Transportation Worker Identification Credential Reader Pilot Program

In accordance with Section 104 of the Security and Accountability For Every Port Act of 2006, P.L. 109-347

(SAFE Port Act)

Final Report

February 27, 2012

Homeland Security

Transportation Security Administration

Message from the Secretary

I am submitting the Transportation Worker Identification Credential (TWIC) Reader Pilot Program report pursuant to the Security and Accountability for Every Port Act of 2006 (SAFE Port Act) (P.L. 109-347).

This report is being provided to the following Members of Congress:

The Honorable John D. Rockefeller, IV
Chairman, Senate Committee on Commerce, Science, and Transportation

The Honorable Kay Bailey Hutchison
Ranking Member, Senate Committee on Commerce, Science, and Transportation

The Honorable Joseph I. Lieberman
Chairman, Senate Committee on Homeland Security and Governmental Affairs

The Honorable Susan M. Collins
Ranking Member, Senate Committee on Homeland Security and Governmental Affairs

The Honorable Peter T. King
Chairman, House Committee on Homeland Security

The Honorable Bennie G. Thompson
Ranking Member, House Committee on Homeland Security

The Honorable John L. Mica
Chairman, House Transportation and Infrastructure Committee

The Honorable Nick J. Rahall, II
Ranking Member, House Transportation and Infrastructure Committee

If you have any questions, please do not hesitate to contact the TSA Office of Legislative Affairs at (571) 227-2717.

Yours very truly,
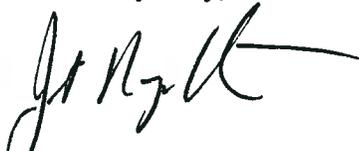
Janet Napolitano

Executive Summary

The Transportation Worker Identification Credential (TWIC) Program provides a tamper-resistant biometric credential to eligible maritime workers requiring unescorted access to secure areas of port facilities and vessels regulated under the Maritime Transportation Security Act of 2002 (MTSA) (P.L. 107-295).

Through the initial rulemaking process, conducted in 2006, the Department of Homeland Security (DHS) concluded that facility and vessel operators should not be required to purchase or install electronic TWIC readers during the initial issuance of TWIC cards. The Security and Accountability For Every Port Act of 2006 (SAFE Port Act) (P.L. 109-347) then directed DHS to conduct a TWIC Reader Pilot Program (Reader Pilot) to inform a second rulemaking that would focus specifically on the use of the TWIC cards with biometric readers.

The TWIC Reader Pilot was conducted through the combined efforts of a number of DHS offices and components. The Transportation Security Administration (TSA) conducted the pilot and was responsible for overall execution of the TWIC Pilot Test and Evaluation Master Plan (TEMP) developed by the DHS Science & Technology (S&T) Directorate. The DHS Screening Coordination Office (SCO) provided policy guidance regarding the use of biometric credentials. The Federal Emergency Management Administration (FEMA) awarded and administered the Port Security Grants that provided funding to ports and individual facility operators to procure and install the readers and reader infrastructure used in the Reader Pilot.

The U.S. Coast Guard (USCG), which is the agency responsible for promulgating the future regulation specifying the use of TWIC readers, participated in all aspects of the Reader Pilot. USCG Headquarters personnel contributed to test scenario development, pilot participant engagement, site visits, and data gathering and analysis efforts of the TWIC Program Office team. As a result of these efforts the USCG was able to receive data and other relevant information from the beginning of the Reader Pilot. The USCG will consider the results of the pilot in preparing a Notice of Proposed Rulemaking and subsequent Final TWIC Reader Rule.

To provide independent verification of test procedures and data gathering, DHS S&T arranged for the U.S. Navy Space and Naval Warfare Systems Center Atlantic in Charleston, SC to serve as the Independent Test Agent (ITA) for the Reader Pilot.

The purpose of this report is to convey the findings of the Reader Pilot that was established under the SAFE Port Act, section 104.

> *"The Secretary shall conduct a pilot program to test the business processes, technology, and operational impacts required to deploy transportation security card readers at secure areas of the marine transportation system. The pilot program shall take place at not fewer than 5 distinct geographic locations, to include vessels and facilities in a variety of environmental settings. The pilot program shall commence not later than 180 days after the date of the enactment of the SAFE Port Act.*
>
> *Not later than 120 days before the promulgation of regulations under paragraph (3), the Secretary shall submit a comprehensive report to the appropriate congressional committees (as defined in section 2(1) of SAFE Port Act) that Includes: (A) the findings*

of the pilot program with respect to technical and operational impacts of implementing a transportation security card reader system; (B) any actions that may be necessary to ensure that all vessels and facilities to which this section applies are able to comply with such regulations; and (C) an analysis of the viability of equipment under the extreme weather conditions of the marine environment."

Background

Pilot Participants:

The TWIC Reader Pilot was conducted at MTSA-regulated ports, individual facilities, and vessel operation sites in the following locations: the New York / New Jersey port complex; Annapolis, MD; Norco, LA; Vicksburg, MS; Brownsville, TX, Los Angeles, CA; and, Long Beach, CA. The pilot required the voluntary participation of facility operators who agreed to acquire, install, and use readers and, in most cases, physical access control systems capable of reading TWIC cards. All costs incurred by the participating ports and facility operators associated with readers and reader infrastructure were fully covered by Port Security Grant funds made available for that purpose. TSA provided guidance to participants throughout the pilot while ports and facility operators were responsible for all associated planning, design, reader selection[1], installation, and operation.

Conducting the Pilot:

Current regulations required MTSA-regulated port and facility operators to visually inspect each worker's TWIC card and make a facial comparison to the photo on the card prior to granting unescorted access to a secure area. The time between a worker arriving at an access point and being granted access following the visual inspection of the TWIC was used to establish a throughput[2] baseline for comparison of throughput times using piloted readers. Once installed, port and facility operators began verifying identities in accordance with test scenarios, which were developed to simulate potential regulation requirements. Throughput data was obtained through direct observation by TSA and independent test agents automatically from readers and access systems. Data on cost, system specifications, and challenges were gathered through participant-provided documents and direct interviews.

Readers used in the pilot were independently developed by commercial vendors to comply with the TWIC Hardware and Card Application Specification. Thirty-five reader models are currently included in TSA's approved reader list. In most cases vendors adapted existing readers or modified reader software to comply with federal standards for Personal Identity Verification (PIV) biometric credentials. TSA oversaw laboratory tests conducted to evaluate reader compliance with the TWIC specification to determine reader performance under conditions simulating current maritime environments.

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[1] Ports and facility operators selected readers based on their assessment of business needs from a list of readers evaluated by TSA and found to be in accordance with the TWIC Hardware and Card Application Specification.
[2] Throughput is defined as the time taken for a vehicle or pedestrian to obtain entry and pass through an access point. All throughput data uses seconds as the unit of measure.

TWIC Readers:

TWIC readers are either fixed, or portable. Fixed readers are stationary and mounted at or near an access point. Fixed readers support the use of physical access control systems which recognize individuals, such as employees, longshoremen, or truckers, previously determined to have a need to access the port or facility. Depending on system design, fixed readers may validate credentials and verify identity independent of the system, or may simply serve to read data from a credential and forward it to the system for these determinations.

Portable readers require operation by security personnel. Portable readers operate independent of an access control system and can be used—at access points, or throughout a facility.

TWIC readers obtain information from a credential's integrated circuit chip (ICC) either through a contactless interface or an optional contact interface. Readers with a contactless interface exchange information with the TWIC by transmitting data via radio frequencies. Readers with a contact interface obtain information from the TWIC through direct contact with the card's ICC. Use of the contact reader requires the card holder to insert their TWIC into a slot to establish contact with the ICC. Contactless readers were favored by ports and maritime facilities due to the ability to make them weather-resistant, whereas contact readers necessarily expose the card-reading components to moisture or debris.

All TWIC readers can operate in two configurations. Readers operating in the first configuration confirm that the card is authentic, was issued by TSA, and has not expired or been revoked by TSA. However, readers operating in the first configuration do not verify that the person presenting the card is the same person to whom the card was issued. Security personnel must visually compare the photo on the card to the individual presenting the card to verify identity before granting access. Readers operating in the second reader configuration conduct biometric verification of identity as well as all of the functions of the first configuration. Thus, readers operating in the second configuration can automate the entry process since the card is validated as authentic and valid, and the identity of the card holder is verified through the biometric match. The biometric match is made by the reader comparing the fingerprint template on the TWIC to a template of the holder's fingerprint obtained by the holder placing his or her finger on the reader's scanner. During the Reader Pilot both configurations were evaluated at each port or facility.

Key Findings

Despite a number of challenges, the TWIC Reader Pilot obtained sufficient data to evaluate reader performance and assess the impact of using readers at ports and maritime facilities. The lessons learned during the Reader Pilot will provide valuable information regarding readers and access control systems to maritime users.

It was determined that TWIC reader systems function properly when they are designed, installed, and operated in a manner consistent with the characteristics and business needs of the facility or vessel operation.

It also found that reader systems can make access decisions efficiently and effectively.

Still, despite the increasing use of biometrics for verifying identity in many commercial and government settings, the Reader Pilot was the first attempt to require biometric identity verification for access control on such a large scale in this environment. A number of operational and technological difficulties were documented that affected overall success at many pilot locations. These will be discussed in greater detail below and included challenges such as complex complexity of biometric credential and reader technology, equipment performance and reliability, operator and user training, card stock durability, and the reluctance of some workers and facilities to use the readers.

Summary of Findings

Business Impact:

Throughput without Biometric Identity Verification– Overall, when TWIC readers are used in a manner consistent with their intended environment, access point throughput times using *contactless* readers to verify that a TWIC is authentic and has not expired are less than the time required by visual inspections by security personnel to determine the same information. In addition, the reader can determine if the TWIC has been cancelled or revoked whereas this cannot be determined by visual inspection alone. However, despite having slower throughput times, *contact* readers proved to have fewer incomplete reader transactions than *contactless* readers as long as they were protected from debris and moisture and not subjected to excessive wear from use in high-volume situations.

Throughput with Biometric Identity Verification—To ensure that the bearer of the TWIC card is the same person to whom it was issued, a biometric match may take longer than a visual inspection alone, but not long enough to cause access point throughput delays that would negatively impact business operations. This was true whether the biometric match involved a *contactless* reader or a *contact* reader. However, the extent of the delay for processing an individual at an access point was sometimes compounded by user unfamiliarity with the TWIC authentication process. It is important to note that when a user is properly trained and acclimated to interface with the card reader, transaction times decrease considerably. TSA plans to issue future documentation of lessons learned to address these and other findings.

When performing the identity verification portion of the transaction, to ensure that the bearer of the TWIC card is the same person to whom it was issued, a biometric match may take longer than a visual inspection alone, but not long enough to cause access point throughput delays that would negatively impact business operations. This was true whether the biometric match involved a contactless reader or a contact reader. However, the extent of the delay for processing an individual at an access point was sometimes compounded by user unfamiliarity with the TWIC authentication process. It is important to note that when a user is properly trained and acclimated to interface with the card reader, transaction times decrease considerably. TSA plans to issue future documentation of lessons learned to address these and other findings.

Training – In general, training requirements were underestimated by the pilot participants. Workers who reported to the same facility daily learned to use the readers quickly. However, when workers were required to access multiple facilities, individuals had to become familiar with site-specific business processes and requirements. Acclimation was further compounded by various reader ergonomics found at different port access points. Readers placed at heights or

distances awkward for drivers to reach slowed access and, in some cases, created a danger to drivers trying to reach misplaced readers. There was also difficulty reading messages on the screens of readers not shielded from direct sunlight, which prevented users from determining the cause of access denial.

In addition to proper training for worker populations, facilities and security personnel required training on how to use the TWIC system. Successful reader and access control system operations require an understanding of the reader and system operation appropriate to the role of the user. Some access control system operators and their security personnel were unfamiliar with the messaging provided by their readers and access control systems, resulting in incorrect assumptions as to the cause of an incomplete read of a card or access denial. In some cases, workers were told there was a problem with their TWIC card when it was actually functioning properly. In addition, many of these access denial problems were traced to individuals not being registered in the access control system.

This unfamiliarity with reader technology also extended to portable TWIC readers. Without sufficient training, security personnel encountered problems operating portable readers—shifting from one reader mode to another or rebooting readers if they "freeze" or "lock up". At facilities where workers are required to enter and exit secure areas multiple times over short periods, biometric identity verification upon every entry is difficult to maintain, especially using portable readers. In some cases portable readers malfunctioned when used carelessly in wet conditions not aligned with vendor guidance.[3]

Technology

Reader Performance – The Reader Pilot provided one of the first opportunities to gain knowledge regarding the performance of cards and readers in an actual long-term application. Reader performance in this pilot varied widely. Some readers performed well throughout the TWIC Reader Pilot; some readers were not as mature technologically; others required adjustments; and in one case, the readers initially installed at a facility repeatedly failed and were replaced by readers from another vendor.

Card Stock Durability and Electronic Maturity – TWIC card stock is the same as that used for Personal Identity Verification (PIV) cards issued to all federal employees and contractors as well as members of the military. However, through the Reader Pilot, TSA discovered that an unexpectedly high number of TWIC cards had malfunctioned electronically and could not be read with readers.[4] Most TWIC cards that failed could not transmit information to a contactless reader despite the fact that the integrated circuit chip (ICC) could be read by a contact reader.

Privacy – In conjunction with the DHS Privacy Office, TSA conducted a Privacy Impact Assessment (PIA) for the TWIC in 2007. TSA incorporated strict privacy controls to prevent a TWIC holder's biographic and biometric information from being compromised. The PII on the TWIC is limited to name, photo, and fingerprint template. Data on the integrated chip is secure and can only be read by a reader. Readers are not networked to TSA. Further information is available in the published PIA[5].

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[3] A separate USCG effort demonstrated that portable TWIC readers function in a variety of environments.
[4] Subsequently, TSA investigated reports from non-pilot facilities which also had similar card issues.
[5] http://www.dhs.gov/xlibrary/assets/privacy/privacy_pia_twic09.pdf

Infrastructure

System Architecture and Interoperability – Successful implementation of TWIC readers includes the development of an effective system architecture and physical access control system (PACS), properly functioning TWIC cards, and TWIC holders who are familiar with using TWIC readers.

The time and effort required to install readers, and reader infrastructure, varied widely among pilot participants. Facilities with existing systems that could be easily adapted to new TWIC readers took less time to complete installations than facilities with infrastructure and systems that could not be easily adapted to accommodate TWIC readers (i.e., inadequate wiring or power; or a PACS not able to be upgraded.). Participants who either did not have existing systems, or chose to integrate readers into existing systems conducting other functions, such as checking manifests, experienced longer installation periods and initially more problems with readers and access control systems. When reading the TWIC card was added to systems already performing other functions, determining the cause of problems was difficult due to the number of variables that had to be analyzed. In some cases TWIC system integrators were unfamiliar with other components of multi-functional systems resulting in installation delays.

Environmental Considerations

At varying pilot locations, some readers experienced difficulty scanning fingerprints in inclement weather. Fully encapsulated fixed contactless readers withstood harsh weather, whereas readers which were exposed to the elements, and which required insertion of the card to make a contact read were also found to be sensitive to wet conditions. Portable readers are expected to be somewhat sheltered in use to minimize the impact of weather on the readers. Throughout the Reader Pilot, the conditions under which readers had to perform were significantly more challenging than those commonly found at entrances to office buildings, and other more controlled locations and environments. However, the majority of the challenges associated with weather can be overcome with proper planning that takes into consideration the environmental conditions.

Costs and Benefits

Pilot costs varied greatly depending on a number of factors including: age and quality of the facilities' information technology (IT) infrastructure, the number of access points, the distance between the readers and the main building, and system integration decisions.

Federal Emergency Management Administration (FEMA) Port Security Grants (PSGs) funded the entire cost[6] of the readers and infrastructure for the vast majority of pilot participants. In total, $23 million in grant funds were provided; $15 million was expended, with the remaining $8 million held in reserves by the grantees to fund readers to meet future requirements. By law, grant funding must be spent within five years of the fiscal year in which it was appropriated.

When designed, installed, and operated in manners consistent with the business considerations of the facility or vessel operation, TWIC readers provide an additional layer of security by reducing the risk that an unauthorized individual could gain access to a secure area. The security risk reduction can be achieved without significantly increasing throughput times at access points.

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[6] One pilot participant was not funded through TWIC Port Security Grants and instead spent their own money on all Reader Pilot related activities.

Security is further enhanced at facilities and vessels by assigning access privileges to TWIC holders; thereby, allowing owners, operators, and security personnel to limit the population of TWIC holders allowed in secure areas to those authorized by the facility operator for access.

Facilities and vessels that stop issuing site-specific badges and instead use the TWIC card as the only identification needed for access may benefit financially by reducing card management operational costs associated with identity vetting, card inventory, printing equipment, and issuance infrastructure.

Conclusions

The TWIC Reader Pilot was the largest attempt, to date, to test biometric identity verification requirements for physical access control. The adherence to established standards, such as Federal Information Processing Standards 201-1 (FIPS 201-1) and other standards employed across the transportation sector, sets a common baseline for identity verification purposes. The use of biometrics for TWIC, similar to current practices in many other commercial and government environments, is necessary to confront our nation's evolving security challenges. For this purpose, biometric verification of the TWIC holder occurs at enrollment and at card issuance, prior to use for access in a maritime work environment. The lessons learned and technology deployed, as a result of this pilot, provide a critical layer of security at our nation's ports.

Despite the challenges noted, the data collected helped to inform the reader rulemaking effort and comply with the requirements of the SAFE Port Act. The TWIC Reader Pilot demonstrated that many options are available to facility and vessel operators for validating the authenticity of a TWIC card and verifying the identity of the holder. Regardless of the requirements in the final rule for TWIC reader use, a reader option suitable for the many MTSA-regulated facility or vessel operations should be available. The availability of fixed readers for use at facility access points, and portable readers able to be carried by security personnel to where needed, provided flexibility in meeting the business needs of the pilot participants. Over thirty different reader models were available during the pilot. Models ranged from those with basic card-reading capabilities to those with features to read multiple types of identity documents as well as perform other functions.

The Federal Government will offer general guidance, but cannot provide a "one-size-fits-all" reader template due to the uniqueness of each regulated facility and vessel operation. To ensure successful compliance with reader rule requirements, facility and vessel owners and operators must be diligent in their advance planning and closely monitor how installed TWIC reader and reader systems perform the required functions and minimize impacts on the operations of the facility or vessel.

The full report that follows this Executive Summary further expands upon these findings, and provides additional lessons learned. The report also describes the plans for conducting the Reader Pilot, and explains the reasons for deviations from the initial plans, due to challenges encountered along the way. The report summarizes data gathered from individual pilot participants or laboratory results, rather than cite specific data contained in the many reports that underlay this report. This avoids the need to restrict access to the report for security, proprietary and business sensitive reasons. Appendix C shows the documentation and reports supporting the final report.

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Legislative Language

The Transportation Worker Identification Credential (TWIC) Reader Pilot was established under Section 104 of the Security and Accountability For Every Port Act of 2006 (SAFE Port Act) (P.L. 109-347) and codified at 46 USC 70105 (k)(4).

> *"The Secretary shall conduct a pilot program to test the business processes, technology, and operational impacts required to deploy transportation security card readers at secure areas of the marine transportation system. The pilot program shall take place at not fewer than 5 distinct geographic locations, to include vessels and facilities in a variety of environmental settings. The pilot program shall commence not later than 180 days after the date of the enactment of the SAFE Port Act.*
>
> *Not later than 120 days before the promulgation of regulations under paragraph (3), the Secretary shall submit a comprehensive report to the appropriate congressional committees (as defined in section 2(1) of SAFE Port Act) that Includes: (A) the findings of the pilot program with respect to technical and operational impacts of implementing a transportation security card reader system; (B) any actions that may be necessary to ensure that all vessels and facilities to which this section applies are able to comply with such regulations; and (C) an analysis of the viability of equipment under the extreme weather conditions of the marine environment."*

1.   Introduction

The Transportation Worker Identification Credential (TWIC) Reader Pilot provided an opportunity to confirm that the biometric technology of Personal Identify Verification (PIV) smart cards and readers can be used to affirmatively and quickly verify an individual's identity and eligibility for access to a secure area. While various card-based access control systems have been in use for many years, the TWIC Reader Pilot was the first large-scale test of using a biometric credential where facility operators needed to maintain rapid throughput[7] to secure areas by large numbers of workers or truckers. Further, first-time test challenges included the need to read cards under often difficult outdoor and industrial facility conditions, as well as the need to identify workers who required access yet who were not employees of or regular visitors to the facility.

This report is intended to provide a narrative of the conditions and challenges encountered while conducting the pilot, as well as provide a summary of the data collected during the pilot. Detailed results for individual pilot participants or specific readers are included in supporting reports rather than this report due to the potential security risks and business-sensitive nature of this information.

1.1   TWIC Program Background

The TWIC Program provides a tamper-resistant biometric credential to eligible maritime workers requiring unescorted access to secure areas of port facilities and vessels regulated under the Maritime Transportation Security Act of 2002 (MTSA) (P.L. 107-295). The mission of the TWIC Program is to:

- Determine the eligibility of individuals to receive authorized unescorted access to secure areas of the transportation system by conducting a security threat assessment;
- Affirmatively verify authorized individuals who require unescorted access to secure areas of the nation's transportation system;
- Ensure that unauthorized individuals are not able to defeat or otherwise compromise the access system in order to be granted permissions that have been assigned to an authorized individual; and
- Identify individuals who fail to maintain their eligibility requirements subsequent to being permitted unescorted access to secure areas of the nation's transportation system and immediately revoke the individual's permissions.

During the TWIC rulemaking, the Transportation Security Administration (TSA) and the United States Coast Guard (USCG) engaged maritime stakeholders, smart card industry experts, and appropriate federal agency representatives to develop a biometric credential in accordance with Federal Information Processing Standards (FIPS) 201-1, known as Personal Identity Verification

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[7] Throughput is defined as the time taken for a vehicle or pedestrian to obtain entry and pass through an access point. All throughput data uses seconds as the unit of measure.

(PIV)[8], that would meet maritime industry requirements to include a method for the biometric verification of identity.

Based on comments received from the public following publication of the TWIC Notice of Proposed Rulemaking (NPRM) (71 FR 29396) on May 22, 2006, and upon further analysis, TSA and the USCG concluded that facility and vessel operators should not be required to purchase or install electronic TWIC readers during the initial issuance of TWIC cards. The Security and Accountability For Every Port Act of 2006 (SAFE Port Act) then directed the Department of Homeland Security (DHS) to conduct a TWIC Reader Pilot Program (Reader Pilot) to inform a second rulemaking that would focus specifically on the use of the TWIC cards with biometric readers.

1.2 TWIC Reader Pilot Program Background

Section 104 of the SAFE Port Act required DHS to submit the findings of a Reader Pilot which would evaluate the feasibility, technical, and operational impacts of implementing a transportation security card reader system. The Reader Pilot was also designed to address any actions necessary to ensure that vessels and facilities, to which the section applies, are able to comply with such regulations, and provide an analysis of the ability of reader equipment to withstand the extreme weather conditions of the maritime environment.

DHS managed the Reader Pilot through the joint participation of TSA and the USCG, and with grant funding provided by the Federal Emergency Management Agency (FEMA) through the Port Security Grant (PSG) Program to the pilot participants.

In anticipation of promulgating a rule to require the use of biometric readers, the USCG published the TWIC Reader Requirements Advanced Notice of Proposed Rulemaking (ANPRM) on March 27, 2009 (74 FR 13360). Comments received in response to the ANPRM, lessons learned from the Reader Pilot, and detailed participant level data reports are meant to inform rulemaking.

1.3 TWIC Reader Pilot Scope

The DHS Science and Technology Directorate (S&T) designed a three-phase pilot program that is outlined in the TWIC Test and Evaluation Master Plan (TEMP). TSA and the USCG engaged port, maritime facility, and vessel operators, representing a wide variety of sizes and types of stakeholders, to participate in the Reader Pilot.

The first phase (Initial Technical Testing or ITT) of the Reader Pilot focused on evaluating TWIC reader technology. The second phase of the Reader Pilot (Early Operational Assessment or EOA) evaluated TWIC reader performance in the maritime environment. The third phase (System Test and Evaluations or ST&E) assessed the business and operational impacts of using

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[8] Notable differences between TWIC and FIPS 201-1 include: the operational mandate for biometric matching of the TWIC in Physical Access Control Systems (PACS), the ability of TWIC to supply reference biometric information to a Reader without requiring the presentation of a PIN as specified in FIPS201-1, the 5 year life of digital certificates versus 3 year certificate life in FIPS201-1, lack of a comprehensive infrastructure to update the TWIC Card after activation, lack of a sponsorship model in TWIC, eligibility criteria differences between TWIC and FIPS201-1, TWIC vetting of identity, and a TWIC Reader specification as no Reader specification exists for FIPS201-1.

TWIC readers to verify identity. The three Reader Pilot phases are in more detail later in the report.

- Phase 1 - Initial Technical Testing (ITT): Required TWIC readers to be tested under controlled laboratory conditions to verify they correctly processed biometric information from the TWIC card, and could also perform other TWIC card verification and validation operations in maritime environments, in accordance with the TWIC card and TWIC reader specifications.
- Phase 2 - Early Operational Assessment (EOA): Required facility and vessel operators participating in the Reader Pilot to install TWIC readers and begin using them to read TWIC cards. This phase allowed both workers and operators to become familiar with TWIC readers and different operational modes. It also provided an opportunity to evaluate the initial technical performance of readers in maritime settings, and to address any problems or issues before commencing the final phase.
- Phase 3 - System Test and Evaluation (ST&E): Required facility and vessel operators participating in the Reader Pilot to verify the identities of pilot participants needing unescorted access to secure areas. The test scenarios included potential requirements as presented by the USCG's reader requirements ANPRM. The data collected from the ST&E included:
  - o Impact of the biometric verification process on vessel and facility operations;
  - o Measurement of wait times for access to secure areas;
  - o TWIC reader and infrastructure failures and maintenance requirements; and
  - o Implementation and operating costs.

The Navy's Space and Naval Warfare Systems Center Atlantic (SSC-LANT) in Charleston, SC, served as the Independent Test Agent (ITA) for the Reader Pilot. SSC-LANT provided the personnel and equipment resources to gather and analyze test results and data from the field. They also provided technical assistance to pilot participants and verified system readiness prior to commencing the EOA and ST&E phases.

The Reader Pilot officially began with the first TWIC reader tests during the ITT phase on August 20, 2008, and concluded data gathering for this report on May 31, 2011. TSA has maintained contact with the pilot participants to continue learning about their experiences with TWIC readers, so that TSA may be kept apprised of developments as the rulemaking effort moves forward.

Data collected throughout the Reader Pilot was analyzed and compared by grouping facilities and vessels by similar operational characteristics.

The Final Report summarizes the findings and conclusions collected from the Reader Pilot. Most importantly, this report illustrates the positive and negative operational impacts and technical performance of TWIC reader systems. The data elements and comparisons, along with the significant accomplishments and/or anomalies observed, were provided to USCG to inform the TWIC reader rulemaking effort.

1.4   Pilot Participant Groups and Locations

In order to best represent the maritime industry and align pilot participants with the three general risk groups highlighted in the ANPRM, five main pilot participant groups were established for the Reader Pilot. The groups were used for comparing trends in TWIC reader technology

installations, TWIC reader implementation costs, TWIC holder populations, traffic volumes, and access processes and procedures. The five pilot participant groups were:

- o Container Terminals
- o Large Passenger Vessels/Terminals with more than 500 passengers
- o Break-Bulk Terminals
- o Petroleum Facilities
- o Small Passenger vessels/Towboats/Other

Although pilot participants were placed in one of these groups, the groups themselves are broad and do not address all possible maritime intermodal interfaces (e.g., vessel-facility, vehicle-facility).

The Reader Pilot was conducted in seven geographic locations to meet the requirements of the SAFE Port Act. The distinct regions allowed for evaluation of TWIC reader functionality and impact across a variety of environmental and operational conditions found in maritime environments. Figure 1-1 illustrates the wide range of maritime environments covered by the pilot.

Figure 1-1 TWIC Reader Pilot Participants by Geographic Location
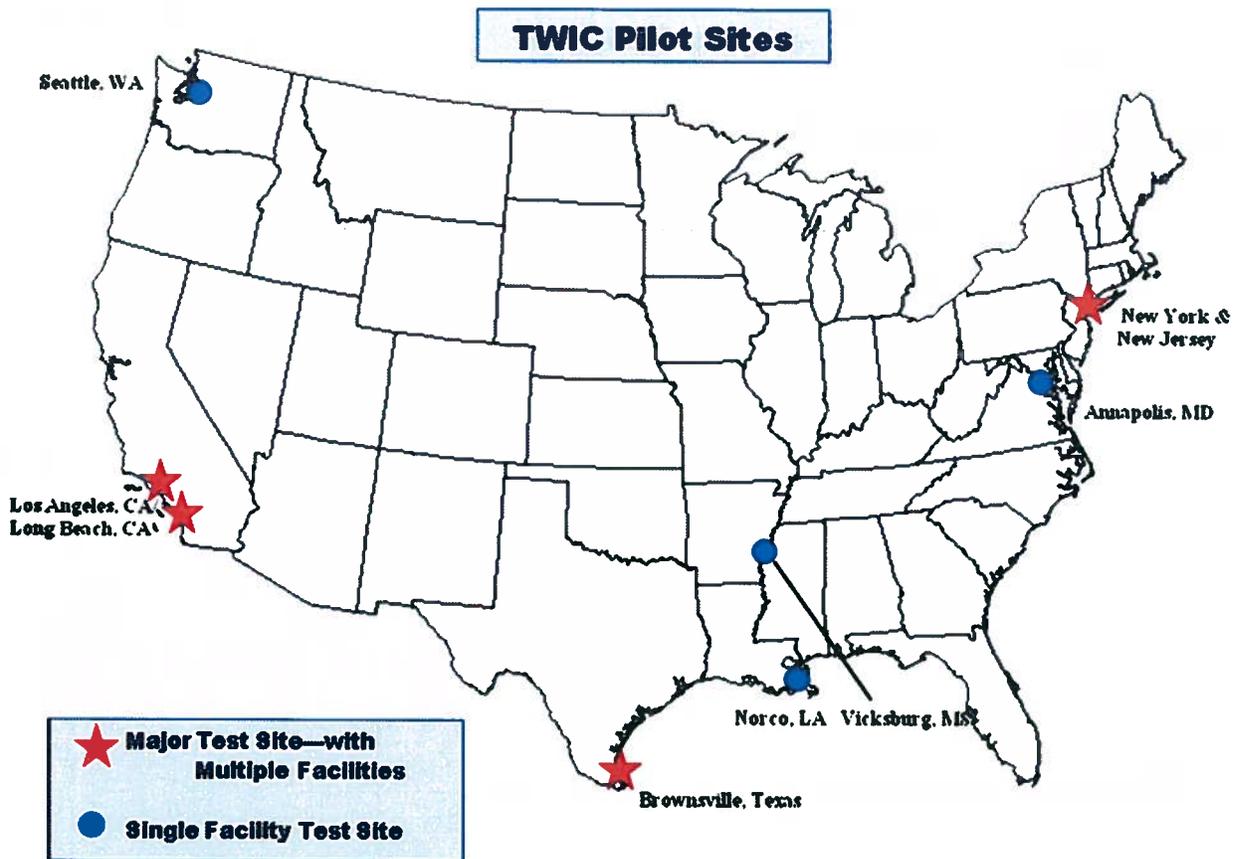
1.5   Pilot Participants

Participation in the Reader Pilot was completely voluntary. Several facility and vessel operators who initially expressed interest in participating in the pilot withdrew for various reasons prior to acquiring and installing readers and are not included in this list. TSA replaced two participants who withdrew with two others of similar business operations. Table 1-1 lists the pilot participants who completed the pilot.

Table 1-1: TWIC Reader Pilot Participants

Location	Participant Name	Industry Group
Port Authority of New York/ New Jersey	Staten Island Ferry	Small Passenger Vessel/Towboat/Other
Port Authority of New York/ New Jersey	APM Terminal	Container Terminal
Port Authority of New York/ New Jersey	Maher Terminal	Container Terminal
Port Authority of New York/ New Jersey	Brooklyn Marine Terminal	Container Terminal
Annapolis, MD	Watermark Cruises	Small Passenger Vessel/Towboat/Other
Vicksburg, MS	Magnolia Marine Transport	Small Passenger Vessel/Towboat/Other
Norco, LA	Shell Chemical LP	Petroleum Facilities
Brownsville, TX	Port of Brownsville	Container Terminal
Port of Long Beach	BP	Petroleum Facilities
Port of Long Beach	Metropolitan Stevedore Company	Break-Bulk
Port of Long Beach	Total Terminals International	Container Terminal
Port of Long Beach	Sea Launch	Small Passenger Vessel/Towboat/Other
Port of Long Beach	SSA Marine	Container Terminal
Port of Los Angeles	NuStar Energy	Petroleum Facilities
Port of Los Angeles	World Cruise Center	Large Passenger Vessel/Terminal
Port of Los Angeles	APL	Container Terminal
Seattle, WA	Clipper Navigation	Small Passenger Vessel/Towboat/Other

1.6   Port Security Grant Process

In Fiscal Year (FY) 2006 and FY 2007, DHS, through FEMA, awarded approximately $23 million in PSG Program funding for TWIC readers and infrastructure. The pilot participants executed contracts to use $15 million of those funds in support of the Reader Pilot. The remaining $8 million was held in reserves by some grantees to fund TWIC readers to meet future requirements as opposed to outfitting all of their access points with TWIC readers for the purposes of the pilot.

Funds for the Reader Pilot were obtained through two sources:

- Appropriated Funds. DHS provided funds to directly support the Reader Pilot.
- PSG Program Funds. The PSG Program provided primary funds for equipment and infrastructure at Reader Pilot sites for testing. These funds were used for test planning and to support data gathering requirements at the local level. In most cases, PSG Program funds were provided to port authorities, and then were further allocated to specific facility or vessel operators within the ports.
  - o The PSG Program is administered through FEMA, which collaborated with TSA, the USCG, the Maritime Administration (MARAD), the DHS Nuclear Detection Office (DNDO), U.S. Customs and Border Protection (CBP), and other federal partners in review and approval of all PSG Program awards. Each award had an assigned program analyst dedicated to the oversight of the award's conformance with programmatic and administrative requirements in accordance to the Code of Federal Regulations and FEMA policies.

1.7   TWIC Reader Pilot Delays

There were several factors that contributed to delays in commencing the Reader Pilot.

- The voluntary nature of participation coupled with the fact that TSA was not administering the grant funds[9] and therefore could not attach specific milestones to the expenditure of grant funds.
- Pilot participants were responsible for completing their TWIC reader plans and installations through contracts with vendors and system integrators.
- All grantees were required by Title 2 Code of Federal Regulations (CFR) Part 230 (OMB Circular A-122); 2 CFR Part 225 (OMB Circular A-87); or FAR 31.2, as well as 44 CFR 13.30 (b)(4) and OMB Circular A-133 to ensure that funds were authorized by the awarding agency and expended in accordance with program requirements.
- The first TWIC readers were not available for testing until July 2008, resulting in a 15 month delay in commencing the Reader Pilot. This delay, in part, was caused by the preference of facilities to obtain the TWIC Privacy Key (TPK) via a network server that captured the TPK during the registration process, as opposed to installing TWIC readers with a magnetic stripe read capability.
- The start and end dates of the EOA and ST&E phases were highly dependent on the readiness of each individual facility's ability to acquire and install TWIC readers.

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[9] FEMA was responsible for Port Security Grant Funds and the oversight associated with those funds.

- Environmental review for compliance with the National Environmental Policy Act and the National Historic Preservation Act were required for all federal projects as a special term and condition of each federal award.
- Some facilities could acquire equipment or services quickly, while others required extensive bid processes or board of directors' approval.

Pilot participant factors that delayed the TWIC reader installations:

- Limited facility resources due to the economic downturn impacted facility resources. Often times the main point of contact responsible for the Reader Pilot was performing multiple job functions. Completing necessary site plans and continued schedule revisions moved installation time frames further out, often by several months. In some cases, after installation contracts were awarded, pilot participants still experienced delays in completing TWIC reader installations due to availability issues, which were the responsibility of the TWIC reader and system integrator contractors.
- Complex access control systems at the three largest pilot participants required significant planning to reach an operational state before the effect of TWIC readers could be assessed.

Additional factors that impeded TWIC reader testing and data collection efforts during the Reader Pilot:

- The majority of facility operators with PACS chose to register each TWIC holder who required access into their system. Registering the workers was time-consuming, but allowed the PACS to make access decisions once the reader identified the worker. Challenges to registering workers for the pilot included:
    - o Inability of port and facility operators to register workers as quickly as planned, due to the limited availability of drivers and other personnel who work in multiple locations.
    - o Reluctance of some port and facility operators at some pilot sites to interrupt their daily operations and/or delay the entry of all workers and truck drivers long enough to register their TWIC cards.
- Participant level delays acquiring and installing TWIC readers due to contracting procedures requiring multiple approval levels.
- Integrating facility operators' non-TWIC requirements with PACS lengthened the installation and integration times. For example, some facilities integrated local regulations to ensure that trucks entering their facility were in compliance with the Clean Trucks Program[10].

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[10] The Clean Truck Program is a central element of the Clean Air Action Plan, with a goal of reducing emissions of harmful pollutants.

2. TWIC Reader Pilot Test Methodology

Because MTSA 2002 covers such a wide variety of maritime facility and vessel operations, TSA ensured the TWIC Reader Pilot participants were representative of the MTSA-regulated facilities and vessel operations, as well as representative of the geographic and climactic conditions under which they operate. Pilot participation was voluntary and the pace and timing of test milestones was often set by the participants in recognition of the fact that they operate businesses in competition with others which were not participating in the test. Test scenarios designed to simulate reader operations under a potential future reader regulation occasionally had to be modified to avoid disruption to traffic through access points, particularly following the activation of access control systems.

The TWIC Reader Pilot phases were conceptually designed to ensure that only readers meeting the TWIC Card and Reader Specification would be acquired and used by pilot participants. To enable pilot participants in each of their design phases to select readers, a third informal test was added to the two formal laboratory reader tests in the initial test plan. In addition, the test plan called for two field test phases, which were designed to clearly separate the effort to install and begin reader operations from assessing the impact on business operations of using readers once reader operators and users were familiar with the systems. While the line between these two phases was blurred in some cases, the data collected was adequate to extract lessons learned and access point throughput impacts.

2.1 Test Phases

The ITT Phase of the TWIC Reader Pilot provided the opportunity to test models of readers from multiple vendors. The ITT Phase included a structured evaluation that led to development of a list of approved readers that demonstrated their ability to read TWIC cards and indicate a correct outcome for various possibilities (i.e., expired card; card listed on Cancelled Card List; and match or no-match of fingerprint). Once the list of approved TWIC readers was available, the pilot participants could procure and install the systems. EOA was the first field testing phase to evaluate the various TWIC systems chosen by pilot participants as well as the best approach to integrate them into their existing access control infrastructure. Once the systems were stable, the ST&E phase was implemented to gather data on the operational impacts of TWIC readers with respect to business processes.

Reader Pilot data measurements were collected using a variety of methods, including: interviews, site visits, surveys, problem trouble reports (PTR), TWIC reader audit logs, observations of testing, Weekly Performance Reports (WPR), Initial Capability Evaluation (ICE), Environmental and Functional Specification Conformance Tests (E-SCT and F-SCT respectively), and System Operational Verification Tests (SOVTs).

2.1.1 Initial Technical Testing

The ITT phase included three testing processes to verify the functionality, performance, and ruggedness of TWIC readers. This phase was not intended to be a formal certification process for

TWIC readers. Rather, it was meant to provide timely results and to reduce the financial risk to the Government as the pilot participants used their grant funds to procure TWIC readers.

Initially, TWIC readers were slated to complete formal testing prior to implementation. TSA determined that waiting for TWIC readers to go through lengthy, formal laboratory testing would cause unacceptable delays to Reader Pilot progress. To alleviate this, the first technical testing performed was ICE, which verified basic TWIC reader operation utilizing TWIC cards and fingerprints.

F-SCT assessed TWIC reader compliance with TWIC working specification requirements, which tested biometric matching, TWIC validation, and other TWIC reader-to-TWIC interactions. F-SCT examined the transfer of various data elements between the TWIC reader and the TWIC card in different modes of operation and different means of connectivity.

E-SCT examined TWIC reader performance and behavior in the expected electrical and environmental conditions presented at pilot participant sites.

2.1.2 Early Operational Assessment

There were four components to the EOA phase, which required facility and vessel pilot participants to install TWIC readers and begin using them to read TWIC cards. EOA focused on installation and implementation.

- The first component collected baseline data for each location's pre-TWIC reader entry process, access point layouts, and throughput metrics.
- The second component collected data on the TWIC reader installation and integration process. Key measures captured during this stage included infrastructure upgrades and installation requirements, TWIC reader integration with new or existing PACS, and costs associated with the installation and integration process.
- The third component was the SOVT, which was used to validate TWIC reader functionality and operability.
- The fourth component was the scenario test phase of EOA. During the scenario test stage, information on throughput times, TWIC reader and TWIC card issues, queue backups, and preliminary operational workflow impacts were collected.

This data, along with reader logs, were collected on a regular basis and analyzed to determine the validity of the data, as well as system operation and TWIC reader impact to current operations. Discrepancies and deficiencies were documented in reports compiled at the conclusion of each site visit and in the formal Test Report at the completion of EOA.

2.1.3 System Test and Evaluation

The ST&E phase focused on operational and business impacts and required vessel and facility pilot participants to verify the identities of TWIC holders needing unescorted access to secure areas. The data collected included security related costs, access/denial processes, policy integration, and information technology (IT) maintenance.

During ST&E, TSA observed changes to maritime business processes, access procedures, modifications to access control systems, and other factors that the vessel and facility operations

used to comply with the ANPRM. Results from this test phase will be used by the USCG to develop the TWIC reader rule.

2.2　TWIC Reader Modes of Operation

Throughout the Reader Pilot, TSA tested the modes of operation in which a TWIC reader was used to identify and authenticate a TWIC holder. TWIC readers use a combination of methods to authenticate an identity. These methods and the corresponding TWIC reader mode of operation are illustrated in Table 2-1.

Authentication factors can be combined to increase the level of security through fingerprint templates, TWIC holder identification number, and electronic certificates. This can be accomplished using either the contactless or contact chip embedded in the TWIC card. The contactless chip is used by holding the TWIC card to the surface of the TWIC reader. The contact chip is used by inserting the TWIC card into a slot.

Table 2-1 illustrates the four operational modes and their desired results as described in the TWIC Reader Hardware and Card Application Specification.

Table 2-1: TWIC Reader Modes of Operation

Mode	TWIC Identification / Authentication Description	Method of Card Validation and Identity Verification
1	Card Holder Unique ID (CHUID) Identification	Card validated by match of a number to a previously registered number in a PACS. Identity verified by visual comparison of the photo on the TWIC card to the TWIC holder.
2	Active Card Authentication (ACA)	Reader conducts checks of the TWIC card to validate issuance by TSA. Identity verified by visual comparison of the photo on the TWIC card to the TWIC holder.
3	Biometric User Authentication (BUA)	Card validated by match of a number to a previously registered number in a PACS. Successful biometric match of the TWIC holder to the reference biometric on the TWIC card verifies identity.
4	Card + Biometric User Authentication (CBUA)	Reader conducts checks of the TWIC card to validate issuance by TSA. Successful biometric match of the TWIC holder to the reference biometric on the TWIC card verifies identity.

Figure 2-1 illustrates that the level of identity verification confidence increases as more authentication factors are added.

Figure 2-1 TWIC Identity Verification Confidence: Visual Inspection vs. Reader
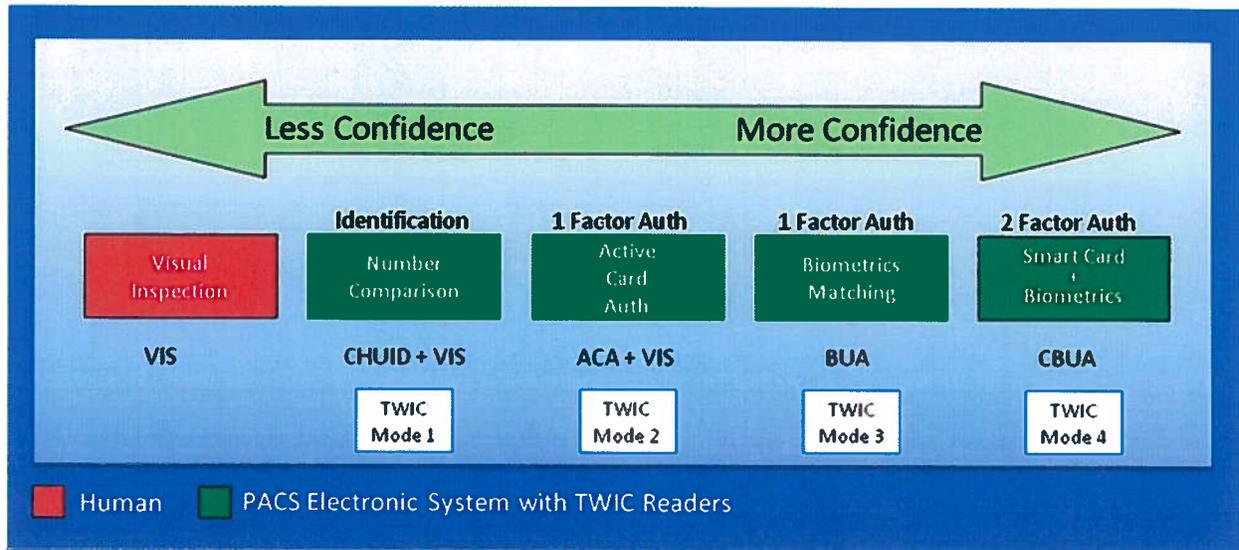
2.3   Canceled Card List

The Reader Pilot included evaluating the ability of pilot participants to have their readers or PACS use the Canceled Card List (CCL) to prevent the use of cards that had been reported lost, stolen, or canceled due to a loss of eligibility to hold a TWIC card. Pilot participants accessed and downloaded the CCL from TSA's public website on a daily basis. The CCL database of revoked TWIC cards is maintained by TSA[11].

Pilot participants using fixed readers downloaded the CCL onto the PACS. Pilot participants using portable readers downloaded the CCL either by synchronizing through PACS or directly from TSA's public website.

The CCL check differed among pilot participants. Some pilot participants conducted the CCL check on the TWIC readers during each transaction, while others used PACS to conduct the CCL check against a database of registered TWIC holders. Both configurations could be carried out automatically or manually. For example, if a TWIC holder appeared on the CCL, the system could automatically deactivate the TWIC holder's access rights or alert the pilot participant's security personnel. If the system alerted security personnel, the decision could be made by the pilot participant whether to revoke the TWIC holder's access rights.

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[11] The CCL contains the unique identifier for each card that is no longer valid. A card reader must be used to determine the unique card identifier; the number is not printed on the card, and there is no way to link the information on the CCL to an individual using the publically available list. Once read by a card reader, either the card reader itself, or a PACS, can compare the unique identifier of a specific card to the CCL. The CCL is a feature that allows detection of canceled cards in a timely fashion, without needing continuous connectivity to a database.

3. Initial Technical Test

In preparation for the TWIC Reader Pilot, TSA worked with the card reader industry, maritime stakeholders, and other government agencies to develop the TWIC Card and Reader Specification. The purpose of the specification was to enable biometric matching using the TWIC card without the need to use a contact reader[12]. To ensure that the TWIC readers acquired by the TWIC Reader Pilot participants met the newly developed TWIC Card and Reader Specification, the pilot included several reader tests whose purpose was to determine if reader vendors could produce readers compliant with the specification.

As is reported in this section, most readers had difficulty meeting the harshest of the tests subjecting readers to laboratory simulations of conditions likely to be found in maritime settings—blowing rain; temperature extremes; dirt and grit; salt spray; solar radiation; shock and vibration; and electromagnetic fluctuations. Two factors should be kept in mind regarding the environmental tests: (1) the tests were purposefully designed to strain the limits of conditions readers might encounter; and, (2) the tests were conducted only once on each reader and vendors were not permitted to resubmit readers for further testing, even in cases where a minor adjustment might have resulted in satisfactory completion of the test.

3.1 TWIC Reader Types

Both fixed and portable TWIC readers were tested during the ITT phase. Fixed readers are physically attached to an infrastructure associated with an access point and are typically controlled by a PACS. This type of reader authenticates a TWIC card and communicates the information to the PACS. Fixed readers have two variants: stand-alone and network attached. Stand-alone readers have a one-way communication channel with the PACS. Network attached readers have a two-way communication channel with the PACS. The two-way communication channel may be used to obtain data that is stored in the PACS.

Portable readers have all of the TWIC functions within the reader and do not require network connectivity. These readers were most commonly used at vehicle entrances during the pilot and were also useful for random TWIC card checks by security personnel within secure areas.

3.2 Initial Capability Evaluation

TSA released a series of Broad Agency Announcements (BAA) to solicit vendors to provide smart card biometric readers capable of reading TWIC cards. If vendor readers demonstrated suitable applicability to the Reader Pilot, they were invited to participate in ICE testing.

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[12] PIV card functionality requires insertion of the card into a contact reader and entering a PIN before the fingerprint algorithm is released to the reader. This functionality protects the unintended release of the fingerprint algorithm, but has limitations in the maritime environment. As a result TWIC had to develop an alternative method to release the fingerprint algorithm while still maintaining security.

ICE testing consisted of 14 scenarios that addressed reader requirements and were designed to determine if the TWIC readers could pass basic functionality tests.[13] The performance of each participating TWIC reader was measured and recorded on a pass/fail basis. Vendors were allowed to set up and configure their system for each ICE.

Currently, 34 different combinations of TWIC readers and software have been tested. By the conclusion of the pilot, 16 portable and 13 fixed TWIC readers were approved by TSA for inclusion on the ICE list. TSA continues to maintain the ICE list, adding new readers as they are nominated by vendors and satisfactorily complete evaluation.

3.3   Functional Specification Conformance Test

The F-SCT was designed to achieve a comprehensive evaluation of the industry's ability to provide TWIC readers that comply with the TWIC reader working specification. TSA began by performing functional test validations on the participating TWIC readers. After validation testing was completed, a formal test run was executed. The formal test consisted of performing a clean run of all technical test procedures to generate final test results with official documentation, objective witnesses, and electronic recording in operation. TSA completed functional TWIC reader tests in February 2010 on eight readers from eight different vendors—five portable and three fixed. Vendors remained independent of all setup and configuration procedures and were allowed to run through the tests one time, at which point they were provided with the results.

Testing was conducted by Identification Technology Partners (IDTP)[14] in a laboratory setting. The test took several months to set up and execute. Testing was extremely rigorous and required many pretest runs to assure tests could be executed properly. There were 116 tests completed on each TWIC reader, and they varied slightly depending upon several configuration differences.

Based on the testing performance of TWIC readers and considering the relevance of each test to Reader Pilot site testing activities, TSA determined that TWIC readers were capable of performing in the Reader Pilot.

3.4   Environmental Specification Conformance Test

The E-SCT was designed to evaluate the ability of TWIC readers to operate in a range of environmental and electrical conditions in maritime environments. TSA selected five readers for environmental testing - two portable and three fixed. Both portable readers had contact and contactless card interfaces. Two of the fixed readers had only a contactless card interface, and one fixed reader had a magnetic stripe and contactless interface.

Testing was conducted by Naval Air Systems Command (NAVAIR) in a controlled laboratory setting that exposed readers to potential conditions encountered in the maritime environment. Vendors remained independent of all setup and configuration procedures, and were allowed to submit their readers for testing only one time.

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[13] While the Broad Agency Announcement (BAA) is still active, the 14 scenarios can be found at: https://www.fbo.gov/index?s=opportunity&mode=form&id=754c0e6d0d419dd843570f8f2489277f&tab=core&_cview=0.

[14] IDTP is an independent private sector contractor. IDTP designed and conducted the F-SCT based on the TWIC specification through their consulting contract with TSA.

The high cost and length of time to perform environmental testing limited the number of TWIC readers eligible for testing. Despite this challenge, a representative mix of both fixed and portable readers were exposed to the harsh conditions mentioned above, and yielded sufficient information to identify which environmental conditions presented problems with reader performance and reliability.

Some of the tests applied only to fixed or portable readers respectively, while the remaining tests applied to both types of TWIC readers. Table 3-1 shows the types of environmental tests performed on each fixed or portable reader.

Table 3-1: Environmental Tests

Test	Reader type	
	Fixed	Portable
High Temp. Storage and Operation	✓	✓
Low Temp. Storage and Operation	✓	✓
Thermal Shock		✓
Icing	✓	
Solar Radiation	✓	✓
Rain Drip		✓
Blowing Rain	✓	
Humidity	✓	✓
Salt Fog	✓	✓
Dust	✓	✓
Vibration	✓	✓
Shock, Transit Drop		✓
Shock and Bump	✓	
Electrical Operation		✓
Electrical	✓	
Performance Criteria EMC Testing	✓	✓

NAVAIR established the requirements for the TWIC reader environmental tests based on Military Standards for electronic equipment intended to be used in exposed, industrial conditions. This resulted in exposing readers to extreme conditions in most cases. During the post-test briefings provided individually to the vendor of each reader tested, the vendors stated that producing readers capable of passing all of the environmental tests would represent a serious business challenge to manufacturers in terms of cost per unit. The tests were run one time on each reader. Vendors were not provided an opportunity to make adjustments to readers, or correct simple problems that might have enabled a reader to pass a test.

TSA completed environmental TWIC reader tests in September 2009. The E-SCT results showed that:

- Nearly all TWIC readers passed temperature storage and operation, thermal shock, solar radiation, rain drip, blowing rain, humidity, salt fog, dust, vibration, shock drop and bump, and electrical tests identified in Table 3-1.

- Some TWIC readers were more resilient than others, with respect to preventing moisture or water from intruding into the unit, resulting in electrical malfunctions. Fixed readers were subjected to blowing rain; portable readers to dripping rain. Fixed readers were mounted to panels. Resistance to wet conditions was partially dependent on how the reader was mounted, and if the wire connections were protected or of a weatherproof design.
- Most TWIC readers failed the icing and EMC tests. TWIC readers were subject to failure with icing tests because moisture either intruded the TWIC reader, or caused the inability to capture a fingerprint. Based on the icing tests, fixed readers may fail unless protected from icing. This is especially true for the fingerprint scanner.
- EMC test failures resulted from exposing readers to highly concentrated test voltages that would be atypical of installations in many industrial locations. The high voltages affected the internal electronic circuitry and impeded the ability of the reader to process TWIC cards.

Vendors that supplied readers for the environmental tests were individually debriefed on the test results for their equipment. The need to improve reader resistance to water intrusion was a key finding. In most cases, simply enhancing seals and using water-resistant wire harnesses would have improved wet weather performance. During these discussions, vendors stated that many of the failures could be corrected with minor design or manufacturing adjustments to their readers.

Some TWIC readers selected by facilities for the Reader Pilot (not necessarily those selected for environmental testing) were found to have non-environmental issues, including poor assembly and lack of version control on software. These additional issues lowered overall confidence in the TWIC reader's ability to perform.

The robustness, quality, and reader's overall ability to perform reliably in the maritime environment varied among tested-SCT results. Therefore, it is recommended that facility and vessel operators seeking to acquire readers discuss with prospective vendors the environmental conditions their readers will encounter when in use, and acquire readers that are deemed suitable for those conditions.

TSA monitored all TWIC readers during the Reader Pilot to see if similar results from the E-SCT occurred in field testing at pilot participant sites. One site did experience EMC sensitivity with fixed TWIC readers causing the readers to stop working after varying periods of time. This site corrected the problem by swapping out modified TWIC readers that addressed the EMC sensitivity through changes in the TWIC reader electronics.

4. Early Operational Assessment

The EOA Phase of the TWIC Reader Pilot provided an opportunity for participants to become familiar with operating their readers or reader systems, and for workers to experience using readers. It also provided for a period to allow operators to make adjustments to reader systems prior to using them and to simulate extended operation for access control decisions. As users became familiar with readers and access control systems, useful throughput data was obtained. However, close analysis was required to avoid mixing data acquired before system operators and workers became proficient in using the system. The EOA Phase was important primarily to allow time for reader operators and users to develop stable routines applicable to their business operations, so that reader data acquired during the System Test and Evaluation (ST&E) Phase reflected the impact of long-term reader usage.

This section describes implementation challenges and costs; discusses the pros and cons of registering[15] TWIC cards into a physical access control system; and includes a discussion of throughput measures at access points.

4.1 Baseline

A baseline study of access control costs, entry procedures, access point layouts, and throughput times was conducted at each pilot participant location prior to the installation and/or use of TWIC readers. This data was used to identify any operational impact resulting from TWIC reader use, as well as any changes that would need to be made to existing access control conditions for each pilot participant.

Access point throughput time was used throughout the Reader Pilot to provide a basis for comparing times through a specific access point for a TWIC card visual inspection compared to the time required to pass through an access point using a reader in various modes. Throughput was calculated from the time the individual or vehicle stopped at the access point until the person or vehicle was cleared through the access point. Although reader response time data was acquired during the pilot, throughput time data was most relevant to determining the impact of readers on business operations. Throughput time measured the time it took to clear an access point using readers instead of conducting a visual inspection of the TWIC card. Activities beyond verifying the TWIC card and identity often occur at access points. Additionally, turnstile or gate opening times vary among access points. By using throughput times, these differences were accounted for, leaving only the variance of visual inspection versus reader times for comparison.

USCG requirements for the visual inspection of the TWIC card prior to granting an individual access to a secure area include checking the card expiration date, verifying at least one security feature on the card, and confirming identity by matching the photograph to the holder.

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[15] Registering is the process of acquiring a person's unique card identifier in a physical access control system (PACS) and assigning access privileges. After a person is registered in a PACS, their card identifier can be read by a reader and transmitted to the PACS, which automatically approves entry.

According to the USCG, a compliant visual inspection takes approximately six seconds. Navigation and Vessel Inspection Circular (NVIC) 03-07 (Enclosure 3, 3.3 a (7)) states that visual inspection must include the following provisions: (1) a match of the photo on the TWIC card to the individual presenting the TWIC card; (2) verification that the TWIC card has not expired; and (3) a visual check of the various security features present on the credential to ensure the TWIC card has not been forged or tampered. In instances when gathering visual inspection baseline data took less than six second for visual inspection, the baseline throughput was adjusted to account for the difference.

4.2   TWIC System Implementation

Data concerning TWIC hardware and software installation, duration, costs, obstacles/issues, environmental factors, access modifications, and pilot participant registration processes was collected and compared for each pilot participant. The comparisons were made in order to determine any overarching implementation and/or integration issues that pilot participants might experience. Listed below are some of the implementation considerations associated with each facility group:

Container Terminals - Infrastructure upgrades were required to accommodate TWIC reader installation and use. Common implementation procedures involved the modification of access points. Three of the five facilities upgraded existing pedestrian access points with the installation of new turnstiles. Existing power and connectivity infrastructure was used by three facilities while two facilities had to install new fiber cables to power and connect the fixed readers to PACS. Of the five facilities, three used landlines, one used wireless, and one used both to support TWIC reader connectivity.

Large Passenger Vessels/Terminals – Both pilot participants used portable TWIC reader configurations; however, one of the pilot participants used a PACS integrated fixed TWIC reader system at two vehicle access points. As a result, the pilot participant had to upgrade the existing lift-gate at both access points as the older system was unable to receive the output signal of the TWIC reader system. This process required the installation of two new vehicle lift gates and the laying of new fiber cables to power and connect the fixed TWIC readers to the PACS.

Petroleum Facilities – Only one of the five petroleum facilities had to install infrastructure to support TWIC reader use. Infrastructure upgrades were minimal at the remaining facilities as access points were already equipped with power and connectivity and existing PACSs only required software updates.

Break-Bulk Terminals - The break-bulk terminals ran fiber cables to establish power for the fixed TWIC readers and connectivity between the TWIC readers and the PACS. One of the three pilot participants also installed a back-up wireless communication system to maintain connectivity with the TWIC readers. Two of the pilot participants installed new guard booths and all three pilot participants installed new fencing and gates.

Small Passenger/Towboats/Other – All but one of the pilot participants in this group used portable TWIC readers, which eliminated the need for any infrastructure upgrades or installations and in most cases better suited for their operational environment. Infrastructure upgrades and installation for the other pilot participant included the installation of three new turnstiles, new fiber cables to power and connect the fixed TWIC readers to the PACS, a new vehicle lift gate system, and a new guard booth.

4.2.1　TWIC Reader Installation Timelines

TWIC reader installation timelines began with the start of infrastructure upgrades/installation through the integration process and were completed when the reader(s) were operational. The duration of each installation depended on the capabilities of existing infrastructure and access point layouts to accommodate TWIC reader use. The timeline was highly dependent on a wide range of external variables, including permitting, contracting, and resource availability. The average installation timeframe for each participant group is as follows:

> Container Terminals .... 180 days
>
> Large Passenger Vessels/Terminals ..... 45 days
>
> Petroleum Facilities .... 60 days
>
> Break-Bulk Terminals .... 90 days
>
> Small Passenger/Towboats/ Other........ 120 days

4.2.2　Environmental Factors

4.2.2.1 Environmental Factors on TWIC Readers

Environmental conditions of the installation site such as dust, vibration, humidity, temperature, ultra-violet (UV) rays, rain, ice, condensation, radio frequency emissions, and salt had the potential to affect TWIC reader performance differently over various time periods. The ITA recorded the environmental factors present during site visits to determine what types of conditions caused changes in performance. A comparison of data from TWIC readers used in one geographical area to data from TWIC readers in other areas showed no difference in the impact of environmental conditions among the areas on TWIC reader performance.

Portable readers used at one site suffered weather-related failures when the readers were used in contact mode (i.e., inserting the TWIC card into the reader slot) during periods of rain and snow and when wet cards were inserted. In this case, use of the contactless reader mode would likely have avoided the reader failures.

4.2.2.2 Environmental Factors during Installation

Five of the pilot participants used heavy equipment for trenching during installation. The duration of equipment use was limited and conducted during non-peak hours of operation to mitigate the impact on traffic flow and operations. Trenching is likely to be required to install the infrastructure for the readers at many facilities; trenching can be disruptive and can lead to environmental concerns (pollution; historical artifact discovery). Often times an environmental impact study may be required.

4.2.3　Pilot Participant Implementation Costs

Pilot participant implementation costs included readers (hardware/software), PACS (hardware/software), infrastructure and installation costs. Some pilot participants upgraded their PACS, while others installed new PACS solutions. The range of costs in Table 4-1 reflects the breadth of implementation decisions each pilot participant made.

Table 4-1: TWIC Implementation Costs provides a breakdown of TWIC reader implementation costs incurred by pilot participants. As seen in the table, container terminal implementations were the most costly.

Table 4-1: TWIC Implementation Costs

Participant	Reader Costs (HW / SW)	PACS (HW/SW)	Infra-structure Costs	Installation Costs	Total
Container Terminals					
1	$239,914	$184,342	$216,494	$467,099	$1,107,849
2[16]	$263,083	$138,625	$15,463	$50,000	$467,171
3[17]	$172,967	$138,625	$90,000	$50,000	$451,592
4	$266,400	$713,190	$400,000	$645,500	$2,025,090
5	$245,463	$646,707	$592,893	$724,925	$2,209,988
Large Passenger Vessels/Terminals					
1	$53,903	None	None	$9,933	$63,836
2	$243,462	$80,283	$391,396	$106,836	$821,977
Petroleum Facilities					
1	$64,155	$272,836	$162,440	$80,133	$579,564
2	$152,000	$103,500	$301,000	$142,500	$699,000
3	$4,240	None	$2,000	$4,000	$10,240
Break-Bulk Terminals					
1	$75,000	$150,000	$711,583	$50,000	$986,583
2	$109,203	$138,625	$8,000	$12,000	$267,828
3	$68,340	$120,983	$196,376	$81,661	$467,360
Small Passenger Vessels/Towboats/Other					
1	$15,845	None	None	None	$15,845
2	$16,200	None	None	None	$16,200
3	$15,282	None	None	None	$15,282
4	$83,405	$69,000	$350,000	$455,060	$957,465

4.3   TWIC Reader Type per Participant Group

When selecting TWIC readers, some pilot participants considered incorporating new technology with existing PACS. Table 4-2: TWIC Reader Types per Participant Group shows the number of each type of TWIC reader that was installed collectively by each of the participant groups.

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[16] This participant chose not to fully outfit their facilities with TWIC readers; therefore, costs are not reflective of full implementation.
[17] See above.

The majority of pilot participants designed their TWIC systems to use fixed readers with the contactless card interface.

Table 4-2: TWIC Reader Types per Participant Group

TWIC Reader Technology Types In Pilot Testing				
	Fixed		Portable	
Participant Groups	Contactless Only	Contact/ Contactless	Contact/ Contactless	Total Count
Container Terminals	41	19	13	73
Large Passenger Vessels/Terminals		2	25	27
Petroleum Facilities	20	1	4	25
Break-Bulk Terminals	12		6	18
Small Passenger Vessels/Towboats			6	6
Other	5		2	7
Total	78	22	56	156

4.4   System Operational Verification Test

The SOVT was conducted to ensure TWIC readers were ready for use by validating the installation and operability of each TWIC reader. It covered the proper installation, integration, and check-out of each TWIC reader to ensure:

- Installation met the requirements of applicable rules and regulations;

- The system could perform the necessary functions of each TWIC reader mode of operation; and

- Quantities, types, and locations of installed equipment were accurately documented.

TSA validated and recorded the functionality of all TWIC readers by testing them in each TWIC reader mode before starting to collect pilot data. Each TWIC reader had to be tested against active TWIC cards, a TWIC card on the CCL, an expired TWIC card, and a scenario where an incorrect biometric was presented. Completion of this test procedure without a TWIC reader malfunction or incorrect result was considered successful. Facilities worked to refine their systems until it passed all of the requirements set forth in the SOVT.

4.5   TWIC Reader Pilot Participant Registration

Registration captures specific information provided by TWIC holders along with limited information from their TWIC card and stores the collected information in a PACS database to allow access to secure areas. Pilot participants registered TWIC holders when it was required by their PACS solutions and if the business situation during the pilot allowed them to invest the time necessary to register workers. In some cases, a portion of the workers at a facility were enrolled in the PACS to enable limited testing during the pilot.

Registration typically applies to fixed readers, but it can be done with certain portable readers. TWIC systems that required registration for access had to capture the TPK, which decrypts the encrypted fingerprint algorithm transmitted to readers in contactless operation, for biometric matching. Some fixed TWIC readers operated without a network connection as "stand-alone" readers. These readers had built-in memory sufficient to capture and store the TPK locally on the reader during the first encounter. This enabled the reader to quickly perform biometric matches when encountering the same card in a future transaction. These stand-alone readers did not require registration since the TWIC reader essentially performed the function of a PACS. The key advantage of locally storing the TPK is that TWIC holders could perform a biometric match transaction without performing additional registration processes at a site.

There were two possible methods used to register a TWIC holder into a PACS for access. The first method used a regional database that provided a central location for all TWIC holders to be registered into a port wide system. This database was connected to multiple terminals and communicated the registrant information to each terminal. In this configuration, a TWIC holder could register either at a terminal or at the central location. The security personnel could then assign access privileges as appropriate. The key benefit is that the TWIC holder had to register only once for access to multiple participating sites within the region.

The second method of registration was local registration. Local registration required each TWIC holder to register their card with the PACS at each facility where access would be requested.

A factor that complicated registration was the choice by some facility operators to capture the digital photograph on the TWIC card along with the registration of other data on their PACS. The TWIC holder must enter their Personal Identification Number (PIN) to release the digital photograph. Since many TWIC holders rarely, if ever, used their PIN since activating their TWIC card, and since the PIN is not necessary to conduct a biometric match for TWIC cards, some workers could not remember their PIN. Workers then had to visit a TWIC enrollment center to reset their PIN and return to the facility to complete the registration process.

The following summarizes how pilot participants in each participant group registered TWIC holders:

Container Terminals - Three pilot participants conducted local registration while two pilot participants conducted regional registration of employees and dock workers at the start of the EOA, to build-up a database of registered TWIC holders, and then conducted registration of the truck driver population. Two pilot participants did not conduct registration but used contact TWIC readers capable of retrieving and storing the TPK. The TWIC readers functioned as a stand-alone registration method.

Large Passenger Vessels/Terminals - These pilot participants did not conduct registration because portable readers operated as stand-alone systems.

Break-Bulk Terminals - These pilot participants conducted local registration of the TWIC holder populations. Two pilot participants established main access points to register TWIC holders, while another pilot participant required TWIC holders to register at the main office on specific dates.

Petroleum Facilities - These pilot participants conducted local registration of the TWIC holder populations.

Small Passenger Vessels/Towboats - These pilot participants did not register TWIC holders.

Other - These pilot participants conducted local registration of the TWIC holder population.

4.5.1   TWIC Holder Population

Table 4-3: TWIC Holder Population represents the estimated potential population of TWIC recipients who might access participating facilities by various means, including truck, vehicle, or pedestrian gate. The truck column represents tractor-trailer drivers who transport containerized cargos, oil/petroleum products, and/or break-bulk payloads. The vehicle TWIC holder population consisted of vendors, delivery truck drivers, employees and security personnel who access facilities using vehicles. The pedestrian population included labor, facility employees, and others who access facilities through pedestrian gates.

Table 4-3: TWIC Holder Population

Estimated Population of TWIC Holders Per Participant Group			
Participant Group	Truck	Vehicle	Pedestrian
Container Terminals	19,200	100	4,700
Large Passenger Vessel/Terminals	20	200	1,700
Break-Bulk Terminals	700	210	700
Petroleum Facilities	225	110	4,765
Small Passenger Vessels/Towboats/Other	0	100	400
Total	**20,145**	**720**	**12,265**

5. System Test and Evaluation

One of the biggest challenges to conducting the TWIC Reader Pilot in accordance with the test plan was acquiring accurate throughput data during the ST&E Phase. The focus of this phase was to identify and measure the impact of long-term reader use on business operations, an on-site presence was required by the government's independent test agent to acquire the most accurate data. Readers and reader systems automatically recorded precise measures of reader processing times as well as each successful card read and/or biometric match. However, readers and reader systems often could not determine the causes of the failure if a card reader and/or biometric match was unsuccessful. Without the observations of the on-site inspectors and evaluation teams, it would have been impossible to know if unsuccessful transactions were due to equipment or technology issues, or if a worker simply removed their card from the reader too quickly.

It is important to note that access point *throughput time* best describes the impact of using readers. It can be compared to the throughput baseline times for conducting a visual inspection of the TWIC card. *Reader reaction time* alone does not account for the time required to present the card to the reader, place a finger on the scanner, or other activities associated with conducting a successful card read. Therefore, throughput time is used in determining business impact.

5.1 Test Initiation

Upon the completion of the EOA, the ST&E was initiated. To simulate the operational environment as closely as possible, pilot participants who chose to register workers did so for TWIC holders who regularly accessed the site.

5.2 Data Collection Tools

In addition to the PDA used for throughput measures, TSA also used a Card Analysis Toolkit (CAT) to examine TWIC cards that did not function correctly. The CAT is a laptop computer with a contact and contactless TWIC reader and software that provided information that included basic diagnostics, fingerprint quality, which fingerprints were enrolled, CHUID and a validation that all data objects were present on the TWIC card. If a TWIC holder could not successfully complete a transaction on the TWIC reader, they were asked to present their TWIC card for analysis on the CAT, if available.

5.3 Access Control Costs

Access control cost data was collected throughout all phases of the Reader Pilot. A comparison of security costs following TWIC implementation and use was made against baseline access control costs to identify possible increases or decreases in security expenditures. The extent to which access control cost either increased or decreased was heavily dependent on the nature of the business process changes implemented by the pilot participant, such as changes in the quantity of security personnel, additional hours incurred by pilot participant staff to support and manage TWIC reader operations, and long term maintenance/support of the entire TWIC reader system.

Most of the pilot participants chose to reassign existing security personnel to TWIC reader access points instead of adding new security personnel. TWIC readers operating in Mode 3 or Mode 4, which use biometrics to verify identity, eliminated the need to conduct visual inspections of TWIC cards, which, allowed the pilot participants to remove two security personnel posted who previously conducted TWIC card visual inspections. The pilot participant reported the security personnel reduction resulted in an annual savings of $100,000. Several other pilot participants noted that in the future, readers may allow them to reduce the number of guards at access points controlled by biometric readers. Other pilot participants stated that they might be able to reduce the number of security personnel in the future as confidence in the access systems was gained.

5.4   Access Point Throughput

During the EOA phase, throughput data was collected at each access point where a TWIC reader was used. Throughput is defined as the time taken for a vehicle or pedestrian to obtain entry and pass through an access point. The TWIC holder process for each TWIC reader mode of operation follows:

- **Mode 1**[18] – The TWIC holder held their TWIC card on or near the surface of the TWIC reader. The reader validated the TWIC card, checked the expiration date and CCL. Security personnel then visually compared the facial photograph on the card to the TWIC holder.

- **Mode 2**[19] – This mode was not tested during the Reader Pilot because some of the TWIC readers selected by the pilot participants did not support active card authentication without being in the biometric matching mode.

- **Mode 3**[20] – The TWIC holder presented their TWIC card and fingerprint to the TWIC reader. Once the biometric match was confirmed, entry was granted.

- **Mode 4**[21] – The TWIC holder presented their TWIC card and fingerprint to the TWIC reader. Once the biometric match was confirmed, entry was granted.

TWIC card verification occurred each time a truck, vehicle, or pedestrian entered through an access point configured with a TWIC reader. Each of these transactions was recorded by the TWIC reader and/or PACS.

The timing process was as follows:

- Pedestrian – Timing began when the TWIC holder presented their TWIC card to the TWIC reader, and ended once the TWIC holder proceeded through the access point.

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[18] Card validated by match of a number to a previously registered number in a PACS. Identity verified by visual comparison of the photo on the TWIC card to the TWIC holder

[19] Reader conducts checks of the TWIC card to validate issuance by TSA. Identity verified by visual comparison of the photo on the TWIC card to the TWIC holder.

[20] Card validated by match of a number to a previously registered number in a PACS. Successful biometric match of the TWIC holder to the reference biometric on the TWIC card verifies identity.

[21] Reader conducts checks of the TWIC card to validate issuance by TSA. Successful biometric match of the TWIC holder to the reference biometric on the TWIC card verifies identity.

- Vehicle/Truck – Timing began once the vehicle stopped, and ended when the vehicle moved forward through the access point.

Data collection by Reader Pilot team members lasted four to eight hours per site visit at each access point and coincided with peak times of operational activity. In between site visits by the Reader Pilot team, data was collected through reader and PACS logs, and observations and PTRs submitted by operators of pilot test sites and vessel operations.

TSA used PDAs to record and calculate throughput measures and document access point data. The PDAs ensured the accuracy of the data captured for the installation, integration, TWIC reader check-out, and mode changes at each site location.

Throughput varied based on several interrelated factors including:

- the TWIC reader mode of operation,
- the smart card interface used,
- the TWIC holder familiarity with TWIC readers,
- the conditional need for the TWIC holder to present their fingerprint for biometric matching, and
- the method implemented by the site to check the CCL.

5.5   Alternative Access Control Methods

Visual inspection of the TWIC card served as the only alternative to using TWIC readers for access control under the current USCG regulation. Visual inspection was used in the following situations:

- TWIC reader was inoperable;

- TWIC reader was unable to validate a TWIC card and/or biometric;

- TWIC holder was denied access by reader (not registered in PACS or unreadable card); and/or

- Queue length to use TWIC readers impeded operations. By agreement, participating pilot test sites and vessel operators were allowed to temporarily suspend TWIC reader operations, if they determined continued use of TWIC readers would impact business operations. The option to temporarily suspend the test was used rarely during the pilot, and moderately during the learning curve at the start of TWIC reader operations.[22]

5.6   TWIC Card Impact

The ability of a TWIC reader to work properly is, in part, dependent upon a functioning TWIC card. If a TWIC card is damaged or broken, the TWIC reader is unable to validate or even recognize the TWIC. Regardless of the reason for a TWIC card's failure, these failed TWIC cards did challenge data collection efforts during the Reader Pilot. Prior to TWIC readers being installed, many workers never encountered a TWIC reader and therefore, they did not know that their TWIC card had suffered a malfunction which prevented an electronic read of the card

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[22] It is likely, that once a regulation is promulgated requiring the use of readers, some facilities will need to evaluate the number of access points into their facility to determine if they need to add additional access points to account for impacts to throughput times.

sometime between issuance and the opportunity to use their TWIC card with a TWIC reader. Instances where TWIC readers encountered malfunctioning TWIC cards were accounted for in the analysis of Reader Pilot data.

TSA established an Integrated Product Team (IPT) in conjunction with DHS that is continuing to review the nature and prevalence of TWIC cards that were not functioning properly. The IPT analysis indicated that while most TWIC cards that malfunctioned could not transmit information to a contactless reader, the integrated circuit chip (ICC) could be read by a contact reader. Most workers whose TWIC card had failed had not used their TWIC card with a reader prior to encountering a reader at a participating pilot site. In addition to TWIC cards that do not function properly, the team observed discolored, faded, stained, and pealing or delaminated cards. Harsh environmental factors such as the sun, wind, dirt, dust, and grime may have caused these card conditions.

6. Findings

TSA compiled and analyzed data from the three phases of the Reader Pilot; ITT, EOA, and ST&E to evaluate the technical impacts, operation impacts and feasibility of implementing a transportation security card reader system, in addition to addressing actions necessary to ensure the vessels and facilities are able to comply with future regulations.

Following delivery of the report to Congress, TSA intends to make available lessons learned from the pilot to assist those who may wish to use readers to reduce security risks and/or take advantage of access control efficiencies that can be achieved for many business models.

6.1 Technical Impacts

6.1.1 System Architecture

The Reader Pilot demonstrated that system architecture had a significant role in overall technical efficiency, performance, and throughput times. The pilot participant with a dedicated network that was only used by the TWIC readers and PACS showed faster transaction times, higher validation rates and fewer technical issues than those of other pilot participants which shared the network with other systems.

System configurations that used hard wired networks were more efficient with respect to network speed and availability than wireless networks. This was most evident in Mode 4 transactions that required the maximum amount of data to be transferred. Systems that included TWIC readers within the security architecture encountered fewer operational issues.

The Reader Pilot demonstrated that implementation costs were lower if pilot participants were able to use existing infrastructure. This reduced the need for additional installation costs associated with items such as permits and physical site preparations. As a result, these pilot participants required less time to begin and complete TWIC reader installations. On the other hand, sites that did not have an access control system prior to the Reader Pilot were able to optimize system choices for their particular facility.

6.1.2 Fixed Reader Use

The Reader Pilot demonstrated that the use of fixed readers with both contact and contactless interfaces yielded a higher validation rate than fixed readers that only used the contactless interface to read the card. A contact read required the TWIC card to be inserted into the contact slot of the TWIC reader, which reduced the potential for incorrectly placing the TWIC card to the TWIC reader and provided an alternative to the card's internal antennae.

The Reader Pilot also demonstrated that a successful contactless read required the user to hold the card motionless on or near the surface of the TWIC reader. Placing a TWIC card to the contactless sensor area of a contactless-only TWIC reader was not intuitive. Adding graphics showing where to hold the TWIC card were added during the pilot to some readers to help workers with the contactless read process and proved to be beneficial to TWIC holders. Any abrupt movements of the TWIC card during the contactless read increased the possibility of an

invalid transaction which required the user to repeat the transaction. In general, workers learned how to properly present their TWIC card, and for how long to hold their TWIC card when using contactless readers. However, some pilot participants expressed concern that longshoremen, truckers, and others who visit multiple facilities may have the same difficulties as they visit facilities and vessels that use different models of readers.

6.1.3 Portable Reader Use

The Reader Pilot demonstrated that the use of portable readers proved useful for pilot participants with small TWIC holder populations, and access points with minimal traffic. Some portable readers were able to conduct mobile registration into a PACS. Portable readers are useful for redundancy at fixed reader locations due to a variety of operational scenarios. The contact interface proved to be the preferred method of reading the TWIC card.

6.2 Operational Impact

6.2.1 TWIC Holder Training

The Reader Pilot demonstrated that switching among the different TWIC reader modes complicated the learning process, and therefore, impacted the efficiency of TWIC reader use. Without coaching or instruction from security personnel, TWIC holders were confused by the different procedural requirements for the different TWIC reader modes of operation. Attempts to notify TWIC holders of mode changes through signage or email were less effective. TWIC systems that remained in the same TWIC reader mode of operation for a sustained period allowed TWIC holders to perform better over time, as they became acclimated by repetitive use.

The Reader Pilot also demonstrated that TWIC holders had difficulty interacting with fixed readers from multiple manufacturers with differing designs and user interfaces. TWIC holders would not fully present or insert their TWIC card to a TWIC reader or would not leave the TWIC card in place long enough for the TWIC reader to complete the transaction. In addition, some TWIC holders presented the wrong finger, or did not hold their finger on the fingerprint sensor long enough to complete the transaction, resulting in a failed attempt to biometrically verify identity. These occurrences impeded operations and increased throughput times, as they required manual intervention or assistance from security personnel to resolve the situation.

6.2.2 Security Personnel Training

The Reader Pilot also demonstrated the need for training security personnel regarding TWIC reader and/or system usage. Without training, some security personnel struggled to master TWIC reader operations, recognize TWIC reader error messages, or troubleshoot concerns. Overall, these issues were more prevalent at pilot participants using portable TWIC readers.

6.2.3 Registration

The Reader Pilot demonstrated that registration of TWIC holders into a PACS was a time-consuming process that needed to be completed without error to avoid access denials at access points. Facilities and vessels that are in close proximity to each other may benefit from a cooperative registration effort. Some pilot participants that were located within the same geographical region chose to operate using a regional registration database. This was a

successful way to populate their various PACS; however, the decision by some pilot participants to require PINs during registration resulted in registration delays. Individuals who had forgotten their PINs needed to visit a TWIC enrollment center to have their PIN reset then return to complete the registration of their card.

6.2.4   Access Management

The Reader Pilot demonstrated the need to properly grant access rights when using a physical access control system. Some pilot participants failed to grant TWIC holders rights to specific access points, which increased the number of invalid transactions. Some of the pilot participants who registered their TWIC holders neglected to assign privileges during the process, resulting in denied access. Developing standard operating procedures to assign access privileges should mitigate this issue.

6.2.5   Canceled Card List

The Reader Pilot demonstrated that TWIC reader transaction times decreased when the CCL check was conducted as a back-end host batch process against a registered population of TWIC holders, rather than performing the CCL check during each presentation of the TWIC card to the TWIC reader. The CCL proved to be a successful approach for TSA to communicate to the field a list of cards that were no longer valid, and for the pilot participants to receive that information in a timely manner.

6.3   Feasibility

6.3.1   TWIC Reader/PACS Integration

The Reader Pilot demonstrated that TWIC readers approved for operation with their PACS encountered fewer integration and operational technical issues. Conversely, TWIC readers not approved for operation with their PACS took more time and resources to implement. Pilot participants with existing vendors that were included on the TSA ICE list were able to integrate their existing readers and software to TWIC-enabled versions with fewer complications.

TWIC reader systems would benefit from consistent transaction audit logs to allow for accurate understanding of transaction history, and to assist with troubleshooting.

6.3.2   Access Point Placement

The Reader Pilot demonstrated that the placement of fixed TWIC readers at pilot participant access points was a key variable on how TWIC reader use impacted the flow of traffic. Pilot participants that chose to integrate the use of fixed readers along with their respective business processes had fewer traffic flow disruptions. This was most evident in the flow of truck traffic. Placing the TWIC reader at a location and height where it could be easily accessed by the TWIC holder increased usability. The physical installation and location of readers are critical to ensuring efficient throughput at access points. In addition, readers that were placed at heights or distances awkward for drivers to reach slowed access and, in some cases, created a danger to drivers trying to reach misplaced readers. Reading the messages on the screens of readers not shielded from direct sunlight also prevented users from determining the cause of a denial of access.

6.3.3 Maintenance

The Reader Pilot demonstrated that TWIC readers installed in harsh environments will occasionally be contaminated with debris, and a maintenance program to perform regular inspections and cleaning cycles is necessary.

6.3.4 TWIC Reader Pilot Throughput Observations

This section compares and contrasts facility and vessel throughput against two baseline measures:

- The time to perform a visual inspection, and
- The throughput time per TWIC reader mode of operation as observed during ICE testing.

EOA and ST&E throughput depended upon several interrelated factors including the TWIC reader mode of operation, the smart card interface (i.e., contactless or contact) used, TWIC holder familiarity with TWIC readers, conditional need for the TWIC holder to present their fingerprint for biometric matching and the method implemented by the pilot participant to check the CCL.

6.3.4.1 Baseline Throughput for Visual Inspection

The baseline measure of throughput was the visual inspection of the TWIC card by the USCG personnel, a process taking approximately 6 seconds. Throughput times at all pilot participant access points were measured against this baseline.

6.3.4.2 Baseline Transaction Times Observed During ICE Testing

ICE transaction time is defined as the time taken for an ICE participant TWIC holder to obtain a favorable response from the TWIC reader. As opposed to throughput, ICE transaction time does not include the time it takes an individual to pass through an access point, since it is a bench test conducted in a simulated environment.

ICE was performed as a series of anticipated operational scenarios. System implementation for ICE was permitted to be constructed by the prospective TWIC reader vendor. For ICE, the vendor system implementation was presumed by TSA to represent a preferred configuration for their TWIC reader. ICE TWIC holders were selected as participants based on their familiarity with the use of their TWIC card for all four TWIC reader modes of operation a TWIC reader might support. TSA permitted either real or simulated PACS to be used during TWIC reader evaluation. The method of CCL checking was allowed to be optimized by the prospective TWIC reader vendor.

The TWIC reader baseline transaction times from ICE were:

Table 6-1: TWIC Reader ICE Transaction Times Baseline in Seconds by Mode of Operation

TWIC Reader	Mode 1	Mode 2	Mode 3	Mode 4

| Portable | 2.58 | 5.04 | 12.82 | 14.86 |
| Fixed | 1.75 | 4.00 | 8.36 | 8.40 |

The ICE baseline transaction time calculations are detailed in Appendix G.

6.3.4.3 Comparison of ICE Baseline Measures Against the Visual Inspection Baseline Measure

ICE transaction times were compared against the visual inspection time of 6 seconds. Please note that full identity verification was not performed in ICE for Mode 1 and Mode 2 to ensure an accurate measure of TWIC reader transaction times. In order to comply with current USCG regulations, a visual inspection would still need to be performed to ensure that the TWIC holder is who they say they are.

Mode 1 provides enhanced security over visual inspection using many automated cross checks including a canceled card check against the CCL. Mode 1, for fixed readers, was more than 3 times faster (343%) than visual inspection. Mode 1 for portable readers was more than twice as fast (233%) as visual inspection.

In addition to Mode 1 cross checks, Mode 2 ensures that the TWIC card presented is an authentic TWIC card. Mode 2, for fixed readers, was one and a half times faster (150%) than visual inspection. Mode 2 for portable readers was slightly faster (119%) than visual inspection.

In addition to Mode 1 cross checks, Mode 3 ensures that the TWIC holder is the intended bearer of the TWIC card. Mode 3, for fixed readers, was 2 seconds slower (71%) than visual inspection. Mode 3 for portable readers took an additional 4 seconds and was slower (47%) than visual inspection.

Mode 4, for fixed readers, was 2 seconds slower (71%) than visual inspection. Mode 4 for portable readers took an additional 6 seconds and was slower (40%) than visual inspection. Mode 4, the highest assurance of identity verification supported, provides a check that the TWIC card is authentic, that the TWIC holder is the intended bearer of the TWIC card and Mode 1 cross checks.

Figure 6-1 compares the confidence gained in identity verification with the time it takes to perform the different modes. It should be noted that in Modes 1 and 2, a visual inspection of the photograph must also be performed. This may add an additional 2-3 seconds since the expiration date and security features do not need to be verified.

Figure 6-1: TWIC Identity Verification Confidence versus Time
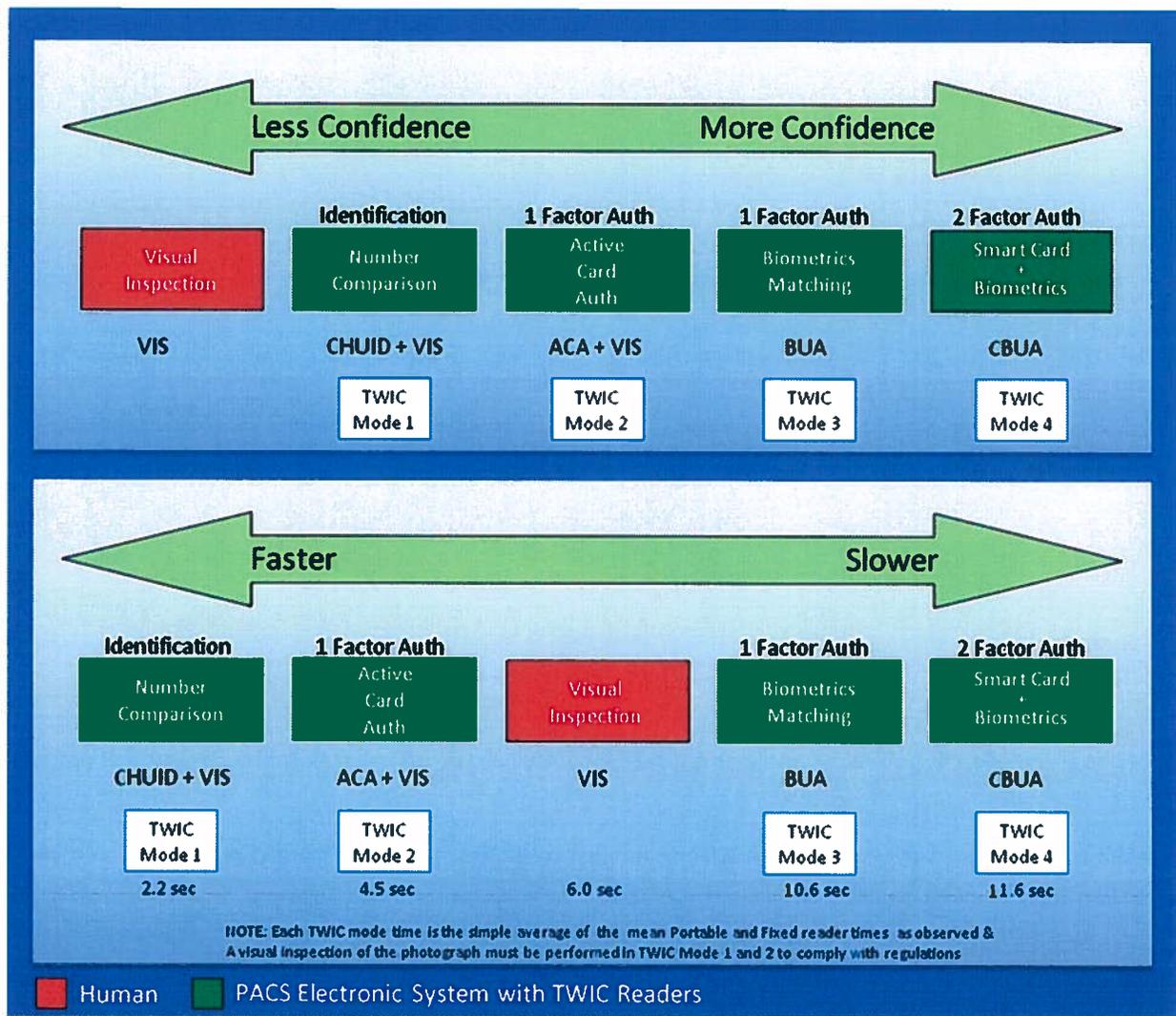
Throughputs for Mode 3 and Mode 4 reflect the time a TWIC holder needed to properly place their finger on a biometric sensor; a contributor in the final throughput value. Further, ICE observed that even experienced TWIC holders' finger placement on the biometric sensor would occasionally result in a failure to attain a biometric match, thereby, requiring a second attempt.

6.3.5 Conclusions

The Reader Pilot provided one of the first opportunities to gain knowledge of centrally issued card performance with independently designed and installed card reader systems in an actual long-term application. In order to successfully implement TWIC readers[23], the pilot showed that the installation of readers needs to be part of a wider effort, which includes an effective system

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[23] TSA is in the process of establishing a process to qualify reader products for use with the TWIC Program. Products that are deemed to be compliant with the TWIC specification will be placed on a list referred to as the TWIC Qualified Technology List (QTL) which can be used by owners and operators of the Port to make the purchasing decisions

architecture and PACS, functioning TWIC cards, and TWIC holders who are familiar with using TWIC readers. These responsibilities need to be shared by the government, the facility owner or operator, and the TWIC holder:

Government:
- Certify readers against the TWIC Reader Hardware and Card Application Specification;
- Ensure that government-issued TWIC cards can be read by certified readers; and,
- Provide best practices/lessons learned for implementing a TWIC reader system.

Facility:
- Develop sound access control plans taking into account business and operational needs;
- Ensure work is only performed by well-qualified system installers and integrators;
- Select certified readers appropriate for the conditions and needs of their particular facility; and,
- Train personnel in using the system commensurate with their job (i.e., a TWIC holder vs. security personnel).

TWIC holder:
- Take proper care of their TWIC card;
- Know and safeguard their PIN;
- Remember which finger to place on the reader fingerprint scanner to obtain a biometric match[24];
- Learn how to use the TWIC reader at each facility they have access; and,
- Ask for assistance when uncertain of the TWIC reader process.

Facilities and vessels employing the TWIC card as a site access card, in addition to identification, may benefit financially by reducing card management operational costs associated with identity vetting, card inventory, printing equipment, and issuance infrastructure.

While the operational and technological difficulties were wide-ranging, the Reader Pilot successfully examined the impacts to business. Although current infrastructure was key to installation costs and time the Reader Pilot also noted that reader performance varied widely and there were problems with the durability of the card stock and ability of the cards to be read by the various readers that were used throughout the pilot.

The TWIC Reader Pilot demonstrated that many options are available to facility and vessel operators for validating the authenticity of a TWIC card and verifying the identity of the holder. Regardless of the requirements in the final rule for TWIC reader use, a reader option suitable for the many MTSA-regulated facility or vessel operations should be available.

When the rule has been finalized, advance planning and attention to detail will be required by facility and vessel owners and operators to ensure that the TWIC reader and reader system installed performs the required functions and minimizes impacts on the operations of the facility

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[24] The fingerprints from the right and left index finger are favored when creating the two fingerprint algorithms placed on the card; however prints from other fingers may need to be used if the prints of the index fingers are of poor quality. This determination is made by the TWIC system. Workers are advised which fingers to use during the card activation process at TWIC enrollment centers.

or vessel. DHS will provide lessons learned and general guidance, but cannot provide a "one-size-fits-all" reader template due to the uniqueness of each regulated facility and vessel operation. Moreover, a TWIC reader program maximizing flexibility for vessels and facilities will encourage innovation in the card and card reader industry while meeting the regulatory needs of those facilities and vessels.

Despite the challenges noted throughout this report, the requirements of the SAFE Port Act to evaluate TWIC reader performance and impacts on business operations among a variety of MTSA-regulated facilities and vessels were met. This report, and the wealth of data contained in the many underlying reports, helps to inform the implementation of a rule specifying requirements for the use of TWIC readers.

Appendix A: **Glossary**

Access Control Point	A truck lane, door, turnstile, parking gate, or other physical barrier where granting access can be controlled
Biometric	As used within the TWIC Reader Pilot, the term refers to the fingerprint template stored on a TWIC card and/or the finger of a TWIC holder that is presented to the fingerprint scanner of a TWIC reader to biometrically match the TWIC card to the TWIC holder
Canceled Card List	List of canceled FASC-Ns maintained by TSA (formally known as the Hotlist)
Enrollment	The process that applies to obtaining a TWIC card from TSA at an established enrollment office
Fingerprint template	A live scan of a fingerprint which is digitally processed to create a collection of extracted features subsequently stored on a TWIC card for use in matching
Hotlist	See Canceled Card List
Identity Verification	The process of validating a claim of identity
Infrastructure	The basic physical and organizational structures needed for the operation of a TWIC system
Log	A chronological sequence of audit records, each of which contains evidence directly pertaining to and resulting from the execution of a business process or system function
Invalid Transaction	A transaction which occurs when either the TWIC card and/or fingerprint cannot be confirmed. (*However, an invalid transaction does not mean unescorted access was denied. Unescorted access may be granted in accordance with the USCG TWIC card visual inspection requirement*)
Mode	The data manner, way or method of doing or acting
Participant Group	The grouping of pilot participants of similar operational types

Registration	The process of entering a TWIC holder's credential data into a participant's access control system to obtain access rights to controlled areas
Risk Group	The risk-based model proposed by the USCG that separates vessels and facilities into one of three risk groups, each with its own TWIC reader requirements. The factors used to develop the risk groups include: (1) the maximum consequence resulting from a terrorist attack, e.g., injury and loss of life, economic and environmental impact, symbolic effect, national security impact, and first responder capability to mitigate consequences; (2) the criticality of the facility or vessel to the nation's health, economy, and national security; and (3) the ability of TWIC card to reduce risk. Further, in defining the three risk groups, the Coast Guard looked at whether there were differences in the hazardous nature of the cargo or in the number of passengers aboard a vessel. As risks increased based on changes in these factors, the Coast Guard defined a higher risk group. The highest risk group is Risk Group A, followed by lesser risk groups B and C
Throughput	The time taken for a vehicle or pedestrian to obtain entry and pass through an access point (details on events that impact throughput times can be found in Appendix E)
TWIC Card	A GSA FIPS201 Approved Product List (APL) PIV Smart Card that contains Transportation Worker specific credentials inclusive of reference biometric data and digital certificates that may be used by a TWIC Reader to verify, with high assurance, the identity of a Transportation Worker
TWIC Privacy Key	A symmetrical key used to recover the fingerprint biometric template without the use of a PIN
TWIC Reader	A smart card reader capable of authenticating a TWIC card and performing a biometric match to the fingerprint template stored on the card
Verified	After a TWIC holder has successfully presented his/her TWIC card to a reader, gaining access to a given port

Appendix B: Acronyms and Abbreviations

ACA	Active Card Authentication
ANPRM	Advanced Notice of Proposed Rulemaking
APL	Approved Product List
BAA	Broad Agency Announcement
BUA	Biometric User Authentication
CAT	Card Analysis Toolkit
CBP	U.S. Customs and Border Protection
CBUA	Card + Biometric User Authentication
CCL	Canceled Card List
CHUID	Card Holder Unique Identifier
DHS	Department of Homeland Security
DNDO	Department of Nuclear Detection Office
EHP	Environmental Historical Preservation
EMC	Electromagnetic Capability
EOA	Early Operational Assessment
E-SCT	Environmental Specification Conformance Test
FASC-N	Federal Agency Smart Credential Number
FEMA	Federal Emergency Management Agency
FIPS	Federal Information Processing Standard
F-SCT	Functional Specification Conformance Test
FY	Fiscal Year
ICC	Integrated Circuit Chip
ICE	Initial Capability Evaluation
IDTP	Identification Technology Partners
IPT	Integrated Product Team
IT	Information Technology
ITA	Independent Test Agent
ITT	Initial Technical Testing
MARAD	Maritime Administration
MTSA	Maritime Transportation Security Act of 2002
NAVAIR	U.S. Navy Naval Air Systems Command
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPRM	Notice of Proposed Rulemaking

NVIC	Navigation and Vessel Inspection Circular
OMB	Office of Management and Budget
PACS	Physical Access Control System
PDA	Personal Digital Assistant
PIN	Personal Identification Number
PIV	Personal Identity Verification
POC	Point of Contact
PSG	Port Security Grant
PTR	Problem Trouble Report
RF	Radio Frequency
SAFE Port Act	Security and Accountability For Every Port Act of 2006
SOVT	Systems Operational Verification Test
SSC-LANT	Space and Naval Warfare Systems Center, Atlantic
S&T	Science and Technology
ST&E	System Test and Evaluation
TEMP	Test and Evaluation Master Plan
TPK	TWIC Privacy Key
TSA	Transportation Security Administration
TWIC	Transportation Worker Identification Credential
USCG	United States Coast Guard
UV	Ultraviolet
VIS	Visual TWIC inspection
WPR	Weekly Performance Report

Appendix C: **Supporting Pilot Documentation**

The below flowchart shows the flow, structure, and relationship of each key TWIC Reader Pilot document beginning with the test plans, and ending with the final report. There are two chart shapes seen below representing data collection and reporting. The primary testing data elements consist of: Baseline, Technical, Operational, and Participant feedback. For the participant data, each site visit produced pilot data for trip reports which fed into the individual participant level reports for both the EOA and ST&E phases. Near the bottom of the chart, the overall pilot EOA and ST&E reports are shown to represent data from all participant reports. The key data from these reports were imported into the Final report in addition to site feedback and key points from the baseline, technical, and operational testing reports.
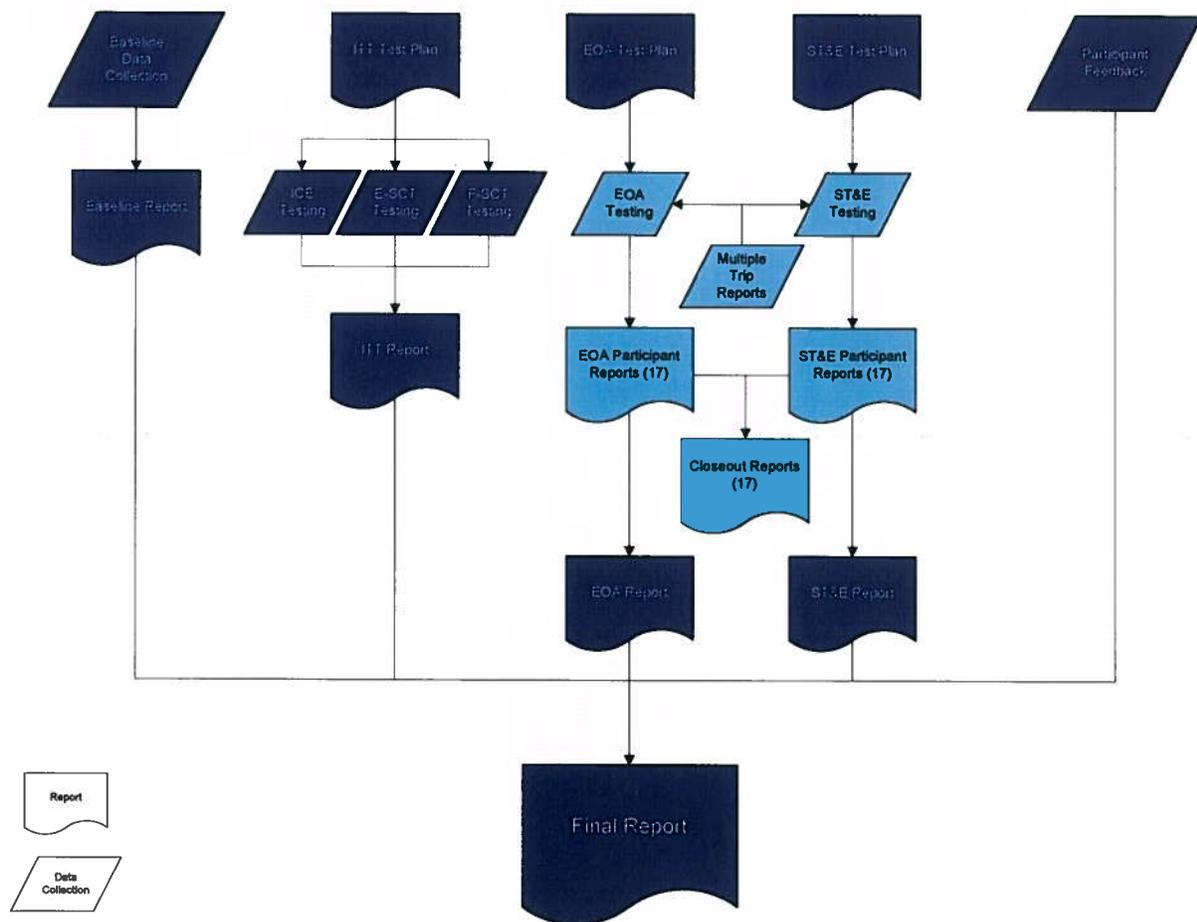
Appendix D: References

Law

- Aviation and Transportation Security Act (ATSA) of 2001 (P.L. 107–71)
- Maritime Transportation Security Act (MTSA) (P.L. 107-295), 116 Stat 2064, November 2002
- Security and Accountability For Every Port Act of 2006 (SAFE Port Act) (P.L. 109-347)
- The United States Coast Guard Authorization Act of 2010 (P.L. 111-281)

Regulatory & Policy

- Port Security/TWIC Program- Final Rule, January 2006
- Navigation and Vessel Inspection Circular no. 03-07; Subj: Guidance for the implementation of the Transportation Worker Identification Credential program in the maritime sector; July 2007
- Transportation Worker Identification Credential (TWIC) Implementation in the Maritime Sector; Hazardous Materials Endorsement for a Commercial Driver's License; Final Rule, January 2007 (72 F.R. 3492).

TWIC Documents

- System Overview and Concept of Operations Transportation Worker Identification Credential Program Phase IV Implementation, January 2006
- System Overview and Concept of Operations, Transportation Worker Identification Credential Program Phase IV Implementation, Version 2.0, July 20, 2006
- GAO-06-982 Report, TRANSPORTATION SECURITY, DHS Should Address Key Challenges before Implementing the Transportation Worker Identification Credential Program, September 2006
- Phase IV Master Test Plan (Document Number: TWIC-A016-07-0001), January 2007
- Test and Evaluation Master Plan (TEMP)
- Baseline Report
- Initial Technical Test Plan
- Initial Technical Test Report
- Initial Capability Evaluation Report
- Environmental Specification Conformance Report
- Functional Specification Conformance Report
- Mission Needs Statement for the TWIC Program, September 2006
- Participant Level EOA Reports
- Participant Level ST&E Reports

Technical

- FIPS Publication 201-1 Personal Identity Verification (PIV) of Federal Employees and Contractors (March 14, 2006)
- National Maritime Security Advisory Committee TWIC Working Group Maritime Operating Requirements, January 2007
- Transportation Worker Identification Credential (TWIC) Biometric Reader Specification and TWIC Contactless Smart Card Application Version 1.0, September 2007
- Transportation Worker Identification Credential (TWIC) Biometric Reader Specification and TWIC Contactless Smart Card Application Version 1.1.1, May 2008

Appendix E: Legislative Language

Maritime Transportation Security Act of 2002 (MTSA) (P.L. 107-295)

The TWIC Program provides a tamper-resistant biometric credential to eligible maritime workers requiring unescorted access to secure areas of port facilities and vessels regulated under the Maritime Transportation Security Act of 2002 (MTSA), P.L. 107-295. The TWIC Reader Pilot was established to ensure TWIC and TWIC reader interoperability and to assess the technical and operational impacts of implementing a transportation security card reader system.

Section 104 of the Security and Accountability for Every Port Act of 2006 (SAFE Port Act) (P.L. 109-347)

Requires the Department of Homeland Security (DHS) to submit the findings of the pilot program with respect to technical and operational impacts of implementing a transportation security card reader system; any actions that may be necessary to ensure that all vessels and facilities to which this section applies are able to comply with such regulations; and an analysis of the viability of equipment under the extreme weather conditions of the marine environment. The Department of Homeland Security managed the TWIC Reader Pilot through the joint participation of the Transportation Security Administration (TSA) and the United States Coast Guard (USCG).

Coast Guard Authorization Act of 2010 (P.L. 111-281)

SEC. 802 TRANSPORTATION WORKER IDENTIFICATION CREDENTIAL.

(a) IN GENERAL.—Not later than 120 days after completing the pilot program under section 70105(k)(1) of title 46, United States Code, to test TWIC access control technologies at port facilities and vessels nationwide, the Secretary of Homeland Security shall submit to the Committee on Homeland Security and the Committee on Transportation and Infrastructure of the House of Representatives, the Committee on Commerce, Science, and Transportation of the Senate, and to the Comptroller General a report containing an assessment of the results of the pilot. The report shall include—

(1) the findings of the pilot program with respect to key technical and operational aspects of implementing TWIC technologies in the maritime sector;

(2) a comprehensive listing of the extent to which established metrics were achieved during the pilot program; and

(3) an analysis of the viability of those technologies for use in the maritime environment, including any challenges to implementing those technologies and strategies for mitigating identified challenges.

(b) GAO ASSESSMENT.—The Comptroller General shall review the report and submit to the Committee on Homeland Security and the Committee on Transportation and Infrastructure of the House of Representatives, and the Committee on Commerce, Science, and Transportation of the Senate an assessment of the report's findings and recommendations.

Appendix F: Impacts to Throughput Times

The Reader Pilot demonstrated that many factors impacted throughput times. Throughput is defined as the time taken for a vehicle or pedestrian to obtain entry and pass through an access point. The timing process was as follows:

- Pedestrian – Timing began when the TWIC holder presented their TWIC card to the TWIC reader and ended once the TWIC holder proceeded through the access point.
- Vehicle/Truck – Timing began once the vehicle stopped and ended when the vehicle moved forward through the access point.

The following had the most significant impact on throughput times:

TWIC Holder Training

- Unfamiliarity with how to use their TWIC card with the TWIC reader;
    - Multiple read attempts occurred due to TWIC holder not fully presenting their TWIC card and/or not holding their TWIC card in place long enough for the TWIC reader to complete the transaction.
- Not prepared to present their TWIC card as they approached the access point;
    - TWIC card was located in the vehicle/truck or wallet. TWIC holders had to remove objects from their hands before their TWIC card could be presented to TWIC reader.
- Not remembering which finger to use to obtain a biometric match and multiple attempts were made to obtain a biometric match with the wrong finger;
- Reluctant to use TWIC readers; and
- Distracted by conversations with security or facility personnel.

Access Management

- TWIC card was not registered in the PACS or access rights were not properly assigned.

Placement of Fixed Readers

- TWIC reader was positioned where the pedestrian could not see the display panel;
- TWIC reader was positioned where the driver was unable to reach without having to remove their seatbelt, place the truck/vehicle in park, turn the truck/vehicle off or get out of the truck/vehicle to use the TWIC reader; and
- Container Terminals experienced truck drivers who stalled their engine when trying to proceed through the access point after using the TWIC reader.

TWIC Card Issues

- TWIC cards with intermittent antenna problems were presumed to be defective or the TWIC holder had to bend the TWIC card to work

Facility Processes

- Turnstiles used for both ingress/egress traffic had to wait for egress traffic to clear before using the TWIC reader;
- Drivers entering the wrong lane, not familiar with facility layout or have discrepancies with container number or other documents caused delays; and
- Some facilities had random vehicle/truck MARSEC spot inspections.

System Architecture

- Wireless systems can have a delay which caused the fixed reader to timeout while waiting for the TPK response from the PACS;
    - System/network piggy backed by other systems also caused delays
- Facility firewalls caused the TWIC reader to timeout; and
  The PACS releasing the lock on the turnstile or engaging the lift-gate/physical barrier caused time delays.

Appendix G: Initial Capability Evaluation Baseline Throughput Calculations

The calculations for the Initial Capability Evaluation (ICE) baseline throughput values are shown in Tables G-1 and G-2 respectively of types of readers and modes.

The ICE process resulted in 16 portable and 13 fixed TWIC readers approved for placement on the ICE List.

Reader / Mode	Mode 1 Fastest	Mode 1 Slowest	Mode 2 Fastest	Mode 2 Slowest	Mode 3 Fastest	Mode 3 Slowest	Mode 4 Fastest	Mode 4 Slowest
Portable 1	6	6	8	8	11	14	17	18
Portable 2	2	3	4	5	8	9	10	11
Portable 3	2	3	5	7	13	15	18	20
Portable 4	2	3	4	4	6	9	11	11
Portable 5	1.5	3	4	6	13	14	15	16
Portable 6	2	2	3	4	10	19	11	14
Portable 7	1.3	1.5	4	4	10	13	14	14
Portable 8	2	3	6	6	11	15	14	14
Portable 9	4	4	6	7	14	20	21	21
Portable 10	6	6	5	6	9	11	15	15
Portable 11	0.5	0.5	5	5	13	23	16	16
Portable 12	1.5	2	4	5	2	10	11	11
Portable 13	3	5	5	6	25	27	25	27
Portable 14	1	1	5	5	6	9	11	11
Portable 15	2	2	4	4	5	7	10	10
Portable 16	1.6	1.7	5	5	12	25	20	20
Mean (*)	2.3	2.9	4.7	5.4	10.9	14.7	14.6	15.1
Baseline	2.58		5.04		12.82		14.86	

Table G-1: Portable reader ICE throughput in seconds by TWIC reader mode

(*) The mean is computed as ((Sum of all times) – Fastest – Slowest) / (14)

Baseline values for each mode as shown in Table 6-1 is therefore (Fastest Mean + Slowest Mean) / 2.

A blue colored cell represents an excluded value when calculating the mean.

Reader / Mode	Mode 1 Fastest	Mode 1 Slowest	Mode 2 Fastest	Mode 2 Slowest	Mode 3 Fastest	Mode 3 Slowest	Mode 4 Fastest	Mode 4 Slowest
Fixed 1	1	1	N/A	N/A	7	7	N/A	N/A
Fixed 2	1	1	4	4	5	8	10	10
Fixed 3	1	2	4	4	4	8	8	8
Fixed 4	2	2	4	4	5	7	10	10
Fixed 5	1	1	4	4	3	5	7	7
Fixed 6	1	2	4	4	7	7	7	7
Fixed 7	1	2	4	4	7	7	6	6
Fixed 8	4	4	N/A	N/A	8	13	N/A	N/A
Fixed 9	0.6	0.7	N/A	N/A	14	19	N/A	N/A
Fixed 10	2	2	N/A	N/A	5	18	N/A	N/A
Fixed 11	1.5	2	N/A	N/A	5	19	N/A	N/A
Fixed 12	2	2	N/A	N/A	2	4	N/A	N/A
Fixed 13	4	5	N/A	N/A	10	15	18	18
Mean (*)	1.6	1.9	4.0	4.0	6.0	10.7	8.4	8.4
Baseline	1.75		4.00		8.36		8.40	

Table G-2: Fixed reader ICE throughput in seconds by TWIC reader mode

(*) The mean is computed as ((Sum of all times) – Fastest – Slowest) / (Number of included values)

Baseline values for each mode as shown in Table 6-1 is therefore (Fastest Mean + Slowest Mean) / 2.

A blue colored cell represents an excluded value when calculating the mean.

Appendix H: TWIC Reader Pilot Activity and Milestone Estimated and Actual Completion Dates

Activity / Milestone	Estimated Completion	Actual Completion	Description
Develop Contactless Card / Reader Specification			
Obtain TWIC Contactless Specification Recommendation from the National Maritime Security Advisory Committee (NMSAC) Note: The smart card reader industry required the specification to integrate TWIC functionality into contactless readers.	28-Feb-07	28-Feb-07	In response to TSA/USCG request, NMSAC recommended a specification enabling the TWIC biometric to be read by contactless readers. The recommended specification included reader performance requirements consistent with operations in the maritime environment.
Publish NMSAC Recommended Specification for Public Comment	Mar-07	16-Mar-07	The comment period was 15 days. Thirty comments were received.
Publish Working Contactless Specification	Aug-07	20-Sept-07	Following a review of comments and technical alignment, TSA published the working specification. Development of contactless readers and the TWIC card application began.
Reader industry delivers first TWIC contactless readers for testing and installation at limited number of test facilities.	FY08 Q3	27-Aug-08	Readers and TWIC cards with a contactless capability are required prior to beginning pilot testing of contactless performance.
Identify Pilot Test Locations / Sites			
Hold Initial Meetings with Port of Los Angeles (POLA) / Port of Long Beach (POLB)	Dec-06	7-Dec-06	DHS/TSA/CG representatives met with POLA/POLB officials to discuss pilot test plans and finalize Cooperative Agreements.
Establish Goals for Gaining Participation of a Variety of Pilot Test Locations / Facilities / Vessels	Mar-07	Mar-07	In conjunction with USCG identified desired mix of facilities / locations / vessels for pilot tests: Locations: East Coast, West Coast, Gulf Coast, Great Lakes, Inland Rivers Facilities: container, petro-chemical, bulk cargo, large passenger terminals Vessels: small passenger, ferries, and towboats
Hold Initial Meetings with Port of NY / NJ	May-07	1-May-07	Reviewed potential test facilities and their respective advantages / constraints.
Hold Initial Discussions with Port of Brownsville, TX and Passenger Vessel Association (Watermark Cruises of Annapolis, MD)	Jul-07	13-Jul-07	Confirmation of interest in pilot; Port Security Grant status; initiated planning for site visits.
Conduct various site visits to gather detailed baseline and test scenario data.	On-going until pilot end	31-May-11	Site data collection ended as of 31 May.
Identify additional primary test participating ports / facilities / vessels	Ongoing until pilot end	Jul-10	The current pilot sites will provide sufficient data to achieve all goals of the pilot.

Activity / Milestone	Estimated Completion	Actual Completion	Description
Test Planning			
Establish TWIC Test Planning Working Group (TPWG)	Mar-07	28-Mar-07	DHS established a TPWG which includes system and test engineers and other resources to plan and oversee the pilot test.
Develop TWIC Test and Evaluation Master Plan (TEMP)	Aug-07	14-Dec-07	The TEMP identified the pilot test concept, scope, resources, and test plan requirements. It was approved by DHS. The TEMP identifies the following critical items: --Testing TWIC card and reader performance --Obtaining an Independent Test Agent (ITA) to perform test integrator tasks (i.e., plan / oversee tests; collate data; prepare final report --Develop a Test Plan -- Obtain test data that will support rulemaking requirements.
Develop Early Operational Assessment (EOA) Test Plans	FY09 Q3	18-Mar-09	Established test plans that addressed specific tests to be accomplished during the EOA phase.
Initial Technical Testing (ITT)	Dec-09	Mar-10	Evaluated card reader technology. Determined if industry-developed biometric card readers met TWIC card reader working specifications by conducting technical and environmental laboratory testing.
Conduct Early Operational Assessment (EOA)	FY11-Q2	FY11-Q3	EOA began April 2009. Some late starting sites caused EOA to be extended into Q3 FY-11.
Conduct Full System Impact Testing (ST&E Phase)	FY11 Q2	FY11-Q3	ST&E began November 2009. Some late starting sites caused EOA to be extended into Q3 FY-11.
Complete Testing, Prepare Final Test Evaluation and Analysis	FY11 Q3	FY11-Q4	Assessment of interim data throughout the pilot enabled the final report to be drafted shortly after the conclusion of data collection.

The voluntary nature of the Reader Pilot, coupled with competing business priorities of the participants, caused occasional delays in achieving identified milestones.