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Usability Study of Dominion Voting Systems ImageCast™ Evolution version 4.1.1.1. and 4.6.1.1

Version: 1.0.0::36

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Chapter 1

Executive Summary

The ImageCast™ Evolution is a Precinct Count Optical Scanner (PCOS) with an integrated touch screen interface and an internal ballot marker for fully accessible voting.

Dominion Voting Systems (or DVS) conducts ongoing usability tests of the ImageCast™ Evolution (or ICE). This usability testing program is aimed at improving the usability of the ICE throughout the design and development process.

This purpose of this usability test report is to fulfill the requirements of the Voluntary Voting System Guidelines 2005 (VVSG). It will be offered to regulatory agencies such as the National Institute of Standards and Technology (NIST) and the Election Assistance Commission (EAC).

Usability tests have been conducted on ICE firmware versions 4.1.1.1 and 4.6.1.1 Testing took place in a simulated polling place with a registration desk, voting booths, and a free-standing voter-fed tabulator (the ICE). This configuration was set up at the DVS office in San Leandro, CA, and at the Center for Independent Living (CIL) in Berkeley, CA.

Date	Location	ICE Firmware Version
August 16, 2011	DVS, San Leandro, CA	ICE 4.1.1.1
August 17, 2011	DVS, San Leandro, CA	ICE 4.1.1.1
August 30, 2011	DVS, San Leandro, CA	ICE 4.1.1.1
September 8, 2011	CIL, Berkeley, CA	ICE 4.1.1.1
November 4, 2011	CIL, Berkely, CA	ICE 4.6.1.1

Table 1.1: Usability testing dates, locations, and ICE firmware version tested.

During the usability tests, 14 participants (mainly older voters and voters with physical limitations) used the ICE to vote in a simulated election. The election consisted of one test ballot (created by DVS) with 5 contests, including:

- Federal and state contests
- Partisan and nonpartisan contests
- Single member contests
- Propositions

Voters were asked to mark the ballot in a prescribed pattern that models typical ballots from around the country.

Participants were given 2 voting scenarios that were designed to test the various features and user interfaces of the ICE. Participants were to vote in at least 1 of the given scenarios.

The first scenario will be referred to as manual voting (or MV) and requires that the participant be able to make their selections on a paper ballot using a marking pen. The marked ballot is inserted into the ICE for participants to review their ballot selections and cast their ballot using the ICE touch screen interface. This scenario is designed to evaluate the usability of the ICE touch screen interface and ballot review features. This scenario includes 13 tasks that simulate typical voting procedures using the ICE.

The second scenario will be referred to as accessible voting (or AV) and is designed to evaluate the usability of the ICE accessible voting interfaces, specifically the ballot marking feature. Voters use an electronic input device to navigate, mark, and cast their ballot. Though 3 different accessible input interfaces are offered, all participants chose to use the Audio Tactile Interface (or ATI).

This scenario includes 8 to 10 tasks depending on their preferred interface (audio only, visual only, or audio and visual).

During the usability testing, participants worked alone and were not provided assistance or help by the test administrators, unless requested. While participants voted, test administrators noted accessible interface(s) used, assists requested, verbal comments, and anything that may affect the data being collected.

The usability test administrators collected and analyzed the following types of data to determine participant effectiveness, efficiency, and satisfaction using the ICE:

- Number of ballots successfully cast.
- Number of contests voted as per instructions.
- Count of assists provided.
- Time to complete the voting session.
- Voters' confidence that they had used the system correctly.
- Voter satisfaction with the system.

Below is a high-level summary of the results:

Measure	Description	Usability Test Results
Successful Completion	<i>The average number of voters who were able to successfully complete their voting session.</i>	100%
Number of ballots cast without any errors	<i>Count of the number of voters who were able to submit their ballot(s) without any errors.</i>	12 of 14 voters
Count of assists provided	<i>The total number of assists provided to voters during the usability tests.</i>	3
Average Session Time for Manual Voting (MV)	<i>Mean time taken per test participant to complete the process of hand marking, reviewing, and casting the ballot.</i>	2 minutes and 50 seconds
Average Session Time for Accessible Voting (AV)	<i>Mean time taken per test participant to customize the ICE accessible voting interface and use it to mark and cast their ballot.</i>	8 minutes and 11 seconds
Average Voter Confidence	<i>Mean confidence level expressed by voters that they believed they voted correctly and the system successfully recorded their votes.</i>	MV: 4.77/5 AV: 4.36/5
Voter Satisfaction Score	<i>Mean satisfaction level expressed by voters in response to a 5-question post test satisfaction questionnaire.</i>	MV: 91.9/100 AV: 73/100

Chapter 2

Introduction

2.1 Full Product Description

The ImageCast™ Evolution (or ICE) is a precinct-level voting system that uses scan technology to validate and tabulate marked paper ballots. The ICE unit features an 18.5” touch screen display that allows voters to review and cast their marked paper ballot through a customizable visual interface. In addition, the ICE features several accessible voting interfaces that allow voters with various disabilities to effectively mark, review and cast a paper ballot in a private and independent manner. When a voter casts their ballot, the ICE stores a complete image of the ballot and selections, and the paper ballot is securely deposited into a sealed ballot box located under the unit. When polls close, the ICE produces a results report with cumulative totals of all votes cast. The ICE is evaluated as part of Dominion’s ongoing usability testing program. So far, ICE firmware versions 4.1.1.1 and 4.6.1.1 have been evaluated. ICE hardware remains unchanged.

ICE firmware 4.1.1.1 was the first version evaluated during usability testing. Based on voter feedback, the following modifications were made to the ICE accessible voting interfaces for firmware version 4.6.1.1.

- Static screens displayed during the accessible voting instructions were modified to create a more uniform and consistent appearance.
- Static audio instructions were added to notify accessible voters that their ballot was being printed.

ICE firmware version 4.6.2 is being provided to the Voting System Test Laboratory (VSTL). This is an upgrade from version 4.6.1.1. Features added include:

- An audio interface for accessible ballot review. Previously, voters only had the option to review their ballot through the ICE visual interface.
- A detailed and informative message displayed when the ICE detects an issue with a scanned ballot. Previous versions gave a standard “Ballot Rejected” message without describing the issue.

The ICE is typically used in federal, state and local elections and is set up in designated voting locations. The usability testing attempts to simulate these environmental conditions and users’ real-world context of use.

Dominion’s ongoing usability testing program evaluates the ICE user interfaces. This includes:

- The ICE touch screen interface for visual ballot review and ballot casting.

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- ICE-accessible ballot marking interfaces (both audio and visual).
 - Assistive input devices for accessible ballot navigation and voting.

Accessible voting interfaces are the primary focus of ICE usability testing. This is an area that is susceptible to usability issues. Dominion Voting strives to enhance the accessibility and usability of its ICE system for voters who face barriers to equal participation.

Standard scanning and ballot review features were included in the evaluation because they are most frequently used.

2.2 Test Objectives

The usability test objectives are:

- To assess the effectiveness of the ICE by measuring the abilities of various user groups to successfully complete and cast a ballot.
- To assess the efficiency of the ICE by measuring the average time to complete a voting session.
- To assess the user satisfaction of the ICE system by measuring average voter confidence and ease of use.
- To assess the usability of the ICE accessible voting interfaces for different disability groups.
- To elicit user feedback on how the accessible voting interfaces can be further developed and/or improved.

Chapter 3

Method

3.1 Participants

A total of 14 voters have participated in the ICE usability testing program so far. Each round of usability testing targets a specific type of user group.

The first round of usability testing focused on users who were over 60 years old and had at least 10 years of voting experience. These users were recruited through asking friends and family if they knew someone over 60 years old in the San Leandro area who would be available to participate.

The second round of usability testing focused on people with physical limitations. Dominion Voting teamed up with the Center for Independent Living (CIL) in Berkeley, California to recruit participants with mobility impairments, visual impairments, and hearing impairments.

All participants received a \$10 gift card (for Starbucks™ or Peet's™) as compensation for their time.

Participants were not Dominion Voting employees or family members of employees. All participants were over the age of 18, eligible to vote in the U.S., and fluent in English.

Note: In the State of California, there are restrictions to the collection of data related to race or ethnicity and disability. There appeared to be a range of ethnically diverse people in the participant sample, representative of the larger population. Many participants volunteered information about limitations they have that may restrict their access to voting privately and independently.

The following tables show the additional participant demographics.

Targeted User Group	
Over 60 years old	6
Mobility Limitation	5
Low Vision (Legally Blind)	3
Completely Blind	1
Auditory Disability	1
Dexterity Disability	1
General Population (under 60)	1

Gender	
Men	7
Women	7
TOTAL (participants)	14

Table 3.2: Participant Gender

Table 3.1: Participants For Each Targeted User Group.
Note that user group characteristics intersect.

Age	
18-24	0
25-34	2
35-44	2
45-54	2
55-64	4
64+	3
Unknown	1
TOTAL (participants)	14

Table 3.3: Participant Age Group

Years of Voting Experience	
None	1
Less than 2 Years	1
2-5 Years	0
5-10 Years	2
10-20 Years	3
More than 20 years	7
TOTAL (participants)	14

Table 3.4: Participant Voting Experience

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

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 5 contests, including:

- Federal and State Offices
- Partisan and Nonpartisan Contests
- Propositions

The participants simulated typical voting scenarios for marking this ballot by hand, then used the ICE to thoroughly test the ICE touch screen interface for ballot review and ballot casting. Participants also tested the ICE accessible ballot marking feature using the accessible interfaces that best suited their needs. These tasks were designed to evaluate the defined objectives of this usability test.

Participants who could hand mark a ballot were asked to perform 13 tasks:

- Take their blank ballot to a voting booth.
- Follow the voter instructions printed on the ballot.
- Vote the ballot contests in the pattern prescribed on the instructions.
- Undervote the ballot.
- Take their ballot to the ICE.
- Follow on-screen prompts and instructions.
- Review their contest selections on the ICE display screen.
- Move through the ballot review using the ICE touch screen interface.
- Use the touch screen interface to return their ballot without casting.
- Return to the voting booth.
- Vote the remaining office on the ballot.

-
- Bring their ballot to the ICE again to review their modified ballot on the ICE display screen.
 - Cast their ballot using the ICE touch screen interface.

Participants who tested the ICE accessible ballot marking feature were first given audio instructions that described how to use the equipment.

For the purpose of this usability testing session, the test administrator acted as a poll worker and handed an ATI, with connected headphones, to the voter. Once the voter was comfortably seated in front of the ICE and had the headphones on, the test administrator activated an accessible voting session using the ICE touch screen interface, as a poll worker would normally do.

Voters are instructed to increase the volume immediately by using the volume control button on the ATI. Note: this is necessary because the ICE is set to the VVSG initial volume requirement of 40 - 50 dB SPL. This volume tends to be too low for many people.

Accessible voters were asked to perform the following tasks during their accessible voting session:

- Select the input interface they are using for navigation, as instructed on the ICE display screen. Note: All voters chose to use the ATI for their voting session. The ICE audio and visual interfaces provide prompts to voters informing them of which buttons to press throughout the instructions and ballot marking session.
- Customize the AV session by turning the display screen off or leaving it on according to their needs.
- If voters leave the display screen on, they are given the option to turn the audio track off or leave it on.
- Press the down arrow on the ATI to continue through the instructions.
- Voters who left the display screen on were also given the option to customize their visual interface by setting the zoom and/or contrast.
- Press the down arrow on the ATI to begin the voting session.
- Continue using the ATI to navigate through contests and names within a contest.
- Use the ATI to mark their selections in the pattern prescribed on the instructions.
- Press the X shaped select button on the ATI to cast the ballot.

In both scenarios, participants were instructed to perform these tasks without assistance. The voting session was considered successful if the participant was able to independently cast their ballot using the an ICE interface.

Data was collected for these tasks, including successful completions, time to complete voting, number of errors, and number and type of assists provided.

3.2.2 Test Location

The ICE is intended to be used at precinct level polling locations across the U.S., including schools, libraries, churches and other public facilities large enough to house multiple voting stations. ICE usability testing has taken place at the DVS office in San Leandro, California and also in an office at the Center for Independent Living in Berkeley, California. Usability tests are always held in wheelchair accessible locations.

In order to simulate the polling place environment, testing locations are set up with a registration desk, two voting booths, and one ICE unit that sits above a free standing ballot box. The simulated polling place is arranged in a way that maximizes privacy and accessibility.

Please see Appendix H for a diagram of the room layout.

Standard usability testing procedures for obtaining consent forms and informing participants that their actions will be recorded is an imperative part of the test plan. These activities took place at the registration desk. Voters who could not complete surveys on their own received help from their personal assistants or from the testing administrators.

3.2.3 Voting Environment

During an actual election, voters are expected to use the voting system provided at the polling location. Voters 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 use the ICE just as if this system was implemented at their local polling location.

3.2.3.1 Display Devices

The ICE has an integrated 18.5 inch full color touch screen display. The touch screen interface is used for poll worker menu navigation and voter ballot review. During an accessible voting session, the display screen acts as a visual interface that displays instructions and a digital image of the ballot. Voters can customize the zoom and contrast of their ballot display, or simply turn it off using an accessible input device (such as the ATI).

All text is displayed in sans serif font at a default size of 3.00mm or higher.

8.5" x 14" paper ballots were provided for hand marking. DVS provided optional Fresnel sheet magnifiers to assist those with perceptual disabilities. A copy of this ballot is included in Appendix D.

3.2.3.2 Audio Devices

The ATI provides its audio signal through an industry standard connector for private listening using a 3.5mm stereo headphone jack to allow voters to use their own audio assistive devices. Voters are given headphones with new sanitary coverings that are disposed of after each use.

The initial (default) volume for each voter is set between 40 - 50 dB SPL for each device as per VVSG requirements. This volume level was typically inaudible for most voters and needed to be increased.

Voters can hear all the voting instructions, navigational prompts, and all ballot content through audio headphones.

Voters use an input device, such as the ATI, to control the audio. Voters can adjust the volume and speed of the synthesized audio track. Voters can also pause or replay instructions.

3.2.3.3 Input Devices

During an accessible voting session, voters do not use the ICE touch screen interface. Though the ballot and accessible voting instructions can be shown on the ICE display screen, voters use one of three accessible input devices to navigate their ballot and make their selections:

- The Audio Tactile Interface (ATI)
- Paddle button Interface

-
- Gooseneck Sip and Puff device

The audio and visual instructions reflect the device selected.

All the participants who tested the ballot marking interface chose to use the ATI.

3.2.4 Test Administrator Tools

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

- Pen and paper
- Stopwatch
- Demographic Questionnaire (See Appendix F)
- Informed Consent Form (See Appendix B)
- Instructions for Participants (See Appendix C)
- Post-test Questionnaire (See Appendix G)

Participants' votes were recorded by the ICE system, as it would be in a real election. Test facilitators used a stopwatch to time voter sessions. Pen and paper was also used to record assists and verbal comments, as well as other relevant data during the voting sessions.

3.3 Experimental Design

During the usability test, participants interacted with only one voting system, the ICE. Each participant voted the same demonstration ballot in at least one testing scenario.

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

- Number of ballots successfully cast/completed
- Percent of tasks completed without any errors
- Count of assists provided
- Time to complete the voting session
- Voters' confidence that they had used the system correctly
- Voters' satisfaction with the system

Additional information about the various measures and associated metrics can be found in Section 3.4 Usability Metrics.

3.3.1 Procedure

The usability test administrators introduced themselves to participants upon arrival. Participants were informed that the usability of the ICE voting system was being tested. The goal was to make private and independent voting accessible to everyone, including voters such as themselves, and that usability feedback was much appreciated. Participants were reminded that this was a test of their abilities and that their identities would remain confidential.

Participants were then asked to complete a demographic questionnaire (Appendix F). The ICE usability testing program targets specific voter groups for each testing session. However, no eligible participant is turned away.

Following the questionnaire, participants were asked to review and sign the Informed Consent Agreement (Appendix B), which described their rights during the study. Participants were then given the following instructions:

We can only work with one person at a time. Today's demo is in English only. Please follow all ballot instructions and attempt to vote unassisted. It is important to completely fill in the oval when marking your paper ballot. This is a test of the tabulator and not of you or your ability to follow instructions. You will be observed and timed. If necessary, you may request help at any time by raising your hand or by asking for assistance.

During the usability test, test administrators observed users' interactions with the ICE interfaces and timed each test session with a stop watch. Once the user finished the test, he/she was asked to complete a Post-Test Satisfaction Questionnaire (Appendix G). At the conclusion of the test, participants were thanked for their time and given a \$10 gift card for StarbucksTM or PeetsTM. Participants were welcome to stay and try out other features of the ICE when all the testing was complete.

Three DVS staff members shared the responsibilities for administering the usability test, collecting the demographic survey, and logging the data. One administrator was responsible for interviewing each participant after they completed their voting session. Every individual was thanked for their participation and feedback.

3.3.2 Participant General Instructions

During the usability sessions, the participants were instructed that they should try to complete the tasks without assistance. However, they could still ask for assistance if they felt it was necessary.

3.3.3 Participant Task Instructions

Participants were also provided with verbal and written instructions on how to vote in the mock election. These voter instructions were provided to users on a piece of paper (Appendix C). Participants testing out the accessible voting interface were also given a quick audio guide for how the ICE ballot marking feature works.

3.4 Usability Metrics

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

3.4.1 Effectiveness

To measure the effectiveness of the ICE, the testing team measured voters' completion rate, errors encountered and assists provided.

3.4.1.1 Completion Rate

Measure: Ballots successfully completed and cast.

Description: *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. Failure to cast a ballot might involve problems such as a voter simply "giving up" during the voting session because of an inability to operate the system, or a mistaken belief that the casting has been successful.*

3.4.1.2 Errors

To measure voters' error rate, the testing team calculated the percentage of voters who were able to accurately mark and cast their ballot as per instructions.

Measure: Ballots completed and cast without any errors.

Description: *Percentage of ballots that were completed without any errors. An error might involve a voter selecting a different candidate than instructed.*

3.4.1.3 Assists

To measure voters' abilities to successfully use the ICE without assistance, the testing team recorded the count and type of assistance provided.

Measure: Count of assists provided.

Description: *Count of the number of times assistance was given to participants. Each assist was also categorized into one of three categories:*

- Technical assistance to help voters recover from a system error or bug.
- Instructional assistance to provide clarification on the test or task instructions.
- Task assistance to help voters a complete a task. Tasks that were completed with the assistance of the test facilitator were recorded as a failure.

3.4.2 Efficiency

To measure the efficiency of the ICE, the testing team measured voters' average time to complete the voting session in each testing scenario.

3.4.2.1 Time on Task

To measure voters' efficiency with the ICE, the testing team analyzed the time it took participants to complete their testing session.

Measure: Average voting session time.

Description: *Mean time taken per test participant to complete the process of activating, filing out and casting the ballot, or for ICE accessible ballot marking, the mean time taken per test participant to go through the accessible voting instructions, start their voting session, mark their ballot, and cast their ballot.*

3.4.3 Satisfaction

To measure voters' satisfaction with the ICETM, the testing team measured voters' confidence levels and usability perceptions through a post test satisfaction questionnaire.

3.4.3.1 Confidence Rating

Measure: Average voter confidence level.

Description: *mean confidence level expressed by voters when asked if they felt confident using the voting machine. Rating is calculated using numbers assigned on the Likert Scale.*

3.4.3.2 Satisfaction Rating

Measure: Average voter satisfaction.

Description: *Mean satisfaction level expressed by voters in response to a 5 voter satisfaction ratings in the post-test satisfaction questionnaire.*

The satisfaction score was calculated based on the System Usability Scale (SUS). Voters expressed their reactions to questions about their ICE voting experience on a Likert Scale.

The scale positions are as follows:

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

Responses to the following statements were included in the satisfaction rating.

3B (Negative): I think that I would need support to be able to use this voting machine.

3C (Positive): I think that most people would be able to use this voting machine without problems.

3D (Negative): I found that voting on this machine was unnecessarily difficult.

3E (Positive): I thought this voting machine was easy to use.

3F (Negative): I felt voting on this machine was very awkward.

Each item was given a score contribution that ranged from 0-4. For 'positive' questions, the score contribution is the scale position minus 1. For 'negative' questions, the score contribution is 5 minus the scale position.

Satisfaction ratings were calculated for each scenario.

The mean score contribution for each item was calculated and the sum of the score contributions was multiplied by 5 to obtain the overall satisfaction score (a range from 0 to 100).

Chapter 4

Results

4.1 Data Analysis

Demographic and satisfaction data was captured by paper and pencil. Voters who could not independently complete the paper questionnaires received help from their personal assistant or from a test administrator. Votes were automatically recorded by the voting system and the paper ballot was kept as a reference for data loggers. Time data was captured with a stopwatch and then entered into a spreadsheet. Open-ended comments were noted by hand by the test facilitators during and after the voting session. If assists were provided to voters by test administrators, the type of assist and details were recorded by the test administrator. To analyze the data, each voting session was scored for completion, ballot marking accuracy, number and type of assists required during the voting session, and time to complete all the tasks. Each contest that was not voted as instructed was counted as an error (this can include voting for a different candidate, skipping the contest, or over voting the contest).

In addition, the test administrators analyzed voter's satisfaction and confidence using the post-test satisfaction questionnaire.

All data was scored manually by all the test administrators.

4.2 Presentation of Results

This section details the performance results for effectiveness (completion rate, errors, assists), efficiency (time to vote) and satisfaction (satisfaction and confidence rating). Specifically, this section includes:

- Number of ballots successfully submitted/completed
- Number of ballots completed without any errors
- Count of assists provided
- Time to complete the voting session for each scenario
- Voters' confidence that they had used the system correctly
- Voters' satisfaction with the system

4.2.1 Performance Results

100% of the ballots were cast successfully. Of the 14 participants, 12 were able to accurately select all the candidates as instructed. No participant made more than 2 (out of a possible 5) ballot marking errors on a given ballot. A total of 3 assists were provided during the usability testing. All of the assists were instructional.

The average manual voting session time was 170 seconds (or 2 minutes and 50 seconds) The average accessible voting session time was 491 seconds (or 8 minutes and 11 seconds)

More detailed results can be found in Appendix E.

4.2.2 Satisfaction Results

Following the completion of the usability tasks, participants completed a Post Test Satisfaction questionnaire. 5 questions in this questionnaire were related to ease of use of the ICE. Based on voters' responses to these questions, a satisfaction rating, ranging from 0-100, was calculated. The average satisfaction rating for manual voting was 92 and the average satisfaction rating for the accessible voting interface was 73.

In addition, voters gave the system an overall confidence rating of 4.56 out of 5.

More detailed results can be found in Appendix E.

Chapter 5

Conclusion

Dominion strives to continuously enhance the usability and accessibility of the ImageCast™ Evolution . All the usability testing conducted so far has been fundamental in making modifications that have improved the user interfaces. The changes between versions, as outlined in the introduction of this usability report are examples of improvements that have been incorporated in the ICE firmware version being submitted to the VSTL.

5.1 Ongoing Usability Testing

As part of the ongoing ICE usability testing program, Dominion Voting Systems plans to conduct more usability studies on its continuously improving ICE firmware. Future usability tests will continue to evaluate the usability of the ICE accessible voting interfaces for:

- Voters with mobility limitations
- Voters with partial vision
- Voters who are completely blind
- Voters with cognitive impairments
- Voters with dexterity disabilities
- Voters who need alternative languages

In addition, usability tests will continue to evaluate the efficiency of standard ballot review and ballot casting using the ICE touch screen interface. User groups from various age groups and from the general population will be recruited.

Lastly, Dominion Voting Systems will be working with poll workers to evaluate the usability of the ICE administrator interfaces.

Appendices

Appendix A

Participant Demographics

Voter	Sex	Age	Years of Voting Experience	Types of Voting Machines Used Before	Physical Limitations (if any)
1	F	77	Over 20	Punch Card, Touch Screen DRE, Optical Scan	Mobility
2	M	78	Over 20	Punch Card, Touch Screen DRE, Optical Scan	Low Vision
3	M	67	Over 20	Mechanical lever, Punch Card, Touch Screen DRE, Optical Scan	
4	F	43	10 - 20	Touch Screen DRE, Optical Scan	Mobility
5	M	60	Over 20	Punch Card, Optical Scan	
6	F	61	Over 20	Punch Card	
7	M	48	10 - 20	Touch Screen DRE, Optical Scan	
8	F	32	5 - 10	Optical Scan	Auditory, Mobility
9	M	N/A	Over 20	Punch Card, Touch Screen DRE, Optical Scan	Mobility
10	M	48	10 - 20	Punch Card, Optical Scan	Low Vision
11	M	60	Over 20	Mechanical lever, Punch Card, Optical Scan	Low Vision
12	F	34	None	None	Completely Blind
13	F	56	Under 2	None	Mobility
14	F	41	5 - 10	Optical Scan	Auditory

Table A.1: Summary of All Participant Demographics

Appendix B

Informed Consent Agreement

Dominion Voting Systems regularly conducts community outreach demonstrations to determine how easy it is for voters to use its voting systems. By testing with a broad spectrum of voters, overall system usability can be measured and voter satisfaction gauged. Your participation in this testing is appreciated!

You will receive written instructions on how you, as a voter will "want to vote". In addition to collecting your votes, there may be a camera focused on the system and your hands, but your face will not be photographed. After you cast your ballot, you will be asked for your opinion about the voting system and your voting experience. You will also be asked for demographic data to include age, gender, education level, and other experiences related to voting. This process should take you no more than 30 minutes.

CONFIDENTIALITY: All the data collected will be anonymous. The data will be used by Dominion Voting Systems to evaluate the usability of the ImageCast tabulators. The data will not be associated with any particular individual. All of the time and error data, demographic data, and voter experience and satisfaction data will be anonymous. All of the data will only be identified and linked together by a number, and will not be linked back to an individual in any way.

You are free to withdraw from the study at any time during the experiment. In total, we expect to have approximately 20 subjects complete this demonstration.

There are no risks involved in participating in this study, nor are there any immediate benefits. The long term benefits of this study should be improved voting systems.

CONTACT INFORMATION: For questions regarding this study, please contact:

Larry Korb (510) 373-0818 x9405 <mailto:larry.korb@dominionvoting.com>

"I have read the above description of this demonstration. I have also spoken to the test facilitator who answered any questions I had about this project. I acknowledge that I have received a personal copy of this form. I agree to participate in this demonstration and I understand that I may withdraw at any time."

Signature: _____ . Date: _____ .

Appendix C

Instructions for Participants


VOTER INSTRUCTIONS

Please vote the ballot as shown:

FAMOUS NAMES

Demonstration Ballot

To **VOTE**: Completely fill in the oval , next to your choice like this Mark with a blue or black ink pen, or with a pencil.



FEDERAL OFFICES	STATE OFFICES	PROPOSITIONS
UNITED STATES SENATOR <small>(Vote for ONE)</small>	STATE SENATOR 37th DISTRICT <small>(Vote for ONE)</small>	PROPOSITION 1 Shall the President of the United States be elected for no more than three terms?
EVERETT DIRKSEN <input type="radio"/> <small>VIRGINIA PARTY</small>	FLORENCE NIGHTINGALE <input type="radio"/> <small>VIRGINIA PARTY</small>	YES <input checked="" type="radio"/>
CHARLES CURTIS <input type="radio"/> <small>OHIO PARTY</small>	ANDREW CARNEGIE <input type="radio"/> <small>OHIO PARTY</small>	NO <input type="radio"/>
JOHN HANCOCK <input checked="" type="radio"/> <small>CALIFORNIA PARTY</small>	FRANCIS SCOTT KEY <input checked="" type="radio"/> <small>CALIFORNIA PARTY</small>	
Write-in <input type="radio"/>	Write-in <input type="radio"/>	
UNITED STATES REPRESENTATIVE <small>(Vote for ONE)</small>	NONPARTISAN OFFICES	
	BOARD OF EDUCATION <small>(Vote for ONE)</small>	
WILLIAM B. WILSON <input type="radio"/> <small>VIRGINIA PARTY</small>	BOOKER T. WASHINGTON <input type="radio"/>	
ROBERT LA FOLLETTE <input type="radio"/> <small>OHIO PARTY</small>	ALBERT EINSTEIN <input checked="" type="radio"/>	
W.C. REDFIELD <input checked="" type="radio"/> <small>CALIFORNIA PARTY</small>	THOMAS ALVA EDISON <input type="radio"/>	
Write-in <input type="radio"/>	HELEN KELLER <input type="radio"/>	
	Write-in <input type="radio"/>	

- Follow the voter instructions printed on the ballot or displayed on the voting machine.
- Please try to vote the exact pattern shown in red on the ballot to the left:

John Hancock
 W.C Redfield
 Francis Scott Key
 Albert Einstein
 "Yes" on Prop. 1
- Try to vote un-assisted if you can, and cast the ballot as shown.
- If you are lost or stuck, you can ask for assistance.
- Remember that this is a test of the voting system, NOT of you the voter.

THANKS!

Appendix D

Demonstration Ballot for Voters

The following ballot was created by Dominion Voting Systems, using Democracy Suite. To include a replica of the ballot, factoring in the size (8.5" x 14"), an image of the ballot has been split into two on the following two pages.

FAMOUS NAMES Demonstration Ballot



To VOTE: Completely fill in the oval , next to your choice like this .
Mark with a blue or black ink pen, or with a pencil.

FEDERAL OFFICES	STATE OFFICES	PROPOSITIONS
UNITED STATES SENATOR (Vote for ONE)	STATE SENATOR 37th DISTRICT (Vote for ONE)	PROPOSITION 1
EVERETT <input type="radio"/> DIRKSEN <input type="radio"/> VIRGINIA PARTY	FLORENCE <input type="radio"/> NIGHTINGALE <input type="radio"/> VIRGINIA PARTY	Shall the President of the United States be elected for no more than three terms?
CHARLES <input type="radio"/> CURTIS <input type="radio"/> OHIO PARTY	ANDREW <input type="radio"/> CARNEGIE <input type="radio"/> OHIO PARTY	YES <input type="radio"/>
JOHN <input type="radio"/> HANCOCK <input type="radio"/> CALIFORNIA PARTY	FRANCIS SCOTT <input type="radio"/> KEY <input type="radio"/> CALIFORNIA PARTY	NO <input type="radio"/>
Write-in <input type="radio"/>	Write-in <input type="radio"/>	

NONPARTISAN OFFICES	
UNITED STATES REPRESENTATIVE (Vote for ONE)	BOARD OF EDUCATION (Vote for ONE)
WILLIAM B. WILSON VIRGINIA PARTY <input type="radio"/>	BOOKER T. WASHINGTON <input type="radio"/>
ROBERT LA FOLLETTE OHIO PARTY <input type="radio"/>	ALBERT EINSTEIN <input type="radio"/>
W.C. REDFIELD CALIFORNIA PARTY <input type="radio"/>	THOMAS ALVA EDISON <input type="radio"/>
Write-in <input type="radio"/>	HELEN KELLER <input type="radio"/>
	Write-in <input type="radio"/>



Appendix E

Results

The following two pages shows the results from testing in tabular format. Some results headings have been shortened. The responses 3A, 3B, 3C, 3D, 3E, and 3F refer to question 3 on the Post Test Questionnaire.

The actual questions are as follows: 3A: I felt confident using this voting machine.

3B: I think that I would need support to be able to use this voting machine.

3C: I think that most people would be able to use this voting machine without problems.

3D: I found that voting on this machine was unnecessarily difficult.

3E: I thought this voting machine was easy to use.

3F: I felt voting on this machine was very awkward.

A rating of 1 to 5 was given as it corresponds to the Likert Scale.

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

Participant Number	Successful Completion	Completion Time (Seconds)	Assists Requested	3A - Voter Confidence	3B - Would Need Support	3C - Most people can learn to use it	3D - Unnecessarily Difficult	3E - Easy to use	3F - Awkward to use	Notes Recorded During the Participant's Voting Session	
1	Yes	133	5/5	0	5	4	5	1	5	1	Comment: "This is easy"
2	Yes	354	5/5	0	5	1	3	2	5	1	Voter returned his ballot after initial review and proceeded to re-insert it in each of the 4 ballot orientations.
3	Yes	72	5/5	0	5	1	4	1	5	1	Comment: "I like the touch screen"
4	Yes	198	4/5	1	5	2	4	1	4	1	Instructional Assist: The voter stopped after the ballot review and asked if she should return her ballot to complete voting the final office. She was instructed to follow her instructions if possible. She completed her ballot without further assistance.
5	Yes	79	5/5	0	5	2	5	1	5	1	
6	Yes	86	5/5	0	5	1	4	1	5	1	
7	Yes	65	5/5	0	5	2	4	2	5	2	
8	Yes	372	5/5	0	4	1	4	1	4.5	2	Voter had difficulty holding and marking the ballot, but was able to successfully feed it into the tabulator. She was very proud that she was able to vote un-assisted.
9	Yes	302	5/5	0	5	1	4	1	4.5	1	Comment: "I'm glad my marks did not have to be perfect." Voter found it easier to vote ballot on lap than to use a voting booth.
10	Yes	214	5/5	0	5	1	5	1	5	1	Voter needed to hold ballot to face (<5 cm) to see.
11	Yes	152	5/5	0	4	1	5	1	5	1	
13	Yes	100	5/5	0	4	1	5	1	5	1	
14	Yes	81	5/5	0	5	1	5	1	5	2	Comment: "Was there an audio confirmation of ballot acceptance?" Informed voter that there was an audio tone at ballot acceptance. Voter asked that we include a visual confirmation message.
Average	100%	170	4.9/5	0	4.77	1.46	4.38	1.15	4.85	1.23	
Usability Score Contribution:											
						3.54	3.38	3.85	3.85	3.77	Total: 18.38 - Multiply by 5 for Usability Score = 91.9/100

Note: Participant number 12 had no sight and did not attempt to vote.

Figure E.1: Results from scenario 1 (Using the ICE to review and cast a manually marked ballot)

Participant Number	Successful Completion	Completion Time (Seconds)	Contests cast per instructions	3A - Voter Confidence	3B - Would Need Support	3C - Most people can learn to use it	3D - Unnecessarily Difficult	3E - Easy to use	3F - Awkward to use	Notes Recorded During the Participant's Voting Session	
											Assists Requested
1	Yes	380	5/5	0	5	2	5	1	5	1	Comment: "No notice that system is printing."
2	Yes	440	5/5	0	4	1	2	4	2	4	Voter did not like the fit of the headphones
3	Yes	311	5/5	0	5	2	4	3	4	2	Comment: "The two different voices are confusing."
4	Yes	670	3/5	1	4	3	3	3	3	3	Instructional Assist: Voter got lost moving from contest to contest. Voter was instructed to press the left arrow button to move to the next contest.
5	Yes	428	5/5	0	5	1	4	1	4	1	Comment: "The instructions after selecting a candidate, to move to the next office are not clear."
6	Yes	424	4/5	1	4	2	4	2	4	2	Request for assistance: "Help I'm Stuck" Instructional Assist: Voter was instructed to press the left arrow button to move to the next contest.
7	Yes	577	5/5	0	4	2	4	3	4	2	Comment: "It's kind of slow and the instructions could be better."
9	Yes	434	5/5	0	5	1	4	2	5	2	
10	Yes	644	5/5	0	4	2	5	2	3.5	2	Comment: "The multiple voices were hard to understand."
11	Yes	416	5/5	0	5	1	3	1	5	2	
12	Yes	676	5/5	0	3	3	4	3	4	2	Voter did not like the buttons and braille labels on the ATI.
Average	100%	491	4.9/5	0.16	4.36	1.82	3.82	2.27	3.95	2.09	
Usability Score Contribution:						3.18	2.82	2.73	2.95	2.91	Total: 14.59 - Multiply by 5 for Usability Score = 73/100

Note: Some participants were not available for the accessible voting test usability test date.

Figure E.2: Results from scenario 2 (Accessible ballot marking with the ICE accessible voter interfaces)

Appendix F

Demographic Questionnaire



DEMOGRAPHIC QUESTIONNAIRE

Any information you share will be kept strictly confidential and your name will not be associated with the data we collect. **Your privacy will be protected.**

Please tell us a little about yourself:

First name (only) _____

Are you:

- Male
- Female
- Decline to state

What is your age? _____

Are you eligible to vote in the USA?

- Yes
- No
- Don't Know

How many years of voting experience do you have?

- None
- Less than 2 years
- 2-5 years
- 5-10 years
- 10-20 years
- More than 20 years

Different areas in the US have used various types of voting systems over the years. Which, if any, of the following types of machines have you used?

- I have never used any voting system.
- Mechanical lever machine – where the voter sets switches and pulls a big lever on a mechanical voting machine.
- Punch card – where the voter uses a device that punches holes in a ballot card.
- Touch screen / DRE – an electronic voting system where the voter touches a screen to record their vote.
- Optical scan – a paper ballot system where the voter fills in a circle or oval to indicate a vote and which is counted by a machine.
- Other, please describe _____

Have you ever worked as a poll worker?

- Yes
- No

Do you have any physical limitations?

- Visual impairment – low vision, partial or complete blindness, other visual impairment?
- Auditory impairment – hearing loss, deafness or other hearing impairment?
- Mobility impairment – any condition that limits your physical activities?
- Speech impairment – difficulty speaking or communicating?
- Cognitive impairment – problems with learning, remembering, comprehending or other impairment?
- Decline to state

Thank You!

Appendix G

Post-Test Satisfaction Questionnaire

Upon completing their voting session, each participant was asked to fill out a Post-Test Satisfaction Questionnaire. Participants who could not complete the questionnaire independently received assistance filling it out from their personal assistant or from the usability administrator.

QUESTIONNAIRE

DOMINION
VOTING



Please complete the following questionnaire

1. To the best of my ability, I followed the instructions telling me how to vote.

- Yes
- No

2. I am confident I was able to vote this ballot exactly as instructed.

- Agree
- Disagree
- Don't Know

3. Place an "X" in the choice that describes your reaction to each statement.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	1	2	3	4	5
I felt confident using this voting machine.					
I think that I would need support to be able to use this voting machine.					
I think that most people would be able to use this voting machine without problems.					
I found that voting on this machine was unnecessarily difficult.					
I thought this voting machine was easy to use.					
I felt voting on this machine was very awkward.					

Thank You!

Figure G.1: Post Test Satisfaction Questionnaire

Appendix H

Voting Location

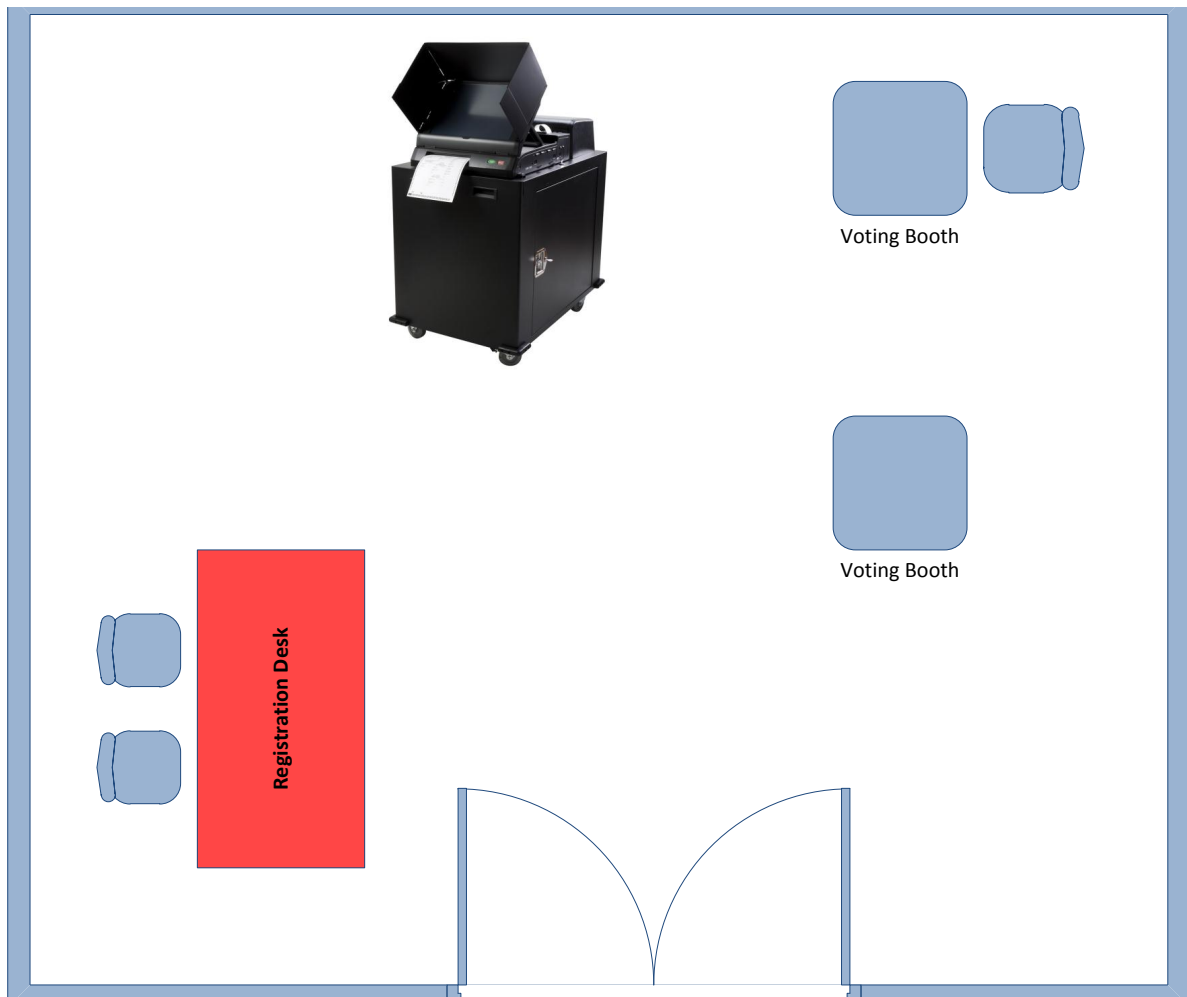


Figure H.1: ICE Usability Testing Location Layout