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Test and Evaluation Plan for the Checkpoint Evaluation at the Hartsfield Atlanta International Airport

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Systems Integration Branch
Federal Aviation Administration
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May 2001

Test and Evaluation Plan

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16. Abstract
This document describes a plan to conduct baseline and follow-up measurements of operational effectiveness and efficiency of the security checkpoint at Hartsfield Atlanta International Airport. The project will consist of carefully structured observations of checkpoint tasks under operational conditions. Data collection will be accomplished by live observation of the checkpoint and the use of video recordings from the airport's closed-circuit security monitoring system. Analyses will specifically focus on screener's adherence to standard operating procedures, individual and bag volume, and timing of individual- and bag-screening procedures.

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EXECUTIVE SUMMARY

This test and evaluation plan describes the baseline and follow-up checkpoint evaluation at Delta Airline's main checkpoint (North Terminal) at Hartsfield Atlanta International Airport. Data will be collected to establish baseline checkpoint effectiveness and efficiency measures. The checkpoint will be undergoing modifications, which will include being equipped with advanced security technologies. On completion of these changes, a follow-up study will be performed and analyzed to evaluate the effects of the modifications on performance.

Analysis of the data will compare pre- and post-modification performance on the Measures of Performance at the checkpoint. The primary analytic statistics will be Chi-Square for data based on counts and frequencies and *t*-test or analysis of variance for continuous data. Quick-look reports will be prepared summarizing the results of the data collections, and a final report will discuss the comparison between pre- and post-modification performance.

ACRONYMS

ATL	Hartsfield Atlanta International Airport
BWMTD	Back Walk-Through Metal Detector
COIC	Critical Operational Issues and Criteria
CSS	Checkpoint Security Supervisor
ETD	Explosives Trace Detector
FAA	Federal Aviation Administration
FWMTD	Front Walk-Through Metal Detector
HFE	Human Factors Engineer
KSA	Knowledge, Skills, and Abilities
MOP	Measure of Performance
SOP	Standard Operating Procedure
WTMD	Walk-Through Metal Detector

1. INTRODUCTION

The Aviation Security Improvement Act, Public Law 101-604, mandates the Federal Aviation Administration (FAA) to enhance and improve X-ray baggage screener selection, training, and performance. The effectiveness of the national civil aviation security system is highly dependent upon the people trained to enforce airport security, especially those employed as checkpoint screeners. Therefore, the FAA is very interested in measuring and enhancing screener performance and further improving their readiness for the job, as well as optimizing the checkpoint design for maximal threat detection and throughput. The Aviation Security Human Factors Program (AAR-510) of the Aviation Security Research and Development Division is the FAA unit tasked with this responsibility.

1.1 Background

Checkpoint effectiveness and efficiency baselines have been performed at Dallas/Fort Worth International, Detroit Metropolitan Wayne County International, and Seattle-Tacoma International Airports [1-5]. These evaluations identified the baseline status of checkpoints in the terms of efficiency of individual and baggage movement and effectiveness in screening individuals and bags. A baseline evaluation was never performed for the Human Factors Test Bed located at the Hartsfield Atlanta International Airport (ATL).

1.2 Scope

This project is to collect, analyze, and report baseline data for screeners' adherence to standard operating procedures (SOPs), individual and bag volume, and timing of individual- and bag-screening procedures for each position at the ATL checkpoint. These baseline data will then be compared to identical measures from a follow-up data collection.

2. CRITICAL OPERATIONAL ISSUES AND CRITERIA

The Critical Operational Issues and Criteria (COIC) and Measures of Performance (MOPs) that will be investigated are listed in the following subsections. These measures will be used to determine whether certain criteria have been met.

2.1 Issue 1 - Screening of Individuals

Are checkpoint procedures effective and are staffing and equipment levels adequate to prevent individuals from carrying threats through the checkpoint? Do screeners follow SOPs when screening individuals? Do individual volume levels affect detection of threat objects on individuals?

> Criterion 1-1. There is no loss of effectiveness in threat detection for individuals with changes at the checkpoint.
>
> > MOP 1-1-1. Type and frequency of errors in Front Walk-Through Metal Detector (FWTMD) procedures with differing volumes of people

MOP 1-1-2. Type and frequency of errors in Back Walk-Through Metal Detector (BWTMD) procedures with differing volumes of people

MOP 1-1-3. Type and frequency of errors in hand-wanding procedures with differing volumes of people

MOP 1-1-4. Type and frequency of errors in pat-down search procedures

MOP 1-1-5. Number of Walk-Through Metal Detectors (WTMDs), hand wands, X-ray machines, and Explosives Trace Detectors (ETDs) machines

MOP 1-1-6. Number of screeners assigned to each function, with differing volumes of people

2.2 Issue 2 - Screening of Carry-On Baggage

Are checkpoint procedures effective and are staffing and equipment levels adequate to prevent threats in baggage from going through the checkpoint? Do screeners follow SOPs when screening baggage? Does bag volume affect detection of threat objects in baggage?

Criterion 2-1. There is no loss of effectiveness in threat detection for carry-on baggage with changes at the checkpoint.

MOP 2-1-1. Type and frequency of errors in X-ray operations with differing volumes of bags

MOP 2-1-2. Type and frequency of errors in bag-search procedures

MOP 2-1-3. Type and frequency of errors in trace procedures with differing volumes of bags

2.3 Issue 3 - Exit Lane Monitoring

Are exit-lane monitors vigilant in guarding the sterile area?

Criterion 3-1. Investigative in nature. There is no loss of exit-lane security with checkpoint changes.

MOP 3-1-1. Number and duration of times the exit-lane monitor is apparently less than 100% vigilant (engaged in conversation, reading, or other activities)

2.4 Issue 4 - Timing and Volume Measures for Individual Screening

Criterion 4-1. Investigative in nature.

MOP 4-1-1. Amount of time to process each person through the FWTMD with differing volumes of people

MOP 4-1-2. Amount of time to process each person through the BWTMD with differing volumes of people

MOP 4-1-3. Amount of time to process each person with a hand-held metal detector with differing volumes of people

MOP 4-1-4. Type and frequency of individual screening procedures (i.e., FWTMD, BWTMD, hand-wanding, and pat downs) for experimental and control groups

2.5 Issue 5 - Timing and Volume Measures for Carry-On Bag Screening

Criterion 5-1. Investigative in nature.

MOP 5-1-1. Amount of time for X-ray scanning with differing volumes of bags

MOP 5-1-2. Amount of time for searching bags with differing volumes of bags

MOP 5-1-3. Amount of time for using trace detection on bags with differing volumes of bags

MOP 5-1-4. Amount of time people wait for their bags with differing volumes of bags

MOP 5-1-5. Type and frequency of baggage-screening procedures (i.e., X-ray screening, bag searches, and bag traces) for experimental and control groups

2.6 Issue 6 - Supervision

Does supervision contribute to effective and/or efficient screening procedures?

Criterion 6-1. Investigative in nature. The effectiveness of supervisor's interventions must be inferred from behavioral and situational cues.

MOP 6-1-1. Type and frequency of errors in screening procedures corrected by supervisors with differing volumes of people

3. METHOD

Most checkpoint operations can be subdivided into a set of discreet tasks performed by screeners and supervisors. Each task serves the overall mission of effectively deterring and detecting threats and efficiently screening individuals and their baggage. Human Factors Engineers (HFEs) reviewed previous analyses of checkpoint operations and the knowledge, skills, and abilities (KSAs) [6-8] involved in performing specific checkpoint tasks. Based upon that review and the need to acquire particular information relevant to issues of throughput, security breaches, and threat detection, HFEs developed a set of evaluation checklists (see Appendix A). These checklists organize the evaluation of specific checkpoint tasks by determining how frequently a task is performed, whether task-based KSAs are followed, and the time required to complete each task.

HFEs will use these forms to record data from both real-time information at the checkpoint and videotapes from security cameras. In addition, HFEs will always record the following parameters whenever data are being collected: (1) individual and bag volume, (2) the condition of all operating equipment, and (3) the number of screeners and supervisors working the checkpoint.

3.1 Site

Delta Airline's main checkpoint is located in the North Terminal of ATL. It is very large, open, and spread out and is comprised of multiple X-ray machines, metal detectors, and ETDs. The Checkpoint Security Supervisor (CSS) station is located on a raised podium (in the center of the checkpoint) behind the X-ray machines and WTMDs.

The ATL checkpoint will be undergoing modifications that will include being equipped with advanced security technologies. These modifications will be completed prior to the follow-up evaluation.

3.2 Procedure

Two HFEs will travel to ATL for 2 days prior to baseline data collection to observe closed-circuit camera locations, their panning and zooming abilities, videotape recording capabilities, remote-monitoring areas, checkpoint layout, and checkpoint procedures. This will be performed to develop an effective and efficient plan for data collection. A schedule will be developed that will allow them to collect data under different levels of individual volume. This schedule will be based on the anticipated volume of passengers and flight departure times provided by Delta during the planning trip.

Baseline data will be collected and analyzed for screeners' adherence to SOPs, individual and bag volume, and timing of individual- and bag-screening procedures for each position at the ATL checkpoint. These will then be compared to identical measures from the follow-up data collection. It is anticipated that 7 days will be required to collect sufficient baseline data.

The follow-up visit will be conducted a reasonable time after changes have been made so that throughput and screening effectiveness become stable. The same measures will be recorded as in the baseline data recording. The COIC will be investigated by a statistical comparison of baseline and follow-up measures to see if there are any differences in screening performance and throughput.

During the baseline evaluation, information gathered at the checkpoint will include the number of X-ray machines, FWTMDs, BWTMDs, hand-held metal detectors, and ETD systems available during data collection events. The number of screeners on duty (by position) and supervisors will be noted, along with the volume of individuals and bags being screened. Each of the MOPs will be recorded under varying individual and bag volumes (i.e., low and high) to determine if there are any significant differences in screener performance between volume levels. A prepared checklist (see appendix A) will be used to record major deviations from SOPs. Checkpoint operations will be observed at various times of the day and week to acquire baseline measures for low and high traffic volumes. Where possible, traffic volume will be based upon actual counts rather than subjective estimates. In accordance with the COIC, data collectors

a. will evaluate the overall effectiveness of baggage screening positions (i.e., the X-ray operator, bag checker, and trace operator),

b. will evaluate the performance of the exit-lane monitor,

c. will evaluate the frequency and duration of individual screening procedures (e.g., FWTMD, BWTMD, hand-wanding, and pat downs),

d. will record the frequency of all baggage-screening activities (i.e., X-ray screening, physical bag searches, and bag traces) and the amount of time it takes to screen bags at each activity, and

e. will evaluate CSS activities and record the frequency (if any) of errors and their effectiveness.

A follow-up data collection session will take place at the same location as the baseline using the same measures and following the same procedures and protocol. The date for this phase of data collection will be determined after advance technology equipment has been deployed or checkpoint modifications have been completed.

3.3 Data Analysis

The primary objective of the follow-up studies is to evaluate any changes in performance at the checkpoint resulting from modifications. The analyses will compare pre- and post-modification data. The primary statistical tools will be Chi-Square, *t*-test, and analysis of variance. Where significant performance changes have occurred, HFEs will attempt to determine the basis for the changes, although this may not be possible in all cases.

When data are frequencies and counts, Chi-Square analysis will be used to compare pre- and post-modified frequency. Other data (latencies, durations, etc.) will be analyzed by *t*-tests or analysis of variance, where appropriate.

4. DOCUMENTATION

Quick-look reports will be prepared summarizing the results of the data collections. A final report will discuss the comparison between pre- and post-modification performance.

5. TEST LIMITATIONS

Not all changes to the checkpoint between baseline and follow-up data collection phases can be controlled. Further, any changes can contribute to baseline/follow-up differences. This includes personnel changes due to attrition and modifications to procedures.

Evaluating the COIC may be affected by the amount of activity at the checkpoint. The availability of security personnel and equipment may also vary.

Another limitation is that the ATL checkpoint is very wide and open, making it very difficult to gather data without being observed by the participants. HFEs may have to rely solely on a live video feed to gather data, which leads to another possible limitation. HFEs do not know whether the closed-circuit television cameras have the capability to be orientated to maximize data collection efforts. Generally, cameras at the checkpoint are focused on individuals entering the checkpoint and are used to identify people who breach the sterile area. They tend not to be focused on the screeners themselves.

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APPENDIX A
Evaluation Checklists for Checkpoint Tasks

Form 1
Security Personnel and Equipment

This form is filled out as checkpoint background information on the available personnel and equipment.

Security Personnel and Equipment

Date _____ Time _____

Number of Personnel

X-Ray Screeners	_____
Bag Checkers	_____
Trace Operators	_____
Front walk-through metal detector Operators	_____
Back walk-through metal detector Operators	_____
Exit Lane Monitors	_____
CSSs	_____
Hand Wanders	_____

Amount of Equipment

X-Ray Machines	_____
Front walk-through metal detectors	_____
Back walk-through metal detectors	_____
Hand Wands	_____
ETDs	_____

Form 2
Individual Volume

This form is filled out for different volumes of people passing through the checkpoint. Each row is completed for some fixed amount of time (e.g., 5 minute timing duration) and entries represent the number of occurrences for each column.

Passenger Volume

Volume	Date	Start/End Time	Front WTMD	Re-WTMD	Back WTMD	Hand Wand	Pat Down	Timing Duration_____ **Notes:**
1. Low								
2. Low								
3. Low								
4. Low								
5. Low								
6. Low								
7. Low								
8. Low								
9. Low								
10. Low								
11. High								
12. High								
13. High								
14. High								
15. High								
16. High								
17. High								
18. High								
19. High								
20. High								

Form 3
Individual Timing

This form is filled out for the amount of time it takes for people to pass through various segments of the checkpoint. Each row is completed for some fixed amount of time (e.g., 5 minute timing duration) and entries represent the time for each column. It is difficult for a single data collector to time each of these segments for all of the people passing through. It is instead suggested that individual columns be scored, one at a time, during each sampling duration.

Passenger Timing

Timing Duration_____

Time Interval	Date	Start/End Time	Front WTMD Time	Re-WTMD Time	Back WTMD Time	Hand Wand Time	Pat Down Time	**Notes:**
1								
2								
3								
4								
5								
6								
7								
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9								
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Form 4
Bag Volume

This form is filled out for different volumes of bags passing through the checkpoint. Each row is completed for some fixed amount of time (e.g., 5 minutes) and entries represent the number of occurrences for each column.

Bag Volume

Timing Duration_____

Volume	Date	Start/End Time	Number X-Rayed	Number Searched (whole/limited)	Number Traced	Notes:
1. Low						
2. Low						
3. Low						
4. Low						
5. Low						
6. Low						
7. Low						
8. Low						
9. Low						
10. Low						
11. High						
12. High						
13. High						
14. High						
15. High						
16. High						
17. High						
18. High						
19. High						
20. High						

Form 5
Bag Timing

This form is filled out for the amount of time it takes for carry-on bags to pass through various segments of the checkpoint. Each row is completed for some fixed amount of time (e.g., 5 minutes) and entries represent the time for each column. It is difficult for a single data collector to time each of these segments for all of the bags passing through. It is instead suggested that individual columns be scored, one at a time, during each sampling duration.

Bag Timing

Timing Duration_____

Time Interval	Date	Start/End Time	X-Ray Time	Trace Time	Bag Search Time & Whole or Limited	Time Individual Waits	**Notes:**
1							
2							
3							
4							
5							
6							
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11							
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Form 6
X-ray Operations

Each row of this form is completed for some fixed amount of time (e.g., 5 minutes) and entries represent the number of occurrences for each column.

X-Ray Operations

Date _____ Start Time _____ End Time _____ Traffic Volume _____ X-Ray # _____

Timing Duration_____

Notes:

Time Interval	No Errors	Fails to Orient to Monitor	Convetsations with Belt On	
1				
2				
3				
4				
5				
6				
7				
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Form 7
Bag Search

Each row of this form is completed for some fixed amount of time (e.g., 5 minutes). Entries represent the number of occurrences for each column and search errors are noted.

Bag Search

Date _____ Start Time _____ End Time _____ Traffic Volume _____

Passenger	No Errors	Limited/Whole Bag Check (L/W)	Fails to Ask Permission	Fails to Maintain Control of Bag	Fails to Check All Pockets	Fails to Open Bag Toward Self	Fails to Check in Circular Pattern	Fails to Check Top, Bottom and Sides of Bag	Fails to Check Through Layers of Clothing	Fails to Check Individual Containers Within Bag	Fails to Restrict Passenger's Access to Contents of Bag	Duration	Notes:
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
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39													

Form 8
Trace Operations

Each row of this form is completed for some fixed amount of time (e.g., 5 minutes). Entries represent the number of occurrences for each column and search errors are noted.

Trace Operations

Date _____ Start Time _____ End Time _____ Traffic Volume _____ Trace Machine # _____

Timing Duration_____

Passenger	No Errors	Fails to Acquire Consent	Fails to Maintain Control	Fails to Carry bag by Sides	Fails to Swab Zippers, etc	Fails to Swab Handle Last	Only 1 Bag on Table	**Notes:**
1								
2								
3								
4								
5								
6								
7								
8								
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12								
13								
14								
15								
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Form 9
Front WTMD

A row of this form is completed for each individual passing through the walk-through metal detector. Entries represent procedural errors made by the screener monitoring the front walk-through metal detector.

Front WTMD

Date _____ Start Time _____ End Time _____ Traffic Volume _____ WTMD # _____

Timing Duration_____

Passenger	No Errors	Inappropriate Items thru WTMD	Fails to Check Divest Tray	Fails to Check Carried Items	Fails to Check Electronics	No Transition to Back WTMD	Engaged in Conversation	**Notes:**
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
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Form 10
Back WTMD

A row of this form is completed for each individual passing through the walk-through metal detector. Entries represent procedural errors made by the screener monitoring the back walk-through metal detector.

Back WTMD

Date _____ Start Time _____ End Time _____ Traffic Volume _____ WTMD # _____

Timing Duration_____

Passenger	No Errors	Fails to Direct Divestiture	Fails to Direct Thru WTMD	Fails to Monitor Alarm Status	Fails to Direct For Hand Wand	Fails to Direct For Pat Down	Fails to Search Divest Tray	**Notes:**
1								
2								
3								
4								
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8								
9								
10								
11								
12								
13								
14								
15								
16								
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Form 11
Hand Wanding

A row of this form is completed for each individual that is hand-wanded. Entries represent procedural errors made by the screener performing the hand-wanding operations.

Hand Wanding

Date _____ **Start Time** _____ **End Time** _____ **Traffic Volume** _____

Passenger	No Errors	Fails to Ask Permission	Fails to Direct Pass. To Divest	Fails to Search Divest Tray	Fails to Test Hand Wand	Fails to Ask Pass. To Spread Arms	Touches Pass. With Hand Wand	Fails to Outline Body	Fails to Check Front/Back of Pass.	Fails to Positively ID Each Alarm	Fails to Resume Wanding at Alarm	Fails to Inspect Belt Buckle/Hat	Fails to Check Ankles & Back	Duration	**Notes:**
1															
2															
3															
4															
5															
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Form 12
Whole-Body Pat Down

A row of this form is completed for each individual undergoing a whole-body pat down. Entries represent procedural errors made by the screener performing the pat down.

Whole-Body Pat Down

Date _____ **Start Time** _____ **End Time** _____ **Traffic Volume** _____

Passenger	No Errors	Fails to Ask Permission	Searched by Opposite Sex	Fails to Ask Pass. To Divest	Fails to Inspect Divest Tray	Fails to Ask Pass. To Spread Arms	Fails to Check Arms/Legs	Fails to Use Back of Hands	Fails to Check Front/Back	Fails to Check Sides	Fails to Check Waist Area	Fails to Check Shoes/Boots	Fails to Check Crotch Area with Hand Wand	Duration	**Notes:**
1															
2															
3															
4															
5															
6															
7															
8															
9															
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Form 13
Exit Lane

Each row of this form is completed for some fixed amount of time (e.g., 5 minutes) and entries represent the number of occurrences for each column.

Exit Lane

Date _____ **Start Time** _____ **End Time** _____ **Traffic Volume** _____

Timing Duration_____

Notes (including circumstances accompanying a breach)**:**

Time Interval	No Errors	Fails to Orient Self to Public Area	Duration/# of Times Not Vigilant	Duration/# of Times Screened & Unscreened in Close Proximity	# of Equipment Screened	# of Individuals Screened	
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39							

Form 14
Equipment Search

Each row of this form is completed for some fixed amount of time (e.g., 5 minutes) and entries represent the number of occurrences for each column.

Equipment Search

Date _____ Start Time _____ End Time _____ Traffic Volume _____

Timing Duration_____

Notes:

Passenger	No Errors	Fails to Check Seat Pan (Inside)	Fails to Check Seat Pan (Outside)	Fails to Check Seat Back (Inside)	Fails to Check Seat Back (Outside)	Fails to Check Compartments	Fails to Check Undercarriage	Fails to Check Other Component	
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Form 15
Checkpoint Security Supervisor

Each row of this form is completed for some fixed amount of time (e.g., 5 minutes) and entries represent the number of occurrences for each column.

Checkpoint Security Supervisor

Date _____ Start Time _____ End Time _____ Traffic Volume _____

Timing Duration_____

Notes:

Time Interval	No Errors	Corrects Screener Errors	Clears Special Individuals	Rotates Screeners	Tests Screeners	Fails to Dress Distinctively	
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Form 16
Individual Activities

Each row of this form is completed for some fixed amount of time (e.g., 5 minutes) and entries represent the number of occurrences for each column.

Passenger Activities

Date _____ Start Time _____ End Time _____ Traffic Volume _____

Timing Duration_____

Passenger	No Inefficiencies	Waiting for Family/Friends, Arranging Bags, Etc.	Didn't Take Most Direct Route Out of Checkpoint	Stood in Back Mag. Line Unnecessarily	Asked Screeners/ CSS Questions	Amount of Time Spent in Checkpoint With Their Bags	**Notes:**
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