ClearVote

ClearVote Quality Assurance Program

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Preface

This section defines the purpose of this document.

About this document

This document outlines the general quality assurance policies that Clear Ballot follows in producing the ClearVote system. The information corresponds to the requirements for the technical data package (TDP) described in the *Voluntary Voting System Guidlines* (VVSG) 2005, Volume 2, Section 2.12.

Scope of this document

This document contains the following chapters:

- Chapter 1. Overview
- Chapter 2. The ClearVote system
- Chapter 3. Hardware
- Chapter 4. Integration with EMS

Intended audience

The document is for state and federal election officials and their voting system test laboratories. This document is part of the Technical Data Package (TDP) required to certify the ClearVote system for use. Clear Ballot personnel also use this document to support election officials and staff.

Conventions

This section describes conventions used in this document.

References to ClearVote products

A ClearVote® system can comprise the ClearAccess®, ClearCast®, ClearCount®, and ClearDesign® products. Jurisdictions are not required to purchase all products. You can ignore references to any ClearVote products that are not part of your voting system. Also ignore implementation options that are not relevant to your policies and procedures.

BDF and ADF

ClearAccess imports an election definition contained in an accessible definition file (ADF) created by ClearDesign. ClearCount and ClearCast import an election definition contained in a ballot definition file (BDF) created by ClearDesign.

Versions of ClearDesign earlier than 2.0 created unencrypted ADFs and BDFs. ClearDesign 2.0 and later versions produce encrypted ADFs and BDFs. You can distinguish between unencrypted and encrypted ADFs and BDFs by the ending of the filename.

File type	Filename ends in
Unencrypted accessible definition file	adf.zip
Encrypted accessible definition file	adfx.zip
Unencrypted ballot definition file	bdf.zip
Encrypted ballot definition file	bdfx.zip

In this document, the general terms ADF and BDF can refer to both the unencrypted and encrypted versions of these files.

For the specifics of the ADF and BDF file formats, see the following:

- *ClearDesign Accessible Definition File Guide*
- *ClearDesign Ballot Definition File Guide*

Chapter 1. Overview

Clear Ballot is committed to delivering reliable high-quality products to its customers in the election industry. The entire Clear Ballot team works together to ensure that it achieves the specified requirements for all ClearVote systems and components.

1.1 Goals of the QA program

The primary goals of the quality assurance (QA) program are to:

- Maintain best practices throughout the entire product-development lifecycle
- Ensure that the hardware, software, and testing meet *VVSG 1.0* requirements as published by the US Election Assistance Commission (EAC)
- Adhere to requirements regarding development, testing, documentation, submission, and distribution
- Verify the performance of each product's components
- Comply with state-level certification requirements

1.2 Product-development process

The QA program at Clear Ballot is part of the overall product-development process. Clear Ballot continually monitors, evaluates, and improves this process.

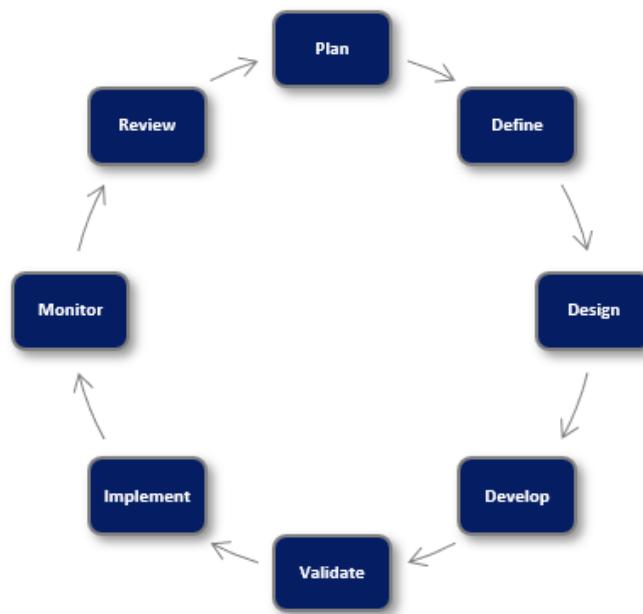Figure 1-1 shows an overview of the product-development process.

Figure 1-1. The product-development process at Clear Ballot

The following list describes each phase of the product-development process shown in Figure 1-1 on page 8:

Plan—Clear Ballot senior management meets annually to outline the product roadmap for the upcoming year, and then meets monthly thereafter to review and revise the plan as necessary. The roadmap is a high-level schedule of feature and maintenance releases for Clear Ballot's suite of products.

Define—The Product Management and Engineering teams collaborate to define the scope and detailed requirements of each product release. Requirements definitions rely upon customer and field support feedback, regulatory compliance, company strategy, and market analysis. Weekly meetings ensure that requirements are reviewed and revised as necessary to align with scope and schedule. Additionally, meetings occur weekly to ensure that each release includes as many product enhancements and bug fixes as possible.

Design—The Product Management, Engineering, Hardware, and Quality Assurance teams work together to design and test software. Hardware is designed, specified, and tested to meet the defined requirements.

Develop—The Engineering teams create and deliver release candidates that meet the release requirements and design specifications.

Validate—The Product Management, Hardware, and Quality Assurance teams evaluate and test the release candidates and hardware to ensure they meet the specified requirements. This is an iterative process until the Product Management team determines that the software and hardware have met the specified requirements and are ready for customer implementation.

Implement—The Customer Success team installs the product on-site with the customers, performs acceptance testing, and conducts end-to-end system testing. Implementation also includes customer training, performance testing, and logic and accuracy testing, as well as customer feedback.

Monitor—The Quality Assurance and Customer Success teams record customer feedback and product issues in the field. Enhancement requests and bugs are logged in the Jira system. Customers can also enter feedback directly into Clear Ballot's customer portal, or via email or telephone. The Customer Success team monitors each customer case through resolution. Weekly meetings are held to review product issues, perform root cause analyses, and determine corrective measures. When necessary, Clear Ballot issues a field service bulletin to notify customers about product issues and corrective measures.

Review—The Engineering Management and Product Management teams lead reviews of each aspect of the product-development lifecycle in search of process improvement opportunities to incorporate into the next release cycle. These opportunities are reviewed with each team and implemented into Clear Ballot's best practices through standard operating procedures or the product roadmap.

1.3 Scope of the quality assurance program

The QA program encompasses all aspects of development and testing of Clear Ballot's proprietary software for ballot design, tabulation, accessible voting sessions, and results reporting in conjunction with specific commercial off-the-shelf (COTS) hardware (such as, computers, scanners, printers, network switches, external hard drives). It also includes manufacturing oversight and testing of Clear Ballot's ClearCast precinct voting station.

Clear Ballot establishes specific requirements and release criteria for each product's components, and conducts thorough validation testing to ensure conformance. The QA program follows product testing lifecycle best practices in the following areas:

- Requirements analysis
- Test planning
- Test case development
- Environment setup
- Test execution
- Results reporting

1.3.1 Items in scope

The major areas of the QA program at Clear Ballot include:

- The requirements definition, design, and process documentation of the ClearVote software programs
- Validation and verification of the function, performance, and integration of the ClearVote system component, the ClearDesign election management system (EMS), the accessible definition files (ADFs) and ballot definition files (BDFs) created in ClearDesign or adapted from third-party EMS, the ClearAccess accessible-voting system, the ClearCast precinct-count system, and the ClearCount central tabulation and reporting system
- Determining the specifications that COTS hardware must meet to provide the level of quality (workmanship) and performance necessary for the individual ClearVote products
- The requirements definition, design, and process documentation of the ClearCast hardware
- Validation and verification of the process for installation of the ClearVote products, along with the necessary steps to secure the systems as would be required in a jurisdiction
- The requirements and process for integrating other EMS information into the ClearVote system—primarily creating and validating the BDF

1.3.2 Items out of scope

The following items are out of scope for the Clear Ballot QA program:

- Predelivery tests or maintenance records for third-party hardware

- Development of third-party election management systems

- Hardware development, manufacturing, and testing (with the exception of the ClearCast voting station)

Information about the hardware quality programs of manufacturers can be found in their documentation.

Chapter 2. The ClearVote system

The ClearVote system includes the following products:

- ClearDesign—Election management system (EMS)
- ClearAccess—Accessible-voting station
- ClearCast and ClearCast Go (referred to collectively as ClearCast)—Precinct voting station
- ClearCount—Central tabulation, results consolidation, and reporting system

With the ClearDesign EMS, jurisdictions can design ballots independently, proof their design (including accessible ballots), lay out and review one or all ballot styles (including HTML-based accessible ballots), generate PDFs for ballot-printing companies and ballot-on-demand printers, and generate the election definition files that program the other ClearVote products.

The ClearAccess accessible-voting and ballot-marking station allows voters with sight or mobility limitations to vote in an unassisted manner. The software runs on a touchscreen computer installed with an accessible keypad and a sip-and-puff device. The voter can make ballot selections by tapping the touchscreen, pressing buttons on the keypad, or using the sip-and-puff device. Ballot selections can be presented on the touchscreen, played over audio headphones, or presented on the touchscreen with audio. After the voter has finished voting, selections are printed to a paper ballot and then cast.

The ClearCast precinct-count, paper-based optical-scan voting system quickly scans and tabulates ballots. Scanned ballots are then securely deposited into a durable, detachable ballot bag or ballot box. ClearCast results are uploaded and merged into the ClearCount system.

The ClearCount central-count, paper-based optical-scan system captures voter intent and retains ballot provenance to improve election reporting and administration. Vote and ballot visualizations allow marginal votes to be identified and corrected by authorized election officials without requiring extensive retabulating of ballots. This provides a higher level of visibility and transparency for reviewing election results.

2.1 Product requirements

The *ClearCount Functionality Description* provides the general functional requirements for the ClearCount system. The *VVSG 1.0* requirements regarding accuracy (*Volume 2, Appendix C.5*) were also considered when designing and performing stress tests. *VVSG 1.0* requirements for security, accuracy, error recovery, and integrity, as described in *Volume 1, Section 2.1*, were taken into account in all cases.

- The *ClearCast Functionality Description* describes the ClearCast system and is responsive to *VVSG 1.0.*
- The *ClearAccess Functionality Description* describes the ClearAccess system and is responsive to *VVSG 1.0.*

- The *ClearDesign Functionality Description* describes the ClearDesign system and is responsive to *VVSG 1.0*.

2.2   Documentation of quality procedures

General

Clear Ballot's internal ticketing system, Jira, is the system of record for product requirements, functional problems, design issues, enhancement requests, and tasks. (See the *ClearVote Test and Verification Specification* for more information.) Clear Ballot's intranet contains information about functional and process standards.

Information from Jira tickets and the intranet are incorporated into the *ClearVote Configuration Management Plan* and additional technical data package (TDP) documents as appropriate. As the *ClearVote Test and Verification Specification* details, this information is also incorporated into test plans and test cases. Each major or minor build undergoes acceptance testing. Bug fixes are verified by QA. The QA staff also performs smoke testing based on which components have changed.

ClearCast

Clear Ballot maintains clearly defined procedures for specifying, procuring, inspecting, accepting, and controlling parts and raw materials for the manufacture and assembly of its ClearCast and ClearCast Go precinct-count products.

These procedures are version-controlled and are stored in a secure repository. Any changes to the procedures require an engineering change order (ECO), which is a written formal request that must be approved by all pertinent parties at Clear Ballots. Approved ECOs are time-stamped and stored in the secure repository.

2.3   Quality responsibilities

The vice president of engineering is responsible for the software quality assurance program at Clear Ballot, and the hardware lead is responsible for the hardware quality assurance program. Additionally, the product managers, the quality assurance lead, software engineers, and the quality assurance engineers all assist in the definition and enforcement of quality in the ClearVote products.

2.4   Tests and verification

The *ClearVote Test and Verification Specification* describes test plans (explaining the test approach) and test cases (detailing the test categories) for the ClearVote system.

2.5 Documentation feedback and process review

The assembly of the TDP documentation and corresponding testing and analysis of the ClearVote software identifies areas where the QA program requires review. The vice president of engineering convenes a series of meetings to institute additional levels of feedback and peer review into the QA program. These meetings occur periodically, and updated processes are documented on the Clear Ballot intranet, as well in subsequent versions of this document.

Chapter 3. Hardware

As described in the hardware specifications for the individual products, system hardware components, including computers and scanners, undergo extensive validation and verification. Hardware validation and verification follow the same development process as software development and testing.

3.1 Hardware specification review

All ClearVote hardware components must meet stringent requirements for reliability, ease of use, availability of support, durability, and their ability to meet *VVSG 1.0* requirements (for example, operation in specified temperature ranges). Clear Ballot seeks manufacturers that are ISO 9000-certified, such as Dell and Fujitsu. Such manufacturers have established quality assurance and quality control programs that adhere to rigorous industry standards. These programs are fully described in the manufacturers' corporate literature.

Clear Ballot staff reviews the specifications for all proposed hardware and conducts in-depth research with the manufacturer. In addition, certifying different hardware models at different price points is frequently a requirement to meet the needs of jurisdictions of various sizes.

3.1.1 Computer review and requirements

As described in the *ClearVote Approved Parts List*, the requirements for the computers involve the operating system, CPU, and memory. Different models are therefore selected for the CountServer and for the ScanStation and CountStation clients. The servers and clients were used in an extended series of in-house and field tests, including a million-ballot performance and stress test that exercised each computer for approximately ten hours as it tabulated the card images for 100,000 ballots (ten ScanStations were used in the test).

The ClearAccess station uses all-in-one form factor computers. Selection and testing of these computers follows the same process used with ClearCount computers, with specific ClearDesign and ClearAccess requirements added to the selection considerations.

3.1.2 Scanner review and requirements

For ClearCast and ClearCount tabulation, the major scanner requirements are:

- Scanners must be able to accept all ballot weights.
- Scanners must scan a range of sizes between 8.5" x 5" and 8.5" x 22".
- The scanner must produce acceptable quality images (200 or 300 dpi) as JPEGs for correct analysis by the tabulators.
- Scanners must simultaneously scan both sides of ballots.
- Scanner settings, such as contrast, must be configurable.

- The scanner software must be able to rename the images when provided with the target card's barcode (used in ClearCount), and to deposit the scanned images into a designated folder.

- Scanner performance must be acceptable for extended periods of time of continuous use.

- Scanner performance must degrade only slightly (and ideally not at all) when scanning folded ballots. Accuracy of results must not be affected.

- Scanners must have sensitive and accurate capabilities for detecting size and width irregularities, multi-feeds, and other mechanical obstructions. Recovery must be clear and immediate.

3.1.3 Manufactured product review and requirements

Clear Ballot has defined and documented minimal acceptable standards for all ClearCast component parts, including packaging materials. External manufacturers are, by signed agreement, responsible for compliance to Clear Ballot bills of materials, assembly drawings, and methods of construction. Clear Ballot retains responsibility at all times for the bills of materials and assembly drawings, although these are sometimes produced in collaboration with a manufacturer.

Software control is managed according to Clear Ballot's configuration management process. Software hash values are validated in each voting station before beginning the production burn-in process, which occurs during test and prior to shipment. Clear Ballot uses a companion document to the bill of materials, called a software configuration matrix, to maintain and record the proper software load for the ClearCast product. Clear Ballot staff review and sign the matrix before the start of a subsequent production run, if the matrix is changed.

Clear Ballot orders parts for the manufacturing process according to the bill of materials, and, if applicable, through an external manufacturer. Clear Ballot receives the parts, verifies their identity, performs, at minimum, a visual inspection; and inventories the parts. Upon completion of verification testing, parts are then designated for production. The components are assembled into a voting station according to established assembly methods. Each voting station undergoes documented testing to verify that it complies with performance specifications. Voting stations that do not meet specifications (and any component parts at receiving and on the production line) are removed from the production process and later dispositioned.

The production and assembly processes are documented by Clear Ballot staff. Assembly procedures are reviewed, updated, and approved on a regular basis by Clear Ballot.

Unit factory testing includes accuracy, performance, reliability testing, as well as visual inspection for compliance to cosmetic specifications.

Clear Ballot also performs in-process inspection and testing of the ClearCast components to ensure proper fabrication and assembly of the final hardware.

Finished goods are packaged for delivery to a customer by Clear Ballot. Upon receipt of a finished product, the customer performs a physical inspection, followed by acceptance testing. Clear Ballot then conducts preliminary performance testing before the customer's first official logic and accuracy testing.

3.1.3.1 ClearCast & ClearAccess COTS requirements

The key hardware components that comprise both ClearCast and ClearAccess include the computer, the scanner, the touchscreen, and the printer.

3.1.4 Assistive device requirements

In addition to its touchscreen, the ClearAccess station includes a modified keypad (with or without braille), a sip-and-puff input device, and optional keyboard and mouse. These devices are selected for compliance with *VVSG 1.0* accessibility requirements and cost-effectiveness.

3.1.5 Printer requirements

The ClearAccess system includes an integrated printer for printing voters' marked ballots. QA verifies that ballots generated from the ClearAccess system are indistinguishable from ballots of nondisabled voters.

The ClearCast voting station incorporates a tape printer that logs election modes and vote tallies.

3.1.6 Network switch requirements

The network switch used to connect the components in the closed network of the ClearCount and the ClearDesign systems must be a gigabit switch with a minimum of four ports.

3.2   Hardware responsibilities

COTS hardware

The hardware product manager is responsible for the selection of the COTS hardware, with input and assistance from the vice president of engineering and the chief executive officer. A dedicated hardware components engineer researches specifications and sourcing, and evaluates COTS candidates to ensure that *VVSG* and Clear Ballot requirements are met. Upon selection, COTS equipment is submitted to QA for testing. The QA staff verifies that the hardware meets *VVSG 1.0* requirements for the ClearVote system and for election jurisdictions.

The hardware components engineer obtains advance notice of end-of-life status for each hardware component, and identifies replacement hardware, as required.

Manufactured products hardware

The hardware product managers and manufacturing engineers develop and document processes and procedures related to manufactured products. The strategic procurement manager serves as the purchasing and control manager for the manufacturing process. He or she works closely with the Manufacturing team to ensure that each part, component, and finished product adheres to Clear Ballot's defined specifications.

3.3 Future development and COTS integration

Clear Ballot continues to work with Fujitsu and other vendors to ensure functions required for the ClearVote system are included in future scanner models, incorporating them in the scanner configuration software.

Clear Ballot staff is committed to making the ClearVote system available on the latest models of COTS computers with the latest operating systems. Clear Ballot continues to test (and submit for certification as appropriate) as new versions of Microsoft Windows become available.