DOT/FAA/CT-94/31

FAA Technical Center
Atlantic City International Airport,
N.J. 08405

FAA Technical Center Enhanced Airport Security System Project

Vehicle Portal Subsystem Cost Benefit Analysis

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January 1995

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Federal Aviation Administration

Technical Report Documentation Page

1. Report No. DOT/FAA/CT-94/31	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle FAA TECHNICAL CENTER ENHANCED AIRPORT SECURITY SYSTEM PROJECT: VEHICLE PORTAL SUBSYSTEM COST BENEFIT ANALYSIS		5. Report Date January 1995 6. Performing Organization Code ACA-400
7. Author(s) Ralph Yost, Edward Ocker and Martha Snyderwine		8. Performing Organization Report No. A-2001001-94-U-10054
9. Performing Organization Name and Address U.S. Department of Transportation Federal Aviation Administration Technical Center Aviation Security Research and Development Service Atlantic City International Airport, NJ 08405		10. Work Unit No. 11. Contract or Grant No. DTFA03-93-C-00042
12. Sponsoring Agency Name and Address U.S. Department of Transportation Federal Aviation Administration Assistant Administrator for Civil Aviation Security, ACS-1 800 Independence Avenue, S.W. Washington D.C. 20591		13. Type of Report and Period Covered Final Vehicle Portal Subsystem Cost Benefit Analysis 14. Sponsoring Agency Code ACS-1

15. Supplementary Notes:
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16. Abstract

A ten year Life Cycle Cost/Cost Benefit Analysis has been conducted on the Vehicle Portal Subsystem of the Enhanced Airport Security System Project at Baltimore-Washington International Airport (BWI). The Life Cycle Cost of the subsystem is estimated at $695,867, as compared with a baseline system cost of $18,030. The primary benefit of this subsystem is in an increased level of airport security.

17. Key Words Life Cycle Cost, Cost Analysis, Cost Benefit Analysis, Vehicle Portal, Power Gate.		18. Distribution Statement This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 30	22. Price

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

TABLE OF CONTENTS

EXECUTIVE SUMMARY vii

1. INTRODUCTION 1

   1.1 OBJECTIVES 1
   1.2 SCOPE 1

2. SYSTEM DESCRIPTION 2

3. ASSUMPTIONS 6

   3.1 ECONOMIC YEAR OF ESTIMATE 6
   3.2 NON-RECURRING COSTS 6
   3.3 PROGRAM LIFE CYCLE 6
   3.4 PROGRAM MANAGEMENT 6
   3.5 OPERATIONS/SUPPORT PERSONNEL 6
   3.6 EQUIPMENT OPERATING HOURS PER YEAR 7
   3.7 ENERGY AND UTILITIES 7
   3.8 RELIABILITY AND MAINTAINABILITY 7
   3.9 EQUIPMENT REPAIR COSTS 7
   3.10 PECULIAR SUPPORT EQUIPMENT 7
   3.11 COMMON SUPPORT EQUIPMENT 7
   3.12 INVENTORY MANAGEMENT AND STORAGE 8
   3.13 TRANSPORTATION AND PACKAGING 8
   3.14 TERMINATION COSTS 8
   3.15 SALVAGE VALUE 8

4. COST METHODOLOGY AND DATA 9

   4.1 COST BREAKDOWN STRUCTURE 9
   4.2 COST DATA 11

5. COST ESTIMATES 13

6. COST BENEFIT ANALYSIS 18

   6.1 BASELINE SYSTEM DESCRIPTION 18
   6.2 BASELINE SYSTEM LIFE CYCLE COST ESTIMATE 18
   6.3 COST COMPARISON 18
   6.4 BENEFITS 19

7. REFERENCES 20

LIST OF ACRONYMS AND ABBREVIATIONS

AOA	Air Operations Area
AVI	Automatic Vehicle Identifier
BWI	Baltimore-Washington International Airport
CBS	Cost Breakdown Structure
CCTV	Closed Circuit Television
COTS	Commercial Off-The-Shelf
DWG	Engineering Drawing
EASSP	Enhanced Airport Security System Project
FAA	Federal Aviation Administration
FAATC	Federal Aviation Administration Technical Center
HBS	Hardware Breakdown Structure
INSPC	Initial Spares and Consumables
INST	Installation
LCC	Life Cycle Cost
LCCA	Life Cycle Cost Analysis
MAN	Technical Manuals
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair
NDI	Non-Development Items
PME	Prime Mission Equipment

EXECUTIVE SUMMARY.

The Federal Aviation Administration Technical Center (FAATC) established the "Enhanced Airport Security System Project" (EASSP) at the Baltimore-Washington International Airport (BWI) as a Research and Development (R&D) Project in 1988. Installation of the EASSP equipment took place between late 1991 and early 1993. System evaluation and testing was completed in December of 1993.

The Vehicle Portal Subsystem of the EASSP provides a means of limiting entry and exit to the Air Operations Area (AOA) that contributes to increased airport protection of BWI. The portal is installed at Power Gate A in the Ramp Area Intrusion Detection System (RAIDS) Sector 4 as a double-gate sally port.

The purpose of this Life Cycle Cost Analysis/Cost Benefit Analysis is to present estimates of the total costs in all phases of the Vehicle Portal Subsystem. This document details the assumptions, cost methodology, and data used in the analyses. Also addressed are the quantitative and qualitative benefits of the Vehicle Portal Subsystem as compared to a baseline system.

The primary benefit of the Vehicle Portal Subsystem lies in the increased level of security provided. The enhanced portal is designed to prevent or inhibit unauthorized vehicles from entering the AOA. The vehicle portal does provide an enhanced method of protection from potential threats. This analysis does not attempt to quantify the millions of dollars that may be saved by stopping just one adversary from reaching a target (an airplane with passengers and crew).

1. INTRODUCTION.

1.1 OBJECTIVES. This is the Life Cycle Cost Analysis (LCCA) for the Vehicle Portal Subsystem of the Enhanced Airport Security System Project (EASSP) at Baltimore-Washington International Airport (BWI) for contract DFTA03-93-C-00042, Task Order 001. This report is formatted in accordance with U.S. Department of Transportation (DOT) Federal Aviation Administration (FAA) Order 1810.3. Estimates of the sum total of the direct, indirect, recurring, non-recurring, and other related costs in the design, development, production, operation, maintenance, support, and phase-out of the Vehicle Portal Subsystem of the EASSP are presented.

1.2 SCOPE. This report presents the LCCA for the Vehicle Portal Subsystem installed at Power Gate A in EASSP Ramp Area Intrusion Detection System (RAIDS) Sector 4 at BWI. Only equipment directly associated with the Vehicle Portal is analyzed. Excluded from this analysis are the Bird-Eye Infrared sensors, the Vindicator Taut Wire sensors and the Perimeter Products Fence Cable sensors, as well as Closed Circuit Television (CCTV) and area lighting systems that are integral components of the EASSP at BWI.

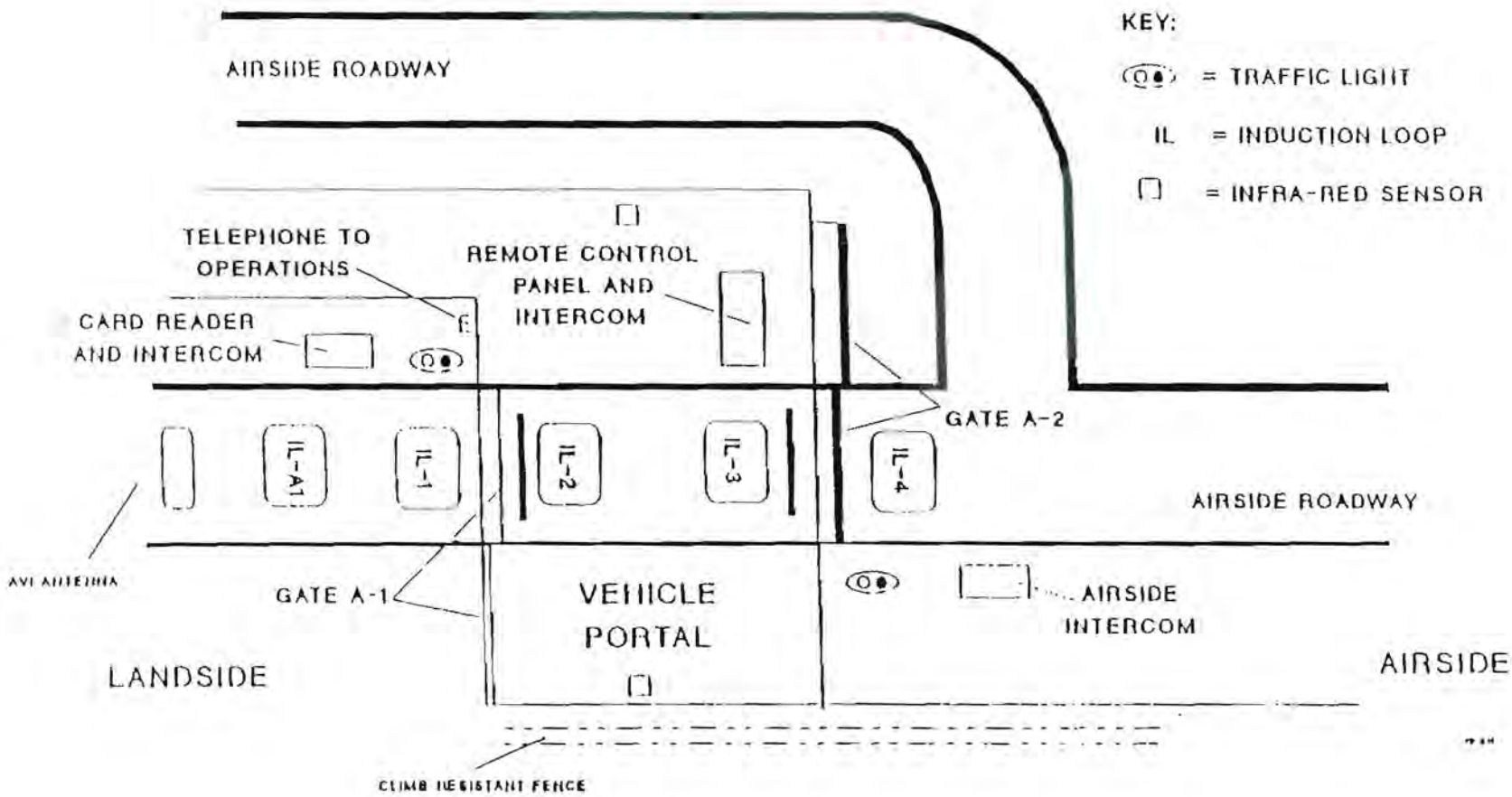

Figure 2. Vehicle Portal Overview

Table 1. EASSP Life Cycle Cost Hardware Breakdown Structure
Vehicle Portal Subsystem, Gate A and SOC (continued)

1.4 Remote Traffic Control Panel

1.4.1	Lamps (9)
1.4.2	Switches (9)

1.5 Traffic Lights (2)

1.5.1	Bulbs (2 ea)

1.6 Object Present Sensors (2)
1.7 Card Reader (2)
1.8 Intercom

1.8.1	Remote Intercom (3)
1.8.2	RP755 Intercom Station
1.8.3	Power Supply A24MT350

1.9 Crash Sensor Transmitter (2)

2. ELECTROMECHANICAL/MECHANICAL ASSEMBLIES

2.1 Gate Controller (2)
2.2 Beacon (2)
2.3 AVI Loop
2.4 Induction Loop (5)
2.5 Gate A1
2.6 Gate A2 Crash Gate

3.6 EQUIPMENT OPERATING HOURS PER YEAR. The EASSP equipment was assumed to operate full-time. Therefore, for the purposes of this analysis, the operating hours per year were assumed to be 8,760. Total operating time was assumed to be nine (9) years (excluding Termination Phase) or 78,840 hours.

3.7 ENERGY AND UTILITIES. The cost of energy and utility usage at BWI is included in the overall charges for building maintenance and overhead and, as such, is passed on to the tenants in their baseline rental fees. Power consumption is not a separate chargeable item. For the purpose of this analysis it was considered to be zero ($0).

3.8 RELIABILITY AND MAINTAINABILITY. The factors used herein for reliability (i.e. Failure Rates, Mean Time Between Failure (MTBF)) and maintainability (i.e. Mean Time To Repair (MTTR)) are derived from either best engineering estimates or from observed failures and/or repair actions. While attempts were made to obtain these data from the respective manufacturers, they stated that COTS equipment is not normally subjected to quantitative reliability or maintainability analyses. Failure data from field service and factory repair personnel are utilized to identify product improvement target areas, but are not quantified into reliability predictions. Therefore, the reliability data presented herein are not based on quantitative analyses, but on the analyst's best judgement and experience with similar hardware. For a detailed history of all failures and maintenance actions involving the EASSP hardware, refer to the monthly Maintenance Repair Reports prepared under contract DFTA03-93-C-00042.

3.9 EQUIPMENT REPAIR COSTS. These estimates are for material only. Where an item must be replaced, the full cost of that item is assumed to be its repair cost. Where an assembly may be repaired by replacing a component, the cost assumed is that of an average (or highest failure rate) part. The number of repair actions is based on the MTBF, number of identical items, on-hand (initial) spares and the total operating time. Where the number of repair actions is calculated to be less than one (1), it is assumed to be zero (0), otherwise any fraction will be raised to the next highest whole number.

3.10 PECULIAR SUPPORT EQUIPMENT. No peculiar (unique) support equipment was used to maintain the EASSP equipment. For the purposes of this analysis, the peculiar support equipment cost was assumed to be zero ($0).

3.11 COMMON SUPPORT EQUIPMENT. The total estimated cost of the EASSP common tools and test equipment (hand tools, multimeters, oscilloscope and various other generic test equipment) is $20,000. For the purpose of this analysis, an allocation of one tenth (.1) of the total program cost was assumed to be the cost apportioned to this subsystem.

4. COST METHODOLOGY AND DATA.

4.1 COST BREAKDOWN STRUCTURE. The following Cost Breakdown Structure (CBS) was utilized to estimate the LCC for the analyzed subsystem. Details of the methodology and calculations used to arrive at each individual CBS element are contained in the description of the LCC model presented in Section 5, Cost Estimates.

COST BREAKDOWN STRUCTURE
(DOT FAA Order 1810.3)

$$LCC = C_1 + C_2 + C_3 + C_4 - C_5$$

C_1 NON-RECURRING COST

NOTE All EASSP hardware and software is assumed to be Commercial Off-the-Shelf (COTS) or Non-Development Items (NDI). Therefore, for the purpose of this analysis, no non-recurring costs are included.

C_2 PRODUCTION AND INSTALLATION

$C_{2.1}$ Program Management

$C_{2.2}$ Real Property Improvements

$C_{2.3}$ Prime Mission Equipment

$C_{2.4}$ Peculiar Support Equipment

$C_{2.5}$ Common Support Equipment

$C_{2.6}$ Equipment Installation and Test

$C_{2.7}$ Initial Spares and Consumables

$C_{2.8}$ Initial Training

$C_{2.9}$ Data

4.2 COST DATA. The following cost data from Table 2, Life Cycle Cost Data Analysis, was utilized in the preparation of the LCC Analysis. Prices were extracted from the EASSP Project Inventory, 1 April 1993.

Table 2. Life Cycle Cost Data Analysis

HBS#	PRICE	DESCRIPTION
1.1	$ 2,400.00	SPC Portal Traffic Control Panel
1.2.1	160.00	PS LUS8A-12
1.2.2	100.00	TB RD25(2)
1.2.3	90.00	PCLD-780 Terminal Board
1.2.4	180.00	PCLD-785 Relay Board
1.2.5	50.00	8007 Relay Module w/8012 DPDT (2)
1.2.6	650.00	Fiber Optic Receiver 250D-R (2)
1.2.7	650.00	Fiber Optic Transmitter 250D-T
1.2.8	1,700.00	PLC TSX-172-3428
1.2.9	1,000.00	PLC Extension TSX-DMF-342A
1.3.1	121.00	Power Supply 5VDC
1.3.2	260.00	Power Supply 12VDC
1.3.3	90.00	PCLD-780 Terminal Board
1.3.4	180.00	PCLD-785 Relay Board
1.3.5	260.00	AVI Decoder
1.3.6	340.00	Quad Loop Detector
1.3.7	359.00	Lightening Protection Block
1.3.8	50.00	OP Relay, RBSN
1.3.9	50.00	Traffic Light Filament Detectors (4)
1.3.10	50.00	Gate A1 Control Relays

5. COST ESTIMATES. The following is a detailed description of the LCCA model utilized for this analysis. Each element of the CBS is addressed along with the cost estimating relationships or formulae used to quantify that element. Table 3, Vehicle Portal Subsystem HBS with Cost Estimates, contains the details of the HBS including MTBF, initial spares, repair costs and repair material estimates. Table 4, Life Cycle Cost Model, is the LCC model that calculates each cost element based on the formulae below.

$$LCC = C_1 + C_2 + C_3 + C_4 - C_5$$

C_1 = \$0 (see paragraph 3.2, Non-Recurring Costs)

$C_2 = C_{2.1} + C_{2.2} + C_{2.3} + C_{2.4} + C_{2.5} + C_{2.6} + C_{2.7} + C_{2.8} + C_{2.9}$ Where:

$C_{2.1}$ = \$0 (see paragraph 3.4, Program Management)

$C_{2.2}$ = \$0 (No Real Property Improvements were made or purchased in association with the EASSP)

$C_{2.3}$ = PME (Total of Prime Mission Equipment Cost - see Table 3, Vehicle Portal Subsystem HBS with Cost Estimates)

$C_{2.4}$ = \$0 (see paragraph 3.10, Peculiar Support Equipment)

$C_{2.5}$ = \$2,000 (see paragraph 3.11, Common Support Equipment)

$C_{2.6}$ = Installation & Testing (INST+TST) Where:

INST = \$115,500 (Total RAIDS installation cost per Sandia National Laboratories report, Enhanced Airport Security System Project Final Report (Draft), December 2, 1993, paragraph 4.3.3 is \$462,000. Although the Vehicle Portal represents only one of twelve sectors, it is estimated that it consumed one-fourth of the RAIDS installation costs. Therefore, \$462,000 ÷ 4 = \$115,500.)

TST = \$0 (There is no cost directly attributable to certification, commissioning or flight test that is not included in the INST costs.)

$C_{2.7}$ = INSPC (Initial Spares and Consumables - see Table 4, Life Cycle Cost Model)

$C_{2.8}$ = \$0 (No initial maintenance or operational training is required for operation of this subsystem over and above normal familiarization that is accounted for in personnel costs)

$C_{2.9}$ = DATA (see Table 4, Life Cycle Cost Model)

Table 3. Vehicle Portal Subsystem HBS with Cost Estimates

HBS	PRICE	QTY	MTBF (HRS)	MTTR	INSPC	$/REPAIR	T PME$	INSPC$	#REP	REPSP
1.1	$ 2,400	1	25,000	1	0	$ 25	$ 2,400	$ 0	4	$ 100
1.2.1	160	1	45,000	1	1	160	160	160	1	0
1.2.2	100	2	100,000	1	1	100	200	100	1	0
1.2.3	90	1	75,000	2	1	90	90	90	1	0
1.2.4	180	1	25,000	3	1	15	180	180	4	45
1.2.5	50	2	15,000	1	2	15	100	100	9	105
1.2.6	650	2	50,000	1	1	650	1,300	650	3	1,300
1.2.7	650	1	50,000	1	0	650	650	0	1	650
1.2.8	1,700	1	75,000	4	0	340	1,700	0	2	680
1.2.9	1,000	1	90,000	3	0	200	1,000	0	0	0
1.3.1	121	1	25,000	1	0	121	121	0	4	484
1.3.2	260	1	25,000	1	0	260	260	0	4	1,040
1.3.3	90	1	75,000	2	0	90	90	0	2	180
1.3.4	180	1	25,000	3	1	15	180	180	3	30
1.3.5	260	1	50,000	1	1	260	260	260	1	0
1.3.6	340	1	50,000	1	1	340	340	340	1	0
1.3.7	359	1	100,000	4	0	359	359	0	0	0
1.3.8	50	2	25,000	1	0	50	100	0	7	350
1.3.9	50	4	25,000	1	0	50	200	0	13	650
1.3.1	50	2	25,000	1	0	50	100	0	7	350
1.3.1	650	2	50,000	1	1	650	1,300	650	3	1,300
1.3.1	650	1	50,000	1	0	650	650	0	2	1,300
1.4	500	1	100,000	4	0	50	500	0	0	0
1.5	190	2	15,000	4	0	3	380	0	11	33
1.6	1,375	2	35,000	2	0	150	2,750	0	5	750
1.7	2,030	2	50,000	4	0	200	4,060	0	4	800
1.8.1	560	3	75,000	2	0	560	1,680	0	4	2,240

Table 4. Life Cycle Cost Model

CBS	COST BREAKDOWN STRUCTURE ELEMENT	COST
C1	Non-Recurring Cost	$ 0
C2	Production and Installation	213,779
C2.1	Program Management	0
C2.2	Real Property Improvements	0
C2.3	Prime Mission Equipment	41,169
C2.4	Peculiar Support Equipment	0
C2.5	Common Support Equipment	2,000
C2.6	Installation and Test	115,500
C2.7	Initial Spares and Consumables	2,710
C2.8	Initial Training	0
C2.9	Data	52,400
C3	Recurring Costs - O&S	426,396
C3.1	Operations Costs	394,200
3.1.1	Personnel	394,200
C3.1.2	Consumables	0
C3.1.3	Energy & Utilities	0
C3.1.4	Leases/Subcontracts	0
C3.1.5	Operator Training	0
C3.2	Support Costs	32,196
C3.2.1	Personnel	13,260
C3.2.2	Replenishment Spares	18,565
C3.2.3	Repair Material	0
C3.2.4	Support Equipment Maintenance	0
C3.2.5	Inventory Management & Storage	0
C3.2.6	Transportation & Packaging	371
C3.2.7	Recurring Training	0
C4	Termination Costs	57,750
C5	Salvage Value	2,058
Total Life Cycle Cost = $C_1 + C_2 + C_3 + C_4 - C_5$		$ 695,867

6.4 BENEFITS. The benefits of the EASSP Vehicle Portal Subsystem must be assessed by evaluating qualitative versus the quantitative attributes, since the cost of the enhanced portal was more than that of the baseline. The primary benefit of the Vehicle Portal Subsystem lies in the increased level of security provided. The enhanced portal is designed to prevent or inhibit unauthorized vehicles from entering the AOA.

Seen as a possible path for a potential hijacker or terrorist, the portal was one of the paths evaluated during EASSP testing and reported and quantified in DOT/FAA/CT-94/15 (Working Ramp Area Security Effectiveness Test Report). While the specific intrusion paths, vulnerabilities, and measures of effectiveness of the enhanced system versus the baseline are classified, the Vehicle Portal does provide an enhanced measure of protection from potential threats. This analysis does not attempt to quantify the millions of dollars that may be saved by stopping just one adversary from reaching an aircraft with passengers and crew. This document serves as a basis for enabling federal, state, and local authorities to assess the benefits of the added measures of security achieved by the EASSP when balanced with the Life Cycle Cost of the enhanced subsystem.