ISO/IEC 25062 Common Industry Format for Usability Test Report

DS200 Precinct Ballot Scanner
Version1.2.1

Tested by:

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Document Section	Description
Entire Document	CIF Usability Test Results and Methodology

Executive Summary

A summative usability test was conducted to evaluate the effectiveness, efficiency, and satisfaction of registered voters when they filled out a paper ballot and cast that ballot into the DS200 precinct-based, paper ballot tabulator.

The DS200 v1.2.1   paper ballot tabulator designed for polling place use. After a voter marks and inserts a ballot into the DS200, digital sensors simultaneously read both sides of the ballot, accurately record voter selections, and the counter passes the ballot to the integrated ballot box.

Twenty participants representative of the general voting population participated in the study. Each participant performed standard voting tasks using a paper ballot. First, the participant filled out a paper ballot with a pen, and then they cast their ballot using the DS200 precinct based tabulator.

The mean task completion time for all 20 participants was 26.38 seconds for submitting the paper ballot into the DS200 and casting their vote. The user group had a base accuracy score of 99.55% and an unassisted task completion rate of 100%. There were 5 dependent variables; these were unassisted task completion rate, base accuracy score, time to task completion, voter confidence and SUS score.

A questionnaire was also administered to participants after they cast their ballot, which resulted in a mean score of 86.125 based on the standard method of the System Usability Scale (SUS) and a 4.7 confidence score.

The test focused on evaluating the total number of correct votes and the number of ballots cast without any errors. The tasks were designed for the correct recording of the ballot selections while ensuring both independence and privacy.

- Table 1 -Summary Performance Results by User Type

User Type	Number of Participants Completing the Ballot	Base Accuracy Score (%)	Voting Time Mean	Voter Confidence Score Mean	Summative Usability Score Mean
General Population	20 of 20 (100%)	99.55%	26.38 seconds	4.70	86.125

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Introduction

Full Product Description

DS200 Precinct Ballot Scanner Firmware version 2.1.0.0, Hardware version 1.2.1

The DS200 is a paper ballot tabulator designed for the general voting population, intended to be used in a standard polling place. After a voter marks and inserts a ballot into the DS200, the system simultaneously scans both sides of the ballot using a high-resolution image-scanner. The system then decodes ballot images using a proprietary recognition engine.

A 12.1-inch touch screen display provides clear voter feedback and poll worker messaging. Once the system tabulates a ballot and updates internal vote counters, the ballot is transferred to a secure ballot box. An integrated thermal printer generates zero reports, log reports, and polling place totals after the polls officially close.

The DS200 accepts ballots inserted in any orientation – top first, face up; bottom first, face down; etc. Digital sensors simultaneously read both sides of the ballot, and accurately record voter selections, as the Counter passes the ballot to the integrated ballot box. The system either accepts the ballot, updating the internal count, or identifies and alerts the voter to exception conditions such as undervotes, overvotes, write-in votes or ballot mismarks with large, easy to read system messages and an audible alert. The DS200 provides clear instructions for resolving exception conditions, improving voter oversight and accountability and dramatically reducing the number of invalid ballots cast during an election.

Technical Overview – Physical Characteristics

DS200 unit dimensions	5.5" H (stowed) x 14" W x 16" D 19.5 pounds with internal battery
Storage & transport case dimensions	10.5" H x 16.5" W x 22" D 11.5 pounds
Ballot box dimensions (operational)	35"H x 20.75" W x 25.25" D 45 pounds

Test Objectives

The goal of this summative usability test for voting systems is to identify and measure failures, not to diagnose their cause. The focus is on the accuracy, efficiency, and confidence of the voter experience. This test fundamentally adopted the usability goals for a voting system as one that allows voters to cast their vote:

- Correctly – to use the voting system to register their intended selections with minimal errors and easily detect and correct errors when they occur.
- Efficiently – to complete the voting process in a timely manner and without unproductive, unwanted, incomprehensible, or frustrating interactions with the system.
- Confidently – to be confident (1) in what actions they had to perform in order to vote, (2) that their votes were correctly recorded by the system and will be correctly counted, and (3) that their privacy is assured.

Conformance test goals are to detect aspects of the system that do not meet a standard, not to identify the cause of failure. A usability test for conformance to a usability standard is a specialized type of summative test. For voting systems, such a test requires usability performance benchmarks as part of the standard to test against. These benchmarks include a representative set of test ballots and a well-specified test protocol that is explicit about how many and what types of voter populations to test against. Further, the conformance test has to be validated to produce repeatable results.

Therefore this summative test took the first steps towards meeting the proposed benchmarks for Voting System Standards Usability Testing. Because there is not an adopted benchmark to date, this test was administered in line with the intent of the proposed benchmarks. The results and findings of the test will not attempt to mirror those of the proposed benchmark.

Among the basic metrics for voting usability are:

- Low error rate for marking the ballot (the voter selection is correctly conveyed to and represented within the voting system)
- Efficient operation (time required to vote is not excessive)
- Satisfaction (voter experience is safe, comfortable, free of stress, and instills confidence)

Method

Participants

The test was conducted using twenty individuals' representative of the general population of US voters. All participants were required to have the following characteristics to participate:

a) Eligible to vote in the United States;

b) Speaks English fluently;

c) Willing to sign a non   disclosure agreement;

d) Willing to sign a Participant Consent form;

Participants were selected by using a recruiting screener (Participant Screener for Voting System Testing) to ensure the specific demographic characteristics of age, education, race, gender, and voting experience were representative of the general U.S. voting population. There is no reason to believe that there were any significant differences between the participant sample and the general voting population.

Table 2 Participant Profile

Participant #	Years Voting	Age	Education	Race	Gender	Geographic Background
1	Many	35-44	High School Degree	Caucasian	Female	Rural
2	Many	35-44	Some College	African-Am	Female	Urban
3	Few	25-34	College Grad	Hispanic	Male	Urban
4	Many	45-54	College Grad	Caucasian	Male	Urban
5	Few	45-54	Some College	Caucasian	Female	Rural
6	Many	45-54	Some College	African-Am	Male	Urban
7	Many	35-44	High School Degree	Caucasian	Female	Urban
8	Few	35-44	Some College	Caucasian	Female	Urban
9	Few	25-34	Post Graduate Degree	Caucasian	Male	Urban
10	Many	25-34	College Grad	Caucasian	Male	Urban
11	Many	35-44	College Grad	Caucasian	Female	Urban
12	Many	45-54	College Grad	Caucasian	Female	Urban
13	Many	25-34	College Grad	Caucasian	Female	Urban
14	Few	35-44	College Grad	Hispanic	Female	Urban
15	Many	35-44	Some College	African-Am	Male	Rural
16	Few	35-44	Some College	African-Am	Female	Urban
17	Many	45-54	College Grad	Caucasian	Male	Urban
18	Many	25-34	College Grad	Caucasian	Male	Urban
19	Few	25-34	High School Degree	Caucasian	Female	Urban
20	Few	25-34	College Grad	Caucasian	Female	Urban

Context of Product Use in the Test

Tasks

The test was comprised of two primary tasks; filling out a paper ballot and casting the paper ballot in the DS200 tabulator. These are the primary voting tasks that have a direct effect on the test objectives of allowing a voter to cast their vote correctly, efficiently and comfortably.

The test participants were instructed to make specific voting choices on the paper ballot. All instructions about filling out the ballot were given to the participants in writing, with no additional individual assistance offered. (See Appendix B)

Instructions for the participants included directions to represent realistic and commonly occurring ballot selections such as:
- Voting for names that appeared at various positions within a list of names
- Not voting in specific contests on the ballot
- Indicating a write-in vote

The participants were given verbal instructions on casting the ballot.

The key consideration for selecting the tasks was to balance of representative voter use of the product with the need to achieve future voting system benchmarks.

The source of the tasks was collaboration between product management and usability.

Test Facility

Intended context of use:
Precinct based voting can take place at any facility meeting the local jurisdictions requirements. Standard precinct based voting facilities vary widely from homeowner's garages, to public school auditoriums.

Context used for the test:
The usability test was conducted at the ES&S headquarters in 2 standard conference rooms. The voting system was installed in a room that resembled a realistic voting location. Participants filled out their ballots in one room that contained a table and chairs and then proceeded to a second room that contained the DS200 where they cast the paper ballot. The participants' actions of inserting the ballot, reviewing screen messages and casting the ballot were recorded using 3 cameras and Morae Usability testing software.

Participant's Computing Environment

The DS200 Precinct Ballot Scanner uses the hardware version1.2.1 and firmware version 2.1.0.0.

Display Devices:
The DS200 uses a touch screen as the mechanism for participants to both view the messages presented and make selections such as accepting the option to reject or cast a ballot.

The LCD display is an LG Phillips 12.1" SVGA (800x600) TFT color display model LB121S03-TL01 with a LVDS interface to the VIA motherboard. It has a color depth of LVDS 6-bit, 262,144 colors with an anti-glare surface treatment.

The paper ballot was 8.5" x 11"in   size.

Test Administrator Tools

Tasks were timed using Morae Recorder Usability Testing Software. Sessions were videotaped (one camera was used to capture the participants interaction with the screen and two different views of the participant were captured with webcams); although information derived from the recordings are not part of this report. At the end of the sessions, participants completed a 2 part questionnaire. The first part of the questionnaire assessed confidence and the second part assessed usability with the standard System Usability Scale (SUS) using a 5-point Likert scale.

Experimental Design

The experimental design was a between subject study. No control variables (other than voter type) were accounted for either experimentally or statistically. Counterbalancing was not done because the two tasks needed to occur in chronological order.

Several additional control variables were recorded, to ensure participants were representative of the general voting population including voting experience, English proficiency, voting eligibility, gender, age, race, education and geographic background.

There were 5 dependent variables: unassisted task completion rate, base accuracy score, time to task completion, voter confidence and System Usability Scale score.

Procedure

- Upon arrival at the test lab, the participants, were asked to first fill out the consent form and were offered a second form for their records.
- They were given the same greeting; "Thank you for your interest to participate in our study. We appreciate your help. We are researching which things are easy to do and which are difficult to do on the DS200 Precinct Based Vote Tabulator. Please understand that we are not in any way testing your ability. We are evaluating the DS200's Usability."
- They were then given paper ballot (Appendix A), a black pen, and a set of written instructions (Appendix B). They were told that the test facilitator will not be able to assist them once they had started.
- When the participant finished filling out the paper ballot in the first room, they were instructed to take their paper ballot to the next room where they would cast their ballot. The instructions provided verbally in the second room were: "Welcome. Please close the door behind you. I will need to give you a set of instructions before we can get started".
- The voting instructions given by the test facilitator were "Please cast your ballot as if this were a real election and when you think you are finished please say I'm finished.
- Once the participant indicated they were finished, they were verbally instructed to: "Please return to the first room to complete a quick survey of 12 questions to provide us feedback on their voting experience."
- Once the participant was finished with the survey they were thanked and dismissed.

Participant General Instructions

Once the test began, the following statement was read by the test facilitator in response to any question from a participant:
"I'm sorry but I'm not allowed to   help you once you start. If you are having

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difficulties you can try to finish. If you are stuck and cannot continue, you can stop if you wish."

Participant Task Instructions

The test participants were told to make specific voting choices on the paper ballot. All instructions about filling out the ballot were given to the participants in writing, with no additional individual assistance offered. (See Appendix B)

The following statement was read by the test facilitator in response to any question from a participant:

"I'm sorry but I'm not allowed to help you once you start. If you are having difficulties you can try to finish. If you are stuck and cannot continue, you can stop if you wish."

Various tasks were included in the instructions for the participants to represent realistic voting events. These included:

• Voting for names that appeared at various positions within a list of names

• Not voting in specific contests on the ballot

• Indicating a write-in vote

By instructing the participants how to vote, the difference between the "intended" votes of the test participants and the actual votes that they cast can be determined. Accuracy of the cast ballot is calculated by counting the number of correct votes, 11 being a perfect score. Note that both the test ballot and the tasks were constructed to be complex enough to expose the different types of errors that would occur if a voting system design had poor usability.

Once the participant finished filling out the paper ballot in the first room, they were instructed to take their paper ballot to the next room where they would cast their ballot. The instructions provided verbally in the second room were:

"Please cast your ballot as if this were a real election and when you think you are finished please say I'm finished.

Once the participant indicated they were finished, they were verbally instructed to:

 "Please return to the other room to complete a quick survey of your voting experience."

Usability Metrics

Effectiveness

Completion Rate: Unassisted task completion rate was defined as the percentage of participants who completed each task correctly without assistance from the test administrator.

Base Accuracy Score: is the mean of the percentage of all ballot choices that are correctly cast by each of the test participants.

Efficiency

Task time: is the amount of time to complete the task.

Satisfaction

Voter Confidence Score: the mean confidence level expressed by the voters that they believed they voted correctly and the system successfully recorded their votes. This was based on a confidence question developed specifically for this type of test.

System Usability Scale: is a simple, ten-item scale giving a global view of subjective assessments of usability.

Results

Data Analysis

Data Scoring: Participant behavior was categorized into groups of successes, accuracy, and satisfaction. Behaviors were marked as errors when a participant made an action that could not lead to them successfully casting their ballot.

Data Reduction: Data for each task was analyzed separately and summarized together. Data were also separated into 2 groups based on user type.

Statistical Analyses: Descriptive statistics used included: means, minimum values, and maximum values. There were no inferential statistical analyses performed.

Presentation of the Results

Performance Results

The mean task completion time for all 20 participants was 26.38 seconds for submitting the paper ballot into the DS200 and casting their vote. The user group had a base accuracy score of 99.55% and an unassisted task completion rate of 100%. There were 5 dependent variables; these were unassisted task completion rate, base accuracy score, time to task completion, voter confidence and SUS score.

Participant #	Unassisted Task Completion Rate	Base Accuracy Score	Casting Ballot Task Time
1	100%	11	24.8
2	100%	11	44.29
3	100%	11	40.4
4	100%	11	24.02
5	100%	11	18.69
6	100%	11	23.59
7	100%	11	20.3
8	100%	11	32.2
9	100%	11	27.38
10	100%	11	29.82
11	100%	11	23.51
12	100%	11	22.9
13	100%	11	22.42
14	100%	11	17.9
15	100%	11	18.5
16	100%	11	25.41
17	100%	10	23.8
18	100%	11	36.78
19	100%	11	31.41
20	100%	11	19.5

Satisfaction Results

A questionnaire was administered to participants after they cast their ballot, which resulted in a mean score of 86.125 (out of a 100) based on the standard method of the System Usability Scale (SUS) and a 4.7 (out of 5) confidence score.

Participant #	Voter Confidence	SUS
1	5	90
2	5	97.5
3	5	95
4	3	55
5	4	67.5
6	5	85
7	5	87.5
8	4	80
9	4	77.5
10	5	77.5
11	5	90
12	5	87.5
13	5	97.5
14	5	97.5
15	5	85
16	5	90
17	5	97.5
18	5	97.5

19	3	80
20	5	87.5

Appendices

Appendix A – Test Paper Ballot

This provides a reduced size image of how the ballot was laid out.

Appendix B -- Instructions for Participants

These are the instructions that were given to each participant on how to mark their ballot.

Appendix C -- Facilitator Notes

These are the instructions that were given to each facilitator to ensure consistent interaction with the participant.

Appendix D -- Voting System Usability Scale – Voting SUS

This document contains a list of questions and the 5 point Likert scale for the SUS assessment and the two questions used to establish confidence.

Appendix A
Test Paper Ballot

GEN02 CERTIFICATION TEST CASE
ELECTION DISTRICT 1

GOVERNOR AND LIEUTENANT GOVERNOR
(VOTE FOR ONE)

GOVERNOR
THOMAS DEVINE ○
LT. GOVERNOR
SHARON BECK ORANGE

GOVERNOR
NANCY BROWN ○
LT. GOVERNOR
EDWARD ROCK YELLOW

GOVERNOR
WILLIAM GILBERT ○
LT. GOVERNOR
JOE SULLIVAN COMPOSER

GOVERNOR
JEFF J. MARSHALL ○
LT. GOVERNOR
M.K. WATSON SCIENTIST

SECRETARY OF STATE
(VOTE FOR ONE)

TONI MORRISON ○
YELLOW

FRANK SAMSON ○
COMPOSER

GEORGE TARKETT ○
SCIENTIST

ATTORNEY GENERAL
(VOTE FOR ONE)

D. GRANITE ○
YELLOW

Write-In ○

COUNTY COMMISSIONER
(VOTE FOR TWO)

DAISY GANNON ○
NONPARTISAN

NICK CARRAWAY ○
NONPARTISAN

SCOTT FITZGERALD ○
NONPARTISAN

JAY GATSBY ○
NONPARTISAN

COUNTY TREASURER
(VOTE FOR ONE)

ROSS PEROT ○
COMPOSER

DONALD TRUMP ○
SCIENTIST

Write-In ○

SHERIFF
(VOTE FOR ONE)

ERIC CLAPTON ○
NONPARTISAN

BOB MARLEY ○
NONPARTISAN

Write-In ○

CITY COUNCIL
(VOTE FOR THREE)

JANE DOE ○
ORANGE

ANDREW WISE ○
ORANGE

ERICK COPELAND ○
COMPOSER

ANDREW WISE ○
COMPOSER

THOMAS EDISON ○
SCIENTIST

JOHN FOXWORTH ○
SCIENTIST

ROBERT SHAW ○
SCIENTIST

Write-In ○

Write-In ○

Write-In ○

SUPERINTENDENT
(VOTE FOR ONE)

B. BAKER ○
YELLOW

Write-In ○

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Appendix B

Instructions for Participants

In our mock election, we will be using fake names for candidates and for political parties.

Parties will be represented by either colors or occupations.

For example, you might see or hear this:

Joe Jones / Yellow Party

-or-

Mary Smith / Scientist

Any similarity between names of candidates and real people is purely coincidental.

Please attempt to vote exactly as described on the back of this page

Once you start, we will not be able to help you.

Please do the best you can. If you are stuck and cannot continue, inform the facilitator.

Thank you.

For Governor and Lieutenant Governor, vote for

William Gilbert & Joe Sullivan

For Secretary of State, vote for
Frank Samson

For Attorney General,
Do not vote

For County Commissioner, vote for the following candidates:
Daisy Gannon
Scott Fitzgerald

For County Treasurer, vote for
Ross Perot

For Sheriff,
Do not vote

For City Council, vote for the following candidates:
Jane Doe
Erick Copeland
Robert Shaw

For Superintendent, write in a vote for
Bob Adams

Cast your ballot

Appendix C

Facilitation Notes

Facilitator and Participant interaction

To minimize interference in the measurement of usability, once the participant has begun the test, the facilitator's interaction with them is limited to the following statement:

 "I'm sorry but I'm not allowed to help you once you start. If you are having difficulties you can try to finish. If you are stuck and cannot continue, you can stop if you wish."

The only facilitator interaction allowed will be to provide the blind participants the instructions on which contest selections are to be marked. They must be read exactly as the written instructions. They can be read to the participant as many times as requested.

Appendix D

Voting System Usability Scale

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

☐ Yes   ☐ No

2. I was able to cast all of the votes in today's test exactly as instructed

Strongly disagree   Strongly agree

1   2   3   4   5

3. I think that I would like to vote on this system in a real election

Error! Objects cannot be created from editing field

1	2	3	4	5

4. I found the voting system unnecessarily complex

1	2	3	4	5

5. I thought the voting system was easy to use

1	2	3	4	5

6. I think that I would need the support of a poll worker to be able to use this system

1	2	3	4	5

7. I found the various functions in this voting system were well integrated

1	2	3	4	5

8. I thought there was too much Inconsistency in this voting system

1	2	3	4	5

9. I would imagine that most people would learn to use this voting system very quickly

10. I found the system very cumbersome to use

1	2	3	4	5

11. I felt very confident using the system

1	2	3	4	5

12. I needed to learn a lot of things before I could get going with this system

1	2	3	4	5

codes.

1	2	3	4	5

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Instructions to the participant:

I am going to ask you to rate some things on a 1 to 5 scale. You can choose one, or five, or any number in between. If you feel that you cannot respond to a question please choose the center point of the scale.

Please record your immediate response to each item, rather than thinking about items for a long time.