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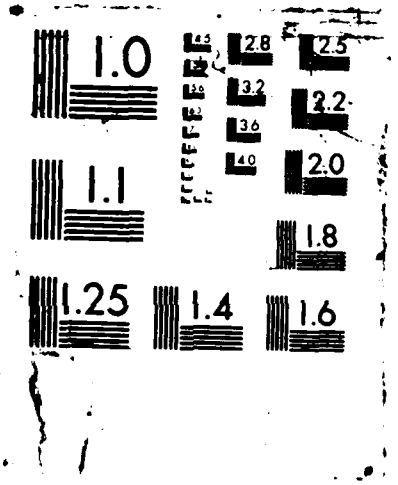
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ANNEX B

ARMY TACTICAL COMMAND AND CONTROL SYSTEM (ATCCS)

COST ANALYSIS

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The Army Tactical Command and Control System (ATCCS) Cost Benefit Analysis (CBA) is a three-part study: benefit analysis, cost analysis, and a cost/benefit comparison analysis. The ATCCS CBA is required to determine the extent to which an ATCCS Common Hardware and Software (CHS) strategy is implementable, as well as associated costs and benefits. The ATCCS CBA is required to support a Designated Acquisition Program (DAP) Milestone III procurement decision for ATCCS CHS.

The cost/benefit analysis was designed to determine and compare various ATCCS automation alternatives, determine relative costs and benefits, and determine a relative ranking based on a comparison of the costs and benefits.

Results of the ATCCS CBA are based on system descriptions, the Army Command and Control Master Plan, the ATCCS Family Requirements and Operational Capability Document, Battlefield

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ANNEX B

1. INTRODUCTION

This cost analysis was conducted as part of the ATCCS CBA being prepared by the Combined Arms Combat Developments Activity (CACDA). The ATCCS requires an integrated family of computer systems to support commanders and their staffs at the tactical levels. This analysis examines the hardware (HW) and software (SW) costs of various alternative methods of obtaining this integrated family of computer systems. The CBA will provide insight to a designated acquisition program (DAP) milestone III procurement decision.

2. BACKGROUND

a. ATCCS includes the command and control systems at corps and below for employement and sustainment of Army operating forces. The reader is referred to annex A for a more detailed discussion of ATCCS. The control systems which support the various battlefield functional areas (BFAs) are listed below:

BFA	Control System
Maneuver	Maneuver Control System (MCS)
Fire Support	Advanced Field Artillery Tactical Data System (AFATDS)
Air Defense	Forward Area Air Defense Command, Control, and Intelligence (FAAD C^2I)
Combat Service Support	Combat Service Support Control System (CSSCS)
Intelligence/Electronic Warfare (IEW)	All-Source Analysis System (ASAS)[1]

In addition to the BFA control systems, the force-level control system (FLCS) software will also reside on the BFA systems' hardware to support the commander and staff.

b. The ATCCS requires computer HW and SW to meet BFA control system and FLCS requirements. Although the Army has decided to field common hardware and software (CHS) to accomplish this, HQDA requires an analysis of alternative approaches prior to initiation of the final procurement action.

[1] ASAS is not included in this study (see paragraph 3. SCOPE).

3. SCOPE

a. ASAS HW was considered to be outside the scope of this study due to security requirements[2]. However, MCS HW required to establish an FLCS in the IEW area is included in this analysis. ASAS and the associated interfaces are not costed. The HW/SW for the Air Defense Reserve Component is also limited to the FLCS since FAAD C^2I is not fielded in the reserve component.

b. The CHS cost data, upon which this analysis is based, was developed using the unit cost data (expressed in constant FY88 dollars) contained in the MITRE Corporation's Working Paper[3] dated April 1987. This working paper provided unit cost estimates of acquisition, initial spares and yearly maintenance. When extrapolated to user requirements, one obtains an estimate for the costs to be incurred by the Program Manager (PM) for the Army Command and Control System (ACCS). BFA control system PM costs associated with system integration and software development and sustainment were then merged with these base estimates to obtain the cost estimates used in this analysis. Program costs are discussed further in the methodology section.

4. SYSTEM DESCRIPTIONS

Each alternative includes both the interim and objective systems. For a more detailed description of the interim and objective systems, the reader is referred to annex A.

a. Interim System Descriptions

(1) Interim T/P (denotes TCT, TCP and AC). Under this interim system, the Tactical Computer Terminal (TCT), Tactical Computer Processor (TCP), and Analyst Console (AC) are fielded to all BFA headquarters to establish an initial FLCS in the active component.

(2) Interim T (denotes TCT only). Under this interim system, only the TCT is fielded.

b. Objective System Descriptions. As discussed in section 3, the IEW BFA and the Air Defense Reserve area receive only FLCS HW/SW.

(1) BFA Unique

(a) Active Component. Unique HW is fielded to all BFAs. Maneuver BFA retains interim T/P equipment and also fields Battalion Terminals (BTs).

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[2] More recently, US Army Intelligence Center and School has recognized computer requirements for their internal command and control and to interface with the other BFAs.

[3] MITRE Working Paper, "Cost Estimates for Army Command and Control System Common Hardware and Software Items", Sponsor: PM ACCS, Contract No.: 19628-86-C-0001, April 1987.

(b) Reserve Component. BFA-unique HW is fielded. Maneuver fields additionally purchased TCTs, TCPs, ACs, and BTs.

(2) CHS except Maneuver

(a) Active Component. CHS is fielded except in Maneuver. Maneuver fields BTs and retains Interim T/P equipment.

(b) Reserve Component. CHS is fielded except in Maneuver. Maneuver fields additionally purchased TCTs, TCPs, ACs, and BTs.

(3) CHS except Maneuver Reserve

(a) Active Component. CHS is fielded to all BFAs.

(b) Reserve Component. CHS is fielded to all BFAs except Maneuver. Maneuver retrofits Interim T/P equipment displaced from active component. Maneuver also purchases some CHS equipment to meet the requirements fulfilled by BTs.

(4) CHS

(a) Active Component. CHS is fielded to all BFAs.

(b) Reserve Component: CHS is fielded to all BFAs.

c. Configuration of Alternatives

Alternative	Interim System	Objective System
1	T/P	BFA Unique
2	T/P	CHS except Maneuver
3TP	T/P	CHS except Maneuver Reserve
5X	T/P	CHS
3T	T	CHS

5. ASSUMPTIONS

a. There will be no significant military construction costs.

b. Inclusion of BFA control system program costs excluded from this analysis would not alter the conclusions reached.

c. Current or projected Army communication systems will be adquate for all automation alternatives. Costs of the communication systems are the same for all alternatives.

d. ATCCS CHS will interface with TCT, TCP, and AC HW.

6. GROUND RULES

a. Funds expended or committed prior to FY88 are sunk.

b. Cost estimates are presented in FY88 dollars and validated at level II. TRAC-RPD agreed to waive the requirement for time phasing of the estimates for this study.

c. All system alternatives are based on a 10-year operating life for computers.

d. BFA control system Program Manager costs included in this analysis are generally limited to SW and system integration. Power supplies utilized in MCS are included in both unique and CHS cost estimates.

7. ESSENTIAL ELEMENTS OF ANALYSIS (EEAs)

a. What are the HW and SW costs associated with each of the ATCCS alternatives?

b. For the MCS, what are the costs associated with fielding CHS to reserve component versus retrofitting unique HW?

c. What are the costs associated with retaining unique MCS HW in active component?

d. What are the costs associated with T/P Interim System?

8. METHODOLOGY

a. The MITRE Working Paper discussed previously was prepared for PM ACCS to provide cost estimates for items being acquired under the CHS program. Two different procurement strategies were included in the MITRE study.

(1) Worst Case Estimates. Assume both a basic award and year-by-year option invocations, in quantities of less than 1000 items per device type per obligation.

(2) Best Case Estimates. Assume a basic award for quantities to satisfy all BFA control system and Unit Level Computer requirements over a multiyear period[4].

b. Best and worst case unit costs were developed for acquisition, initial spares, yearly maintenance, and replenishment spares. BFA control system program costs associated with SW development and sustainment and those

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[4] Since Unit Level Computers are subordinate systems, they were not costed in this analysis.

costs incurred for system integration were added to the CHS estimates. MCS power supplies were also added. The resulting cost estimates are referred to in this study as "system costs".

c. System costs exclude such Program Manager costs as Government Furnished Equipment (shelters, environmental control equipment, vehicles, etc), consumables, system/project management, fielding costs, and common Military Personnel Maintenance Pay and Allowances. MCS and FAAD C^2I, which field MILSPEC equipment for their unique HW, would require additional GFE under the "TEMPEST-ruggedized" CHS alternatives. Based on analysis of estimated GFE costs for the FAAD C^2I area, these costs would not alter the conclusions reached in this analysis. A more detailed analysis of FAAD C^2I cost estimates is presented in appendix 1 which includes GFE and fielding costs to include Post Deployment Software Support. AFATDS fields TEMPEST-ruggedized equipment in all cases.

9. COST ANALYSIS

All costs are presented in FY88 dollars.

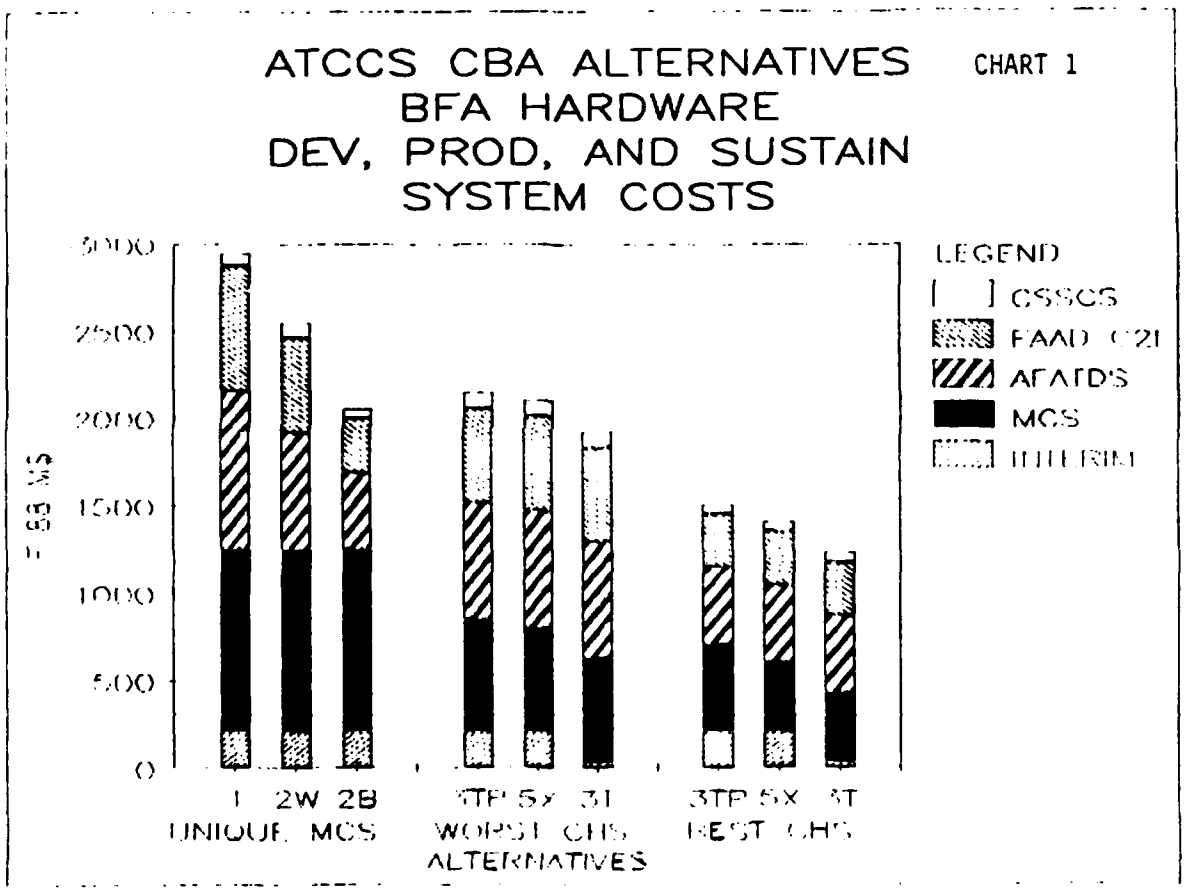
a. System Costs of Study Alternatives

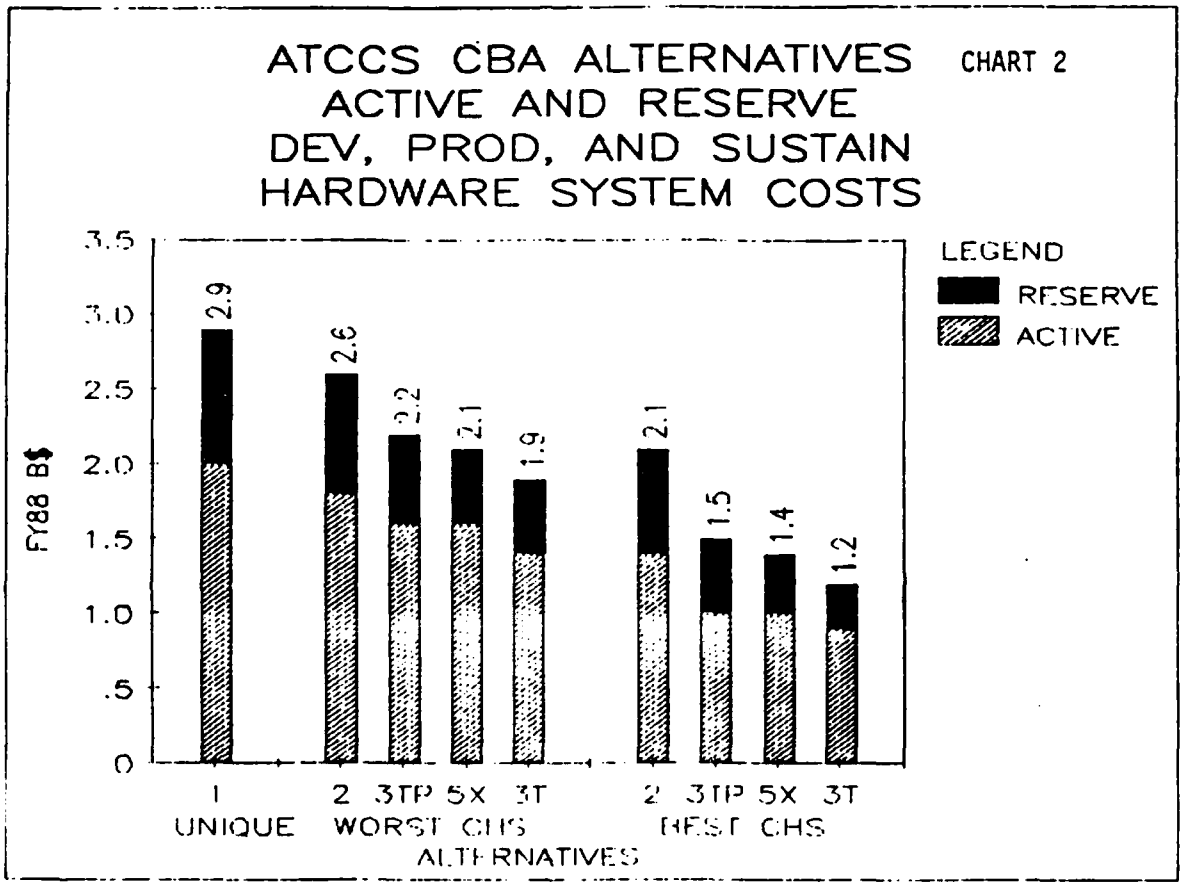
(1) System costs of the study alternatives are shown in table 1. As shown, differences in SW costs were not significant. The two highest cost alternatives (alternatives 1 and 2) have unique HW in the MCS. Alternative 3T is the least costly CHS alternative due to its "TCT only" interim system. CHS and MCS unique equipment quantities are shown in appendix 2.

Table 1. ATCCS CBA ALTERNATIVES' HARDWARE AND SOFTWARE SYSTEM COSTS (FY88 B$)

Alternative		HW	SW	Total
1		2.9	.9	3.8
2	Worst	2.6	.9	3.5
	Best	2.1	.9	3.0
3 TP	Worst	2.2	.9	3.1
	Best	1.5	.9	2.4
5X	Worst	2.1	.9	3.0
	Best	1.4	.9	2.3
3 T	Worst	1.9	.9	2.8
	Best	1.2	.9	2.1

(2) Chart 1 displays system costs of the study alternatives' hardware by BFA. The high costs associated with unique MCS hardware is shown in alternatives 1 and 2. The cost differences between best-case CHS and worst-case CHS (alternatives 3TP, 5X, 3T) are also significant. Chart 2 displays system costs of the study alternatives' hardware by active and reserve component. For alternatives 3TP and 5X, the marginal cost difference of .1B (FY88$) represents the difference between fielding all CHS to the MCS reserve component or fielding retrofitted interim T/P equipment.




ATCCS CBA ALTERNATIVES
ACTIVE AND RESERVE
DEV, PROD, AND SUSTAIN
HARDWARE SYSTEM COSTS
CHART 2
FY88 B$
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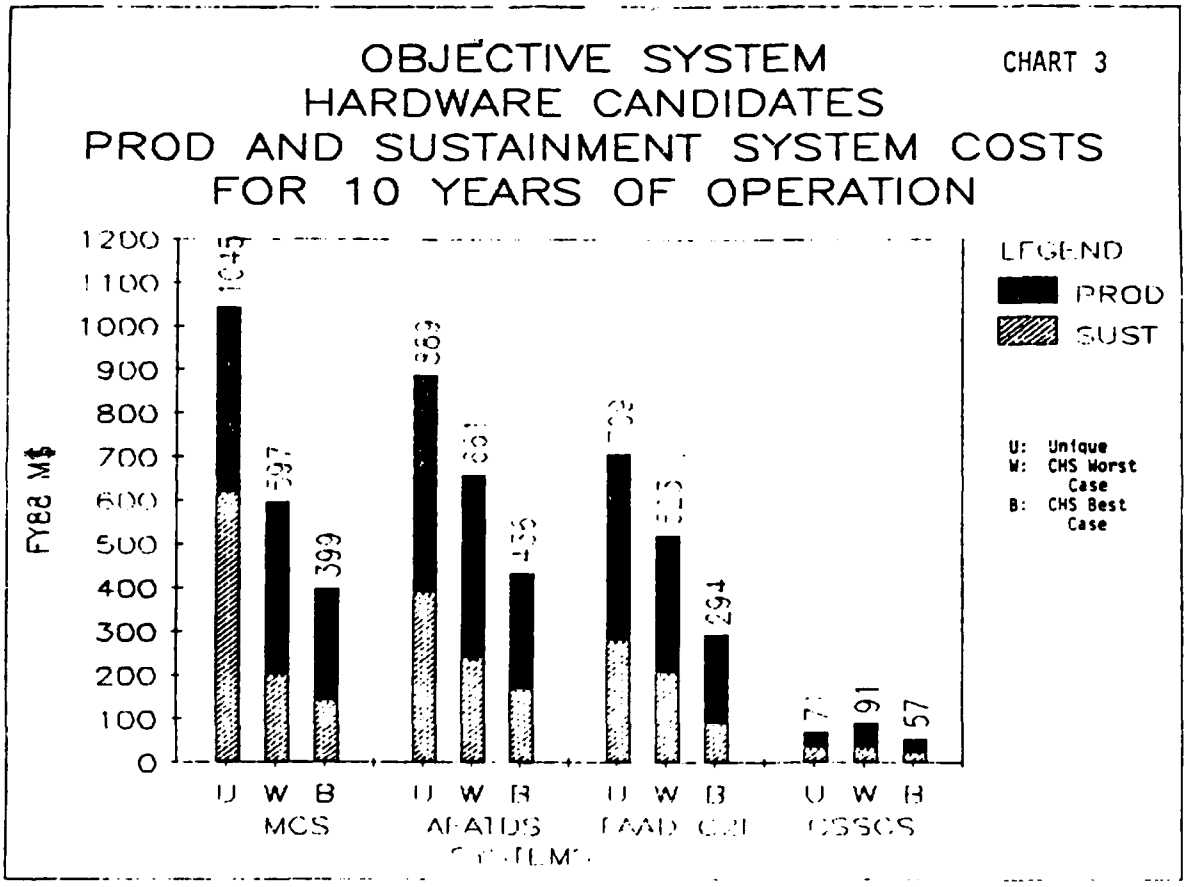
2.0
1.5
1.0
.5
0
2.9
2.6
2.2
2.1
1.9
2.1
1.5
1.4
1.2
LEGEND
RESERVE
ACTIVE
1
UNIQUE
2
3TP
5X
3T
WORST CHS
2
3TP
5X
3T
BEST CHS
ALTERNATIVES

b. System Costs of Objective Candidates

(1) Chart 3 displays the production and sustainment costs of the objective system hardware candidates for each BFA control system. MCS and AFATDS were most costly in the case of unique system candidates. Sustainment costs of the unique MCS candidate are roughly equal to the combined production and sustainment costs in the CHS worst case MCS estimate.



(2) The CSSCS unique objective system was less costly than the CHS worst case system. The unique estimate was based on the Tactical Army Combat Service Support Computer System (TACCS) which is an existing system with low remaining non-recurring production costs. Due to the relative size of CSSCS, this cost difference has little impact at the total alternative level.

(3) No cost difference exists in the case of FAAD C^2I unique and CHS worst case. As discussed in appendix 1, an estimated $150M of additional GFE would be required under the CHS objective system.

(4) Table 2 presents the production and sustainment cost estimates for the objective systems. MCS sustainment costs are much greater for unique HW than CHS worst case HW due to estimated maintenance costs. Production cost estimate of $428M for the MCS unique objective system excludes all production costs associated with the interim T/P system.

Table 2. ATCCS INTERIM AND OBJECTIVE CANDIDATES
PRODUCTION & SUSTAINMENT
HARDWARE SYSTEM COSTS
(FY88 M$)

	Production	Sustainment	Total
Interim			
T	0	32	32
T/P	82	125	207
CHS Objective System - Worst Case			
MCS	395	202	597
AFATDS	422	239	661
$FAADC^2I$	318	205	523
CSSCS	56	35	91
CHS Objective System - Best Case			
MCS	257	142	399
AFATDS	269	167	436
$FAADC^2I$	205	89	294
CSSCS	34	23	57
Unique Objective System			
MCS	428	617	1045
AFATDS	501	388	889
$FAADC^2I$	430	279	709
CSSCS	37	34	71

c. System Costs of Interim Candidates. Table 2 presents production and sustainment costs for the interim candidates. Costs incurred prior to FY88 are considered sunk and excluded from the table. Sunk TCP and AC costs are approximately $75M, with remaining production cost estimated at $82M. All active Army TCT and TCT/B production costs are sunk. Interim candidates' sustainment costs were phased out over 5 years (FY92-96). The difference in system cost estimates between interim T/P and interim T is $175M. This represents about 6 percent of the total system cost for alternative 3TP or 5X using worst case CHS estimates.

d. Comparison of System Costs Under Alternatives 3TP and 5X.

(1) Alternatives 3TP and 5X differ in the HW fielded under the reserve component MCS system. Under alternative 3TP, the interim T/P equipment used by the active component would be retrofitted for use in the reserve component. In addition, the maneuver BFA would also field 468 CHS portable computer units to meet their requirements.

(2) Under alternative 5X, no retrofit would occur, and the total MCS reserve component requirements would be met by fielding CHS equipment.

(3) As table 3 indicates, the retrofit has a relatively low production cost of $60M. However, the sustainment costs associated with this equipment are very large ($152M). The lower CHS sustainment costs result in alternative 5X having a lower total system cost ($242M for CHS worst case).

Table 3. MCS RESERVE COMPONENT CANDIDATES
RETROFIT VERSUS BUY OF CHS
HARDWARE SYSTEM COSTS
(FY88 M$)

Worst Case

3 TP					5X	
	Retrofit	+ 468 PCUs	= Total			
Total	212	74	286		Total	242
Prod	60	49	109		Prod	160
Sust	152	25	177		Sust	82

Best Case

3TP					5X	
	Retrofit	+ 468 PCUs	= Total			
Total	212	50	262		Total	161
Prod	60	32	92		Prod	104
Sust	152	18	170		Sust	57

10. CONCLUSIONS

a. MCS and AFATDS BFA-unique HW has a higher total system cost than CHS. No cost difference exists between FAAD C^2I unique and CHS worst case candidates. CSSCS cost differences were not significant at the total alternative level.

b. There is a significant cost difference between best and worst cases for CHS HW. Cost ranking of the alternatives is the same under best or worst cases.

c. Differences in SW cost estimates between the alternatives are negligible.

d. There is an estimated system cost difference of approximately $170M between interim system candidates.

e. Retrofit of MCS equipment in alternative 3TP is as costly if not more costly than buying additional CHS under alternative 5X.

f. Cost rankings

(1) Alternative 3T is least costly since it fields all CHS and has a lower cost interim system.

(2) Alternative 5X is more costly than alternative 3T due to the interim system T/P.

(3) Alternative 3TP has higher than alternative 5X estimated costs due to the retrofit of MCS equipment for the reserve component.

(4) Alternative 2 incurs the higher costs of unique HW in the MCS system active and reserve components.

(5) Alternative 1 is most costly due to unique hardware in the MCS and AFATDS.

APPENDIX 1
ANALYSIS OF FAAD C^2I
OBJECTIVE SYSTEM CANDIDATES
(All Costs Presented in FY88 Dollars)

The FAAD C^2I cost data contained government furnished equipment (GFE) estimates and fielding costs to include Post Deployment Software Support (PDSS). These cost estimates were not available for the other BFA control system CHS estimates. GFE includes shelters, environmental control equipment, generators, equipment carriers, etc.

Table 1 shows the GFE costs for FAAD C^2I CHS and unique system candidates. Under the unique system candidate, MILSPEC equipment is fielded. Under the CHS candidate, TEMPEST-ruggedized equipment would be fielded requiring additional GFE to meet the FAAD C^2I required operational capability. The GFE cost difference between CHS and unique system candidates is approximately $150M.

Table 1. GFE COSTS FOR FAAD C^2I - ACTIVE ARMY
(FY88 M$)

	CHS	Unique
Total	348	202
1.0	1	1
2.0	99	48
4.0	2	1
5.0	246	152

Table 2 presents the FAAD C^2I cost data with GFE and fielding costs included. Software fielding costs shown represent PDSS. No cost difference exists between CHS-Worst case and the unique candidate. CHS-Best case is the least costly candidate.

Table 2. FAAD C^2I OBJECTIVE SYSTEM CANDIDATE COSTS - ACTIVE ARMY
(FY88 M$)

	CHS Worst Case			CHS Best Case			Unique		
	HW	SW	Total	HW	SW	Total	HW	SW	Total
Total	903	433	1336	664	433	1097	935	466	1401
Dev	22	329	351	15	329	344	19	322	341
Prod	417	--	417	304	--	304	478	--	478
Field	13	45	58	10	45	55	7	5	12
Sustain	451	59	510	335	59	394	431	139	570

APPENDIX 2

ALTERNATIVE EQUIPMENT QUANTITIES

ALTERNATIVE 3TP & 3T ATCCS CHS EQUIPMENT QUANTITIES

		Total	AC	RC
PCU V1	CSSCS	1191	518	673
	MCS	889	869	20
	FATDS	190	161	29
	FAAD C^2I	0	0	0
PCU V2	MCS	1457	1009	448
	FATDS	2715	1817	898
	FAAD C^2I	85	85	0
TCU V1	MCS	304	304	0
	FATDS	97	81	16
	FAAD C^2I	0	0	0
TCU V2	MCS	303	303	0
	FATDS	518	275	243
	FAAD C^2I	172	172	0
HTU	FATDS	3255	1668	1587
	FAAD C^2I	2094	2094	0

ALTERNATIVE 5X MCS RC CHS EQUIPMENT QUANTITIES

PCU V1	419
PCU V2	714
TCU V1	375
TCU V2	145

ALTERNATIVES 1 AND 2 MCS EQUIPMENT QUANTITIES

	AC	RC
TCT/B	54	24
TCT	152	121
TCP	567	375
AC	1079	665
BT	791	468
Total	2643	1653

APPENDIX 3

ABBREVIATIONS

AC	Analyst Console
ACCS	Army Command and Control System
AFATDS	Advanced Field Artillery Tactical Data System
ASAS	All-Source Analysis System
ATCCS	Army Tactical Command and Control System
BFA	Battlefield Functional Area
BT	Battalion Terminal
CACDA	Combined Arms Combat Developments Activity
CBA	Cost Benefit Analysis
CHS	Common Hardware and Software
CSSCS	Combat Service Support Control System
DAP	Designated Acquisition Program
EEA	Essential Elements of Analysis
FAAD C^2I	Forward Area Air Defense Command, Control, and Intelligence
FLCS	Force-Level Control System
GFE	Government Furnished Equipment
HW	Hardware
IEW	Intelligence/Electronic Warfare
MCS	Maneuver Control System
MILSPEC	Military Specifications
PCU	Portable Computer Unit
PM	Program Manager
SW	Software
TCP	Tactical Computer Processor
TCT	Tactical Computer Terminal

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