority. For instance, one state election official said that results of acceptance tests performed by local jurisdictions were certified to the secretary of state.
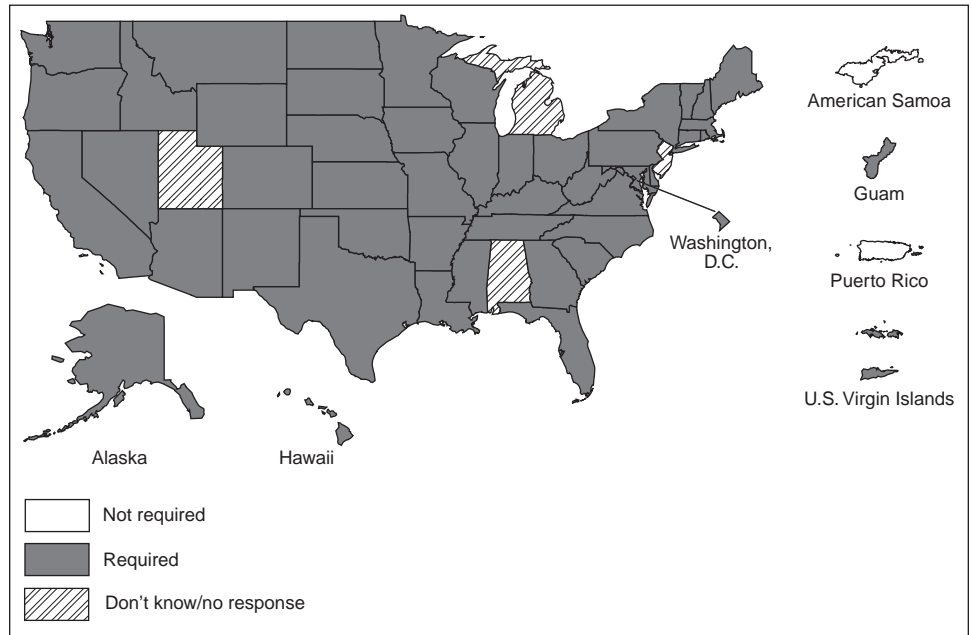
Readiness Testing

Readiness testing, also referred to as logic and accuracy testing, ensures that voting equipment is functioning properly—usually by confirming that predictable outputs are produced from predefined inputs. Readiness tests are sometimes conducted publicly in the weeks leading up to Election Day to verify the readiness of the system for the specific election. Members of the press, the public, and the candidates are invited to observe.

According to EAC guidance,[36] an effective readiness test should (1) verify all of the conditions previously tested during the acceptance test and (2) ensure that each machine is configured for the specific election (e.g., the correct ballot information is loaded, including the names of all applicable candidates, races and contests). The tabulation functions also should be tested by recording test votes on each machine, verifying that it is possible to vote for each candidate on the ballot, and confirming that these votes were tabulated correctly.

Most states reported readiness testing requirements for the 2006 general election, and the conditions for conducting readiness testing were typically specified in state statutes. Specifically, 46 states, 2 territories, and the District reported requirements for readiness testing (see fig. 16).

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[36]U.S. Election Assistance Commission, *Quick Start Management Guide for Ballot Preparation/Printing and Pre-Election Testing*, September 2006. http://www.eac.gov/election/quick-start-management-guides.

Figure 16: Readiness Testing Requirements Reported by States and Others for the 2006 General Election

Sources: GAO 2008 survey of state, territory, and the District of Columbia election officials; MapArt (map).

State statutes or regulations typically specified when readiness testing should be conducted, who was to be responsible for conducting it, and whether public demonstrations were to be required. Statutory requirements ranged from high-level requirements to conduct testing, to specific requirements governing test timing, scope, policies, and responsibilities. The following examples from various state statutes illustrate the specificity of readiness testing requirements:

- *"Electronic ballot tabulating systems shall be tested for logic and accuracy within seven days before their use…"*

- *"The test shall be conducted by processing a pre-audited group of ballots marked to record a predetermined number of valid votes for each candidate and on each measure…"*

- *"If any error is detected, the cause shall be ascertained and corrected and an errorless count shall be made before the machine is approved."*

- *"…the county board of election commissioners shall certify the accuracy of the voting system and file the test results with the county clerk".*

- *"…in addition to conducting the pre-election test itself, the local board shall:*

  (1) Conduct a pre-election public demonstration of how the test was conducted;

 *(2) Allow the public to inspect the printouts of test results"*

Readiness testing also varied in terms of the number of voting units tested and when testing was performed. For instance, some states performed these tests on all units, while others performed them on a certain percentage of units. Furthermore, some state statutes required every type of voting system to be tested prior to use in an election, while others excluded or were silent on certain voting equipment. For instance, one state statute required that at least one memory card from each precinct be tested (e.g. uploaded to the county server to ensure that the upload features necessary to compile and count the votes were working properly). Another state required each tally machine to be tested three times for each election—no later than 5 days before the election, on the morning of Election Day, and when the polls closed. In another state, readiness testing was to be conducted 5 days prior to each election and 5 days afterward, unless a recount was in progress.

All of the states and territories that required readiness testing also reported that they actually performed such testing for the 2006 general election. In addition, a number of states identified readiness testing as their only method of required testing.

In general, local jurisdictions were responsible for developing readiness testing plans and performing them, although some jurisdictions engaged state election officials and vendors in defining and conducting the tests. Of the 49 respondents that reported performing readiness testing, 33 indicated that local jurisdictions were solely responsible for conducting the tests. Responsibilities were shared between local jurisdictions and the state in 9 cases. For example, copies of test reports in one state were maintained at both the state and local levels. Officials from another state told us that the state provided local jurisdictions with minimum requirements for readiness testing and that the local board of elections was responsible for performing the test and ensuring that the minimum requirements were met. State or territory election personnel had sole responsibility for readiness testing in 4 states, 1 territory, and the District (see fig. 17). For example, one state had a centralized approach where all

readiness tests were performed by the state. Officials for this state said that local jurisdictions were unable to pay for the test and the clerks of court had other duties that made their election responsibilities a lower priority.

Figure 17: Responsibilities for Performing Readiness Testing Reported by States and Others for the 2006 General Election

Number of respondents

Entities responsible for performing testing
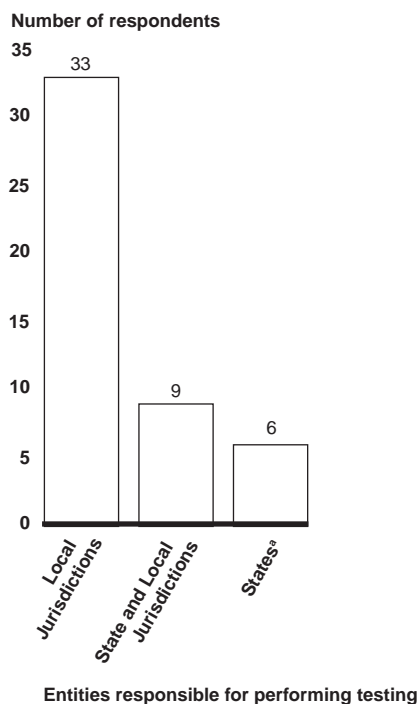
Source: GAO 2008 survey and interviews of state, territory, and the District of Columbia election officials.

Note: One state reported responsibilities for an independent testing authority.

[a]Includes responses from one territory and the District.

Based on survey responses, 14 states used vendors, consultants, contractors, or other entities to assist with readiness testing for the 2006 general election. In almost all cases, they shared responsibility for performing the test with either state or local election officials, or both. For example, one state utilized a committee made up of statisticians and mathematics experts to assist with its readiness tests.

State and territory officials that we interviewed described generally similar readiness testing policies and procedures. For example, they used test ballots to exercise system recording, tabulation, and reporting functions;

verified that test results were complete and accurate; confirmed that the ballot box was empty and vote totals were zero after testing; and sealed the systems until they were activated on Election Day. Further, survey respondents that required readiness testing reported using the actual election definition[37] and ballot formats for the upcoming election to test system recording, tabulation, and reporting functions.

One state's approach illustrates some of the typical aspects of readiness testing. Specifically, the state must test the voting system within 14 days before Election Day to ensure that it will correctly mark ballots using all methods supported by the system and count the votes cast for all candidates and ballot questions. Public notice of the time and place of the test must be given at least 2 days in advance by publishing it in official newspapers. The test itself must be observed by at least two election judges, who are not of the same major political party, and must be open to representatives of the political parties, candidates, the press, and the public. The test is conducted by processing a preaudited group of ballots containing a predetermined number of valid votes for each candidate and on each question. Ballots that have votes in excess of the number allowed by law must be processed to test the ability of the voting system tabulator and electronic ballot marker to reject those votes. In addition, test ballots that have been marked using the electronic ballot marking device, audio ballot reader, or other assistive voting technology are processed and verified.

An atypical form of readiness testing was practiced by one state. Specifically, officials from this state said that postelection readiness testing is performed at the request of state election officials when there is a reported discrepancy or error. The postelection test is performed after the official count has been completed but before reviewing and counting votes by precinct, and producing an official total. The software and data used to set up the election, tabulate the ballots, and conduct the pre-election readiness test are used to conduct the postelection test. According to state officials, the postelection test is intended to demonstrate that no changes occurred in the system's software or setup data since the pre-election readiness test.

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[37]An election definition specifies the contests and questions that will appear on the ballot for a particular election. The electronic definition in a voting system may generate the ballot display (DREs), translate voter selections into ballot marks (ballot marking devices, vote-by-phone), or correctly match voter selections to ballot choices for vote tabulation (DREs, optical scan machines).

Election Day Parallel Testing

Parallel testing verifies the accurate performance of voting equipment through random selection and systematic evaluation of equipment that is operated under simulated Election Day voting. It is typically conducted on Election Day. According to EAC guidance,[38] parallel testing should ensure that: (1) ballots used for the parallel test are identical to the ballots used in the actual election; (2) the test takes place during the hours of the election, using software and hardware that is to be used in the election; and (3) a video record is created of all voting to determine whether or not any discrepancies in the results were caused by data entry errors.
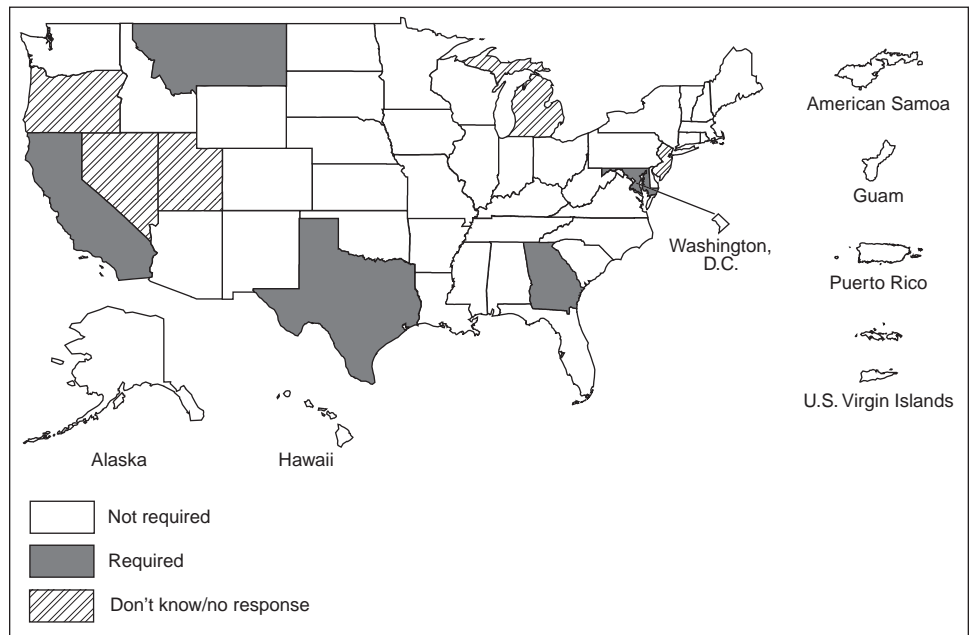
Few states required Election Day parallel testing for the 2006 general election, and neither the territories nor the District did. Specifically, only 5 of 47 states reported a requirement for parallel testing (see fig. 18). In addition, these 5 states' statutes are not specific relative to parallel testing scope, policies, or responsibilities. For example, one statute only states that

"… the local board shall: Conduct parallel testing according to the parallel testing plan developed by the State Administrator."

Because the statutes are not specific, the scope of parallel testing that these states performed varied. For example, one state conducted Election Day parallel testing on 5 percent of its voting systems or a minimum of one per county. Another state conducted parallel testing twice for each election—first in each county during the pre-election public demonstration, then again on Election Day.

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[38]U.S. Election Assistance Commission, *Pre-election and Parallel Testing*, undated. http://www.eac.gov/election/quick-start-management-guides.

**Figure 18: Parallel Testing Requirements Reported by States and Others for the 2006 General Election**

Sources: GAO 2008 survey of state, territory, and the District of Columbia election officials; MapArt (map).

Five additional states reported that they performed parallel testing even though they were not required by statute, code, or regulation. Election officials with other states told us that parallel testing was not performed either because either it was not required, sufficient voting units were not available to perform the tests, or the cost made it prohibitive. For example, officials in one state told us that each polling place had one optical scan and one DRE unit, which made it impossible to perform parallel testing.

According to survey responses, either states or local jurisdictions were responsible for performing parallel testing when it occurred. Specifically, 5 of the 10 states that conducted parallel testing reported that the state was responsible for performing such testing, while 4 other states reported local election officials were responsible, and—in some cases—involved others in the tests (see fig. 19). One of these states reported that while local jurisdictions perform the testing, the state provides guidance and oversight.

Figure 19: Responsibilities for Performing Parallel Testing Reported by States and Others for the 2006 General Election

Number of respondents
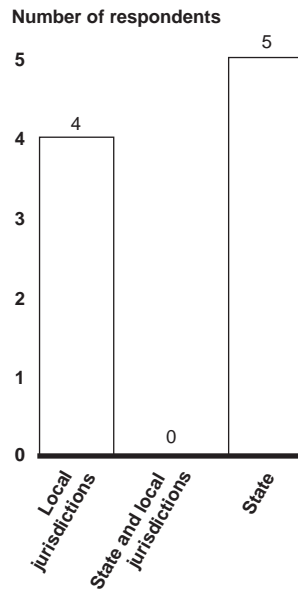
Entities responsible for performing testing

Source: GAO 2008 survey and interviews of state, territory, and the District of Columbia election officials.

Note: One state reported responsibilities for experts or consultants.

Furthermore, 5 of 10 respondents that performed parallel testing reported that vendors, consultants, contractors, or other entities were involved in the testing and that responsibility for performing the test was shared with either state or local election officials in four of these cases. For example, in one state, representatives of the League of Women Voters and members of the public were recruited to participate in parallel testing along with state officials. State officials also told us that some local jurisdictions that have contracts with system vendors for Election Day support use the support technicians to assist them with parallel testing.

For some states, parallel testing occurs at the polling place to make it open to public observation and possible public participation. The approach followed by one state is for two individuals to read aloud actual votes cast on a paper ballot, two people to separately record the votes cast on paper, and two people to cast the votes on a touch-screen voting machine. The teams periodically check to ensure that the two hand tallies match and that the number of cast ballots match. At the conclusion of parallel testing, the two sets of hand tallies are compared to the results generated by the voting unit to see if they match.

For other states, selected machines are removed from the voting equipment pool prior to the election and are tested in a controlled environment. The approach for one state is as follows: two touch-screen machines of each model to be used by a county on Election Day are randomly selected and removed from polling places shortly before the election. They are then transported to the testing facility and tested on Election Day in a simulated election conducted at the same time and in the same manner as the actual election. All test votes are videotaped to compare the results reported by the machine against the votes actually entered on the machine by state testers.

Postelection Audits

Postelection audits are independent, documented reviews of election results to reconcile them with other records to either confirm or correct the results. The audits can uncover problems with voting equipment or election processes. About one-half of survey respondents (21 states and the District) required postelection audits for the 2006 general election. The territories did not report requirements for postelection audits in that election (see fig. 20).

Figure 20: Postelection Audit Requirements Reported by States and Others for the 2006 General Election
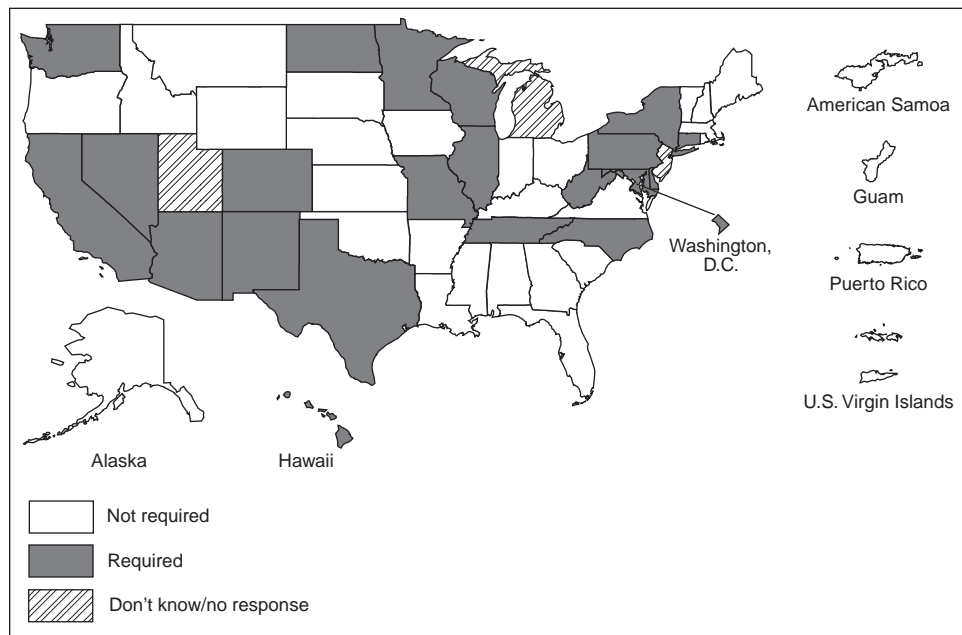
Sources: GAO 2008 survey of state, territory, and the District of Columbia election officials; MapArt (map).

Most states reported that the specific requirements for audits were provided by statute. Based on our review of the statutes, many do not explicitly mention the term "audit," but instead use a wide variety of terms, such as hand or manual count, recount or manual recount, manual tally, statistical recount, or postelection review. Moreover, the elements and details of these statutes also vary widely and in some cases refer to other forms of testing. The following examples taken from various state statutes illustrate the diversity of statutory requirements for postelection audits.

"During the official canvass of every election in which a voting system in used, the official conducting the election shall conduct a public manual tally of the ballots tabulated by those devices … cast in 1 percent of the precincts chosen at random by the elections official. … The manual tally shall be a public process … . The official conducting the election shall include a report on the results … [and] identify any discrepancies between the machine count and the manual tally and a description of how each of these discrepancies was resolved. … the voter verified paper audit trail shall govern if there is a discrepancy between it and the electronic record."

"After each election, the secretary of state shall order a random testing of the voting system programming for one precinct in each county of the state according to logic and accuracy testing procedures … as may be further defined by the secretary of state in writing."

"Following each general election, [the Government accountability board shall] audit the performance of each voting system used in this state to determine the error rate of the system in counting ballots that are validly cast by electors. If the error rate exceeds the rate permitted under the [federal] standards, the board shall take remedial action and order remedial action to be taken by affected counties and municipalities to ensure compliance with the standards."

"… If the secretary [of state] determines that a random audit shall be conducted …, the town clerk shall direct two members of the board of civil authority to transport the ballot bags to the office of the secretary of state. … The secretary shall … conduct the audit … [and] publicly announce the results of the audit as well as the results from the original return of the vote. If the secretary finds that the audit indicates that there was possible fraud in the count or return of votes, the secretary shall refer the results to the attorney general for possible prosecution."

"… the county auditor shall conduct an audit of results of the votes cast on the direct recording electronic voting devices used in the county. This audit must be conducted by randomly selecting by lot up to four percent of the direct recording electronic voting devices or one direct recording electronic voting device, whichever is greater, and, for each device, comparing the results recorded electronically with the results recorded on

paper. … On one-fourth of the devices selected for audit, the paper records must be tabulated manually; on the remaining devices, the paper records may be tabulated by a mechanical device determined by the secretary of state to be capable of accurately reading the votes cast and printed... Three races or issues, randomly selected by lot, must be audited on each device. This audit procedure must be subject to observation by political party representatives..."

"…[the] election authority shall test the voting devices and equipment in 5% of the precincts within the election jurisdiction. The precincts to be tested shall be selected after Election Day on a random basis by the State Board of Elections, so that every precinct in the election jurisdiction has an equal mathematical chance of being selected."

Within these examples are certain common elements that drive the conduct and consequences of the audit. These elements are

- precipitating condition(s) for the audit (e.g., candidate petition, tabulation discrepancy, decision of election official, or automatic);

- criteria for the extent of the audit (e.g., the number or percentage of precincts or voting machines—typically from 1 percent to 10 percent, or conditions for expanding the number of precincts or voting machines to be audited);

- criteria for sampling votes, ballots, voting machines, and precincts;

- instructions for examining electronic voting equipment and records (e.g., printed totals, voter verified paper ballots, or electronic disks or memory); and

- actions to be taken at the conclusion of the audit (e.g., resolve discrepancies, addressing wrongdoing, or notifying stakeholders or the public).

In all, 26 survey respondents reported that they performed postelection audits for the 2006 general election, which represents a small increase from the 2004 general election.[39] Although officials from these states generally attributed their audit activities to statutory or regulatory requirements, 4 states reported that they performed these audits even though they were not required. For example, officials from one state

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[39]In 2006, we reported that 22 states and the District performed postelection audits for the 2004 general election.

described how its local jurisdictions performed pre- and postelection audits on both their optical scan equipment and DREs to ensure that the number of votes matched the number of participating voters. Officials from another state told us that postelection audits were voluntary, and that 11 of 88 counties performed audits. In another state, we were told that an audit was conducted by one jurisdiction for a close race at the request of a political party.

Officials from one of the states that did not require or perform postelection audits told us that they had nevertheless begun defining their postelection audit process, but later decided to stop until the outcome of federal election legislation was clear. Officials from another state told us they were considering adoption of a postelection audit process and that their secretary of state had appointed a task force that included county election commissioners, voting integrity group members, and legislators to study postelection audit procedures.

Most postelection audits were performed by local election officials with guidance and procedures provided by the state. Of the 26 respondents that reported conducting postelection audits, 16 reported that local jurisdictions were responsible for performing audits without the assistance of state election officials. In another 5 states, local jurisdictions shared responsibility with state officials. State officials were responsible for the audits in the other 3 states, 1 territory, and the District (see fig. 21). Even when responsibility for conducting the audits did not reside at the state level, officials with a few states told us that audit requirements or guidance were produced at the state level. For instance, officials for one state explained that state-level standards were developed to provide guidance for audits and voting system audit capabilities, although the state does not require their use. Another state released requirements for a state directive for conducting audits and made it available to local officials on-line. In another state, the elections board is responsible for determining acceptable ballot-counting error rates for voting systems, developing audit procedures, and randomly selecting voting units to be audited, while local election officials actually perform the hand count.

Figure 21: Responsibilities for Performing Postelection Audits Reported by States and Others for the 2006 General Election
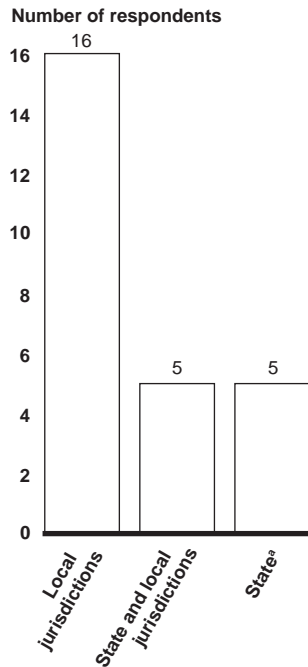
Number of respondents

Entities responsible for performing testing

Source: GAO 2008 survey and interviews of state, territory, and the District of Columbia election officials.

[a]Includes responses from one territory and the District.

Among the states that performed postelection audits, 3 reported that vendors or consultants were involved. For example, officials with one state told us that vendor representatives were on hand to address questions from local election officials as the jurisdiction conducted the audit. Academic institutions also assisted in audit activities. For example, state and local election officials with another state told us that they worked with a statistician from a local university to determine the attributes that governed the size of the audit to ensure a statistically significant result. Officials with another state said that they utilized university staff to analyze results from their postelection audit.

Voting systems with a HAVA-compliant manual audit capacity are required to produce a permanent paper record, which provides the voter with an opportunity to change the ballot or correct any error before the permanent paper record is produced. Most states reported that they require this fundamental capability for their systems, and some designated this paper

record as the official record for recount or verification of election conduct. The following two examples illustrate this:

- Officials from one state told us that they used a real-time printed audit log at the central counting station to record every event, tally, correction, and report produced from the tabulation system. All the audit logs and reports are available for public viewing. The electronic tabulation results can also be printed to paper after the election for a possible recount.

- Officials from another state told us that state statute requires 5 percent of all voting machines used in the election to be audited. At least two races per machine are to be hand-verified using paper ballots or voter-verified paper audit trails against the election night totals from the machine. The results are posted on the secretary of state's Web site.

For many states, the results of postelection audits could have implications for subsequent voting system use. Based on our survey, 26 respondents to this question reported that results from postelection audits could result in revocation of approval for their voting systems.[40] In some instances, differences of a specified magnitude between the manual vote count and the system-reported results could trigger additional review of the systems as well as system reapproval. However, only two states reported that they actually revoked voting system approval based on audit results. Further, officials from some states told us that they randomly audit selected jurisdictions to determine what problems were encountered. State officials from one of these states used these audit results to enforce the use of particular voting systems and to require manufacturer improvements. Officials in another state said that they used their audit results to improve their poll-worker training.

Security Testing

Security testing is used to evaluate the effectiveness of implemented security measures or controls and to identify, validate, and assess security weaknesses so that they can be addressed. Such testing should be one component of an overall security program that also includes assigned security responsibilities, risk assessment, system requirements, planning, policies, and procedures.

EAC's guidance for voting system security includes software security, password maintenance, personnel security, and physical security during

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[40]Respondents that do not report a requirement for voting system approval were excluded from this survey question.

system storage, transport, and at the polling place or operations center.[41] In addition, NIST has drafted guidance for planning and conducting such testing, analyzing findings, and developing mitigation strategies.[42] It recommends that security testing be based on an explicit security testing policy that defines roles and responsibilities, an established methodology, frequency of testing, and documentation requirements.

According to our survey, just over one-half of survey respondents (29 states, 2 territories, and the District) reported that they required security testing for the 2006 general election (see fig. 22). Of these 29 states, 24 indicated that their statutes addressed security management. For example, one statute states that the state board of elections or its designated independent expert is required to review the source code provided by the voting system vendor as a pre-requisite to state voting system certification. The review is to include:

"… security, application vulnerability, application code, wireless, security, security policies and processes, security/privacy program management, technology infrastructure and security controls, security organization and governance, and operational effectiveness, as applicable to that voting system."

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[41]U.S. Election Assistance Commission, *Quick Start Management Guide for Voting System Security*, September 2006. http://www.eac.gov/election/quick-start-management-guides.

[42]National Institute of Standards and Technology, *Technical Guide to Information Security Testing (Draft)*, *Special Publication 800-115 (Draft)*, November 2007. http://csrc.nist.gov/publications/drafts/sp800-115/Draft-SP800-115.pdf.

**Figure 22: Security Testing Requirements Reported by States and Others for the 2006 General Election**
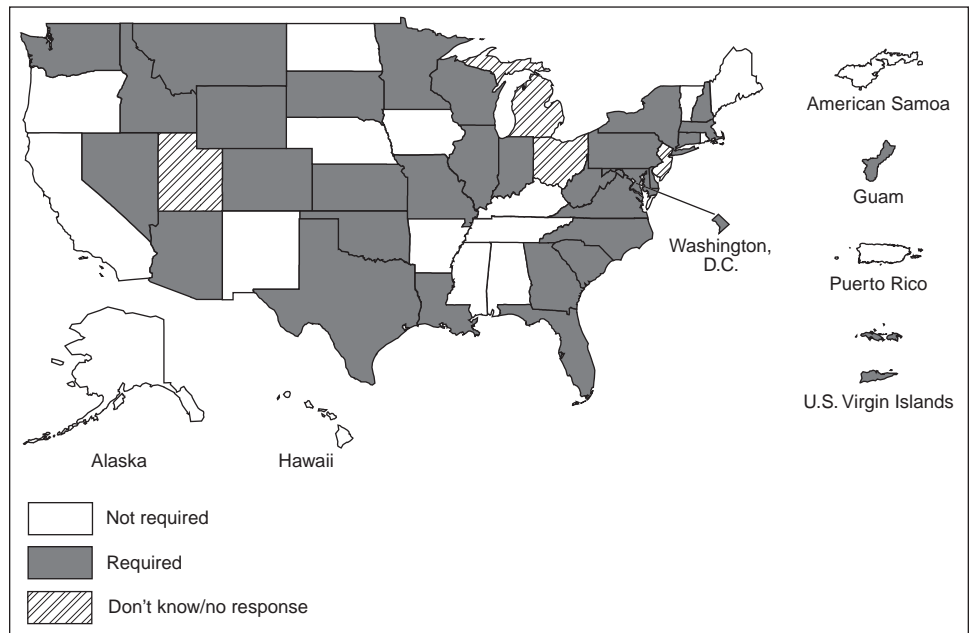
Sources: GAO 2008 survey of state, territory, and the District of Columbia election officials; MapArt (map).

In addition, a number of state officials that we interviewed told us that security testing was typically combined with other types of testing, such as acceptance testing and readiness testing, and thus they viewed it as implicitly covered by statutes requiring these tests.

In addition to the 29 states, 2 territories, and the District that reported having requirements, 3 other states reported that they performed security testing, even though it was not required by statute or regulation. This means that 35 of 52 respondents reported conducting security testing for the 2006 general election.

With respect to the responsibility for security testing, 26 states and one territory reported that local jurisdictions were responsible, in whole or in part. Of these, 7 states reported that security testing was performed at both the local and state levels. According to one official, state officials were invited to attend and participate in the testing at the local jurisdictions. Officials from one state explained that security testing is the responsibility of the county auditor, but security audits are performed by the state elections office. Security testing was conducted primarily by state officials in only 4 states, 1 territory, and the District (see fig. 23).

Figure 23: Responsibilities for Performing Security Testing Reported by States and Others for the 2006 General Election
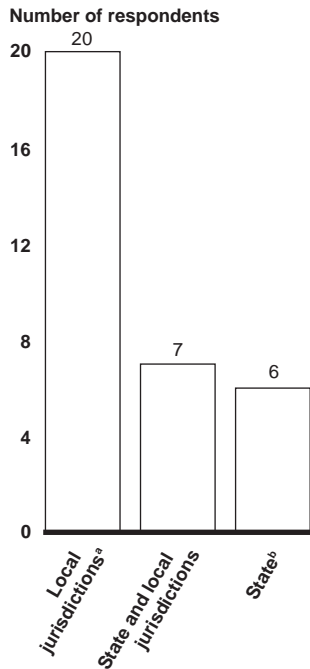
Number of respondents

Entities responsible for performing testing

Source: GAO 2008 survey and interviews of state, territory, and the District of Columbia election officials.

Note: One state reported only responsibilities for experts or consultants and another state reported responsibilities for an independent testing authority.

[a]Includes response from one territory.

[b]Includes responses from one territory and the District.

Vendors, consultants, contractors, or other entities participated in security testing for 10 states and 2 territories in the 2006 election. In these cases, these entities typically shared responsibility for performing the test with either state or local election officials, or both. For example, officials in one state told us that state and local election officials walked through the security test with the consultant.

Based on our interviews with officials in the 32 states, 2 territories, and the District that reported performing security testing for the 2006 general election, the timing, scope, and activities for security testing were quite diverse. In particular, several states and territories focused on assessing the physical security of their systems and the facilities in which they were stored. For example, officials from one territory told us that they

conducted "seal testing" to determine whether physical seals on voting equipment had been broken. Other states' security testing included more technical testing. For example, one state conducted system penetration testing and source code reviews to identify vulnerabilities. Officials from other states told us that they conducted system risk assessments. One state had documented policies and procedures that govern their security tests, which included state requirements for a security plan and security risk assessments for their voting systems. They assessed risks during the various phases of transporting its systems: in storage, in transit, and at the polling place. Another state used a third-party contractor to perform a risk assessment, which included evaluations of threats, vulnerabilities, security controls, and risks associated with the state's voting systems and possible impacts to the integrity of its elections process. In this case, the state's board of elections used the assessment results to develop a formal system security plan, policies, and procedures; establish a formal security training program for all election officials and contractor personnel; and establish a security officer position on the state board of elections.

States, One Territory, and the District Face Various Testing Challenges and Have Adopted Approaches to Address Them

States, territories, and the District reported experiencing all eight of our survey's testing-related challenges relative to their voting systems for the 2006 general election, along with approaches for addressing them. These challenges were viewed by most respondents as minor in nature, although three were characterized as major by 5 or more respondents.

The eight challenges can be grouped into three categories: (1) sufficiency of testing resources, (2) timeliness and thoroughness of testing execution, and (3) utilizing information from stakeholders (see fig. 24). Officials with some of the states, territories, and the District that we interviewed told us that these challenges remain for the 2008 general election. To address these challenges, state and other officials have begun to collaborate with one another to leverage their combined knowledge and skills, and thereby maximize their limited election resources and respective testing efforts.

Figure 24: Testing Challenges Reported by States and Others for the 2006 General Election
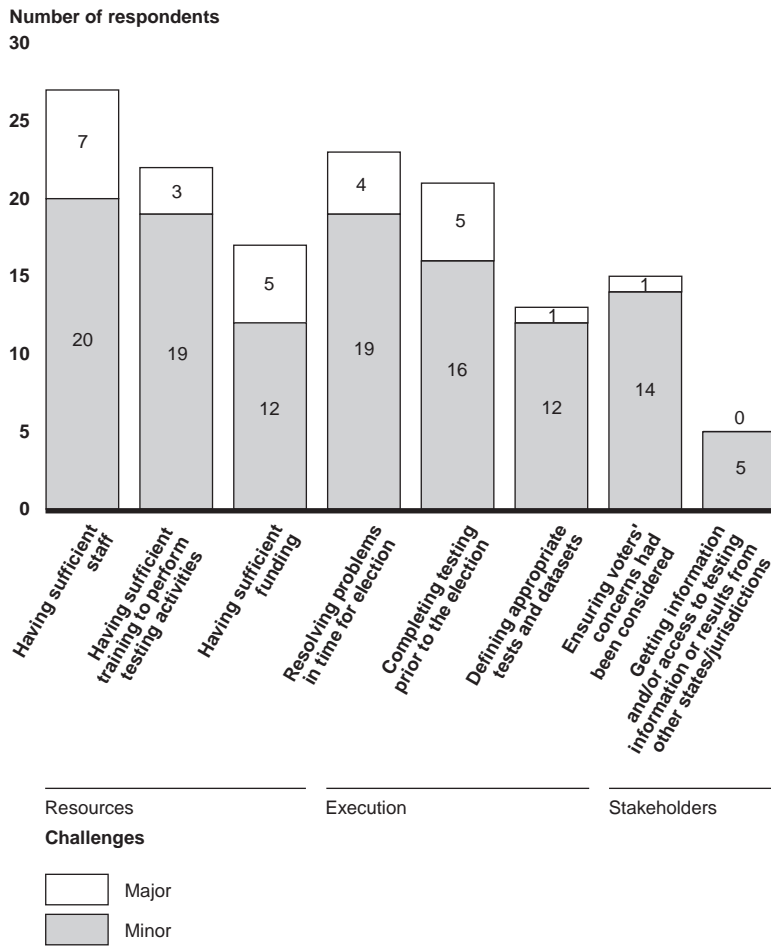
Number of respondents

Resources | Execution | Stakeholders
Challenges

☐ Major
▨ Minor

Source: GAO 2008 survey and interviews of state, territory, and the District of Columbia election officials.

In addition to the eight challenges cited by survey respondents, election officials in a number of states and one territory identified an additional challenge that cuts across the three categories—managing voting system testing in a changing environment.

Resource-Related Challenges

Of the resource-related challenges, the one most frequently reported for the 2006 general election, as well as the one most frequently viewed as being a major challenge, was having sufficient testing staff. Specifically, 25 states, a territory, and the District reported it as a challenge and, of these, 6 states and the territory saw it as a major challenge. According to election officials in some of these states, staffing shortfalls exist in both state and

local election offices. They attributed the shortfalls to such factors as election officials being assigned collateral duties and election-related positions frequently being part-time. To address these shortfalls, officials from one state said that they have started offering flexible work schedules and shorter shifts to attract election workers. Others said that they addressed staffing shortfalls in local jurisdictions by sending state staff to assist the jurisdictions and ensuring that the staff they hired could fulfill the travel requirements.

Another frequently cited challenge by 20 states, 1 territory, and the District is having sufficient training for the staff that perform testing activities. Moreover, 2 of these states and the territory considered this to be a major challenge. According to election officials in some of these states, some part-time election staff, particularly those in the local jurisdictions, do not have the technical expertise to conduct voting system testing. To fulfill their staff training needs, state officials described several approaches that they are taking. These include:

• utilizing more experienced staff to fill knowledge gaps (e.g. recruiting former election officials with testing experience and hiring new staff with the pre-requisite computer expertise);

• establishing training requirements and programs for election workers that include a component on testing (e.g. one state-wide training program for election officials included certification requirements to become an election official); and

• making technical training programs available to election workers throughout the year.

The third resource-related challenge was having sufficient funding to conduct voting system testing (identified by 16 states and 1 territory). Of these, almost one-third considered it a major challenge. Election officials that we interviewed related this challenge to the other two resource challenges by saying that election funding shortfalls have, in turn, limited the number of staff available for testing and the training that these staff members receive. According to one of these officials, they have attempted to address the challenge by persuading state executives to increase funding for voting system testing programs. Officials from one state said that they were planning to reduce testing costs by training state officials to program the voting systems, rather than relying on vendor technicians.

Timely and Thorough Execution of Testing	Another category for survey responses on testing challenges is ensuring that testing is completed on time and is executed using appropriately defined tests and related data. Overall, 26 states, 1 territory, and the District reported facing at least one of the three challenges in this category for the 2006 general election. Of these, 19 states and the District reported two or more challenges and 9 states reported all three.

The most-reported challenge for this category, and the second most reported challenge overall, was resolving problems discovered during testing in time for the election. This challenge was cited by 21 states, 1 territory, and the District, and was considered by 4 states to be a major challenge. Officials from one state attributed this challenge to the small number of voting system vendors relative to the large number of states that required support, thus making it difficult to get vendor support to resolve problems with ballot programming that were discovered during readiness testing. To overcome this challenge, the officials told us that they are considering developing their own in-house ballot programming capabilities to reduce vendor dependence.

Another challenge in this category that was cited by 20 states and the District, and that was viewed by 5 as major, was completing testing in time for an election. According to state officials, the following factors contributed to this challenge:

- Preparation for testing before Election Day depends on key events that occur very close to Election Day by statute, code, or regulation (e.g. two states reported a small window of time to certify candidates, finalize ballot information, print ballots, and conduct readiness testing before the election).

- Delays with certain vendor deliverables reduced the time available to states and local jurisdictions for testing (e.g. a number of state officials reported delayed ballot definitions, test execution, or test results reporting).

- The time needed to perform the volume of work associated with test preparation and execution and mismatches between this volume and available test resources (e.g. officials from one state said that producing the test ballots for optical scan machines was time consuming and labor intensive; officials with another state described the large amount of time and resources required to complete acceptance testing for its 400 voting machines).

To ensure that testing deadlines were met or to reduce the impacts of missed deadlines, state election officials that we interviewed identified several approaches. For example, officials from one state told us that they increased the staff available to support testing during intensive testing periods and, in another one of these cases, the secretary of state requested that local jurisdictions supply the additional staff for the testing. We were also told that the state legislature amended the law to permit testing to begin earlier, thereby providing sufficient time to complete all testing activities before the election. Officials in another state said that they were developing an election management plan and a continuity of operations plan to better manage unexpected events that may surface during the election, for example, should pre-election testing not be completed on time.

Another challenge cited was defining tests and datasets. In particular, about one-quarter of survey respondents saw this as a challenge, with one state reporting it as a major challenge. According to state officials, they experienced difficulty in selecting an appropriate sample size and ballot permutations to test. For example, officials in one state said that they were unsure what test would be appropriate for their ballot marking devices, whether it was necessary to test each ballot face (even those that may not occur within the precinct), and how many test ballots should be produced. Officials in another state said that it was a minor challenge to get their local jurisdictions to define appropriate test decks[43] without relying on the voting system vendor, which was the prior practice. To address this challenge, officials with a number of states told us that they provided direction or guidance for defining tests and data, including sometimes providing the actual test scenarios and data. In one particular case, a state election board had adopted detailed testing procedures and checklists when the system was originally installed. These procedures and checklists have been refined over the years, and they are to be used by the local election boards before each election.

Utilizing Information from Stakeholders

The last category of challenges in our survey related to obtaining or using information from either voters or from states, territories, and the District to improve elections. With respect to the voter-related information, 13 states, a territory, and the District reported that considering voter

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[43]Test decks are used to determine whether the voting equipment (hardware and software) reads and tabulates the marks on a ballot or touches on a screen with 100 percent accuracy.

concerns related to testing systems was a challenge for the 2006 general election, although only one state viewed it as a major challenge. Election officials in one state told us that they were unable to address voters' concerns because testing revealed problems with reading the ballot coding. An official from another state told us that the challenge persists because a portion of the general public remains unsatisfied with the testing that the state has in place. Similarly, election officials from the territory said that the challenge will continue because some people will always oppose electronic voting.

State election officials described various steps that have been taken to alleviate voter concerns. For example, one state included all stakeholders in the process it followed to select voting systems for use in elections. In addition, several other states required public notification of the time and place of voting system tests, and some states require their readiness tests to be open to the public. However, this approach actually introduced an additional challenge for one state because members of the public were not always interested in participating as test observers.

With respect to the challenge of obtaining usable testing information from jurisdictions, other states, territories, and the District, 5 states reported that this was a challenge and each of these states viewed the challenge as minor. According to officials in one state, their specific challenge was obtaining the information needed to verify whether local jurisdictions were actually performing testing as required. In another state, election officials said that county representatives were not always forthcoming with information about their testing activities. To address these information access challenges, state officials described steps taken to promote state-to-state, and state-to-jurisdiction information sharing. Examples include the following:

- A number of states sponsored various meetings (e.g. best practice conferences, annual or quarterly meetings, regional meetings, working groups, and user groups) with local jurisdictions to share testing-related information.

- One state held frequent phone communications with other states and local jurisdictions to discuss, for example, testing protocols and results.

- Several states established statewide Web sites, message boards, or automated e-mail lists for communication and interaction among local jurisdictions, and between the state and these jurisdictions.

- One state had a board of election commissioners with representatives from each of five county districts to actively share and solicit election-related information, including voting system information.

Changing Voting System Testing Environment

In addition to the challenges explicitly identified in our survey, officials with a number of states raised another common challenge—managing voting system testing in a changing environment. In this regard, officials primarily pointed to changes in response to legal actions, changes to statutory and administrative testing requirements, and changes to voting system technologies and products as contributing to this challenge. The following examples illustrate the challenge:

In one case, a state official said that potential changes to existing election law, would be a challenge to implement. In another case, a territory official said that development of federal requirements for voter-verifiable paper audit trails could, in turn, require changes to existing testing procedures. The official said that the extent of the changes is not yet known because EAC has yet to establish the requirements. Officials in some states did not view this as a challenge, however, because they had already incorporated voter-verified paper audit trail testing into their testing procedures when this capability was first added to their voting equipment. They also said that they have adjusted their statutory requirements to reflect this.

States, Territories, and the District Generally Reported Minor Voting System Problems, Diverse Responses, and Challenges in Addressing Them

Most states, territories, and the District reported experiencing a range of problems with their voting systems during the 2006 general election. While the prevalence and impact of the problems varied, survey respondents generally characterized the problems as occurring to a little extent and with little impact. Examples of the most frequently reported problems are systems where paper jammed or was improperly fed or imprinted, systems that stopped operating during the election, systems that would not operate at all, systems with slow response time, and systems that inaccurately reported vote totals.

The extent of the respondents' awareness of system problems is unclear because less than one-half of them had statutory or administrative requirements for local jurisdictions or others to report problems. Rather, officials we interviewed told us that they relied on local jurisdictions, voters, and voting system vendors to voluntarily report problems. A majority of states and others reported that they evaluated the problems after the election, although their approaches varied. The most frequently cited approach was reviewing system logs and reports. Other approaches included audits, investigations, recounts, and retesting of voting systems.
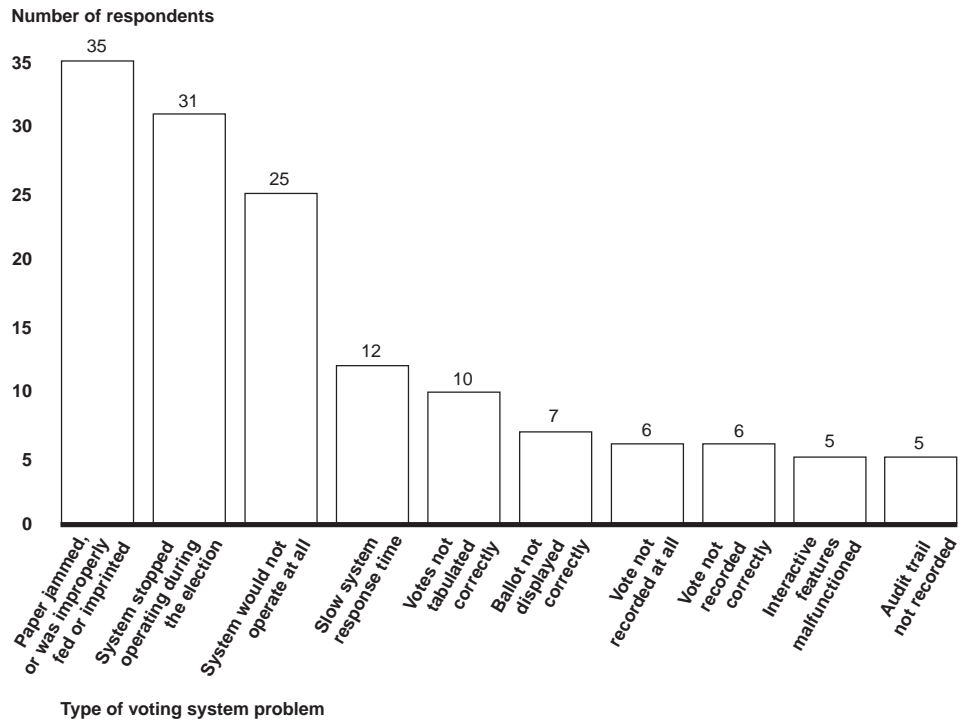
Election officials reported that responsibility for evaluating problems rested either with state officials or local jurisdictions, but that responsibility was rarely shared. They also reported that actions to correct problems were largely the responsibility of both state and local officials, although voting system vendors were another significant participant. Many respondents reported they took corrective action by developing and implementing new policies and procedures.

Almost half of the states and the District reported facing multiple challenges in managing the voting system problems that arose during the 2006 general election related to problem assessment and the implementation of corrective actions. The two most widely-reported challenges were determining the cause of errors or malfunctions, and identifying, evaluating, and selecting corrective actions. A handful of respondents that reported experiencing challenges indicated that all nine of the categories in our survey applied to them. However, about half of the states and the territories indicated that they either did not experience any of the challenges or that the categories did not apply to their election environments. Officials from states that did report experiencing challenges described steps they took to respond to these, including sharing information on problems among election officials.

Types and Prevalence of Voting System Problems Varied among States and Others for the 2006 General Election

Of the 52 survey respondents, 38 states, 1 territory, and the District reported one or more types of problems for the 2006 general election. The three most common problems, as identified by about one-half of the respondents or more, were paper that jammed or was improperly fed or imprinted in voting equipment, systems that stopped operating during the election, and systems that would not operate at all. About one-fifth of the respondents cited slow system response time on Election Day as a problem. Three types of problems related to voting accuracy were experienced by fewer than a dozen respondents—voter ballot selections not recorded, votes incorrectly credited to candidates or measures, and votes tabulated incorrectly. Also, less than 10 respondents reported problems with ballot displays, system interactive functions that assist voters in casting votes, or recording a system audit trail (see fig. 25).

Figure 25: Voting System Problems Reported by States and Others for the 2006 General Election

Number of respondents

Type of voting system problem	Number of respondents
Paper jammed, or was improperly fed or imprinted	35
System stopped operating during the election	31
System would not operate at all	25
Slow system response time	12
Votes not tabulated correctly	10
Ballot not displayed correctly	7
Vote not recorded at all	6
Vote not recorded correctly	6
Interactive features malfunctioned	5
Audit trail not recorded	5

Source: GAO 2008 survey and interviews of state, territory, and the District of Columbia election officials.

Most states and others that reported experiencing problems also reported that each type of problem was experienced to only a little extent, with a few exceptions.[44] Specifically, of the ten types of problems, only five types were reported as being experienced to a moderate extent, and three to a great extent (see fig. 26). Furthermore, 11 respondents experienced a given problem type to either a moderate or great extent.[45] The problem that was most frequently experienced to at least a moderate extent was

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[44]Survey response choices were "great extent," "moderate extent," "little or no extent," "not applicable," and "don't know." We contacted all respondents to clarify whether problems were encountered to a "little extent" or "no extent." To determine the extent to which each type of problem was experienced, state officials told us they considered such factors as the number of machines that malfunctioned, the number of voters affected, and the difficulty they had in identifying and resolving the problem.

[45]One state identified a problem that occurred to a great extent in the category of "Other"—voter assistance terminals that often failed to read ballots.

also the most-experienced problem overall—paper-related jams, feeding, or imprinting problems. Three other problems were experienced to a moderate or great extent by more than one respondent—systems that would not operate, slow system response time, and systems that stopped operating. For example, officials in one state told us that their systems stopped operating in the middle of the election in high population areas. Officials in another state told us that their systems could not transmit totals from polling places to tabulation centers for tabulation of election results.
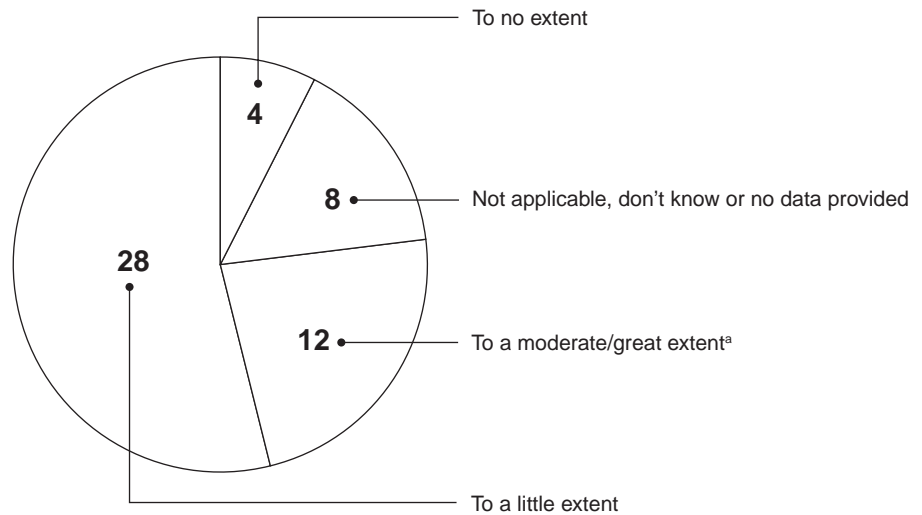
Figure 26: Extent of Voting System Problems Reported by States and Others for the 2006 General Election by Problem Type
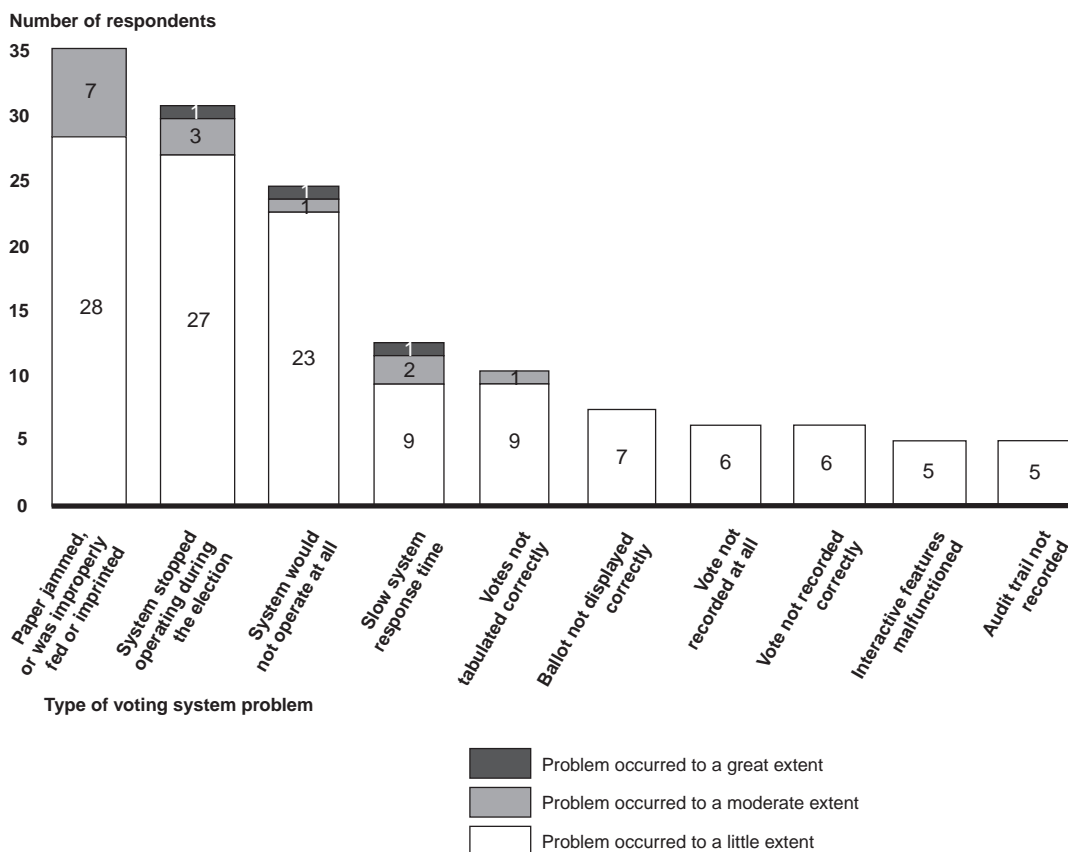
Source: GAO 2008 survey and interviews of state, territory, and the District of Columbia election officials.

Looking across the 40 respondents that reported experiencing any type of voting system problems, approximately two-thirds (28) only experienced problems to a little extent, while almost one-third (12) reported instances of problems that occurred to a moderate or great extent (see fig. 27).

Figure 27: Extent of Voting System Problems Reported by States and Others for the 2006 General Election

Source: GAO 2008 survey and interviews of state, territory, and the District of Columbia election officials.

aAll states that reported problems that occurred to a moderate or great extent also reported problems that occurred to a little extent. These states are only shown in the moderate/great category.
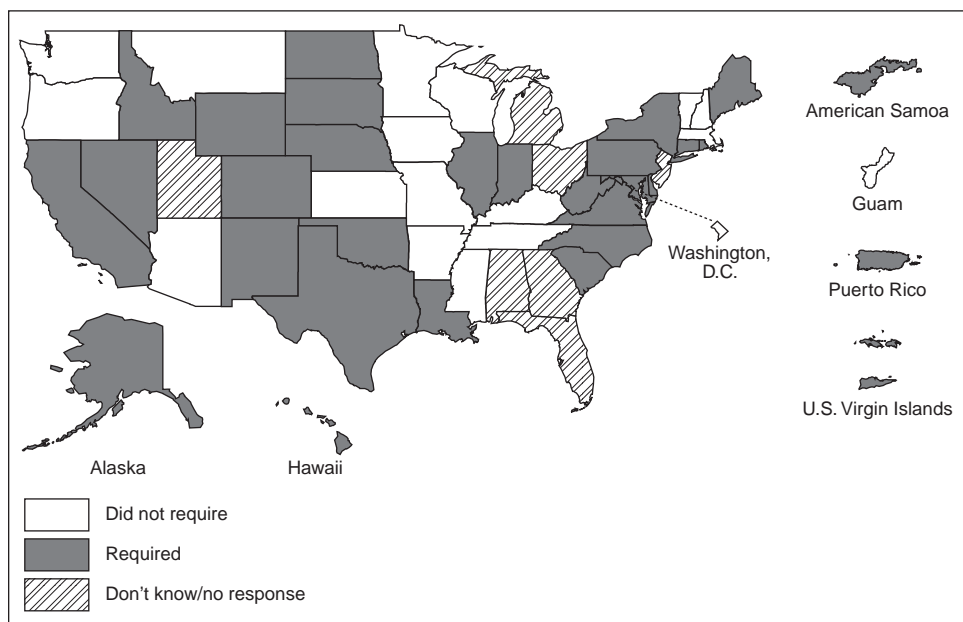
States, Territories, and the District Largely Relied on Others to Report, Evaluate, and Correct Election Day Voting System Problems through a Variety of Approaches

The majority of survey respondents reported having either statutory or administrative requirements for local jurisdictions to report voting system problems during the 2006 general election. Many of these respondents also reported having policies and procedures in place to ensure that the requirements would be met. However, the problem-reporting requirements, policies, and procedures described by election officials varied as to their scope and detail. Whether required or not, the majority of states and one territory reported receiving information on voting system problems from local jurisdictions, and many also received reports from voting system vendors. While most states also reported obtaining information on voting system problems from voters, state and territory officials that we interviewed told us that these problems were not always about specific system errors or malfunctions. About one-half of respondents also participated in evaluations of problems, and many of these collaborated with local jurisdictions in doing so.

Based on survey responses, 27 states and 3 territories required local jurisdictions to report voting system errors or malfunctions that occurred during the 2006 general election; 16 states, 1 territory, and the District did not (see fig. 28).[46] Further, many of the 30 respondents that did require reporting also indicated that they had policies and procedures to guide the reporting.

Figure 28: Voting System Problem Reporting Requirements Reported by States and Others for the 2006 General Election

Sources: GAO 2008 survey of state, territory and the District of Columbia election officials; MapArt (map).

Of the 30 states and territories that had reporting requirements for voting system problems, 8 states provided statutes detailing these reporting requirements. Our review of these requirements found variation in their scope and specificity. In general, they range from a basic reporting obligation for local jurisdictions to detailed reporting responsibilities, data items, and procedures directed at several levels of election administration, up to and including state election officials. For instance,

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[46]The remaining respondents either checked "Don't know" or did not respond to this question.

"… the county auditor shall receive and handle complaints … by any voter or precinct official involving … irregularities of any kind in voting. The county auditor shall refer complaints to the secretary of state or the proper prosecuting authority, as the county auditor deems appropriate."

"The precinct election officials shall immediately cease using any malfunctioning voting equipment and report the problem to the commissioner. … The commissioner shall keep a written record of all known malfunctions and their resolution."

"Each county clerk shall collect the following information regarding each primary and general election, on a form provided by the Secretary of State and made available at each polling place in the county, each polling place for early voting in the county, the office of the county clerk and any other location deemed appropriate by the Secretary of State:

A report on each malfunction of any mechanical voting system, including, without limitation:

(1) Any known reason for the malfunction;

(2) The length of time during which the mechanical voting system could not be used;

(3) Any remedy for the malfunction which was used at the time of the malfunction; and

(4) Any effect the malfunction had on the election process."

In addition, the reporting requirements in statutes and directives are not limited to local jurisdictions. For example, 2 states require voting system vendors to notify state officials of defects or malfunctions with their systems:

"The vendor shall promptly notify the State Board of Elections and the county board of elections of any county using its voting system of any decertification of the same system in any state, of any defect in the same system known to have occurred anywhere, and of any relevant defect known to have occurred in similar systems."

"A vendor (or the political subdivision, if no private vendor supports their system) must give notice to the Secretary of State within 24 hours of a malfunction of its voting system software or equipment in an election held in this state. … the Secretary of State shall determine whether further information on the malfunction is required. At the request of the Secretary of State, a vendor … must submit a report … detailing the reprogramming (or any other actions) necessary to redress a voting system malfunction. … Failure to submit a report within the required period shall be grounds to decertify the system."

To govern the collection and documentation of voting system problems for the 2006 general election, more than half of respondents (26 states and 2 territories) reported having policies and procedures for problem reporting; 18 states and 2 territories did not.[47] Most states and both of the territories that reported having such policies and procedures also reported state-level reporting requirements (20 states and 2 territories). In addition, 6 states had problem-reporting policies and procedures, even though they did not have statutory or administrative reporting requirements.

State election officials that we interviewed described a range of policies and procedures governing how they implemented statutory and administrative problem-reporting requirements. For example, officials with 10 states and the 2 territories told us that they maintained a log of the calls received about election-related system malfunctions. In addition, officials for 7 states, 1 territory, and the District stated that they either maintained voting system problem reports in a file or were developing a database for this information.

Local Jurisdictions, Voters, and Voting System Vendors Were the Most Common Sources for Reports of Voting System Problems

Three sources of information on voting system problems during the 2006 general election were most frequently cited by respondents—local jurisdictions, voters, and vendors. Specifically, 40 states and 1 territory reported receiving information on problems from their local jurisdictions. State officials told us that they received this information in various forms, ranging from phone calls to formal written reports. In addition, 37 states, 2 territories, and the District reported being notified of election-related problems directly by voters; however, several officials that we interviewed stated that voter-reported problems usually did not pertain to voting system errors or malfunctions, but rather to election processes, such as voter registration and polling place operations. Voting system vendors also reported problems, according to responses from 23 states, 2 territories, and the District (see fig. 29). Several states used the term "remote monitoring" to refer to the calls that they received about problems from local jurisdictions, voters, and vendors.

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[47]The remaining respondents either checked "Don't know" or did not respond to this question.

Figure 29: Sources of Information on Voting System Problems Reported by States and Others for the 2006 General Election

Number of respondents

Sources of information on voting system problems
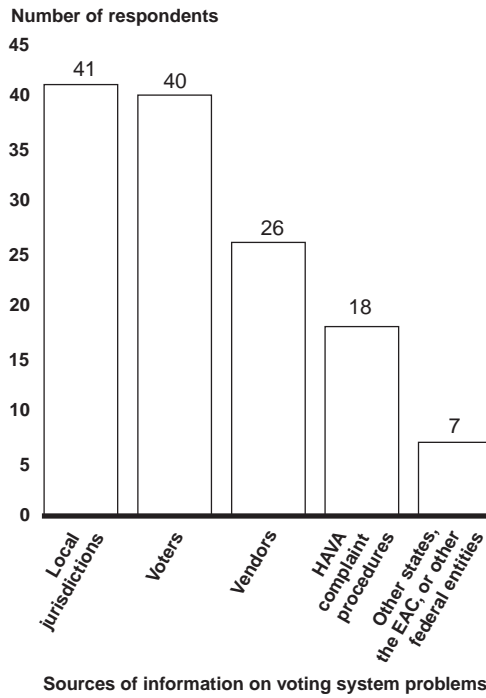
Source: GAO 2008 survey of state, territory, and the District of Columbia election officials.

Two less-frequently cited sources of voting system problems in 2006 were HAVA administrative complaint procedures (18 respondents) and other government entities (7 respondents).[48] According to HAVA, the complaint procedures are to be the mechanism for reporting deficiencies in meeting the act's voting system standards requirements (e.g., voter verification of ballot selections, voter changes to and correction of ballot selections), as well as other HAVA provisions.[49] Notwithstanding the fact that 16 states, 1 territory, and the District cited the complaint procedures as a source of voting system problems, several state officials that we interviewed said that few of the HAVA complaints that they received could actually be linked to a voting system malfunction or error.

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[48]An additional survey choice was "on-site monitoring" of voting system problems, where state election officials traveled to local jurisdictions to observe system operations and problems first-hand.

[49]Section 402 of HAVA requires that states establish complaint procedures to address deficiencies in the voting system requirements of HAVA Title III.

Evaluation and Correction of Voting System Problems Was Primarily Conducted by Either Local Jurisdictions or States

The majority of survey respondents reported conducting one or more types of evaluations of voting system problems for the 2006 general election to gain additional information on voting system errors or malfunctions. Of the five types of evaluations referred to in our survey—investigations, audits, recounts, system retests, and reviews of system logs or reports—39 respondents conducted one or more of them, while 13 did not. Of the 39, 8 states and 1 territory conducted only one type, while the remaining 30 respondents conducted two or more types. Overall, the most widely-performed type was reviewing system logs and reports (25 states, 2 territories, and the District), followed in order by audits, investigations, recounts, and retests (see fig. 30).

Figure 30: Actions Taken in Evaluating Voting System Problems as Reported by States and Others for the 2006 General Election
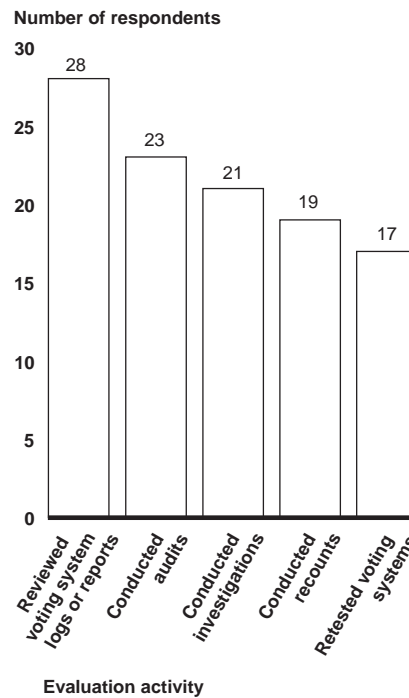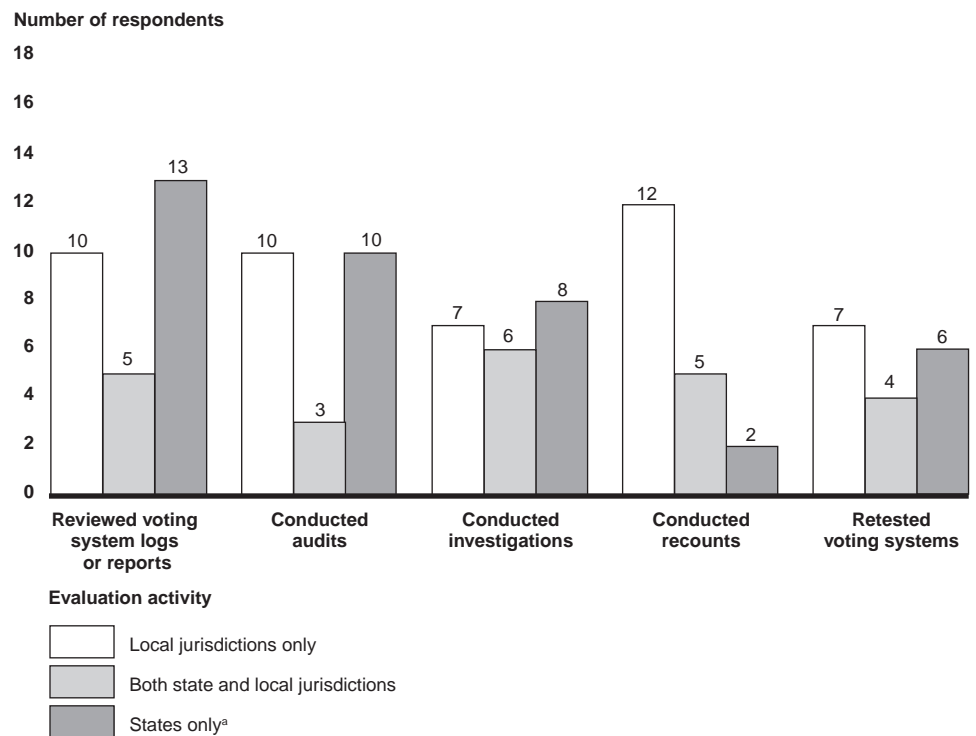

Source: GAO survey of state, territory, and the District of Columbia election officials and analysis of responses.

State officials also reported that for the 2006 general election these evaluations were more commonly conducted by either local jurisdictions or by the states, rather than by both. This was true across all but one type of evaluation. Overall, local jurisdictions were solely involved in conducting the evaluations in 13 states; state officials were solely involved

in 8 states. Another 12 states reported at least one evaluation that involved both local and state officials.[50] With respect to individual types of evaluation, most were again conducted either by local officials or by state officials. For instance, reviewing voting system logs or reports was more often the responsibility of state level officials (13 respondents) than local jurisdictions (10 respondents); only 5 states involved both organizations (see fig. 31).

Figure 31: Participation by States and Local Jurisdictions in Problem Evaluation Activities as Reported by States and Others for the 2006 General Election

Number of respondents

Evaluation activity

Local jurisdictions only

Both state and local jurisdictions

States only[a]

Source: GAO 2008 survey of state, territory, and the District of Columbia election officials and analysis of responses.

[a]Includes territories and the District, where applicable.

According to officials from 2 states, they are involved in evaluations of problems because they have either experienced substantial voting system problems in a past election or have always participated directly in such

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[50]The remainder of states reported that they either did not conduct any of the evaluations or did not know whether a particular action was taken.

activities as a matter of policy and practice. For example, officials for one of these states told us that because of the problems they experienced in 2004, they now have vendor-trained government technicians that are deployed to polling places to directly assist in evaluating system malfunctions. This state has also installed an automated system at polling places to provide direct communications between state officials and poll workers about system problems. Officials for one territory told us that an election board composed of elected representatives from each of its local jurisdictions was responsible for establishing policies and managing activities related to voting system problems. In this way, local jurisdictions and territory officials have worked together to evaluate and address problems that occurred. In contrast, officials in another state told us that they did not see a role for the state in evaluating voting system performance during an election. In another state, officials told us that state participation in problem evaluation and resolution was not necessary because the problems that local jurisdictions had encountered in the 2006 election did not require much evaluation and were easy to remedy.

For the 2006 general election, the majority of states and territories, and the District, reported taking action to correct reported problems. Many reported developing and implementing new policies and procedures (15 states, 1 territory, and the District). In this regard, state officials that we interviewed said that these policies and procedures related to, among other things,

- voting system operations,

- logic and accuracy testing, and

- problem prevention and correction.

Several states also reported that they addressed their problems by changing their voting method (7 states) and a few added a paper-based audit trail to their system (2 states). A few states required their systems to be reapproved, while another fined its vendor when a system failed to meet state requirements.

According to survey responses, state and local election officials were equally involved in implementing actions to correct reported problems (23 respondents apiece). In addition, state executives, such as the secretary of state, were frequently involved (19 respondents), as were voting system vendors (16 respondents). Several states also included experts or consultants in these activities (see fig. 32).

Figure 32: Responsibilities for Corrective Actions to Address Voting System Problems as Reported by States and Others for the 2006 General Election
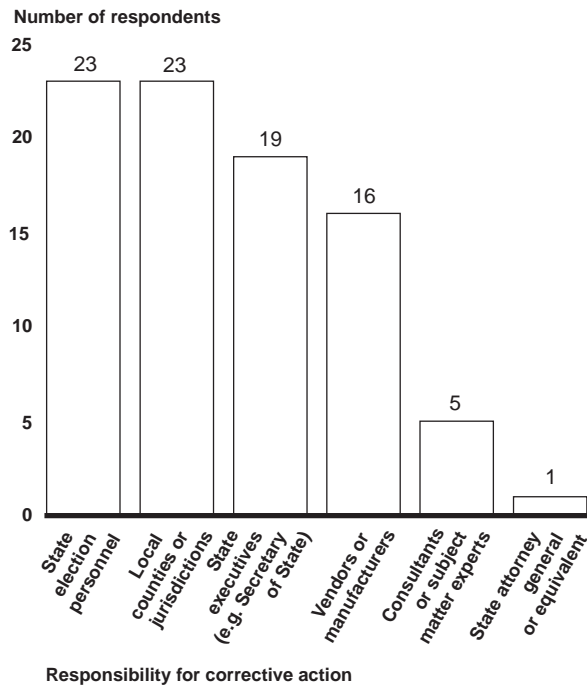
Number of respondents
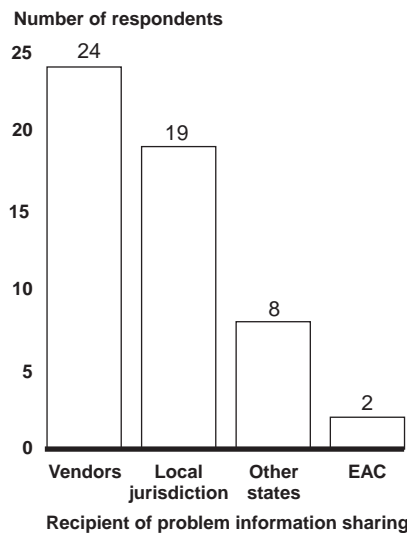

Responsibility for corrective action

Source: GAO 2008 survey of state, territory, and the District of Columbia election officials.

Information from election officials we interviewed about who was involved in correcting reported problems was consistent with these survey responses. According to officials from 22 states, 1 territory, and the District, they typically provided technical assistance to local jurisdictions in resolving problems, and 11 said that they also established resolution teams consisting of state and local election officials and vendor representatives. In addition, officials from 18 states told us that vendors are the primary parties involved in resolving problems; officials from 4 states added that they also hired consultants to obtain technical expertise independent of the vendor, for instance, when retesting equipment that malfunctioned in an election. Officials for a few states told us that they have entered into relationships with academic institutions to support resolution of voting system problems and state studies indicated similar collaboration. For example, officials in one state told us that they rely on an election center at their state university to assist in overseeing voting system performance activities across the state.

Overall, information sharing between a state that experienced voting system problems and other voting system stakeholders occurred much more frequently with vendors or local jurisdictions than it did with other states or EAC. Specifically, of the 40 respondents that reported experiencing voting system problems in the 2006 general election, 24 (23 states and 1 territory) indicated that they communicated with vendors about the problems, while 19 states indicated that they communicated with their local jurisdictions. In contrast, only 8 respondents indicated that they communicated with other states, and 2 communicated with EAC (see fig. 33).

Figure 33: Recipients of Communications about Voting System Problems as Reported by States and Others for the 2006 General Election

Source: GAO 2008 survey of state, territory, and the District of Columbia election officials.

Based on survey responses and interviews with state election officials, communication with other organizations about voting system problems has been influenced by a number of factors some of which are related to the challenges discussed in the following section. These factors include competing demands on a limited number of election staff at both the local and state levels; limitations of the information collected about problems (e.g., typically anecdotal and after-the-fact or of limited usefulness); the diversity of voting system environments among states; and the focus on obtaining timely and accurate election results rather than real-time sharing of problems.

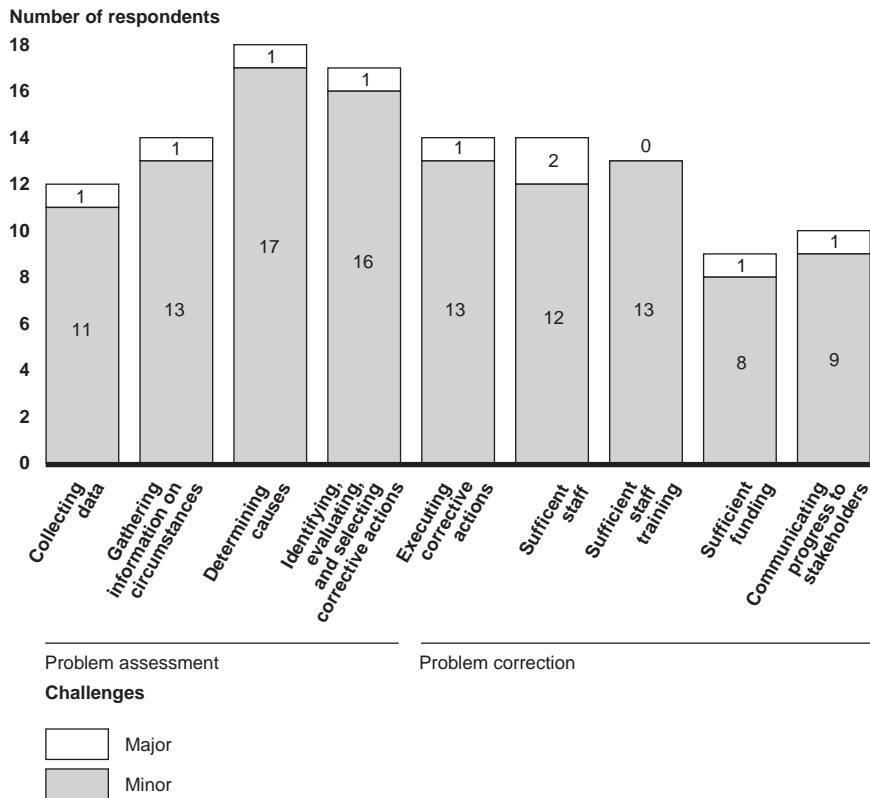| States and the District Reported Many Challenges in Addressing Voting System Problems, As Well As Approaches to Overcoming Them	Almost half of the survey respondents reported facing a range of challenges in evaluating and correcting voting system problems for the 2006 general election.[51] The most frequently cited challenges were determining the causes of problems and identifying, evaluating, and selecting corrective actions. Examples of other frequently cited challenges were having sufficient human resources and funds to implement corrective actions. All of the respondents that reported facing a challenge, except for one, also reported that they experienced more than one challenge; a handful of respondents experienced virtually all nine challenges identified in our survey. To overcome these challenges, officials with the states and the District described a number of actions that they have taken.
A Number of States and the District Experienced a Range of Challenges in Assessing and Correcting Voting System Problems	Of the 52 survey respondents, 21 states and the District reported that they faced at least one of the nine challenges in our survey, which fall into two categories. The first category is problem assessment challenges. These involve the identification and evaluation of problems and are heavily dependent on the availability and quality of information. The second category is corrective action challenges. These involve the identification of the corrective actions to be implemented and the resources required to implement them. The remaining 26 states and all 4 territories reported that they either did not experience any of the nine challenges, or that they did not see their applicability to their voting system environments.

The two most widely-reported challenges were both in the problem assessment category—determining the cause of errors or malfunctions (18 respondents) and identifying, evaluating, and selecting corrective actions (17 respondents). The least-reported challenges were both in the corrective action category of challenges—having sufficient funding (9 respondents) and communicating problem resolution progress with stakeholders (10 respondents). (See fig. 34.) |

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[51]Some of the states we surveyed reported that the challenges were not applicable to their election environment.

Figure 34: Challenges Reported by States and Others in Addressing Voting System Problems for the 2006 General Election

Number of respondents

Problem assessment   Problem correction

Challenges

☐ Major

▧ Minor

Source: GAO 2008 survey of state, territory, and the District of Columbia election officials.

Almost all of the 22 respondents that reported facing a challenge also indicated that they faced more than one of them. Specifically, 16 reported that they faced between two and six of the challenges, while 6 reported that they faced eight or more challenges. In addition, 17 of the states that reported facing challenges also reported having statutory or administrative requirements for reporting voting system problems for the 2006 general election. In contrast, the 15 states that reported no challenges or provided "not applicable" responses were also states that reported not having problem reporting requirements. No relationship was evident between the respondents that cited the most types of challenges and the respondents that reported having experienced voting system problems to either a moderate or great extent.

During our interviews with state election officials, we obtained examples of specific challenges in assessing voting system problems. Two are provided below:

- **Collecting data on voting system errors or malfunctions**. While officials of one state told us that they maintain an electronic county incident log to collect extensive information on voting system errors and malfunctions occurring in elections, they also said that they do not have sufficient staff to ensure the completeness of the logs or to use the data for statewide problem management.

- **Determining the cause of errors or malfunctions**. State officials also told us that much of the information reported by poll workers and voters tends to be stated in terms that are not always useful to state technical staff in understanding and diagnosing a given problem.

To overcome the challenges that they face, state officials described a number of actions that they have taken. For example:

- Officials from 2 states said that they have established user groups made up of election officials and vendors to increase information sharing about identified problems and actions for addressing them.

- Officials in another state told us that they are sponsoring bi-annual conferences with county election officials in which information about election management practices, including problem management, is shared.

- Officials in another state said that they conduct an annual voting system seminar for local jurisdictions that includes separate sessions on different kinds of voting systems and problems that have been experienced with them.

- Officials from 2 other states told us that they interact with local election officials by phone and e-mail to discuss voting system problems and management approaches.

- Officials from several states have also told us that they communicated with the nationwide election community by contributing studies and reports about their systems that include information about identified problems.

States, Territories, and the District Are Largely Satisfied with Federal Voting System Resources and Services, but Their Use Varies

States, territories, and the District expressed general satisfaction with selected voting system resources developed and made available by EAC, namely federal testing and certification of voting systems, voluntary voting system guidelines, accredited voting system testing laboratories, and election administration and voting system management guidance. However, use of these resources varies among states, territories, and the District, in part due to the availability, applicability, or potential cost of the resources. Although, several states see federal certification as the foundation for their respective voting system approval processes, several that require federal certification as a condition of system approval raised concerns over the length of time it takes to complete the federal certification process.

States, territories, and the District have mixed views on the federal voluntary guidelines. Some reported satisfaction with the guidelines' depth and comprehensiveness, while others were dissatisfied with their overly technical content or lack of integration with current state certification processes. A few states reported that they have used federally accredited testing laboratories to support state-level system approval, and those that did reported both challenges and benefits. Finally, most states and others reported that they are satisfied with guidance developed and published by EAC—such as quick start management guides—and they reported making use of the guidance.

Most States and the District Rely on Some Component of Federal Certification, but Time to Obtain Certification Is Affecting Several States' 2008 Election Preparations

Most states and the District rely on some component of federal certification—standards, accredited laboratory testing, or certification—to augment state processes for approving new voting systems or upgrading existing ones. As called for under HAVA, EAC has established a federal certification process for voting systems that includes (1) publishing guidelines against which voting systems can be evaluated; (2) policies, procedures, and criteria for accrediting laboratories to test voting systems; and (3) defining policies, procedures, and criteria for testing and certifying voting systems. According to statutes, regulations, and follow-up with election officials from states, territories, and the District, 38 states and the District require that their voting systems be either tested to federal standards,[52] tested by a federally accredited laboratory, or federally

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[52]Statutes or regulations require testing voting systems to the 1990 or 2002 voting system standards, or 2005 voluntary voting system guidelines.

certified.[53] Election officials explained that requiring federal certification helps to raise confidence in state-approved voting systems because, in many cases, the level of federal testing exceeds that performed at the state level. As such, officials believe that federal certification provides important assurances about the systems' accuracy, security, and reliability.

Of the 38 respondents that reported relying on some component of federal certification, 18 also reported plans to purchase new systems or make upgrades to their existing systems for use in the 2008 election, thus requiring federal system certification.[54] In several cases, states were planning to make upgrades to address known system shortcomings found during a previous election, such as audio errors, incorrect ballot positioning, and scanner workload inefficiencies. In other cases, states were purchasing new systems to comply with new legislation or to introduce a new facet to their election process, such as vote by mail for absentee voting. As of May 2008, none of these systems had been certified by EAC and, as a result, some states expressed concerns regarding the length of time it takes for systems to obtain federal certification. Consequently, these states now face difficult decisions in fielding upgraded or new voting systems that meet state requirements in time for the 2008 general election.[55]

The affected states are considering several approaches to address their dependency on federal certification for the 2008 general election. According to officials for some of the affected states, they may implement operational procedures to temporarily address voting system flaws and shortcomings, or they may delay the implementation of a new system or system upgrade until after the 2008 election. For example, one state

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[53]Prior to July 2006, NASED reviewed testing results from independent testing laboratories and granted qualification to systems that met federal standards, either the 1990 or 2002 voting system standards.

[54]Vendors began submitting voting systems to federally accredited laboratories for review and testing against either the 2005 voluntary guidelines or the 2002 voting system standards in February 2007. As of May 2008, EAC had registered 12 manufacturers and accepted certification applications for 9 different voting systems; none of these systems had received full EAC certification.

[55]EAC has taken steps to inform states and others of the status of the voting systems that are undergoing federal certification and, in May 2008, notified election officials nationwide that it does not expect to expedite the certification process because doing so might lower the quality of testing and jeopardize confidence in the program.

official told us about a county that is currently using an optical scan system, but had planned to move to vote by mail for the 2008 general election. To accommodate the large number of ballots expected to result from this change and to process these ballots faster, the county intended to replace its optical scan system with a new digital scan central count system. However, since the system was not federally certified in time for the state to approve it, state officials told us that the county now expects to use the same system it used in 2006 and to delay the move to vote by mail until 2009. Table 8 identifies the different approaches that state officials told us they may take to address their federal certification requirement for the 2008 election.

Table 8: States' Approaches for Addressing Federal Certification Requirements for the 2008 Election

Number of states	Approach
13	Delay the implementation of a new system or system upgrade and use the same voting systems that were used in the 2006 election.
3	Revise state requirements to allow for state certification of a voting system without prior federal certification.
1	Not purchase a vendor voting system upgrade and instead revise operational procedures for the systems used during the 2006 general election.
1	Allow each local jurisdiction to decide.

Source: GAO summary of information provided by states we interviewed.

Officials from other states that reported a reliance on federal certification of voting systems also expressed concern over the length of time it takes to complete the federal certification process. Most of these states and the District expect to continue using voting systems in the 2008 election that were previously qualified under the National Association of State Election Directors (NASED) program, and thus do not expect to need federal certification for these systems prior to 2008. Nevertheless, election officials in a few of these situations were concerned that the time needed to complete the federal certification process could affect future elections in which federal certification of their systems may be needed. For example, one election official reported that they would like to purchase a new optical scan voting system in 2009; however, they believe the federal certification process has been extremely slow and are concerned that such a purchase may be impacted.

In addition to concerns over the time needed to complete the federal certification process, several states reported that the future costs of testing systems to federal standards could impact their ability to purchase or maintain the systems. Federal certification costs do not directly affect the states, territories, or the District as they are paid by the voting system manufacturers; however, one state official told us that these costs are likely to be passed down to states and local jurisdictions in the costs of purchasing and maintaining the systems as manufacturers look to recoup those expenses. According to one state official and representatives of several voting system manufacturers, the cost for voting system qualification under NASED was roughly $500,000, whereas the cost of testing a voting system to the same standards under the federal certification process is exceeding $2 million. Another state official expressed the view that testing systems to the 2007 voluntary guidelines will increase the cost of federal certification as these guidelines are more voluminous and demanding than the former standards.

Notwithstanding these state concerns, several state officials told us that the federal certification process provides a foundation upon which their respective states' testing can build. For example, an official from one state explained that because they do not have the in-house expertise to conduct the testing performed at the federal level, they require federal certification and review available results prior to testing a system to state-specific standards. In addition, several state officials expressed appreciation for the effort EAC has made to ensure that voting systems are properly tested.

Satisfaction with Voluntary Voting System Guidelines Is Mixed

As described earlier, the voluntary voting system guidelines are a set of federal standards against which voting systems can be tested to determine if they provide the basic functionality, accessibility, accuracy, reliability, and security capabilities needed for federal certification. The voluntary guidelines may also be used in whole, in part, or not at all as the basis for state and local testing and approval of voting systems. EAC issued the initial voluntary guidelines in December 2005 as an update to voting system standards developed in 2002 by the Federal Election Commission, and they became the sole basis for federal certification testing in December 2007. A draft of the next version of the guidelines was submitted to EAC in August 2007. This draft contains new and expanded material in the areas of reliability and quality, usability and accessibility, and security.

Over one-half of the survey respondents were generally satisfied with one or more aspects of the voluntary guidelines—their comprehensiveness,

clarity, or ease of use.[56] Of the 45 respondents that expressed views regarding the guidelines, 22 states, 3 territories, and the District reported being either moderately or very satisfied with at least one of these aspects. Further, over one-half of these 26 respondents were moderately or very satisfied with all three of these aspects. The most common reason for satisfaction was the guidelines' comprehensiveness (23 of 26), while satisfaction with clarity and ease of use were slightly less prevalent (19 of 26 each). Several election officials that we interviewed generally shared the view that the guidelines are more comprehensive than the 2002 voting system standards. For instance, one state official told us that the 2007 voluntary voting system guidelines addresses security capabilities in greater depth than the 2002 voting system standards. Other election officials expressed satisfaction because the 2005 voluntary guidelines helped them to develop state testing without duplicating federal testing.

Notwithstanding that over one-half of respondents were either satisfied with or neutral about the voluntary guidelines, 14 states reported being either moderately or very dissatisfied with the comprehensiveness, clarity, or ease of use of the guidelines. Of these, 3 were moderately or very dissatisfied with all three aspects. The most common reason for dissatisfaction was that the voluntary guidelines were not easy to use (10 of 14); dissatisfaction with clarity and comprehensiveness were not as prevalent (8 of 14 and 7 of 14, respectively). States expressed a variety of reasons for their dissatisfaction. For example, officials from one state told us that the amount of time that it takes to approve a version of the guidelines is lengthy and impacts their ability to implement a new version into their election management processes in a timely manner. Officials from another state said that the guidelines were too subjective, which made it difficult to perform testing against its requirements. In addition, a few other state officials stated concerns with the guidelines during our interviews. Officials from one state stated that the voluntary guidelines need to be more integrated with the current state certification processes and less technical. They also stated that election workers did not always have enough technical background to make the best use of the guidelines, and information technology staff was not always available to provide assistance. Moreover, 2 state officials told us that they were unfamiliar with the technical content of the guidelines and were therefore unable to

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[56]Our survey did not differentiate between the 2005 and draft 2007 voluntary voting system guidelines. As such, survey responses could express satisfaction or dissatisfaction with either set of standards.

discuss how their states could align state approval testing with federal testing. Officials from another state told us that, beyond concerns with the 2005 voluntary guidelines, the 2007 draft voluntary guidelines may be too demanding for any voting system to be certified within a reasonable time frame.

Few States Are Using Voting System Testing Laboratories and These States Have Mixed Views

Reliable testing, systematic reporting of test results, and diligent problem resolution are critical to ensuring that voting systems are accurate, secure, and reliable. Prior to the passage of HAVA, voting systems were tested against the 1990 and 2002 voting system standards by NASED-accredited independent testing authorities. Three laboratories were accredited under this program.[57] Under HAVA, EAC and NIST were assigned distinct but related responsibilities for developing a national laboratory accreditation program to replace the NASED program. In general, NIST is to focus on assessing laboratories' technical qualifications, while EAC is to augment the institute's assessment results and accreditation recommendations with its own review of related laboratory testing documentation to reach an accreditation decision. Voting system testing laboratories are accredited to develop test plans and procedures, conduct analyses and tests, and report results against specific versions of the voting system standards and voluntary guidelines. The laboratories perform these functions under contract with either voting system manufacturers for federal certification, or under contract with states or local jurisdictions for state approval or some type of election testing. EAC had accredited four testing laboratories as of July 2008, and a fifth was under evaluation at that time.

Based on survey and interview responses, 2 states contracted with a testing laboratory to test voting systems in support of their respective voting system approval processes. One state contracted with a laboratory to verify that its voting systems were in compliance with state standards.[58] This state also is using the laboratory's expertise to write a customized test plan for state approval testing. The remaining state contracted with a testing laboratory to help with state approval of a system that was undergoing federal certification but that was not likely to be certified in time for use in the 2008 general election. Officials with this state told us that when they determined that EAC was not likely to certify a new

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[57]These laboratories were CIBER, Inc., SysTest Labs, and Wyle Labs.

[58]This state has no statutory requirement for federal certification prior to state approval of a voting system.

version of their system in time for their 2008 primary election, they approached a testing laboratory to participate in and oversee the state testing of the system. The system was later certified by the state's secretary of state based on the laboratory's findings.

Election officials from these 2 states reported various concerns and benefits in working with a voting system testing laboratory. For example, one state cited the high cost of working with the laboratories, the extensive level of vendor involvement with the laboratories, and the limited scope of the laboratory's testing as concerns. According to one state official, one concern is ensuring that the laboratory tested every requirement that the state provided. According to this official, the state had to work closely with one laboratory to ensure that all requirements were met. Despite voicing concerns, however, each state reported that they were satisfied with the laboratories' efforts and their commitments to testing to state standards and working closely with the states to meet requirements.

Though very few states use a testing laboratory directly as part of a state approval process, several election officials told us that they nevertheless review laboratory test plans and reports as part of their respective approval processes.[59] Several of these officials told us they had reviewed test plans and results produced under the NASED process, and viewed them as useful, but they did not yet have opinions on EAC-accredited laboratory test plans and results.

States and Others Use Federal Guidance in Various Ways and Are Generally Satisfied

EAC has published guidance on a range of topics to assist state and local election officials in managing and administering elections. This guidance includes a number of quick start management guides, election management guidelines, best practices, and other related reports. For example, in October 2007, EAC released a Quick Start Management Guide for Acceptance Testing. This guide provides a general introduction to the purpose of acceptance testing at the state and local levels. It also provides more specific technical recommendations for physical, diagnostic, and functional analysis tests to be performed as part of acceptance testing.

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[59]Generally, test plans outline the approach a testing laboratory expects to take in testing a system to the federal guidelines; test reports describe the system being tested (including hardware and software specifications) and summarize the testing activities performed and the results, including any deficiencies with the system or its documentation.

Table 9 lists EAC guidance documents that are either under development or issued as of May 2008 relative to voting systems.

Table 9: EAC's Guidance Applicable to Voting Systems

Subject	Release date
Election Management Guidelines	Ongoing
Best Practices in Election Administration Tool Kit	July 2004
Quick Start Management Guides	
New Voting Systems	June 2006
Ballot Preparation/Printing and Pre-Election Testing	September 2006
Voting System Security	September 2006
Voting System Certification	August 2007
Acceptance Testing	October 2007
Contingency and Disaster Planning	October 2007
Developing an Audit Trail	March 2008
Central Count Optical Scan Ballots	May 2008

Source: GAO analysis based on EAC Web site documentation.

Officials from almost every state, territory, and the District that we interviewed stated that they received EAC guidance either through the mail or via e-mail. Further, of the 46 survey respondents that provided views on EAC's quick start management guides, 33 reported that they were very or moderately satisfied with the guides. In addition, of the state officials that we interviewed who said they were satisfied with federal guidance, several described how they used the guidance. For example, one state official told us that the quick start management guides were sent to the counties, and the Quick Start Management Guide for Voting System Security was referenced in the state's security directive. In contrast, officials with 2 states expressed moderate dissatisfaction with the quick start management guides, noting that they were too simplistic. The remaining 11 states were neither satisfied nor dissatisfied.

Our interviews with officials from states, territories, and the District provided additional insights on the uneven use of EAC guidance. Specifically, some election officials told us they used EAC guidance in developing both state and local Election Day policies. For example, officials from one territory said that they reviewed both the best practice documents and quick start management guide related to poll workers and used this guidance when developing its poll worker training policy. In contrast, some election officials responded that they do not yet have the

resources to develop Election Day policies and so could not use the guides. One of these officials added that the guides may be used at some point in the future, but did not know how or when this would happen. Finally, election officials with other states told us they did not use EAC guidance because they already had well-developed policies and procedures. For example, one state began work on a poll worker training guide in 2004 and developed a policy on its own before the federal guidance was developed. Later, as state officials received guidance from EAC, they reviewed the poll worker training information but determined that the existing state plan already covered all of the points addressed in EAC guidance.

Concluding Observations

States, territories, and the District play a pivotal role in voting system approval, testing, and problem management. To their credit, most of these entities reported that they required and established mechanisms for evaluating and approving voting systems prior to adoption by local jurisdictions. While the exact manner in which they execute these mechanisms has varied, many report that they have incorporated similar core elements into their approaches and processes. These elements can provide the few states that have not adopted an approval program with useful frameworks for them to learn from and possibly leverage. Moreover, the range of efforts is a valuable resource for any of these entities that are interested in making improvements to their existing programs or in adopting shared services.

In this regard, most states, territories, and the District reported augmenting their approval of voting systems with some type of additional testing, which has provided opportunities to anticipate and address potential voting system problems before they affect election results, as well as a basis for others to learn from. Although some types of tests have been more common than others, a notable subset of states report requirements for testing throughout the voting system life cycle—from acquisition to postelection—and report the establishment of testing programs to accomplish this. The testing frameworks that these entities have in place can assist others in defining and refining testing activities. To the extent that effective testing programs are in place, they can serve to identify and correct voting system problems before they can affect an election.

Nevertheless, even approved and well-tested systems can experience problems. To effectively address problems, objective, timely, and complete information about problems is needed to make informed decisions that

mitigate impacts to elections and avoid repeat occurrences. Since local jurisdictions typically have been responsible for identifying, assessing, and responding to Election Day voting system problems—but states report that many have not been required to report these problems—states, territories, and the District may not have a complete picture of the extent of election problems that stem from voting systems, rather than from human errors. To states' and territories' credit, several report that they have adopted one or more mechanisms for systematically recording, tracking, and informing others about voting system problems, and are thus better positioned to help jurisdictions manage problems as they arise. Furthermore, systematic collection and review of problems has the potential to provide added benefits by allowing states and territories to identify problems that affect multiple jurisdictions, share approaches for troubleshooting and problem resolution, and inform other states and territories that use similar systems.

States, territories, and the District face a number of challenges relative to acquiring, testing, operating, and maintaining voting systems. In general, these challenges are not unlike those faced by any technology acquirer or user—adoption and consistent application of standards for system capabilities and performance; rigorous and disciplined performance of testing activities; reliable measures and objective data on systems' performance; and integration of the people, process, and technology during system acquisition and operation. These challenges are heightened by other conditions common to many technology environments: decentralized and distributed responsibilities, evolving system standards and requirements, and funding opportunities and constraints. In addition, they are compounded by conditions unique to the elections environment, such as the need for transparency; the level of technical knowledge and skills among those responsible for acquiring, testing, and operating voting systems; the timing of the election cycles; and the degree of public attention to and scrutiny of voting systems.

How well states, territories, and the District implement their voting approval, testing, and problem management efforts both within their own election environments and collectively will largely determine how well voting systems perform on Election Day nationwide. EAC has a major role to play in assisting these entities in accomplishing their voting system performance goals by providing resources and services. Although EAC is still in the initial stages of delivering some of these services and resources, the commission's efforts are largely viewed positively by most states and territories, and by the District. As EAC moves forward in providing services and resources, it will be important for it to continue

communicating and coordinating with states and territories about their critical needs.

We are also sending copies of this report to the Ranking Member of the Senate Committee on Rules and Administration, the Chairman and Ranking Member of the House Committee on House Administration, the Chairmen and Ranking Members of the Subcommittees on Financial Services and General Government, Senate and House Committees on Appropriations, and the Chairman and Ranking Member of the House Committee on Oversight and Government Reform. We are also sending copies to the Commissioners and Executive Director of the Election Assistance Commission, state and territory election officials and the election officials for the District of Columbia, and other interested parties. In addition, the report will be made available without charge on GAO's Web site at http://www.gao.gov.

If you have any questions regarding this report, please contact me at (202) 512-3439 or at hiter@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Key contributors to this report are listed in appendix II.

Sincerely,

Randolph C. Hite
Director, Information Technology Architecture
   and Systems Issues

Appendix I: Objectives, Scope, and Methodology

Relative to the 50 states, 4 U.S. territories, and the District of Columbia (District), our objectives were to determine (1) what voting methods and systems they are using in federal elections and what changes are underway; (2) how they certify or otherwise approve voting systems for use in federal elections; (3) what other steps they take to ensure that voting systems are accurate, reliable, and secure; (4) how they identify, evaluate, and respond to voting system problems; and (5) how they view federal voting system-related resources and services.

Three U.S. territories and one commonwealth were selected for this review—American Samoa, Guam, the Commonwealth of Puerto Rico, and the U.S. Virgin Islands—based on their federally mandated requirement to comply with the provisions of Help America Vote Act of 2002. For the purpose of this report, the term "territory" refers to all four entities.

For all five objectives, we conducted a Web-based survey (GAO-08-1147SP) of the 50 states, 4 territories, and the District, which largely gathered data about the 2006 general election. To develop our survey, we reviewed existing reports about the election process, including previous and ongoing GAO work. The studies included those done by national or state organizations and state or local governments relative to prior elections. We also reviewed state statutes and other citations provided in response to a question on states' legal requirements for elections from our survey of state election practices issued on June 6, 2006.[1] In addition, we contacted subject matter experts in elections and voting systems to gain views on themes and issues for topic areas and the applicability of these across the states. We designed the draft questionnaire in close collaboration with subject matter experts and participated in pretesting and refining subsequent drafts of the questionnaire. For the purpose of our survey, each question was asked from a state's perspective. In some instances, states were asked to respond about practices of local jurisdictions. U.S. territories were instructed to complete all survey questions that pertained to their territory's circumstances, including the appropriate equivalent for local jurisdictions. The scope of this work did not include verifying states' survey responses with local election officials. We conducted pretests with representatives of 5 states to help further refine our questions, develop new questions, clarify any ambiguous portions of the survey, and identify any potentially biased questions. These

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[1] GAO-06-450.

pretests were conducted in-person and by telephone with election officials
from states with varying election system characteristics.

Prior to fielding our state survey, we contacted the secretaries of state or
other responsible state-level officials, as well as officials from the
territories and the District to confirm the contact information for each
one's director of elections or comparable official. We launched our Web-
based survey for the states and the District on December 10, 2007, and for
the territories on January 7, 2008. We received all responses by April 18,
2008. Log-in information to the Web-based survey was e-mailed to
directors of elections or comparable officials. We sent one follow-up e-
mail message to all nonrespondents after the questionnaire was online for
4 weeks. After another 2 weeks, we contacted by telephone or e-mail all
those who had not completed the questionnaire. We obtained responses
from 47 states, all 4 territories, and the District (a 95 percent response
rate). Three states (Michigan, New Jersey, and Utah) chose not to respond
to our survey. Even so, the total number of responses to individual
questions may be fewer than 52, depending upon how many states and
territories, including the District, were eligible or chose to respond to a
particular question. In particular, survey respondents who indicated they
did not have a voting system approval requirement were given the option
of skipping all subsequent questions related to approval. In this regard,
one territory reported that they did not have an approval requirement
because they did not utilize electronic voting systems.

Because our survey was not a sample survey, but rather a census of 47
states, the District, and all 4 territories, there are no sampling errors;
however, the practical difficulties of conducting any survey may introduce
nonsampling errors. For example, differences in how a particular question
is interpreted, the sources of information available to respondents, or the
types of people who do not respond can introduce unwanted variability
into the survey results. We included steps in both the data collection and
data analysis stages for the purpose of minimizing such nonsampling
errors. We examined the survey results and performed computer analyses
to identify inconsistencies and other indications of error. Where these
occurred, survey respondents were contacted to provide clarification and
the response was modified to reflect the revised information. For one
survey question, which asked respondents to provide information on the
extent to which they encountered errors or malfunctions with voting
systems, we contacted all question respondents to clarify whether they
encountered errors or malfunctions to "little extent" or "no extent," and
reported responses to this question based on the clarified responses.
Where notable inconsistencies or limited response rates existed for

particular questions or topics, these responses were deemed unreliable
and therefore not reported. A second, independent analyst checked the
accuracy of all computer analyses.

Statute citations were obtained from respondents to our survey. The
statutes from these citations were reviewed to determine the specificity of
the requirements and whether any commonalities existed among them.
For the 3 states that did not respond to our survey, we obtained relevant
statutes to determine their respective requirements for voting system
approval, voting system testing, voting system problem management, and
use of federal resources and services. Where appropriate, we reported on
the requirements of the three states, based on our review of statutes.

Where possible, the results of some questions in the 2001 and 2005 surveys
that GAO conducted after the 2000 and 2004 general elections were
compared with results in the 2008 survey. For these previous surveys,
GAO also surveyed state election officials from all 50 states and the
District. These two surveys had a 100 percent response rate. The
terminology of comparable questions regarding states' involvement in
local jurisdiction selection of voting systems, states' requirements to
certify or otherwise approve voting systems, and states' requirements to
perform testing on voting systems prior to Election Day, was reviewed.
Although the terminology of these questions was not identical, we believe
the questions we asked the states are comparable because the structure
and intent of the questions are alike. We were not able to able to make
comparisons for the territories because our previous reports did not
collect information from them.

For all objectives, we also contacted state, territory, and District election
officials to better understand and illustrate their approaches and issues,
and obtained and reviewed relevant documentation from these officials,
the Web sites they identified, and survey responses. We visited 9 states and
the District, and interviewed by telephone officials from 20 states and two
territories. Although the information obtained from these contacts with
election officials cannot be generalized to other states and territories, the
states and territories that we interviewed either in person or by telephone
were chosen based on a wide variety of characteristics. These
characteristics included voting methods and systems used, geographic
characteristics, and aspects of election administration. Regarding election
administration, we sought to have a mix of states and territories where the
following varied: approval requirements, types of testing performed prior
to Election Day, and requirements for problem management. Visits to
states also were determined based on the election officials' availability due

to the 2008 primary election season. We also contacted 18 states and 2 territories by e-mail to obtain clarifications regarding survey responses. We obtained and reviewed available documentation on the requirements, processes, and technology of election administration for each state, territory, and the District to provide context for survey and interview responses. A summary of the contact method used for each state, territory, and the District is shown in table 10. The scope of this work did not include contacting local jurisdiction election officials about their voting system management practices; however, local officials participated in a few of our interviews with state election officials.

Table 10: Method Used to Contact States, Territories, and the District

Contact method	Contact list
Visit	California; Colorado; Georgia, Louisiana; Mississippi; Nevada; Pennsylvania; Texas; Washington, D.C.; and Wisconsin
Telephone interview	Alaska; Arizona; Arkansas; Delaware; Florida; Guam; Hawaii; Idaho; Illinois; Iowa; Kansas; Kentucky; Maryland; New Mexico; New York; North Carolina; North Dakota; Ohio; Rhode Island; U.S. Virgin Islands; Vermont; and Virginia
E-mail	Alabama; American Samoa; Connecticut; Indiana; Maine; Massachusetts; Minnesota; Missouri; Montana; Nebraska; New Hampshire; Oklahoma; Oregon; Puerto Rico; South Carolina; South Dakota; Tennessee; Washington; West Virginia; and Wyoming.

Source: GAO.

We conducted this performance audit from October 2007 to September 2008 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: GAO Contact and Staff Acknowledgments

GAO Contact

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Staff Acknowledgments

In addition to the individual named above, key contributions to this report were made by Paula Moore (Assistant Director), Gerard Aflague, Mathew Bader, Justin Booth, Scott Borre, Ashley Brooks, Neil Doherty, Michele Fejfar, Nancy Glover, Peggy Hegg, Dave Hinchman, Michael Holland, Valerie Hopkins, Ashfaq Huda, James MacAulay, Lee McCracken, Donald Sebers, Sushmita Srikanth, and Jeffrey Woodward.

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Glossary

This glossary is provided for reader convenience. It is not intended as a definitive, comprehensive glossary of election-related terms.

Absentee and Early Voting

Programs that permit eligible persons to vote prior to Election Day. Absentee voting is generally conducted by mail in advance of Election Day and early voting is generally in-person voting in advance of Election Day at specific polling locations.

Acceptance Testing

The examination of voting systems and their components by the purchasing election authority in a simulated-use environment to validate performance of delivered units in accordance with procurement activities.

Ballot

The official presentation of all of the contests to be decided in a particular election—including candidates for specific offices, and measures to be decided—in printed, electronic display, audio, or tactile formats.

Ballot Marking Device

Electronic devices used to mark an optical scan ballot, interpret and communicate the ballot selections to the voter for verification, and then print a voter-verified ballot to be processed by a precinct-based or central count optical scanner. Ballot marking devices do not store or tabulate votes electronically.

Certification

Written assurance that a product, process, or service conforms to specified requirements.

Federal certification. The process by which the Election Assistance Commission validates the compliance of a voting system with federal voluntary voting system standards and provides written assurance of conformance.

State certification or approval. The process by which a state examines and possibly tests a voting system to determine its compliance with state requirements. The process includes activities undertaken by a state authority to (1) initially determine that a voting system has met or exceeded all minimum standards established for use in its elections, (2) grant reapproval after re-examination or retesting if modifications or enhancements are made to a system, and (3) revoke approval when a voting system fails to fulfill state requirements.

Direct Recording Electronic (DRE)	A voting method that captures votes electronically, without the use of paper ballots. Systems that employ this voting method use electronic components for ballot presentation, vote capture, vote recording, and tabulation.
Election Assistance Commission (EAC)	Commission established by the Congress in 2002 to help improve the administration of federal elections by—among other things—administering the distribution of federal funds to the states for the replacement of older voting technologies, providing voluntary guidance to states on implementing certain provisions of the Help America Vote Act of 2002 (HAVA), serving as a national clearinghouse of state experiences in implementing such guidance and operating voting systems in general, conducting studies, and helping to develop voluntary standards and testing for election equipment.
Election Day Parallel Testing	Testing to verify the accurate performance of a voting system through random selection and systematic evaluation of operational systems during an election.
Election Jurisdictions	Counties, cities, townships, and villages that have responsibility for election administration.
Election Management System	The set of processing functions and databases within a voting system that defines, develops, and maintains election databases; performs election definitions and setup functions; formats ballots; counts votes; consolidates and reports results; and maintains audit trails. Election management systems integrate the functions associated with readying vote-casting and tallying equipment for a given election with other election management functions.
Federal Election Commission (FEC)	Commission established by the Congress in 1975 to administer and enforce the Federal Election Campaign Act—the statute that governs the financing of federal elections. To carry out this role, FEC discloses campaign finance information; enforces provisions of the law, such as limits and prohibitions on contributions; and oversees the public funding of presidential elections. In 1990, it adopted the first federal voluntary voting system standards.

Independent Testing Authorities	Independent testing organizations accredited by the National Association of State Election Directors (NASED) to perform voting system qualification testing.
Lever Machines	Mechanical voting devices that make use of a ballot that is composed of an array of levers. Voters cast their votes by pulling down on levers next to the candidates' names or ballot issues of their choice. After making the ballot selections, the voter moves a handle that simultaneously opens the privacy curtain, records the vote, and resets the levers.
National Association of State Election Directors (NASED)	An independent, nongovernmental organization of state election officials. This organization formed a national program to test and qualify voting systems to the federal standards.
Optical Scan	Voting method that uses electronic technology to tabulate paper ballots. An optical scan system is made up of computer-readable paper ballots, appropriate marking devices (writing instruments), privacy booths, and a computerized device that reads and tabulates the ballots.
Paper Ballots	Printed material which displays the names of candidates and information on ballot measures to be voted on in elections. Voters generally complete their paper ballots in the privacy of a voting booth and record their choices by placing marks in boxes corresponding to the candidates' names and ballot issues. After making their choices, voters drop the ballots into sealed ballot boxes; the ballots are later manually counted and tabulated.
Postelection Audit Testing	Postelection testing to review and reconcile election records to confirm correct conduct of an election or uncover evidence of problems with voting equipment or election processes. The audit includes verifying the accuracy of voting units and reconciling voting system records with information provided by the poll workers. This test can include all election equipment and results for one or more local jurisdictions, or the entire state, but it may focus on a sample of voting units and their outputs.
Punch Card	Voting method that makes use of a ballot, a vote-recording device that keeps the ballot in place and allows the voter to punch holes in it, a

privacy booth, and a computerized tabulation device. The voter inserts a machine-readable card with prescored numbered boxes representing ballot choices into the vote-recording device and uses a stylus to punch out the appropriate prescored boxes. The ballot must be properly aligned in the vote-recording device for the holes in the ballot card to be punched all the way through. Punch card ballots are counted by a computerized tabulation machine.

Readiness Testing

Testing to verify that voting equipment is functioning properly, usually by confirming that predictable outputs are produced from predefined inputs. Readiness testing is typically conducted in the weeks leading up to Election Day. Also referred to as logic and accuracy testing.

Recount

Some states authorize certain persons (e.g., defeated candidates and voters) to request an election recount under specified circumstances, such as a tie vote, a margin of victory that is within a specified percentage or number of votes, or alleged inaccuracies in the vote count. The scope and method of such recounts can vary to include, for example, partial recounts of certain precincts, complete recounts of all ballots, machine recounts, and hand recounts for the office or issue in question. Some states provide for mandatory (or automatic) recounts under certain conditions.

Vote-By-Phone

Voting method that uses electronic and telecommunications technologies, including a standard touch-tone telephone and a printer, to mark a paper ballot, interpret and communicate the ballot selections to the voter for verification, and then print a voter-verified ballot to be processed. A vote-by-phone system does not store or tabulate votes electronically.

Vote Tabulation

The counting of votes, either by hand or by electronic machine, from ballots cast at polling places on Election Day and those cast in person, by mail, or electronically prior to or on Election Day. Tabulation may occur at the polling place or at a central location. Tabulation activities also may include determining whether and how to count ballots that cannot be read by the vote-counting equipment; certifying the final vote counts; and performing recounts, if required.

Voter-Verified Paper Audit Trail

A human-readable printed record of all of a voter's selections, presented to the voter to view and check for accuracy.

Voting Method	The classes or types of machines used in a voting system. There are seven types of voting methods used in U.S. elections: hand-counted paper ballot, lever, punch card, direct recording electronic, ballot marking device, optical scan, and vote-by-phone.
Voting System	The people, processes, and technology associated with any specific method of casting and counting votes. The technology component of a voting system is the mechanical, electromechanical, or electronic equipment; software; firmware; documentation; and other components required for election management activities. This includes ballot layout, vote casting, tabulation, transmission of results, and management of voting systems.
Voting System Security Testing	Testing to verify that technical security controls embedded in voting equipment operate as intended, as well as ensuring that security policies and procedures governing the testing, operation, and use of the systems are properly defined and implemented by the responsible officials before an election.
Voting System Standards	A set of minimum functional and performance requirements for electronic voting systems, which may include specified test procedures to be used to ensure that voting equipment meets the requirements. The FEC issued the first voluntary voting system standards in 1990 and revised them in 2002. In 2002, HAVA assigned responsibility for updating the federal voluntary voting system standards to EAC. The federal voluntary voting system standards issued by EAC in December 2005 were known as the Voluntary Voting System Guidelines. EAC has recently issued a draft of the 2007 guidelines for public comment.
Voting System Testing Laboratory	An organization that has been evaluated and approved as competent to test voting systems by EAC and the National Voluntary Laboratory Accreditation Program operated by the National Institute of Standards and Technology.

Related GAO Products

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