VotingWorks

Usability and Accessibility Test Report of VotingWorks VxSuite, Version 4.0 with 71 participants for VVSG 2.0, Section 8.3

Report Based on ISO/IEC 25062:2006 Common Industry Format For Usability Test Reports

VotingWorks VxSuite, Version 4.0, focused on VxMark, with the option of scanning a completed ballot on VxScan.

Date of Usability Tests:	August 20-25, 2024 & August 28, 2024
Date of Report: Revised:	November 18, 2024 June 25, 2025
Report Prepared by:	VotingWorks Jessica Myers 717-403-6128 jessica@voting.works 548 Market St, Ste 53001, San Francisco, California 94104-5401
Report Prepared for:	VotingWorks Jessica Myers 717-403-6128 jessica@voting.works 548 Market St, Ste 53001, San Francisco, California 94104-5401

Table of Contents

1.0 Executive Summary

A usability test of VxScan and Vx Mark was conducted on August 20-25, 2024 and August 28, 2024 in Austin, TX and Houston, TX by VotngWorks. The purpose of this test was to fulfill Section 8.3 of the Voluntary Voting System Guidelines (VVSG).

During the usability tests, a total of 71 testers used the VxMark and/or the VxScan in a simulated election. The election consisted of one test ballot with 12 contests, including:

- State and Local contests
- Partisan and nonpartisan contests
- Single member and multimember contests
- Ballot questions (retention races)
- Ballot propositions (reflecting referendum, ballot initiatives, and constitutional amendments

This ballot used for the test is based on the test ballot developed by the National Institute of Standards and Technology (NIST), to provide opportunities for various voting tasks. The instructions includes 22 tasks and that model typical ballots from around the country, including:

- Voting for names at various locations within a list of names
- Voting a partial slate in a multimember contest
- Skipping elements of a ballot
- Changing a vote from the review screen
- Write-in votes
- Reviewing a ballot
- Casting a ballot

Following the conclusion of the testing, the results were analyzed to determine participants' effectiveness, efficiency and satisfaction using the VxMark and/or VxScan.

During the usability test, the testing team collected and analyzed the following types of data:

- Number and percentage of ballots successfully submitted/completed (number and percentage)
- Percent of tasks completed without any errors
- Count of assists provided (number or percent of testers needing assists)
- Skipped contests
- Time to complete the voting session
- Rating of Audio
- Rating of Translations
- Rating of write in process
- Rating of changing contest process
- testers' confidence that they had used the system correctly
- testers' overall satisfaction with the system

The testing team also collected less structured feedback on the VxMark during, and after, voting sessions, which included general feedback on the voter's experience during the session and recommendations from the voter on improvements to the system.

Below is a high-level summary of the results:

Measure	Description	Usability Test Results
Successful completion	Average success rate of the 22 tasks performed by testers from the general population.	98.6%
Ballots cast without any assists	Count of the number of testers who were able to submit their ballot without any errors requiring assistance.	27 of 71 ballots (38.1%)

Count of assists provided	Number of testers and assists provided to testers during the usability test.	153 Assists given to 44 testers
VotingSession Time	Mean time taken per test participant to complete the process of activating, filing out and casting the ballot.	10 m 40 s
Rating of Audio quality	Number of audio users and percent who thought audio worked well	35 of 71 testers used this 91.4% thought the audio worked well
Rating of Translations	Number of audio users and percent who thought translations worked well	17 of 71 testers used this 52.9% thought the translations worked well
Rating of Write in process	Mean rating of write in process based on 1-5 scale	3.77
Rating of Process to Change selections	Mean rating of change selection process based on 1-5 scale	4.55
Voter Confidence	Mean confidence level expressed by testers that they believed they voted correctly and	4.85 Confidence Level

	the system successfully recorded their votes.	
Voter Satisfaction	Mean satisfaction level expressed by testers in response to a post-test satisfaction questionnaire.	4.63 Satisfaction Level

2.0 Introduction

2.1 Full Product Description

During the usability test, the VxMark and/or VxScan, both version 4.0, were evaluated. This version is similar to the version that will be provided to the Voting System Test Laboratory, with the exception of some minor updates to the software or hardware based on feedback from this testing.

Designed to present ballots to testers throughout the U.S. and collect voter responses, the VxMark consists of a ballot marking device, which accepts blank thermal ballot paper and provides a ballot on a touchscreen that testers can use to make their selections and print their ballot. The VxMark includes an accessible controller that can be used to navigate through the ballot if the voter is unable to interact with the touchscreen. Audio can be used via headphones, which provides instructions on how to use the accessible controller, navigate through the voting process, make ballots selections, and send the ballot for printing. The voter can cast their ballot on the VxMark, with tabulation occurring at a later point using VxScan or VxCentral. The voter may also take their VxMark ballot and cast it on the VxScan at the polling place.

To enable testers to test scanning the VxMark ballots on the VxScan, we had a VxScan and ballot box on location for all testing sessions and gave testers the option to cast on VxMark **or** VxScan. This is why we include both as named devices for this testing.

The VxMark and VxScan can be used in federal, state and local elections and set up in designated voting locations. VxScan version 3.1.0 and 3.1.1 are currently deployed in several towns and cities in New Hampshire. VxScan version 2.0 is currently

deployed in 5 counties in Mississippi. The hardware for VxMark version 4 is used in LA County and is known as the VSAP. The usability testing attempted to simulate these environmental conditions and users' real-world context of use.

2.2 Test Objectives

The usability test objectives include:

- To assess the effectiveness of the VxMark by measuring the abilities of users to successfully complete and submit a ballot.
- To assess the efficiency of the product by measuring the average time to complete a voting session.
- To assess the user satisfaction of the system by measuring average voter confidence.
- To gather feedback on the experience of using audio, translations, write ins, and changing ballot selections.
- To gather open ended, unstructured feedback on the system and voter experience.

3.0 Method

3.1 Participants

Participants were recruited by VotingWorks staff via cold calls, in person outreach, flyers, and community appeals.

A total of 71 testers, with a varying mix of backgrounds and demographic characteristics, were selected to participate in the usability test. All participants were over the age of 18, eligible to vote in the U.S., and able to communicate in English.

The usability tests used individuals whose visual acuity is less than 20/70 but greater than or equal to 20/200; the usability tests used individuals who can only read large-print, high contrast text; and used individuals who are visually impaired. Wearing corrective lenses did not assist these individuals in reading normal-sized text. VotingWorks had 12 testerswith low vision who were able to complete the

testing session, without assistance. More information available in the table below and Apprendix A.

Please see Appendix A for a full spreadsheet of participant demographics.

Breakdown by demographics for 71 total participants

Demographic	All Participants
Sex	[30] Men
	[41] Women
Age	[5] 18-24 years
	[20] 25-34 years
	[13] 35-44 years
	[14] 45-54 years
	[14] 55-69 years
	[5] 70+ years
Education	[6] Some high school
	[19] High school
	[19] Some college
	[18] College degree
	[9] Graduate/professional degree

Race/Ethnicity	[0] American Indian/Alaska Native
	[4] Asian
	[20] Black/African-American
	[11] Hispanic/Latino
	[1] Pacific Islander
	[31] White/Caucasian
	[5] Other (biracial)
Disability	[14] Blind
*Many testers identified more than one disability	[12] Low vision
	[4] Deaf
	[1] Hard of Hearing
	[12] Limited dexterity
	[13] Intellectual and Developmental disability
	[4] Limited or low literacy
	[17] Mobility
	[11] Brain/cognitive
	[6] NA/would not answer/could not describe

Geographic Distribution	[33] Urban
	[30] Suburban
	[8] Rural
Years of Voting Experience	[4] None
	[4] Less than 2 years
	[7] 2-5 years
	[8] 6-10 years
	[16] 11-20 years
	[32] 20+ years
Number of elections in the past 4 years	[4] None
	[19] 1-2
	[24] 3-5
	[24] 6+

3.2 Context of Use in the Test

3.2.1 Tasks

During the usability test, participants were instructed to vote in a simulated election consisting of one test ballot with 12 contests, including:

- State and Local contests
- Partisan and nonpartisan contests
- Single member and multimember contests
- Ballot questions (retention races)
- Ballot propositions (reflecting referendum, ballot initiatives, and constitutional amendments

Our usability testing team based the test ballot on the medium complexity ballot created by NIST in order to cover all of the possible errors it incorporates.

Using this ballot, participants were asked to perform 22 tasks that were selected to model typical ballots from around the country, as well as to thoroughly test the voting system's capabilities and usability, including:

- Voting for names at various locations within a list of names
- Voting a partial slate in a multimember contest
- Skipping elements of a ballot
- Changing a vote from the review screen
- Write-in votes
- Reviewing a ballot
- Casting a ballot

Participants were provided an overview of the system, description of all tools and accessible options, and were asked to perform the task of reviewing and casting a ballot without assistance. A task was considered successful if the participant was able to cast a vote in a way that matched their preference.

Data was collected for each task, including successful completions, time to complete a voting session, number of errors requiring assistance, number of assists provided, and voter confidence for each task.

Please see Appendix D for the test ballot.

3.2.2 Test Location

The VxMark and VxScan are intended to be used at designated polling locations across the U.S., including schools, libraries, churches and other public facilities large enough to house multiple voting stations.

In order to simulate this environment, the test was conducted at several locations:

- Private residences for 4 testers who were unable to get transportation to a central location, but wanted to be included in testing.
- A banquet room at Kalahari Resort, Austin, Texas.
- A meeting room at Houston Marriott Westchase.
- A community room at Metropolitan Multi-Services Center, West Gray St, Houston, Texas.

3.2.3 Voting Environment

During an actual election, testers are expected to use the voting system provided at the polling location. testers may have experience with a wide-range of systems or may only have experience with one type of system.

During the usability test, all participants were instructed to useVxMark version 4 just as if this system was implemented at their local polling location. They were provided an overview of the equipment, accessible features, and then told to begin their voting session. The test administrator only intervened if assistance was requested by the voter.

3.2.3.1 Display Devices

The VxMark uses a 15.6" screen, with resolution of 1920x1080, and 310 nit brightness. More details are available here: MS603573TDM 15.6IN E976783.pdf

3.2.3.2 Audio Devices

The VxMark uses the following audio cues, which can be found in full on GitHub here.

3.2.3.3 Input Devices

During the test, participants could use: headphones, sip and puff, jelly buttons, Tcoil, the accessible controller, and/or the touch screen. We also offered a stylus, if that made it easier to use the touchscreen.

3.2.4 Test Administrator Tools

During the usability test, various tools were used to facilitate the test sessions, including:

- Informed Consent (See Appendix B)
- Instructions for Participants (See Appendix E)
- Post-test Satisfaction Questionnaire (See Appendix C)

Participants' votes were recorded by the system, similar to a real-world election. Test facilitators recorded time by entering that information on the questionnaire. Start time (when the tester clicked the screen to bring up their ballot) and end time (when the voter cast their ballot) are recorded in the questionnaire and results.

3.3 Methodology

During the usability test, participants interacted with the VxMark and VxScan, if they chose to cast their ballot on VxScan instead of VxMark. Each participant used the system set up in the same way and was provided with the same ballot, system orientation, and instructions.

The system was evaluated for effectiveness, efficiency and satisfaction. To evaluate these factors, the usability team collected data on:

- Number and percentage of ballots successfully submitted/completed number and percentage
- Percent of tasks completed without any errors
- Count of assists provided (number or percent of testers needing assists)
- Skipped contests
- Time to complete the voting session
- Rating of Audio
- Rating of Translations
- Rating of write in process
- Rating of changing contest process
- Testers' confidence that they had used the system correctly

- Testers' overall satisfaction with the system

Additional information about the various measures and associated metrics can be found in the section on Usability Metrics.

3.3.1 Procedure

Upon arrival, participants were greeted and asked to complete a Pre-Test Questionnaire (See Appendix C) to ensure that they qualified for the test. Participants who did not meet the qualifications were allowed to test and provide feedback, but their results are excluded from the data analyzed in this report.

Participants meeting the qualifications were asked to review and sign an Informed Consent (See Appendix B), which described their rights during the study and was provided in four languages: English, Spanish, Chinese (Traditional), and Chinese (Simplified). Participants were then provided an overview of the voting system and assistive technology options. Test administrators described the different settings that could be used by the tester and helped orient anyone using the accessible controller, so they could feel the buttons and easily identify the help button on the controller.

After this overview, they were given the following instructions:

"Please read the instructions on each contest and make your selections using the input method you prefer. Please feel free to write in candidates, change selections, review your selections, print your ballot, review your paper ballot, and let us know if you prefer to cast on this device or the precinct scanner.

As the test administrator, I will function similar to a pollworker and will not interfere with your session unless you request my assistance. Please feel free to provide your thoughts and feedback as you work through the ballot, as that information enables us to improve our system for users like you.

At the end of the session, we will have additional questions about your experience."

During the usability test, test facilitators observed users' interactions and noted feedback they provided as they worked through the ballot. The test administrator only provided assistance when a user was stuck and asked a question. The assistance was limited to the question asked. Test administrators did not walk the voter through the ballot. Test administrators noted the start and end time of each

session. When the participants finished the test, they were asked to complete a Post-Test Questionnaire (See Appendix C).

At the conclusion of the test, participants were thanked for their time and compensated $25 at group sessions or $50 at in-home sessions.

Four staff members participated in this test. Staff members would rotate in shifts where 2 people were working as test administrators and the other 2 people would manage test session logistics.

Test session logistics staff greeted the tester, worked through consent forms, led testers to machines, scheduling test sessions at high volume times, managed the flow of testing, and provided the gift card to the tester at the end of their session.

Usability test administrators providedconducted the test and logged the data. Test session logistics staff greeted the tester, worked through consent forms, troubleshooting, scheduling test sessions, and providing gift cards to testers at the end of their session.

3.3.2 Participant General Instructions

The participants were instructed that they would work alone during the test, but that they could ask for the same sort of assistance or the same sort of questions they might ask an election worker.

3.3.3 Participant Task Instructions

Participants were also provided with instructions on how to use different accessible features, reminded to read instructions and follow screen prompts, and to make sure they reviewed their selections on screen prior to printing their ballot. They were reminded and encouraged to write in candidates and review and change selections as they worked through the ballot. These instructions were provided to users orally.

See Appendix Efor the instructions for participants.

3.4 Usability Metrics

The usability test collected various metrics for effectiveness, efficiency and satisfaction.

Name	Measure	Description
Effectiveness: Completion Rate	Ballots successfully submitted/completed	Percentage of test participants who were able to complete the process of voting and cast their ballots so that their ballot choices were recorded by the system.
Effectiveness: Skipped Contests	Number of testers skipping contests and total contests skipped	Number (and percentage) of testers skipping contests and total contests skipped.
Effectiveness: Errors	Tasks completed according to the on screen instructions without errors or assistance	Percentage of tasks that were completed without any errors. An error might involve a voter not following screen instructions to navigate through the ballot
Effectiveness: Assists	Number of participants needing assists	Count and percentage of the number of participants needing assists
Effectiveness: Assists	Count of assists provided	Count of the number of times assistance was given to participants.
Efficiency: Time on task	Average session time	Mean time taken per test participant to complete the process of activating, marking, and casting the ballot, both overall and by interaction mode

Satisfaction: Audio	Satisfaction with audio quality	Satisfacction expressed by testers in response to a post-test satisfaction questionnaire.
Satifaction: Translations	Satisfaction with translation quality	Satisfacction expressed by testers in response to a post-test satisfaction questionnaire.
Satisfaction: Write in process	Satisfaction with write in process	Mean satisfaction level expressed by testers in response to a post-test satisfaction questionnaire.
Satisfaction: Changing a selection	Satisfaction with changing a ballot selection	Mean satisfaction level expressed by testers in response to a post-test satisfaction questionnaire.
Satisfaction: Overall Satisfaction Rating	Average voter satisfaction	Mean satisfaction level expressed by testers in response to a post-test satisfaction questionnaire.
Satisfaction: Confidence	Average voter confidence	Mean confidence level expressed by testers that they believed they voted correctly and the system successfully recorded their votes.

4.0 Results

4.1 Data Analysis

To analyze the data, each session was scored for completeness, accuracy, errors, number of assists, and time to complete. In addition, the test team analyzed testers' satisfaction and confidence using various post-test questionnaires.

4.2 Presentation of the Results

This section details the performance results for effectiveness (completion rate, errors, assists), efficiency (time on task) and satisfaction (satisfaction and confidence rating).

Name	Measure	Results
Effectiveness: Completion Rate	Ballots successfully submitted/completed	Of the 71 participants included in the test, 70 were able to successfully cast their ballot.
Effectiveness: Skipped Constests	Number of contests skipped by testers	11 of 71 (15.5%) testers skipped one or more contests during their voting session. The total number of contests skipped unintentionally, accidentally, or due to confusion was 40.
Effectiveness: Errors	Tasks completed according to the instructions without any errors	27 of 71 (38.1%) testers were able to complete a voting session according to instructions without any errors.

		During the testing, a total of153 errors were made by the participants
Effectiveness: Assists	Number of participants needing assists	44 [62.9%] of the participants needed assists
Effectiveness: Assists	Count of assists provided	A total of 153 assists were provided to those participants.
Efficiency: Time on task	Average session time	The average session time was 10 minutes 40 seconds.
Satisfaction: Audio	Satisfaction with audio quality	35 of 71 testers used audio during their session. Of the 32 testers using audio, 3 said they could not clearly hear the instructions and ballot information and 32 said they could. (Asked as a YES/NO question)
Satisfaction: Translations	Satisfaction with translation quality	17 of 71 testers used translations. Of the 17 testers who used translations, 8 said they could not clearly hear the instructions and ballot information and 9 said they could. (Asked as a YES/NO question) We identified a software glitch that caused the Spanish language to become “crackly” at a high rate of speed, which caused difficulty for some users.

Satisfaction: Write in process	Satisfaction with write in process	Average voter satisfaction was 3.77. Testers were asked to give their satisfaction rating on a scale of 1-5, with 1 being poor and 5 being excellent.
Satisfaction: Changing a selection	Satisfaction with changing a ballot selection	Average voter satisfaction was 4.55. Testers were asked to give their satisfaction rating on a scale of 1-5, with 1 being poor and 5 being excellent.
Satisfaction: Overall Satisfaction Rating	Average voter satisfaction	Average voter satisfaction was 4.63. Testers were asked to give their overall satisfaction rating on a scale of 1-5, with 1 being poor and 5 being excellent.
Satisfaction: Confidence	Average voter confidence	Average voter confidence was 4.85. Testers were asked to give their confidence rating on a scale of 1-5, with 1 being poor and 5 being excellent.

More detailed results can be found in Appendix F.

5.0 Conclusion

Overall

Most testers expressed that they had a very positive experience. A larger number of blind testers commented that this was the first time they could vote independently and did not need any assistance.

Blind testers really loved that they could have the printed ballot read back to them or use their own screen reader to confirm their selections on the paper ballot.

Testers with IDD, Brain Injury, Literacy, and Cognitive disabilities

Some testers with IDD and all testers with brain injury, low literacy, and cognitive disabilities struggled with following the instructions provided. Although these users were not required for VVSG compliance, we chose to include them to get more well rounded feedback. In the future, we might reconsider that, because the test method required for this testing does not work well for those users.

Instructions

Most testers found the instructions provided by the test administrator easy to understand and follow.

Most testers were able to follow on screen instructions and successfully complete their voting session.

Those using the accessible controller had feedback specific to that device which is covered in a section below.

Audio Quality

Testers, particularly blind testers were very positive about the audio quality, including with increased/decreased volume and rate changes. Testers using Spanish audio found that when the rate was increased, the audio would crackle. We recorded the detailed feedback and provided this information to our software team to work on improvements prior to certification submission.

When typing in write ins, the audio sometimes struggled to keep up with fast typing.

Changing Selections

Users found it easy to change selections either during the course of voting or via the review screen.

Write-in Functionality

A large number of users expressed frustration about the write in process, particulary those using the accessible controller or accessible controller with audio. They found navigating around the QWERTY keyboard was counterintuitive, frustrating, and time consuming. We recorded the detailed feedback and provided this information to our software team to work on improvements prior to certification submission.

Users entering data via the touchscreen found the process easy to complete.

Review Screen

Users expressed excitement about how easy it was to navigate through the review screen, verify selections, and make changes. This helped them feel confident about their selections and the accuracy of those selections.

Reviewing Printed Ballot

Users with limited dexterity were very excited to be able to review their ballot without having to handle paper. They were also excited to have the option to cast directly on the VxMark (for later tabulation) or take their ballot to the VxScan.

Touchscreen Sensitivity

testers with limited dexterity were very excited that they could choose between using the touchscreen and using the accessible controller. Many started with the touchscreen and were delighted to find that the sensitivity of the screen was just right for them and they were able to scroll and select their choices without mistakes.

Screen Tilt and Space for Wheelchair

Wheelchair users expressed gratitude more than once for the ability to tilt the touchscreen and the amount of space they had to manueveur around the machine.

Accessible Controller

Some testers who used the accessible controller expressed concerns and improvements including:

- Braille on the controller to help understand the buttons

- Ability to repeat instructions on screen without moving around the contest page to trigger audio
- Difficulty orienting on the controller and being certain you were touching the correct buttons
- Some actions are counterintuitive

We recorded the detailed feedback and provided this information to our software team to work on improvements prior to certification submission.

Casting a Ballot

Although not the focus of testing, we provided testers with the option to cast their ballot on VxMark or cast their ballot on VxScan.

Testers who cast their ballot on VxMark thought it was simple and easy to do, but did provide feedback on wanting additional verification prior to printing and then casting to make sure that people did not print or cast by accident or unintentionally. We recorded the detailed feedback and provided this information to our software team to work on improvements prior to certification submission.

Some testers wanted to cast their ballot on VxScan, and the feedback for that equipment as relates to accessibility was:

- The height and infeed tray were easy for wheelchair users to feed their ballot into the scanner
- The scanner is fast
- The scanner is easy to use and the ballot is pulled in to the scanner without much ”push” effort

Accidental Activation

Test administrators did not witness or have a tester report to them an instance of accidental activation of actions through an unintended gesture via the touchscreen or other accessible inputs. In fact, test administrators received feedback from several users that they were excited about their interaction with the touchscreen, because even if their hand wobbled or when they scrolled through screens, the system did not make selections for them that they did not intend. We had a couple users that, upon discovering this, chose to use the touch screen over the accessible controller, because they were so excited about the screen interaction experience.

Appendixes

Appendix A: Participant Demographics

UAT Demographics

Appendix B: Informed Consent

Informed Consent Form - VxMark user testing - 2024.pdf

Informed Consent Form - VxMark user testing - 2024 - Spanish.pdf

Informed Consent Form - VxMark user testing - 2024 - Chinese, traditional.pdf

Informed Consent Form - VxMark user testing - 2024 - Chinese, simplified.pdf

Appendix C:Test Session Questionnaire

UAT Data Collection Form - Google Forms.pdf

Appendix D: Test Ballot Specification

sample-precinct-ballot-Precinct_1-1_en (1).pdf

official-precinct-ballot-Precinct_1-1_zh-Hant.pdf

official-precinct-ballot-Precinct_1-1_zh-Hans.pdf

official-precinct-ballot-Precinct_1-1_es-US (1).pdf

Appendix E: Instructions for Participants

Prior to starting the session, test participants were given the following instructions orally after receiving an overview of the accessible options of the VxMark:

1. Please read the instructions at the beginning of each contest carefully.
2. Please read on screen alerts or prompts carefully.
3. Please use the settings menu to select the contrast and font size that works best for you.
4. Work through each contest selecting the candidates you choose.
5. Please complete a write in entry for a contest of your choosing.
6. Please feel free to make a selection change in any contest or on the review screen prior to printing your ballot.
7. Please review all your selections after you've worked through the ballot and make any corrections you believe are necessary.
8. Please print press the cast ballot option to print your ballot.
9. After printing your ballot, it will feed back out to you so you can review it - on screen or on paper - prior to casting.
10. When you are satisfied with your ballot, select the cast ballot option or let the test administrator know you would like to cast your ballot on VxScan rather than VxMark.
11. When you are ready to start, please select the button at the bottom of the screen.

12. The test administrator is available to answer questions as a poll worker, but will not otherwise assist you with your test session.
13. Please feel free to speak feedback or frustrations out loud, the test administrator will note that feedback for system improvements.
14. When you are ready, please select the button at the bottom of the screen.

Appendix F: Results

The results are available here:

UAT Results.xlsx