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EXECUTIVE SUMMARY
JOINT TACTICAL INFORMATION DISTRIBUTION
SYSTEM (JTIDS) COST AND TRAINING
EFFECTIVENESS ANALYSIS/CTEA

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for:

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**EXECUTIVE SUMMARY
TABLE OF CONTENTS**

CHAPTER 1 INTRODUCTION

- 1.1 PURPOSE
- 1.2 BACKGROUND
- 1.2.1 JTIDS
- 1.2.2 CTEA
- 1.2.3 Problem

CHAPTER 2 APPROACH

- 2.1 CTEA OBJECTIVES
- 2.2 SCOPE
- 2.3 MEASURES OF EFFECTIVENESS

CHAPTER 3 METHODOLOGY AND ANALYSIS

- 3.1 METHODOLOGY
- 3.2 ANALYSIS
- 3.2.1 Training Development
- 3.2.1.1 Identification of Tasks
- 3.2.1.2 Selection of Tasks for Training
- 3.2.1.3 Analysis of Tasks
- 3.2.1.4 Generating the Course Structure
- 3.2.1.5 Generation of Training Program Alternatives
- 3.2.1.6 Extended Program of Instruction Development
- 3.2.2 Training Effectiveness Analysis
- 3.2.3 Training Device Requirements Analysis
- 3.2.4 Determination of Training Program Costs
- 3.2.5 Trade-Off Analysis

**CHAPTER 4 ESSENTIAL ELEMENTS OF ANALYSIS SUMMARY AND
CONCLUSIONS**

- 4.1 EEAs
- 4.1.1 EEA One
- 4.1.2 EEA Two
- 4.1.3 EEA Three
- 4.1.4 EEA Four
- 4.1.5 EEA Five
- 4.1.6 EEAs Six and Seven
- 4.1.7 EEA Eight
- 4.1.8 EEA Nine

LIST OF FIGURES

- 1-1 Typical Air Defense Application
- 1-2 JTIDS Class 2M Terminal
- 1-3 Antenna System

- 3-1 CTEA Functional Methodology

LIST OF TABLES

- 3-1 Tasks Required to Establish JTIDS Operations
- 3-2 Tasks Required to Maintain JTIDS Equipment in An Operational State
- 3-3 Sequence for Tasks
- 3-4 Example Extended POI Task Sheet
- 3-5 JTIDS Training Requirements
- 3-6 Cost of Students
- 3-7 Instructor Cost Per Option
- 3-8 JTIDS Equipment Cost
- 3-9 Peak Year Costing of Training Program Alternatives

JOINT TACTICAL INFORMATION DISTRIBUTION
SYSTEM (JTIDS) COST AND TRAINING
EFFECTIVENESS ANALYSIS (CTEA)
EXECUTIVE SUMMARY

CHAPTER 1

1.0 INTRODUCTION

1.1 PURPOSE

This summary presents an overview of the Joint Tactical Information Distribution System (JTIDS) Cost and Training Effectiveness Analysis (CTEA). This analysis was performed by Research Analysis and Maintenance (RAM), Inc. in support of the US Army Air Defense School's training mission associated with the fielding of JTIDS in the Air Defense environment (AD-JTIDS).

1.2 BACKGROUND

1.2.1 JTIDS. The Joint Tactical Information Distribution System (JTIDS) is a secure and jam resistant data communications system. The system enables the exchange of real-time tactical information between friendly Joint Forces concerning friendly and enemy forces. The information exchange includes command and control data and force identification and location data.

The basic architecture of JTIDS provides for distribution of varied types of information to many tactical elements on a real-time basis. JTIDS information is broadcast omnidirectionally at many thousands of bits each second and can be received by any terminal within range. Information flows directly from many transmitters to many receivers using a frequency-hopped, time-sequenced transmission scheme. Each terminal, ground or airborne, can select or reject each message according to its information needs. JTIDS employs a communications method called Time Division Multiple Access (TDMA) which permits new updated

messages to be sent from numerous terminals in a specific network on a time-sequenced basis.

JTIDS communications networks are comprised of information input and/or user nodes, a network control node, and network relay nodes. Figure 1-1 presents a typical Air Defense (AD) application. The core of the communications nodes is the JTIDS Radio Terminal Set (Figure 1-2). The ground based 2M terminal set can be initialized to operate in all three network nodes. The 2M terminal set coupled with a complementary antenna set, a crypto device, a shelter, and an ancillary power source comprise the essential elements of the JTIDS communications nodes (Figure 1-3). The network central node is supplemented by a computer to facilitate establishing a network.

1.2.2 CTEA. Cost and Training Effectiveness Analysis (CTEA) is a methodology for formalizing the collection, analysis, and integration of training program cost, impact, and effectiveness data. Part of the analysis and integration of training-related data concerns the comparative cost and effectiveness of alternative training programs for meeting pre-defined training objectives. Within a specific training program, CTEA also involves the cost and training efficiencies of alternative training methods/media for addressing a particular performance objective.

The specific nature of CTEA often is dependent upon the state of development of the materiel system under study. For conceptual materiel systems, the lack of performance data requires that CTEA be used to forecast training resource requirements and to indicate training-related issues that may require special examination during later field testing. As prototypes of the materiel system become available, CTEA involves updating and validating cost and resource impact projections and empirical investigations of training program effectiveness. Following the field deployment of a materiel system, the emphasis of CTEA

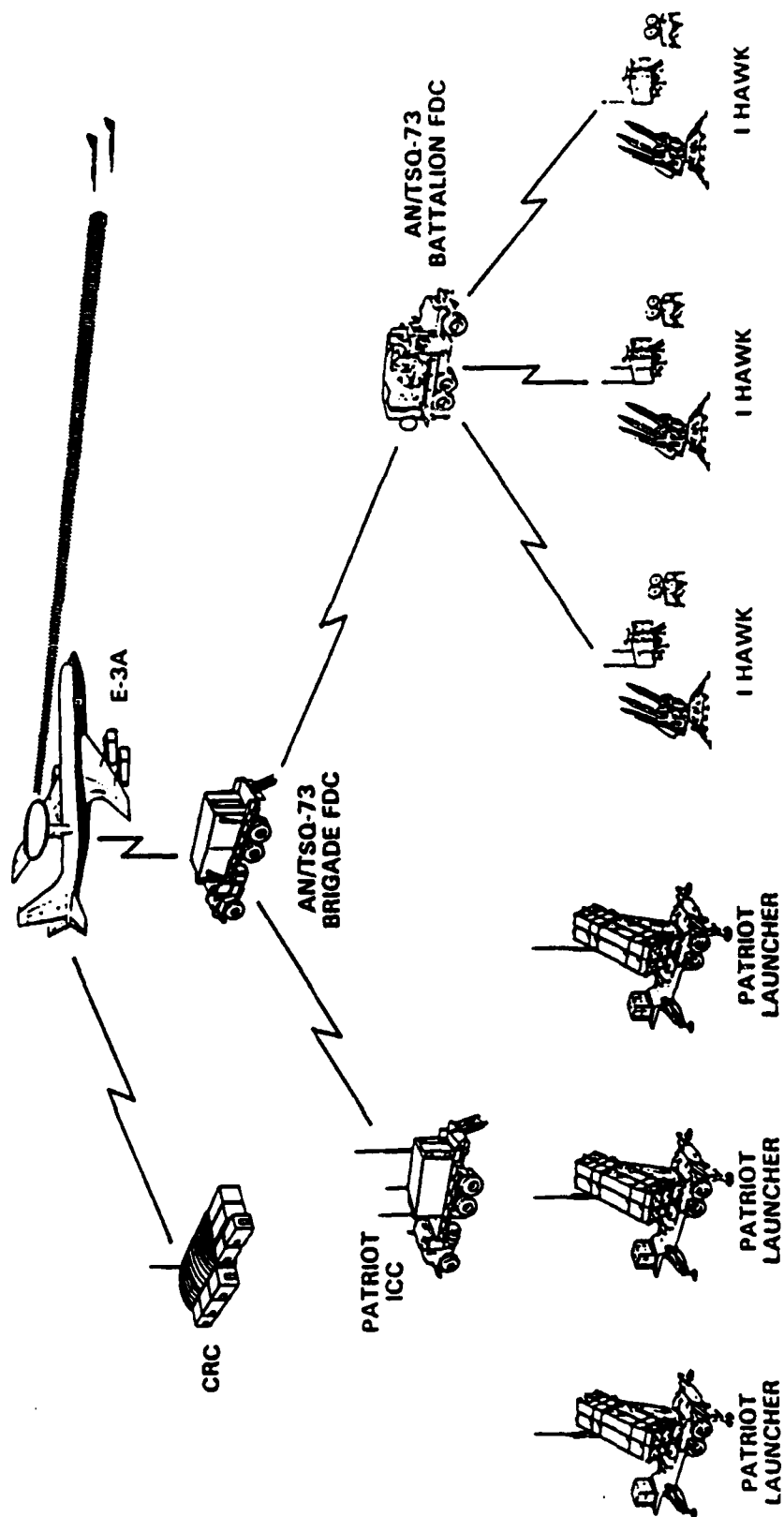


FIGURE 1-1. TYPICAL AIR DEFENSE APPLICATION

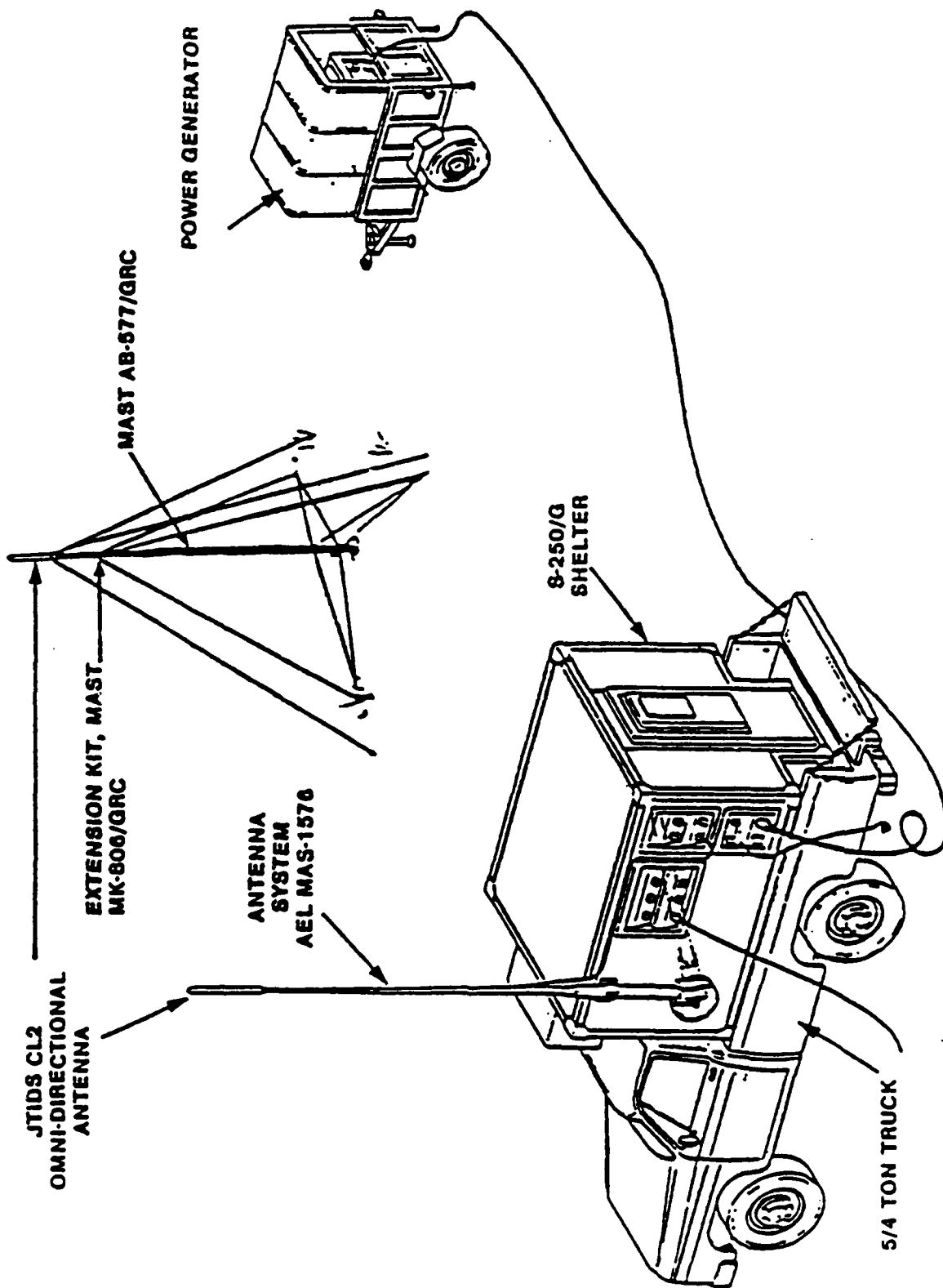


FIGURE 1-3. ANTENNA SYSTEM

shifts to the cost-effectiveness of: (1) training "fixes" designed to address recognized training deficiencies, or (2) training modifications designed to meet an altered threat scenario or to accommodate evolutionary hardware modifications.

1.2.3 Problem. The US Army has planned the acquisition of JTIDS for deployment with HAWK, PATRIOT, AN/TSQ-73 and FAADS C²I systems. Air Defense Artillery personnel must be able to perform JTIDS operator and maintainer tasks to support the planned AD fielding of JTIDS. Since both personnel and dollar resources are limited, the problem is how to provide effective training at an affordable cost. Therefore, this training analysis was conducted to:

- o Identify an acceptable and affordable cost-effective training program.
- o Identify major training resource requirements.
- o Provide confidence that personnel expected to be available to ADA for manning the JTIDS can be cost-effectively trained to perform required JTIDS tasks.

CHAPTER 2

2.1 CTEA OBJECTIVES

The overall goal of this study was to identify an effective training strategy that is cost efficient for training soldiers to operate, maintain, and repair the JTIDS in the Air Defense environment (AD-JTIDS). To achieve this goal, the following objectives were attained:

- o Assurance was provided that personnel who are qualified for training in Air Defense Military Occupational Specialties/Areas of Concentration (MOSS/AOCs) affected by fielding AD-JTIDS can be expected to be cost-effectively trained to perform required JTIDS tasks.
- o A JTIDS training program to be incorporated into resident training for Air Defense MOSS/AOCs affected by fielding JTIDS was specified.
- o A realistic and cost-effective approach for providing JTIDS training to personnel already qualified in Air Defense MOSS/AOCs affected by fielding AD-JTIDS was identified.
- o Major resource requirements for supporting the recommended training programs were identified and incorporated in cost estimates.
- o The general characteristics of any major training devices required to implement the recommended cost-effective (C-E) training programs were specified.

2.2 SCOPE

The scope of the study was limited to the AD user team operation and maintenance duties directly related to deploying the AD-JTIDS with the PATRIOT, HAWK, AN/TSQ-73 and FAADS C²I.

2.3 MEASURES OF EFFECTIVENESS

The focus of this CTEA was to generate and evaluate data upon which recommendations can be made concerning the pursuit of one course of training action over another. Such action required that the CTEA be cast in a decision analytic framework. Without an analytical framework, the rationale for recommendations would have been ambiguous.

The decision analytic framework is structured to proceed, in a systematic fashion, from the generation of alternatives to the ranking of acceptable alternatives. The resulting study recommendations are based on cost-effectiveness and result from analyzing alternative benefits received from competing training and manning options. Training benefit trade-offs between alternative course contents were investigated. Course content is defined as the set of selected critical tasks which will be included in the resident training. Also investigated, were training efficiency trade-offs between alternative task training contexts. Task training context is defined as, the training time allowed, the balance between instruction and exercise/practice, and the media/methods used to support the instruction and exercise/practice.

The measures of effectiveness described below were used to quantify both the worth of training any given task and the efficiencies of different task-training contexts. These two metrics were integrated to provide the Training Program Alternative (TPA) measures of training effectiveness necessary for performing the cost-effectiveness trade-off analyses.

The measure of training efficiency used in this study is the estimated percent of students who will achieve the task performance standard on any given task at the completion of task training, given a particular task training context.

Each task is assigned a relative training worth value based on the benefit of placing a soldier in the field with the ability to perform more critical tasks compared with his ability to perform other less critical tasks specified by his JTIDS duties.

The measure of a TPA's effectiveness is the sum, over tasks to be trained, of each tasks training value weighted by the efficiency of the training context to be used.

CHAPTER 3

3.0 METHODOLOGY AND ANALYSIS

3.1 METHODOLOGY

The study was the initial Air Defense JTIDS Cost and Training Effectiveness Analysis. No AD-JTIDS training programs existed. Methods traditionally used to determine training effectiveness require data that was not available. Therefore, a training effectiveness forecasting method was required. The method used combined the development of viable training program strategies and alternatives, the estimation of individual task training efficiency, the estimation of training program effectiveness, and the integration of cost data to determine the most cost effective training approach. Additionally, the method allowed for assessing the trainability of alternate manning concepts and provided information for developing training plans. The general methodology adopted for this study has been successfully demonstrated in two CTEAs: one for the operators and maintainers of the Army's Remotely Monitored Battlefield Sensor System (REMBASS), and another for the aircrew positions on the AH-64 Advanced Attack Helicopter. The method is documented in the Proceedings of the Human Factors Society - 26th Annual Meeting - 1982.

The approach used for this CTEA consisted of seven major processes and five subprocesses (refer to Figure 3-1):

- o Review of JTIDS literature.
- o Training development.
 - Identification of tasks through analyses of missions and functions.
 - Task analysis.
 - Generation of a course structure.

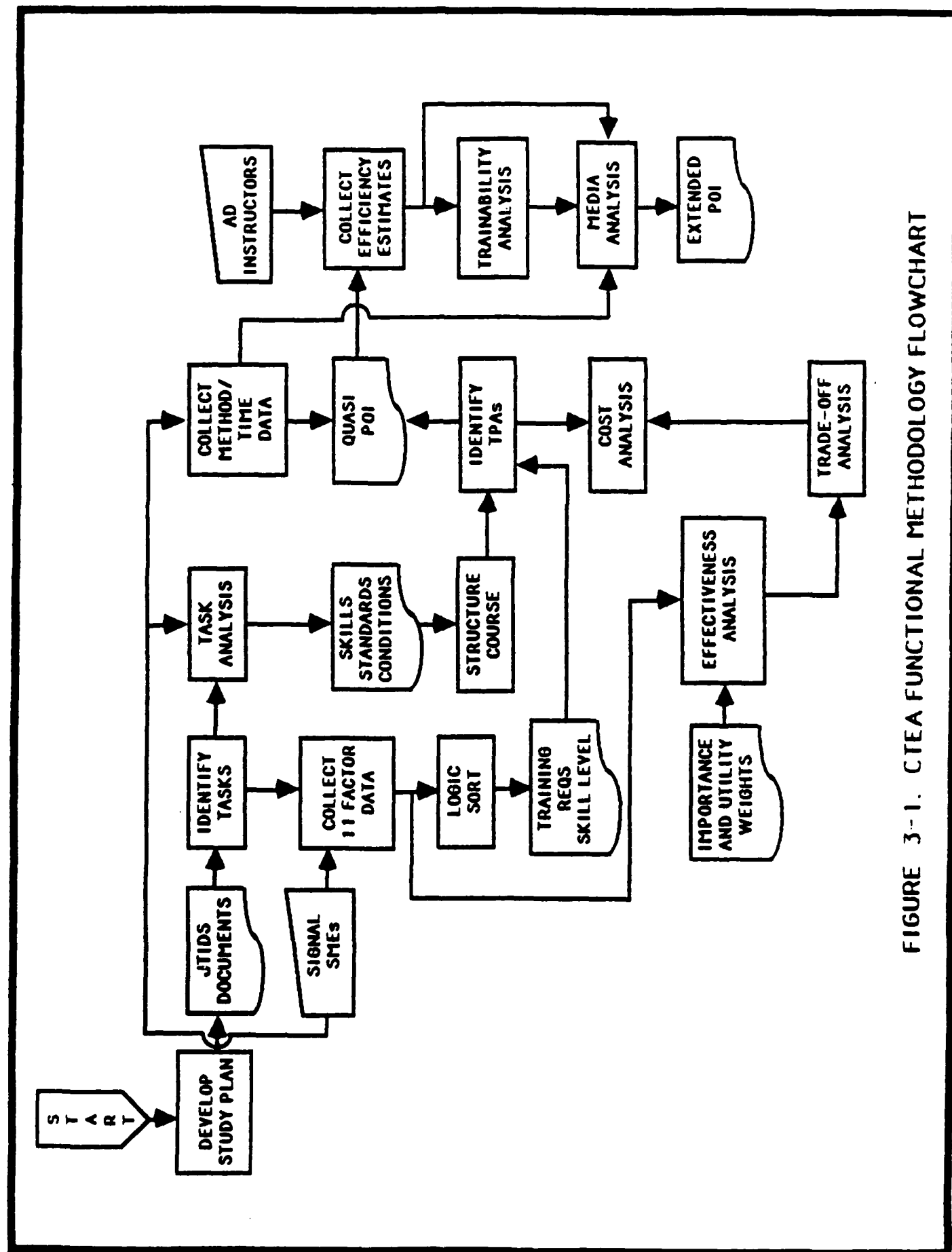


FIGURE 3-1. CTEA FUNCTIONAL METHODOLOGY FLOWCHART

- Development of Training Program alternatives.
- Development of an Extended POI.

- o Analysis of training effectiveness.

- o Trainability assessment.

- o Training device requirements analysis.

- o Determination of training program costs.

- o Cost and training effectiveness trade-off analysis.

3.2 ANALYSIS

This section presents an overview of the CTEA methodology processes and subprocesses.

3.2.1 Training Development. It was essential to the training effectiveness and cost analyses to synthesize a plausible and effective training program to provide a base for obtaining data. The training development (TD) process used consisted of six subprocesses.

3.2.1.1 Identification of Tasks. The first CTEA subprocess accomplished was the specification of job tasks. This activity began with a review of JTIDS documentation to identify missions. The missions were analyzed to identify functions and finally, functions were analyzed to determine specific tasks. The tasks required to establish JTIDS operations and maintain JTIDS equipment in an operational state are presented in Table 3-1 and Table 3-2. An initial list of tasks compiled by RAM analysts was refined after review by the Signal School, Fort Gordon, Georgia. The personnel who performed the review were JTIDS and battlefield communication systems subject matter experts (SMEs).

TASKS REQUIRED TO ESTABLISH JTIDS OPERATIONS

- o Operate Generator Set.
- o Power Up/Down Shelter.
- o Condition Shelter Environmental Control System.
- o De-energize Class 2M Terminal.
- o Assemble/Install/Disassemble Antenna on Shelter.
- o Assemble/Disassemble Antenna at Remote Site.
- o Unload/Load Shelter.
- o Unpack/Pack Shelter.
- o Set Up and Operate Local Communications.
- o Inspect Shelter.
- o Pack/Unpack Generator Set.
- o Connect/Disconnect External Cables.
- o Remote the Indicator Control.
- o Load Crypto Variables.
- o Initialize Class 2M Terminal.
- o Operate and Monitor JTIDS Operations.
- o Assemble/Disassemble 34 Meter Antenna.
- o Select Site and Emplace Equipment.

TABLE 3-1

TASKS REQUIRED TO MAINTAIN JTIDS EQUIPMENT IN AN OPERATIONAL STATE

- o Perform PMCS on Generator Set.
- o Perform Preventive Maintenance on Shelter.
- o Perform Preventive Maintenance on Environmental Control System.
- o Perform Preventive Maintenance on JTIDS Subsystems (Class 2M Terminal and Indicator Control).
- o Unpack/Pack Shop Replaceable Units.
- o Perform Preventive Maintenance on JTIDS Subsystems (Antennas).
- o Unpack/Pack JTIDS Subsystems.
- o Remote/Install Class 2M Terminal and Indicator Control from/into Shelter or Host System.
- o Perform Preventive Maintenance on Local Communication System.
- o Fault Isolate Local Communication System.
- o Fault Isolate Generator Set.
- o Repair Generator Set.
- o Fault Isolate Class 2M Terminal.
- o Repair Class 2M Terminal.
- o Fault Isolate Indicator Control.
- o Repair Indicator Control.

TABLE 3-2

3.2.1.2 Selection of Tasks for Training. Only critical job-related tasks should be included in formal resident training. To assure only critical tasks were included in the CTEA analysis, a task selection process based upon the Instructional System Developmental (ISD) process and automated in ARI's Training Developer's Decision Aids was used. This process provided selected tasks for training and specified the level of training on the basis of the criticality of each task.

3.2.1.3 Analysis of Tasks. Tasks considered for training were next reviewed by SMEs and RAM analysts to provide task content and job context information. Five categories of information were obtained: performance standards, unusual job conditions, stimuli that must be monitored during task performance, skills required for performing the task, and the training time required to teach task performance.

3.2.1.4 Generating the Course Structure. Sequencing methods identified in TRADOC Pamphlet 350-30 were analyzed considering the tasks involved in operating and maintaining a JTIDS Class 2M Terminal and its supporting equipment. SMEs identified tasks that logically or sequentially precede the performance of other tasks and RAM analysts determined inter-task dependency and task complexity. The tasks to be taught are clustered by function then sequenced in the order they are performed modified by their relative importance and progress from less difficult to difficult (Table 3-3).

3.2.1.5 Generation of Training Program Alternatives. Once the general course structure was developed the next subprocess conducted was to identify training program alternative variables that significantly affect cost-effectiveness. Variables identified for use in subsequent analysis included:

- o Instructional method.

**SEQUENCE FOR TASKS - USE FOR ASSIGNING
SKILLS TO NEW SKILLS OR PRACTICE SKILLS**

- 1. POWER UP/POWER DOWN SYSTEM - 'MODULE'**

M-1001 Perform PMCS on Generator Set
O-1001 Operate Generator Set
M-2001 Fault Isolate Generator Set
M-2002 Repair Generator Set
M-1002 Perform Preventive Maintenance on Shelter
J-1002 Power Up/Down Shelter
M-1003 Perform Preventive Maintenance on Environmental Control System

O-1003 Condition Shelter Environmental Control System
M-1004 Perform Preventive Maintenance on JTIDS Subsystems (Class 2M Terminal and Indicator Control)

- 2. OPERATE/MAINTAIN - 'MODULE'**

O-2001 Load Crypto Variables
O-2002 Initialize Class 2M Terminal
O-1004 De-energize Class 2M Terminal
M-2003 Fault Isolate Class 2M Terminal
M-1005 Unpack/Pack Shop Replaceable Units
M-2004 Repair Class 2M Terminal
M-2005 Fault Isolate Indicator Control
M-2006 Repair Indicator Control
O-2003 Operate and Monitor JTIDS Operations

- 3. ANTENNA - 'MODULE'**

M-1006 Perform Preventive Maintenance on JTIDS Subsystems (Antennas)
O-1005 Assemble/Install/Disassemble Antenna on Shelter
O-1006 Assemble/Disassemble Antenna at Remote Site
O-2004 Assemble/Disassemble 34 Meter Antenna

- 4. MARCH ORDER AND EMPLACE - 'MODULE'**

O-3001 Select Site and Emplace Equipment
O-1007 Unload/Load Shelter
O-1008 Unpack/Secure Shelter
M-1007 Unpack/Pack JTIDS Subsystems

- 5. PACKAGE TRAINING/FIELD TRAINING EXERCISE/FOLLOW-ON UNIT TRAINING - 'MODULE'**

M-1008 Remove/Install Class 2M Terminal and Indicator Control from/into Shelter or Host System
M-1009 Remove/Install Local Communication Systems from/ into Shelter
M-1010 Perform Preventive Maintenance on Local Communication System
O-1009 Set Up and Operate Local Communications

TABLE 3-3

- Hands-on (HO) practical exercise.
 - Demonstration (DM).
 - Combination (HO + DM).
- o Media.
 - Actual equipment.
 - Training device.
 - Video tape.
 - o Training time.
 - o Candidate student types characteristics.

These alternatives were used to specify training contexts and student types for obtaining the training efficiency estimates used in subsequent analyses. The efficiency estimate activity is covered under Section 3.2.3, Training Effectiveness Analysis.

3.2.1.6 Extended Program of Instruction Development (POI). The previous course development activities were documented in the form of a quasi POI. Utilizing the quasi POI, training efficiencies were obtained and analyzed with respect to training contexts and prospective student types. The results of analysis identifying proposed training times, methods and media was incorporated in an Extended POI (Table 3-4). The extended POI is the primary document upon which all the following analyses were based.

3.2.3 Training Effectiveness Analysis. The primary requirement in conducting a CTEA is determining the effectiveness of training program alternatives of interest. As stated earlier, the lack of a training program, and consequently empirical data, required the use of a forecasting method to conduct this CTEA. The forecasting method involved obtaining a task by task estimation of the training benefit to be received from training a given task

EXAMPLE EXTENDED POI TASK SHEET

TASK: O-2002

TASK TITLE: Initialize Class 2M Terminal

TASK STATEMENT: Apply power, follow menus and initialization procedures in Operator TM.

SUBTASK 1: Energize the Class 2M Terminal

SUBTASK 2: Prepare TAMMS Forms

NEW SKILLS TRAINED

Locate system components using locational diagrams.

Execute written instructions on electrical device.

Communicate via symbols.

Interpret fault indicators.

LEARNED SKILLS PRACTICED

Recall damage criteria and recognize unsatisfactory conditions.

CONDITION/S: Given an Operating Class 2M Terminal with crypto variables loaded, indicator control, initialization instructions and TAMMS Forms.

STANDARD/S: Class 2M Terminal must be initialized with the correct variables. Any deficiencies identified on the Class 2M Terminal or indicator control must be recorded on a DA form 2404.

PROPOSED METHOD: Demonstration and Practical Exercise

PROPOSED TIME (Minutes): 720

PROPOSED MEDIA: Video Tape and Actual Equipment/Training Device Qualification

TABLE 3-4

and the training efficiency of alternative training contexts. Individual task ratings were aggregated, during subsequent trade-off analysis, to produce an index of expected training effectiveness for each TPA.

3.2.4 Training Assessment. The training assessment phase of the CTEA was directed at evaluating the trainability of possible types JTIDS trainees. Insight concerning whether trainees selected by alternative selection criteria and already trained in AD operator or maintenance MOSS can be trained by a reasonable JTIDS training program is of great importance to JTIDS manning and training decision makers. This information will be used to moderate decisions concerning JTIDS manning options and to highlight any training concerns for further analysis.

3.2.5 Training Device Requirements Analysis. Once the Quasi POI was developed and the efficiency estimates were obtained, an analysis of the efficiency estimates identified practical exercise requirements. After the exercise requirements were

identified, how to best provide the training equipment for supporting the exercises was addressed. There were trade-offs between using actual equipment and training devices plus possible simulator requirements to consider. This phase of the CTEA surveyed training equipment requirements to identify where training devices and/or simulators:

were needed regardless of their cost.

would obviously cost less to use than actual equipment.

may be more efficient to use than actual equipment
(tentative).

Where the requirements are tentative, based on possible increased efficiency, a requirement for further analysis was identified.

The training device analysis produced the following requirements:

- o Mock SRUs, cards for the Class 2M Terminal and Indicator Control, should be obtained. They should be used to train the electrostatic discharge equipment safety subtask of Task M-1005 (Pack/Unpack Shop Replaceable Units).
- o Mock or non-operational SRUs, cards for the Class 2M Terminal and Indicator Control, should be obtained. They should be used to train Task M-2003 (Fault Isolate Class 2M Terminal) and Task M-2005 (Fault Isolate Indicator Control). NOTE: These cards will not be required if a more elaborate training device that can be used to train these tasks is acquired.
- o A mock Class 2M Terminal and a mock Indicator control should be obtained. They should be used to train SRU, card, replacement procedures for Task M-2004 (Repair

Class 2M Terminal) and Task M-2006 (Repair Indicator Control).

The analysis also produced a possible requirements for a device to train Task O-2002 (Initialize Class 2M Terminal), Task M-2003 (Fault Isolate Class 2M Terminal), and Task M-2005 (Fault Isolate Indicator Control): an I-FAULT trainer.

Following are desired functional characteristics for the I-FAULT.

- o Provide for training six students using one instructor.
- o Allow for manual initialization of the 2M.
- o Simulate faults in the 2M Terminal and Indicator Control.
- o Allow for exercising fault isolation procedures.
- o Provide for detection of performance errors and provide feedback to the students and instructor.
- o Provide for controlling performance error feedback from immediate to same-as-system.

3.2.6 Determination of Training Program Costs. The JTIDS system is fairly early in the Life Cycle Systems Management Model process. Therefore, specifying training program variants was of interest was the first task of the analysts. Constraints such as, "Initial training in the field will be by the contractor," have limited the Training Program Alternative (TPA) options. The following four are those the Air Defense School requested be investigated.

- o I-A. The complete Extended POI trained at the Air Defense Artillery School using an I-FAULT Trainer.

- o I-B. The complete Extended POI trained at the Air Defense School using actual equipment.
- o II-A. The Extended POI minus Module 5 trained at the Air Defense Artillery School using an I-FAULT Trainer.
- o II-B. The Extended POI minus Module 5 trained at the Air Defense Artillery School using actual equipment.

The first element of costing to be determined was the student population. The number of students needed for attrition replacement drives resource requirements such as the number of instructors and amounts of equipment needed.

The requirements will be for one trained replacement per year per JTIDS system. In Table 3-5, it can be seen, the number of systems to be deployed as well as the training requirements. The costing figures are based on the peak loads of 291 students from 1997. An E-2's training costs are \$72 per student per day (Table 3-6).

JTIDS TRAINING REQUIREMENT

	FAADS	HIMAD	TOTALS
1993	15	--	15
1994	24	--	24
1995	71	--	71
1996	123	118	241
1997	173	118	291
1998	173	118	291

TABLE 3-5

COST OF STUDENTS		
	OPTIONS IA and IB	OPTIONS IIA and IIB
LENGTH OF COURSE IN DAYS	13	10
COST PER STUDENT PER DAY	72	72
	—	—
	936	720
NUMBER OF STUDENTS PER YEAR	291	291
	=====	=====
	\$272,376	\$209,520

TABLE 3-6

The number of instructors needed and their cost is variable according to the training program alternative selected. Obviously when the class is relatively short in duration, a larger number of classes with fewer students per class will allow for better utilization of instructors and will require less training equipment. Efficient utilization of equipment and instructors occurs with 9 students per class with 36 classes each year.

Explicit instructions for determining Instructor Contact Hours (ICH) are provided in PAM 570-558, Appendix C. In Table 3-7 the ICH for Options I-A&B and II-A&B are computed. The TRADOC-FORSCOM RESOURCE FACTOR HANDBOOK indicates that enlisted instructor personnel at the US Army Air Defense school cost \$30,789 annually. This cost was multiplied by the number of instructor personnel needed for each option. Option I instructor costs are \$277,101. Option II instructor costs are \$215,523.

The final variable in costing is that of equipment. Equipment is identified on Table 3-8 as either tactical or training. Under training the Isolation Fault (IF) trainer (para 3.2.5) price is based on obtaining only two trainers. Each additional trainer

INSTRUCTOR COST PER OPTION

OPTION I-A&B

SUBJECT	TYPE	HOURS	SECTION	GROUP	ICH
a	b	c	d	e	f
Conference	c	8	1	1	8
PE	PE	86	1	3	<u>258</u>
					266
					<u>36</u> Classes
					\$576 Total ICH

9576 = 7.66 = 8 instructors
 1250 per instructor 1 supervisor
 9 TOTAL

\$30,789 annual instructor cost

9
\$277,101 instructor option cost

OPTION II-A&B

a	b	c	d	e	f
Conference	c	7	1	1	7
PE	PE	67	1	3	<u>201</u>
					208
					<u>36</u> Classes
					7488 Total ICH

7488 = 5.99 = 6 instructors
 1250 per instructor 1 supervisor
 7 TOTAL

\$30,789 annual instructor cost

7
\$215,523 instructor option cost

TABLE 3-7

JTIDS EQUIPMENT COST

A TACTICAL	B COST	C LIFE	D DEPRECIATION	E QUANTITY	F TOTAL	G
2M Terminal	353,000	20 years	17,650	7	123,550	
Indicator Control	70,000	20 years	3,500	7	24,500	
Two 10kw Generator (trailer mounted)	35,000	20 years	1,760	3	5,280	
HMMV 5/4 ton	22,600	20 years	1,130	3	3,390	
Shelter (250 g)	20,200	20 years	1,010	3	3,030	
34 meter Antenna	10,485	20 years	525	3	<u>1,575</u>	OPTI IB an \$161
TRAINING						
Isolation Fault Trainer	507,500	20 years	25,375	2	50,750	
Video Tape (Master & 2 copies)	111,006	20 years	5,550	1	<u>5,550</u>	OPTI IA AN \$217
		Same tactical equipment costs as IB & IIB			<u><u>56,300</u></u>	
					<u><u>161,325</u></u>	

TABLE 3-8

costs an additional \$150,000 to include manuals and spare parts. If a decision was made to field the IF trainer for sustainment training the individual cost would be significantly reduced and cost effectiveness of Options I-A and II-A would be increased.

Costing by Training Program Alternatives is found on Table 3-9. This is a compilation of student, instructor, and equipment costs.

3.2.7 Trade-Off Analysis. The final phase of this CTEA process was to conduct a trade-off analysis between cost and effectiveness, that can be used for selecting from the TPAs under consideration. TPA aggregate effectiveness estimates were obtained by summing the product of the task-level training effectiveness estimates and the indices of training worth across tasks:

PEAK YEAR COSTING OF TRAINING PROGRAM ALTERNATIVES

OPTIONS	IA	IB	IIA	IIB
STUDENTS (TABLE 3-17)	272,376	272,376	209,520	209,520
INSTRUCTORS (TABLE 3-18)	277,101	277,101	215,523	215,523
EQUIPMENT (TABLE 3-19)	217,625	161,325	217,625	161,325
	_____	_____	_____	_____
	\$767,102	\$710,802	\$642,668	\$586,368

TABLE 3-9

The training figure-of-merit (FOM) values for the the TPAs of interest are:

TPA	FOM
I-A	194319
I-B	194319
II-A	134173
II-B	134173

The training program merit scores were next combined with training program cost options to establish the training benefit (TB) of implementing each TPA. An index of training benefit was obtained by dividing training program figures-of-merit by training program cost.

$$\text{I-A} \quad 194319/\$767102 = .2533$$

$$\text{I-B} \quad 194319/\$710802 = .2734$$

$$\text{II-A} \quad 134173/\$642668 = .2088$$

$$\text{II-B} \quad 134173/\$586368 = .2289$$

Based on this trade-off analysis, Option I-B, training the complete Extended POI at the Air Defense Artillery School using actual equipment, is the most cost-effective alternative for training replacement JTIDS personnel. However, Option I-Bs FOM is based on a comparatively high cost of an I-FAULT compared to the overall low cost of training. The high cost of the I-FAULT is because the low number of projected students used for this study requires a low number of I-FAULTs and this does not allow for distributing I-FAULT design and development costs. If the student throughput increases significantly or I-FAULTs are acquired to support unit training, a follow-on trade-off analysis would show alternative I-A and I-B to have FOMs much closer to each other.

CHAPTER 4

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 EEAs

This CTEA was focused on, but not limited to, the EEAs provided by the US Army Air Defense School. This chapter summarizes the CTEA from the prospective of those EEAs. Conclusions and recommendations relative to each of the EEAs follows.

4.1.1 EEA One. Based on current air defense operational, maintenance and manning concepts: what are the critical tasks required for operating and maintaining JTIDS?

- o Analysis of JTIDS technical documentation, missions and functions yielded the critical tasks presented in Table 3-3. Additionally, Table 3-14 (Final Report) presents the worth of training each of these critical tasks. The worth of training a task approximates the criticality of the task from a training prospective.

4.1.2 EEA Two. Based on alternative employment/deployment concepts: how are the critical tasks distributed when the JTIDS is employed by or deployed with the PATRIOT, HAWK, AN/TSQ-73 and FAADS C²I systems?

- o The only official, approved Required Operating Capability document for deploying JTIDS with air defense, during the time of this study, was for deployment with FAADS C²I systems. However, it was found that the FAADS deployment would produce the most extensive task list. Therefore, the FAADS deployment task list was used for this study. Other deployment options may reduce the number of required tasks: primarily shelter and generator related tasks reduced or eliminated.

4.1.3 EEA Three. Based on the skills presently required to perform tasks associated with Air Defense MOSS/AOCs affected by the air defense fielding of JTIDS and the skills required to perform critical JTIDS tasks: Are there trainability problems associated with current manning concepts? If so, what are the recommended training solutions?

- o Required training times and training methods were elicited from SME who were familiar with training signal personnel like tasks on like systems. These times and methods were used to elicit training efficiency estimates, for training ADA personnel, from ADA instructors familiar with ADA student's learning characteristics. Analysis based on these estimates revealed no expected training problems.

4.1.4 EEA Four. Based on the trainability assessment: are there more appropriate Air Defense MOSS/AOCs for personnel who must operate and maintain the JTIDS, or could the operation of the JTIDS be designated as a common task for all relevant ADA MOSSs?

- o The trainability assessment was focused on ADA MOS students representative of students currently selected for ADA operator and maintainer training. The assessment indicated that either group can be trained to perform both operator and maintainer tasks. The analysis also indicated that no one group could be more cost effectively trained than another.

4.1.5 EEA Five. Based on the most appropriate AD MOSS/AOCs and training cost-effectiveness considerations: what is the optimum AD MOS structure (MOS and skill levels) for operator and maintainer duties?

- o The trainability analysis identified no optimum MOS (See

4.1.4). Skill levels, based on difficulty of performance mastery, were identified by a logic sort and are presented in Table 3-6 (See 3.2.2.2, Final Report).

4.1.6 EEA Six and EEA Seven. Based on task criticality, training continuity requirements and training cost-effectiveness: what is the recommended training strategy

Based on the recommended training strategy: what is the most cost-effective, yet realistic Program of Instruction (POI) configuration for each required POI?

- o The cost-effectiveness trade-off analysis indicates that JTIDS training for training replacement personnel should be conducted as resident training. The recommended POI configuration is the structure and sequence presented by the Extended POI (Annex D, Final Report).

4.1.7 EEA Eight. Based on the cost-effective POIs and a cost-efficient blend of tactical equipment and training devices: what is the optimal instructional strategy to be recommended for JTIDS training?

- o The recommended training method and training media is identified in Table 3-9, Final Report. The Training Device Requirements Analysis identified a possible requirement for a I-FAULT Trainer. Trade-off analysis, based on the small throughput of students, does not justify acquiring the trainer. This result is based on the large cost of design and development (D&D) plus a small number of required training devices to distribute the cost D&D over. However, if the student throughput increases and/or more devices are procured and distributed to JTIDS user units, the cost per device is greatly reduced and it should be cost-effective to acquire the I-FAULT.

4.1.8 EEA Nine. Based on the AD-JTIDS Fielding Plan, System Training Plan, AD-JTIDS POIs, instructional facilities and media requirements: what is a cost-efficient approach for training present Air Defense MOS/AOC holders affected by fielding JTIDS?

- o During the course of investigation for this study, it was found that it is planned for the JTIDS contractor to conduct initial training in the field as JTIDS is fielded. Replacement personnel should be trained by the Air Defense Artillery School.