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Study Plan For The Joint Working Group For Embedded Training (ET-JWG)

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INSTITUTE FOR SIMULATION AND TRAINING

STUDY PLAN FOR THE
JOINT WORKING GROUP FOR
EMBEDDED TRAINING (ET-JWG)

July 1989

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**STUDY PLAN
for the
JOINT WORKING GROUP
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EMBEDDED TRAINING (ET-JWG)**

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**Study Plan
for the
Joint Working Group
for
Embedded Training (ET-JWG)**

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by the
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Joint Working Group for Embedded Training (ET-JWG)**

Revised July 1989

PREFACE

This document is a revision of the Embedded Training Study Plan prepared by Mr. Donald Peckham of PM TRADE. Major additions and revisions include:

- an expanded list of Army, Navy and Air Force embedded training products
- an updated bibliography
- a selected list of embedded training projects contracted by PM TRADE and NTSC (Appendix A)
- a list of technologies critical to embedded training Appendix B

TABLE OF CONTENTS

PREFACE	ii
INTRODUCTION	1
Purpose.	1
Organization	2
ET-JWG BACKGROUND	3
EMBEDDED TRAINING OVERVIEW.	4
BRIEF TASK DESCRIPTIONS	6
ACTIONS REQUIRED.	7
Task 1	7
Task 2	8
Task 3	14
Task 4	15
Task 5	16
STUDY SCHEDULE.	18
Task 1	18
Task 2	19
Task 3	22
Task 4	23
Task 5	23
APPROVAL SHEET.	24
PRODUCT DESCRIPTIONS.	P - 1
DIRECTIVES	D - 1
REFERENCES.	R - 1
APPENDICES	
A.....Contracted Projects	A - 1
B.....Supporting Technologies.	B - 1

STUDY PLAN
FOR THE
JOINT WORKING GROUP FOR EMBEDDED TRAINING (ET-JWG)

(rev. July 1989)

INTRODUCTION

Embedded training (ET) is defined by the Joint Technical Coordinating Group for Training Systems and Devices (JTCG-TSD) as "training that is provided by capabilities, not specifically required for mission completion, which are built into or added onto operational systems." In a summer study in 1982, the members of the Defense Science Board identified training shortcomings which they felt ET could overcome. The general perception is that applying ET will increase force operational readiness by training more effectively.

A high level of interest in ET exists within the three services because of operational readiness concerns. Policies and procedures are being established to institutionalize ET. Some fielded systems already have ET functions to varying degrees. Some emerging systems have ET functions planned, and various research programs have been initiated to study ET technical and administrative implementation.

Purpose

This document is a plan of action for the Joint Working Group for Embedded Training (ET-JWG). The purpose of this document is to help organize and focus research efforts in ET technology. Tri-service initiatives will be listed to establish a systematic methodology and associated data base specifying ET requirements and products in weapon systems acquisition efforts. The methodology will refine the training requirements definition process and clarify trade-off issues as life-cycle cost, logistic considerations, training system alternatives and system design.

Organization

Five sections are included in this document:

- ET-JWG Background
- Embedded Training Overview
- Brief Task Descriptions
- Actions Required
- Study Schedule

The Actions Required section is the primary section of this document. In this section, the tasks are broken down into subtasks, and related tri-service projects are listed. This listing includes a brief project description, expected products, funding and points of contact.

Two appendices are included in the back of this document. Appendix A describes several projects being performed by agencies under contract to the Department of Defense. Appendix B contains a chart listing technologies that are critical to the development of ET.

ET-JWG BACKGROUND

The ET-JWG consists of a lead individual from each service. The lead individuals will recruit additional members from service personnel who are active in ET. This membership can bring broad-based information and insight, and thereby prevent a restricted view of ET. The Army will act as the lead service. Chairman responsibility will not be rotated for the life of the ET-JWG.

The initiator of this study plan is Mr. Donald Peckham, acting as the chairman for the ET-JWG. Participants from each service include:

- Don Peckham, ET-JWG Chairman, Army Lead Individual
PM TRADE
AMCPM-TND-ET
12350 Research Pkwy
Orlando, FL 32826-3276
(Autovon) 960-4353 (407) 380-4353
- Richard Reynolds, Navy Lead Individual
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Orlando, FL 32826-3224
(Autovon) 960-4739 (407) 380-4739
- William Lloyd, Air Force Lead Individual
ASD/YWB
Wright Patterson AFB, OH 45433
(Autovon) 785-7177
- MAJ W.W. Woodruff, AF Liaison/Officer
NTSC
Code 002
Orlando, FL 32826-3224
(Autovon) 960-8122 (407) 380-8122

ET-JWG activities will be carried out under the direction of the lead individuals. Research efforts will be funded by existing resources.

The anticipated level of effort for each primary ET-JWG member is estimated to be 12 hours each month for the life of the group.

EMBEDDED TRAINING OVERVIEW

Embedded training is defined in a 1986 DoD Directive as "training using operational equipment that involves simulating or stimulating equipment performance." An Army ET policy letter issued in March 1987 refined the definition to "training that is provided by capabilities designed to be built into or added into operational systems to enhance and maintain the skill proficiency necessary to operate and maintain that equipment end item." Sustainment training will always be the major factor in determining the need for embedded training.

Some decision makers consider ET as a way to reduce or limit increasing weapon system costs. By incorporating ET, a more expensive investment in stand alone training devices is avoided. Generally, the life cycle operating costs that might be brought about by ET incorporation have not been explored.

While ET is often seen as the remedy for many training problems, incorporation of ET adds new problems to weapon system development. Increasing dependence of training capability upon the use of operational equipment causes higher life cycle operating costs and more frequent replacement of equipment. Another problem is that guidelines for adjusting RAM and weight requirements to accommodate both ET requirements and combat mission requirements have yet to be established.

Successful implementation of ET requires two analysis: a top down systems engineering approach to the definition of training systems at all levels, beginning in the earliest concept phases, and the definition and continued tracking of man-machine interfaces as an integral part of the system design process.

Trends

In accordance with the system engineering process, candidate ET requirements will be analyzed for implementation feasibility. The following factors will be considered:

- operational interference
- availability for training
- RAM
- cost-effectiveness
- performance monitoring
- graduated skill training (considering level of presentation to match the skill level of individual using ET information)
- parent system changes (considering constraints and costs for upgrading ET hardware/software when parent system is upgraded)

There are many diverse objectives to be addressed as the Army and other services move toward implementation of ET. The major objectives include:

- identifying conditions under which ET should or should not be included in new or upgraded weapon systems.
- identifying functions and tasks (by weapon system class) which best lend themselves to ET.
- identifying critical design tradeoffs related to ET.
- organizing current and existing information on ET in the form of a data base.

As the use of simulation grows, contractors will be required to deliver interactive simulations of the man-machine interface in addition (or perhaps in place of) to paper documentation.

Future Directions

The increasing use of simulation in weapon system design will make possible the early functional definition and continued refinement of the man-machine interface. Each interface will be tested in stand alone simulation. Such simulations will allow early evaluation based on projected performance parameters of weapons systems prior to building the first prototypes. Based on these evaluations, functional allocations can be adjusted followed by corresponding changes in the weapon system design parameters.

Real time man-in-the-loop simulations will also play an increasing role in weapon system design. As computer hardware and software processing capabilities grow, the distinction between non-real time engineering design simulations and real time man-in-the-loop training simulators will become blurred.

In many cases, these activities will converge into a full mission simulator prior to building first hard prototypes. Even when full mission simulators are not developed, the same early simulations will provide the foundation for the synchronous development of the weapon system, training system and ET capability.

BRIEF TASK DESCRIPTIONS

The ET-JWG has been directed by the JTCG-TSD to perform these five tasks:

- Evaluate effectiveness of fielded ET systems (air/surface/submarine), including maintenance trainers.
- Investigate selected tri-service classes or subclasses of materiel items to determine problems, constraints, and impediments to ET implementation. The ET-JWG will analyze resulting data to define potential research programs or administrative action that will develop solutions to those problems.
- Develop a centralized ET data base.
- Conduct a case study of SV-22 variant for potential ET applications.
- Develop guidelines and exemplar products for evaluating proposals under PEP and incorporating ET requirements in System RFPs.

ACTIONS REQUIRED

This section describes the subtasks necessary to accomplish each task and lists related tri-service projects. This listing includes a brief project description, expected products, funding, and points of contact.

Task 1

In order to evaluate the effectiveness of fielded systems, the ET-JWG must:

- Identify fielded systems with ET functions.
- Develop effectiveness-evaluation criteria.
- Collect data on fielded systems.
- Evaluate data.
- Document findings.

Project 1A The ET-JWG has prepared a summary report of data documented in a limited-study report titled "Tri-Service Review of Existing System Embedded Training (ET) Components." The ET-JWG report addresses findings relevant to training effectiveness. The Tri-Service Review, a product of an ARI/PM TRADE contract, examined a selected set of nine currently operational systems (three from each service).

Products:

- Quick-reaction briefing -- completed
- Draft -- TBD
- Final report -- TBD

Funding: TBD

POC: ET-JWG

Project 1B A second proposed initiative represents a long-term effort involving the full scope of Task 1 actions. Depending on the scope, this effort may represent a study of the training effectiveness of fielded ET systems; this study will be more definitive than the Tri-Service Review. Preliminary discussions with Mr. Dick Jarvis (NAVTRASYSCEN) resulted in an interest for his office to evaluate the training effectiveness of fielded ET systems. Mr. Jarvis' organization has the special mission and expertise to evaluate the effectiveness of training systems. The ET-JWG will negotiate with Mr. Jarvis; JCTG-TSD-level interagency negotiation may be required. Funding is expected to be a major obstacle.

Products (prospective):

- Identification of ET systems fielded during study term.
- Assessment of current evaluation techniques, with development as needed.
- Empirical and narrative data on systems evaluated.
- Data evaluation, with documented findings.

Funding: TBD

Project 1C Consolidation of Embedded Training System Experience for Application to AN/BSY-2 training system design NTSC has completed a short-term study focused on ET application and requirements in subsea systems. Although many systems in the Navy have ET functions (to limited degrees), little is known about the effectiveness of these fielded systems. Researchers examined a cross section of these systems and developed guidelines to aid in the design of ET for the AN/BSY-2 Combat Control System aboard SSN-21-class submarines.

Product:

- Technical Report consolidating fielded ET experience for application to AN/BSY-2 embedded-training system design.

Funding: Completed

POC: Richard E. Reynolds, NAVTRASYSCEN, Code 712
AV 960-4739

Task 2

In this task, selected tri-service classes and subclasses of materiel are being investigated to determine problems in implementing ET. Analysis of these problems may help identify potential joint research programs or administrative actions to overcome the problems.

Completion of Task 2 will result in these continuing product-actions:

- Description of problems in ET-implementation in new (and improved) materiel systems and in field application.
- Analysis of data to determine bases.
- Identification of fixes available for administrative implementation without further development.
- Definition of areas requiring further research and development.
- Initiation or coordination of follow-on research and administrative action leading to product-integration with existing doctrine and implementing guidance.

Funding: As described for individual projects.

In addressing these product-actions, the Services divide application areas-of-interest as: pilot training (Air Force), non-pilot/air crew position training (Navy), and ground-crew training (Army).

As directed by the JTCG-TSD, scheduled Task 2 action presently includes a total of 13 short, mid, and long-term projects. These projects are listed by service.

U.S. Air Force (2 projects) The two Air Force ET projects consist of initial ASD/XR studies of tactical aircraft ET concepts and an add-on training initiative to assess the training potential of a given Flight Dynamics Lab system.

Project 2A ASD/XR Investigation - Embedded Trainer Concept for Tactical Aircraft This investigation was a two-phased requirements feasibility effort. In Phase I, potential operational training requirements and ET applications were identified through pilot interviews at five TAC bases. Potential requirements/applications were identified in the areas of air-to-air, air-to-ground, and electronic warfare (EW) training.

The purpose of Phase II was to investigate the feasibility of implementing the Phase I requirements and applications on the basis of pilot acceptance, design and cost. Phase IIA, which has been completed, consisted of manned simulations at McDonnell-Douglas Aeronautics (McAir), St. Louis, MO, and General Dynamics (GD), Fort Worth, TX. The manned simulations were for air-to-air (McAir) and air-to-ground (GD) ET requirements, but both included EW requirements.

Phase IIB consisted of several manned simulations and was based on the pilot recommendations from Phase IIA. In Phase IIB, researchers integrated air-to-air and air-to-ground requirements, assessed safety features, evaluated training feedback, and explored design, cost and transition issues. Capabilities and potential applications of ET for the F-16, Block 50, were presented to TAC DO/DR in November, 1988. As a follow-up, XRS is providing TAC an assessment/comparison of the ET system with the On-Board Electronic Warfare System (OBEWS) and the Block 50 Weapon System Trainer.

Products:

- List of potential operational requirements and feasibility assessment based on pilot viewpoint and design/cost impact.
- Development plan for transition of ET from XR to acquisition and technology laboratories, as appropriate.
- Automated tools for estimating the generic impact of tactical aircraft design, performance, and mission parameters on potential aircraft embedded-training requirements.
- ET evaluation demonstration.

Funding: Completed

POC: Steve Walker, ASD/XR
AV 785-3124

Project 2B Air Combat Engagement System (ACES) An ET task has been added to the Air Force's Wright Aeronautical Flight Dynamics Lab (AFWAL/FIGX) Integrated Controls and Avionics for Air Superiority (ICAAS). The added task assesses the training potential of the ACES simulations which are part of ICAAS to support ET of selected Beyond Visual Range (BVR) tasks.

This project will include the definition, implementation and assessment of required capabilities to support training (such as aircrew performance monitoring and feedback capabilities not currently implemented in ACES), and serve as a baseline for trade-offs in the development of future ET applications. The initial phase of ICAAS included a dual award to McDonnell Douglas and General Dynamics, with a down-select to McDonnell Douglas in December, 1988. McDonnell Douglas researchers have submitted their findings from the initial ET study to develop and field an ET-system capability.

Product:

- Final report to include ET functional specs, training value assessment, and R&M assessment data.

Funding: (\$K)	FY87	FY88	FY89	FY90	FY91	FY92	TOTAL
(Programed)	250	60					310

POC: Larry Butterbaugh, AFWAL/FIGX
AV 785-8479

U.S. Army Project Manager for Training Devices (PM TRADE) and Army Research Institute (ARI) - (3 Projects) *Project 2F Guidelines for Implementing Embedded Training (ET) in Army Systems* Under a 1984 contract jointly sponsored by PM TRADE and ARI, researchers developed guidelines to specify and implement ET in the systems acquisition process. The Life Cycle Systems Management Model was reviewed to determine what was still needed to support the development of an ET component. Eight new or upgraded system development activities requiring documentation were supported. Eighteen categories of potential documentation users were identified; the users range from those who simply must be aware of system ET events to those who do the determining analyses to those who have sign-off authority.

Products:

- Guidance documentation describing design, development and implementation of ET in the system life cycle. This documentation includes guidance in:
 - developing ET requirements based on training strategy.
 - implementing requirements in new and product-improved systems and system-acquisition instruments.

- integrating ET with other instructional delivery approaches in developing fielded training guidance and literature. (This guidance is for training developers.)
- Background studies in existing ET-incorporating systems, factors affecting system-susceptability to ET inclusion, technologies useable in ET, and general approaches to requirements definition.
- System-specific initial ET requirements, concepts and demonstrations.

NOTE: Product-documents are listed under **Army Project Products** in the **PRODUCT DESCRIPTIONS** section.

Funding: Completed

POC: Don Peckham, PM TRADE, AMCPM-TND-ET
AV 960-4353

Project 2G Alternative Conceptual Training Systems for the Armored Family of Vehicles (AFV), with Three General Levels of Devices and ET Integration In extension of work under Project 2F, PM TRADE researchers described derivation and development of several potential new-system training concepts and strategies based on AFV Task Force fielding concepts and normal system training requirements. The study described derivation of training device and ET mixes for operator and maintainer (including) functional systemic interrelationships, for specified function-level hands-on-trained tasks and task-groups.

A test bed was created for application and further development of models described in *Project 2F*. These models (System Concept and Dem/Val Phases) were designed to facilitate early development of training system concepts and strategies and initial definition of supporting hands-on task-training mediation requirements. Further development of these models includes definition and description of differential in the initial and sustainment training of interrelated roles/applications for training devices and ET. Further development also includes functional training requirements for the implementation. Life-cycle resource-based trade-offs were developed and presented.

Based on subsequent Acquisition Authority guidance to AFV-TF, the team developed and presented guidance for implementing procurement-instrument input and proposal

Products:

- Training System Concepts for the Armored Family of Vehicles, With Consideration of the Roles of Embedded Training and Stand-alone Training Devices.
- Armored Family of Vehicles (AFV) Training Study.

- Input to AFV Proof of Principal Phase SOW.

NOTE: Product-documents are listed under Army Project Products in the **PRODUCT DESCRIPTIONS** section.

Funding: Completed

POC: Don Peckham, PM TRADE, AMCPM-TND-ET
AV 980-4353

Project 2H Embedded Training Utilization Tools Two issues will be investigated in this task. The first issue is to identify when it is *not* practical to use ET because of safety, cost-effectiveness, nonavailability of operational equipment for training and other potential contra-indicators. The second issue is how best to incorporate ET into the operational equipment when it is a good training alternative. Steps to complete in this two-fold task include:

- Identify functions and tasks (by weapon-system class) which best lend themselves to ET.
- Identify critical design trade-offs related to ET.
- Organize existing information in data base.

This project will expand upon work completed under Projects 2F and 2G.

Funding: (\$K)	FY90	FY91	FY92	TOTAL
(Unfunded)	125	125		250

POC: Bob Witmer, ARI-Orlando Field Unit, PERI-IF,
AV 960-4367

U.S. NAVY - Naval Training Systems Center (5 projects) *Project 2I Embedded-Organic Training Technology* NTSC researchers are developing an ET capability in the SPA-25G radar repeater. The concept demonstration focuses on Air Intercept Control (AIC) and equipment operation ("knobology") training.

Products:

- Demonstration ET system for the SPA-25G
- Effectiveness test of the training with fleet personnel
- Cost and effectiveness report of the demonstration training system
- Recommendations for future implementations of ET systems.

Funding: (\$K)	FY88	FY89	FY90	FY91	FY92	TOTAL
(Programmed)	375	30				405

POC: Joyce Madden NAVTRASYSSEN, Code 712
AV 960-4826

Project 2J Embedded Training Technology Identification and Development

In this project, NTSC researchers are identifying or developing training technology for incorporation into ET systems. The researchers are evaluating these technologies and developing guidelines for using these technologies.

Products:

- Technical Report on Embedded Training Technology Identification
- Technical Report on Embedded Training Technology Test Bed Evaluation
- Guidelines for Implementation of Embedded Training Technology

Funding: (\$K)	FY88	FY89	FY90	FY91	FY92	TOTAL
(Programmed)	340	285	300	325	325	1575

POC: Richard E. Reynolds, NAVTRASYSSEN, Code 712
AV 960-4739

Project 2K Embedded Training for Airborne Antisubmarine Warfare (ASW)

Recommend deletion as a research project. Funding was postponed until overtaken by events. Update IV software for the P-3 aircraft is already being developed with an ET capability included.

Project 2L Battle Force Research Simulator (BFRS)

Researchers in this project will develop a test bed to support the RDT&E of shipboard ET systems and components. The test bed will be used to identify low cost technological and behavioral simulation alternatives; this identification will lead to significant cost savings in the procurement of complex training systems. Researchers will develop and demonstrate a proof-of-concept performance measurement subsystem for the Advanced Combat Direction System (ACDS) using the test bed. This system will incorporate basic technological and behavior features essential to performance measurement for shipboard ET systems.

NOTE: Previously defined tasks and milestones for Project 2M have been incorporated into Project 2L.

Products:

The facility will support:

- Development and demonstration of cost-effective warfare operations training technology and methods for both shore- and sea-based embedded/organic training.

- Direct support of component development ship-board interface validation, as well as systems integration of embedded battle force training capabilities.
- Quantification of simulation scope and fidelity requirements.
- Concurrent exploration of training system modularity concepts to promote development of systems configured from reusable building block elements.
- A software based performance measurement system usable with ACDS and transferable to other shipboard training systems.

Funding: (\$K)	FY88	FY89	FY90	FY91	FY92	TOTAL
(Programmed)	1302	1342	1181	1128	4953	9906

POC: Ron Stratton, NAVTRASYSSEN, Code 742
AV 960-4587

Task 3

To develop a centralized ET data base, the following subtasks must be performed:

- Define users/clients of data bases.
- Define user's ET information needs.
- Define data base dictionary.
- Define data base and user interface.
- Determine whether existing data bases meet the requirement or can be modified to meet requirement define requirement for new development.
- Determine or negotiate arrangements with host organizations. (Host organization may also be a developer agency.)
- Define hardware architecture and software environments, develop and implement software.
- Establish continuing data base operations.

Several other projects described in this document will also produce mini data bases of restricted scope; some data bases are already defined as microcomputer-resident. Therefore, subtasks A-C should be completed to form data-base interface specifications. These specifications can then be used as guidelines in other projects. Subtask E is dependent upon the completion of subtasks A-C; in subtask E, existing major (mainframe-based) data bases (e.g., DTIC, MATRIS) will be reviewed.

The performing agency is yet to be identified.

Product:

- Centralized data bases targeted to define user-groups.

Funding: TBD (as defined in individual projects)

Task 4

Provisions for ET will be made on the SV-22 aircraft. The ET-JWG will analyze lessons-learned and specifications developed from the SH-60B Deployable Proficiency Trainer (DPT), developed by the Naval Air Development Center. The ET-JWG will provide products identifying problem areas and solutions encountered in transferring requirements between the SH-60B and SV-22 aircraft.

Products:

- Lessons-learned from predecessor-system.
- Issues encountered, with solutions, in transferring knowledge-base, to SV-22, with lessons-learned.

Funding: TBD

Project 4A An ET requirement will be part of the SV-22 Aircrew Trainer suite. The Training System Manager has been working with the Avionics System Program Manager to establish an ET strategy. Funding for the acquisition of ET has not been separated from the trainer line in the PMA budget. Several studies have been funded for support of the SV-22.

Product:

- ET Requirement for SV-22 Aircrew Trainer suite

Funding (\$K) FY88 FY89 FY90 FY91 FY92 TOTAL
(Not separately-defined in PMA budget)

NOTE: This project is currently unfunded because of a lack of requirements.

POC: Joe Cianfrani, NAVAIR, APC 205-27
AV 222-2137

Task 5

Acquisition of ET capabilities or subsystems within a mission system poses new problems for specifying needs in acquisition documentation, particularly in the SOW and RFP. Projective and empirical analyses will be used to create guidelines with exemplar cases for SOW, Specification, and supporting Proposal Evaluation Plan elements. A result of this effort is expected to be development and adoption of DOD and individual service instructions. These instructions will support incorporation of ET requirements in system acquisition documents and contracts.

Project 5A In support of the Army Family of Vehicles (AFV) project, PM TRADE and ARI prepared embedded-training-related requirements guidelines and clauses for the AFV Proof-of-Principal Phase contract. This is one of two final products of the effort described in *Project 2G*.

Product:

- Guidelines for SOW and Specification Development, with Suggested Clauses, and PEP Guidance for Proof-of-Principal Phase Development of the AFV

Funding: (Completed)

POC: Don Peckham, PM TRADE (AMCPM-TND-ET)
AV 960-4353

Project 5B This project extends Project 5A effort through the Proof-of-Principal phase, leading to development of the Concept Formulation Packages for ET and training devices for the initial prime-item Heavy Forces Modernization Program implementations. The effort will include a(n):

- thorough definition of the training strategy and system (including verification or definition of supporting hands-on training requirements)
- investigation of cost and training-effectiveness of alternate hands-on-training implementation strategies
- investigation and demonstration of selected candidate medium-risk-technology implementations of-anticipated ET requirements.

Products:

- Initial training-system definition for proof-of-principals-demonstrator common chassis and mission module.
- Prototype acquisition strategy for acquiring ET and devices as integral elements of both the prime item and the supporting total training system.
- Empirical assessment of the process and interim products.

- Training-system concept(s) and ET and device Concept Formulation Packages in phase with prime-item development.

Funding: Integral component of system-development cost;
not separately defined as a budget item.

POCs: Art Cannon, AMCPM-TND-EC, AV 960-8081
Don Peckham, AMCPM-TND-ET, AV 960-4353

STUDY SCHEDULE

Task 1

Evaluate effectiveness of fielded ET systems (air/surface/submarine), including maintenance trainers.

Project 1A Summary of Training Effectiveness Data for Selected Fielded Systems (ET-JWG)

Activities	Time Frame	Action Responsibility
A. Develop preliminary findings.	Completed	ET-JWG
B. Brief JTCG-TSD Steering Committee.	Completed	ET-JWG
C. Develop, present final report.	TBD	ET-JWG

Project 1B Develop Effectiveness Criteria, Evaluate Training Effectiveness of Present ET (Prop. Navy)

Activities	Time Frame	Action Responsibilities
A. Negotiate with NTSC.	TBD	ET-JWG
B. Define Project Scope.	TBD	ET-JWG/NTSC
C. Initiate Project Development.	TBD	NTSC

Project 1C Consolidation of ET System Experience for Application to AN/BSY-2 ET System Design (Navy) Completed

Task 2

Investigate selected tri-service classes and materiel items to determine problems, constraints, and impediments to ET implementation. Analyze resulting data to define potential research programs or administrative action that will develop solutions to those problems.

Project 2A **ASD/XR Investigation - Embedded Trainer Concept for Tactical Aircraft (Air Force)**
Completed 1Q88

Project 2B **Air Combat Engagement System (ACES) (Air Force)**

Activities	Time Frame	Action Responsibility
A. Define concepts.	Completed	ASD/XR
B. Define system.	FY 90	ASD/XR
C. Demonstrate flight test.	FY 91	ASD/XR
D. Produce final report.	FY 91	ASD/XR

Project 2F **Guidelines for Implementing ET in Army Systems (Army)**
Completed 4Q88

Project 2G **Potential Training-System Alternatives for the Armored Family of Vehicles (Army)**
Completed 4Q88

Project 2H Embedded Training - Criteria for Use

Activities	Time Frame	Action Responsibility
A. Develop guidelines for the use of ET.	FY 90	PERI-IF
B. Identify training requirements best accommodated by ET according to weapon class.	FY 90	PERI-IF
C. Analyze critical design tradeoff dimensions.	FY 90	PERI-IF
D. Develop data base.	FY 90	PERI-IF
E. Organize data to support development of an ET module for OSBATS.	FY 90	PERI-IF

Project 2I Embedded/Organic Training Technology (Navy)

Activities	Time Frame	Action Responsibility
A. Identify and develop instructional features.	Completed	Joyce Madden NTSC, Code 712
B. Identify or develop scenario control software.	Completed	Joyce Madden NTSC, Code 712
C. Perform training needs analysis.	Completed	Joyce Madden NTSC, Code 712
D. Develop real-time/play software.	Completed	Joyce Madden NTSC, Code 712
E. Develop sample training scenarios.	Completed	Joyce Madden NTSC, Code 712
F. Conduct fleet-evaluation.	FY 90	Joyce Madden NTSC, Code 712

Project 2J ET Technology Identification and Development (Navy)

Activities	Time Frame	Action Responsibility
A. Identify candidate technologies and locate technology gaps.	Completed	R. Reynolds NTSC, Code 712
B. Modify current technologies and develop new technologies.	Completed	R. Reynolds NTSC, Code 712
C. Verify ET technology on test bed.	FY 88-FY89	R. Reynolds NTSC, Code 712

Project 2K ET Training for Airborne Anti-Submarine Warfare (ASW) (Navy)
Recommend deletion

Project 2L Battle Force Research Simulator (BFRS) (Navy)

Activities	Time Frame	Action Responsibility
A. Develop design and specifications.	Completed	Ron Stratton NTSC, Code 742
B. Procure hardware and software.	FY90	Ron Stratton NTSC, Code 742
C. Test and integrate.	FY91	Ron Stratton NTSC, Code 742

Project 2M Performance Measurement and Evaluation (Navy)

Previously defined tasks and milestones for this project have been incorporated into Project 2L.

Task 3

Develop and centralize an embedded training data base

Activities	Time Frame	Action Responsibility
A. Define scope.	4Q89	ET-JWG
B. Identify performance resources.	4Q89	ET-JWG
C. Define projects.	1-2Q90	ET-JWG
D. Define data base users.	3Q90	ET-JWG
E. Define information needs of data base users.	FY90	ET-JWG
F. Define data base dictionary.	FY90	ET-JWG
G. Determine if existing data bases meet requirements or can be modified.	FY90	ET-JWG
H. Determine and negotiate with host agencies.	FY90-91	ET-JWG
I. Define hardware architectures. Develop and implement software.	FY91	ET-JWG
J. Establish data base operations.	FY91-92	ET-JWG

Task 4

Conduct case study of SV-22 for potential ET applications

- Project 4A** **Develop ET Requirement for SV-22 Aircrew Trainer Suite**
 Previously defined milestones may no longer be valid; this project is currently unfunded because of a lack of requirements.

Task 5

Develop guidelines and clauses for system SOW and specifications

- Project 5A** **Develop Embedded Training SOW Language for HFMP Proof-of-Principal Phase**
 Completed 4Q88 (see *Project 2G*)

- Project 5B** **Implement Requirements Definition and Explore Total-System Implications**

Activities	Time Frame	Action Responsibility
A. Outline training strategy and requirements.	FY88-89	USACATA
B. Develop program-level scope of work for system development.	Completed	Art Cannon, EC
C. Develop and provide system engineering and training analysis requirements for POP demonstration.	1-3Q89	Art Cannon, EC Don Peckham, ET
D. Prepare SOW S/E and training analysis input and data-item requirements.	2-3Q89	Art Cannon, EC Don Peckham, ET
E. Provide initial training system flesh-out and ET requirements for POP test beds.	FY90-92	Don Peckham, ET Art Cannon, EC
F. Provide system demonstration and engineering analysis.	FY90-93	Art Cannon, EC
G. ET and devices CFP.	FY94-95	Art Cannon, EC
H. Evaluate process.	FY94-95	Art Cannon, EC Don Peckham, ET

APPROVAL SHEET

These signatures signify that the JTCG-TSD approves and supports the initiative.

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PRODUCT DESCRIPTIONS

The following sections summarize significant products. These products are listed by service and project, referenced to the study plan.

ARMY Project Products

Project 2F

Guidance & Procedures products are as follows:

Vol. 1 How to Select and Develop Embedded Training: Overview of Interim Guidelines, Procedures, and Supporting Documentation

- Overview of the entire product set - the series contents, their applications, and how to use them. (March 1988)
- Videotape: "Implementing Embedded Training: An Introduction to Guideline Documents"
- Twenty minute tape summary of Vol. 1 (above). Designed as fast-distribution approach, general-audience introduction to ET. (Dec. 1987)

Vol. 2 Embedded Training as a System Alternative

- Guidelines for the initial system decision--further consideration of embedded training (ET) for both new and improved (P3I, PIP, ECP) or retrofit system efforts. Designed for iterative use, beginning at the Combat Developer's pre-concept requirement, extending through materiel concept development and Proof-of-Principal. (April 1988)

Vol. 3 Role of Embedded Training in the Training System Concept

- Guidelines for early estimation of training systems requirements and potential allocation of hands-on-task training roles to ET, training devices, and actual-equipment. Process is training-strategy-based. Designed for use in Combat Developer pre-concept and materiel concept phases. (March 1988)

Vol. 4 Identifying Embedded Training Requirements

- Procedures for initial (outline) definition of embedded training requirements (the ETR) during the MAA or BDP development) and for translating initial ETR into an initial ET design concept. (March 1988)

Vol. 5 Designing the ET Component

- Procedures for producing an expanded/revised ETR package during Concept Exploration or Proof of Principle phases, and for producing the expanded/revised ET design concept (the ET Concept Formulation Package) from the expanded/revised ETR. Includes:
 - a. Detailing of ETR (based on test results, analyses).
 - b. Detailing of ET design changes (to ET CFP and/or system (CFP) dictated by test.
 - c. Detailing of ET design as a function of system design evolution. (March 1988)

Vol. 6 Integrating ET With the Prime System

- Procedures and guidelines for integrating ET design concept (CFP) into initial and final system design (system CFP). Includes consideration of revisions to system design and ET integration based on results of tests (TT/OT) of system (with ET); changes to final system design/integration due to ET update. (September 1988)

Vol. 7 ET Test and Evaluation

- Guidance for defining TEMP issues for the ET subsystem (for in-plant test or TT/OT) as required. (September 1988)

Vol. 8 Incorporating ET in Unit Training

- Guide to integrating ET in the Army Unit Training Process. (May 1988)

Vol. 9 Logistics Implications

- Guidance to definition of logistical support requirements (LSA) for systems impacted by inclusion of ET. (September 1988)

Vol. 10 Acquisition Guidelines

- Guidance for developing Statements of Work for both ETR-related studies and ETR-incorporating new-systems development or upgrades. (August 1988)

Supporting Products:

- Tri-Service Review of Existing System Embedded Training (ET) Components - Feb. 1987.
- "Review of Eight Army Systems: Characteristics and Implications for Embedded Training" - Jan. 1986.
- "A Procedure for Developing Embedded Training Requirements" - Sept. 1986.
- "Embedded Training Technology Survey" - May, 1986.
- "Interim Procedures for Embedded Training (ET) Component Design" March, 1987.

Exemplar-system products:

- "FOG-M System Task and Training Requirements Analysis for Embedded Training" - (April, 1985; rev. June, 1987)
- "Design Concept for FOG-M System Embedded Training (ET)" (May 1986)
- "FOG-M System Embedded Training (ET) Demonstration Courseware Outlines" (May 1986, rev. March 1988)
- "FOG-M Demonstration Courseware" 5 Vols. - (June 1988)
- "Draft Functional Specification and Data Item Descriptions for FOG-M Embedded Training Subsystem" - (December, 1986)
- FOG-M Embedded Training System Specifications: 6 Vols. (1987)
- "Embedded Training (ET) and Training Devices for the Howitzer Improvement Program (HIP)" (2 Volumes) - (March, 1986)

- "Unit Training Resources Utilization Concept (UTRUC) for the New Training Devices for the Howitzer Improvement Program" (1986)
- "Preliminary Embedded Training Design and Integration Concepts for ASAS/ENSCE (U)" 2 Vols. (January 1988).
- "Preliminary Embedded Training Design Data for ASAS/ENSCE (U)" - (January 1988)
- "Lessons Learned From ET Design Process for ASAS/ENSCE" (December 1987)
- "Upper-Echelon MCS2 Database Embedded Training: Recommended Courseware and Authoring System (November 1986)
- "MCS2 Database Embedded Training (ET): Procedural Findings for Command & Control Systems (December 1987)
- MCS2 Database Embedded Training (August 1987)
- "An Assessment of the SGT YORK Troop Proficiency Trainer (TPT)" - (July 1985)

Project 2G

- "Inputs to the AFV Training System Outline Training Concept Analysis Paper" (August 1987)
- "Training Systems Concepts for the Armored Family of Vehicles, With Consideration of the Roles of Embedded Training and Stand-Alone Training Devices" (August 1987)
- "Armored Family of Vehicles (AFV) Training Study" (September 1987)

Project 5A

- "Procurement and Evaluation Guidance for Acquiring Embedded Training (ET) Components for the Army Family of Vehicles (AFV)" (Sept. 1988)

The following is an example of ET installed in Army platforms

Troop Proficiency Training (TPT)

The platform type for this system is land-based. The TPT is a set of integrated software resident in various computers of the Patriot Missile System firing battery. (The Patriot Missile System is an anti-aircraft missile system.) Upon activation of the TPT radar, targets are automatically identified, engagement eligibility is determined, and threat orders are issued. TPT is an integrated, off-line, full- and part-mission trainer, used to train equipment operator tasks and team operation tasks. Application is for the Patriot missile system. TPT software is resident in the Engagement Control Station (ECS) and the battalion ICC computers. The TPT can be operated in a stand-alone configuration for training one battery or in a networked configuration for training the battalion. TPT provides sustainment level training for both the operator and team training.

Navy Project Products

Reynolds, R.E., Fiedeldey, L.W., Hoskin, B.J., & Jorgenson, W.F. (1988). Lessons learned from currently fielded Navy embedded training systems. Proceedings of the 10th Interservice/Industry Training Systems Conference, Orlando, FL.

Reynolds, R.E., McDonald, B., & Finley, D. (1986, September). Embedded Training technology in current and future DoD combat systems. J.P. Kincaid (Chair), Selected technology thrust supporting emerging training systems: computer-based authoring, Artificial Intelligence, and Embedded Training. Proceedings of the 30th Annual Meeting of the Human Factors Society, Dayton, OH.

Reynolds, R.E., & Williams, K.E. (1987, December). Instructional Technologies for Embedded Training. Proceedings of the 9th Interservice Industry Training Systems Conference, Washington, D.C.

Williams, K.E. (1986). Embedded Training Instructional Technology Identification. Technical Report, Naval Training System Center, Orlando, FL.

Williams, K.E. (1987, February) Embedded Training instructional technology requirements identification. Orlando, FL: Naval Training Systems Center.

Williams, K.E., Reynolds, R.E., and Carolan, T. Embedded Training Technology, Development and Evaluation: Part I. NTSC technical report in preparation.

The following are examples of ET installed in Navy platforms.

Aegis Combat Training System (ACTS)

The platform type for this system is surface ship for deployment on CG-47 class cruisers and DDG-51 class destroyers. Aegis is a centrally controlled array of weapons systems consisting of sonar, radar, and various weaponry. This system correlates the target information from the different sensors and automatically accomplishes intertactical communications. ACTS is an integrated, on- and off-line, full- and part-mission scenario device. The application is for AN/SPY-1A, C&D MK-1, FCS MK-99, and GMLS MK-26. ACTS is an operator and team trainer used for acquisition, sustainment, and full mastery training as well as for preparatory exercises and readiness evaluations. The Aegis software is fully integrated into the Aegis combat system computer.

AN/SQR-17A OBT

The platform type for this system is surface ship for deployment on FF 1040, FF 1052, DD 963, FFG 7, CG 26, and CG 47 class ships. The AN/SQR-17A is a completely integrated sonar signal processing and display set. The onboard trainer provides for active and passive sonar stimulation. The OBT provides for operator and team training. The application is for AN/SQR-17A Sonar Signal Processing System with a built-in configuration.

AN/SQS-T5

The platform type for this system is surface ship for deployment on CG-47 and FF 1052 ships. The AN/SQS T5 onboard trainer is a proficiency training device for passive sonar system operators. This is an operator trainer for application on AN/SQS-53A sonar.

AN/SQS-T6

The platform type for this system is surface, for deployment on CG-47 ships. The AN/SQS T6 onboard trainer stimulates active sonar data for the AN/SQS-53 sonar. This is an operator training with application for AN/SQS-53 sonar. The T6 interfaces with the AN/SQS-53A prior to beam forming. The T6 also interfaces with the T5.

Carrier Air Control Center Shipboard Target Simulation System Device 15G21 (CATCC STSS)

The platform type for this system is surface ship for deployment on CV 61, 62, 63, 65, and 67. CATCC STSS is designed for shipboard use with the AN/SPN 46 Automatic Carrier Landing System, AN/SPN 43 Carrier Surveillance Radar and AN/TPX 42A DAIR (Direct Altitude Identity Readout System). The Trainer provides CATCC DAIR team training by permitting the student to track an aircraft from launch (departure) to touch down. The application is for AN/SPN-43A, 42A, and AN/TPX-42 (V)8. The CATCC STSS provides operator proficiency training for carrier air traffic controllers.

Combat Simulation Test System (CSTS) DDG 993

The platform type for this system is surface ship for deployment in Van Nuys, CA. The DDG 993 is a guided missile destroyer capable of subsurface, surface, and surface-to-air warfare. The CSTS (formerly Combat System Test Set) provides simulated targets for presentation on the ship's radar and sonar displays, as well as additional information concerning the ship's course, speed, pitch, and roll, in order to simulate a realistic combat environment. CSTS is an integrated, off-line, full- and part-mission scenario device, used to train equipment operator and team operation tasks. The application is for DDG 993 AN/SPS-48 & 55, MK-86/5 FCS, MK-74/5 MFCS, MK-116, Link 4A & 11, and IFF. The CSTS is an operator and team trainer used for acquisition and sustainment training as well as preparatory exercises. The CSTS hardware and software components are integrated within the CIC.

Deployable Proficiency Trainer (DPT)

The platform type for this system is air, for deployment on the Lamps-III SH-60B. DPT is a software package for use on the Lamps MK-III SH-60B helicopters. The DPT stimulates the aircraft avionics system to provide refresher training for the helo Aircraft Sensor Operator (SO) and the Airborne Tactical Officer (ATO).

Lesson Translator (L-TRAN)

The platform type for this system is surface ship, for deployment on NTDS carriers, cruisers and destroyers. L-TRAN was designed to provide entry level and skill proficiency training for operators in the use of NTDS consoles, symbology, and the basics of operational mission functions with respect to NTDS. Application is for the Naval Tactical Data System (NTDS). The L-TRAN is an individual operator trainer in which up to four individuals can participate at the same time. The L-TRAN resides in one of the ship's NTDS computers. Depending on an individual CIC configuration, a ship may lose operational capability in 20 percent to nearly all of its NTDS consoles to run the L-TRAN training program.

N/SQQ-89(v) Onboard Trainer

The platform type for this system is surface ship. One of nine possible variants of the AN/SQQ 89 have been approved for installation for the following classes of ships: DD-963, FFG-7, CG 54-73, and DDG-51. The Surface Anti-submarine Warfare (ASW) Combat System transmits and/or receives acoustic signals using a variety of sensors and processes and displays this acoustic information in order to train sonar coordination. The application is for AN/SQQ 89, AN/SQR-19, and AN/SQS-53 sonars. This onboard trainer provides for operator proficiency, sonar/ASW subteam, combat team, and ship/air team training.

Operational Readiness Assessment and Training System (ORATS)

The platform type for this system is surface ship, for deployment on ASW cruisers and frigates. ORATS is a non-automated, manual based instructional system used to support realistic hands-on training using shipboard Sonar, CIC, and UB fire control systems in ASW operation. ORATS is also designed to assess operator and team knowledge and performance of operational tasks. ORATS provides for operator, ASW team training, and CIC team training. The application is for AN/SQS-53 and other sonars, AN/sqr-17, AN/SSQ-28, and LAMPS I. ORATS is a comprehensive, book-based training and evaluation program providing training instructors with detailed information to run various scenarios on target generator equipment. ORATS also provides tapes of sonar signals and canned voice instruction for use in scenarios.

Operational Training Software (OTS-V3R10) (AN/SLQ-32)

The platform type for this system is surface ship, for deployment on platforms with SLQ-32. OTS is a software package which simulates Electronic Warfare (EW) signals on the SLQ-32 to provide for operator training. OTS is an operator training integrated with the SLQ-32 operational equipment. Training requires that the SLQ-32 be taken out of normal operating mode.

Performance Measuring Equipment (PME) (AN/SQQ-23)

The platform type for this system is surface ship, for deployment on DDG 12 and CG 16 ships. The PME was designed to record operational sonar exercises for purposes of evaluating the performance of sonar teams. PME is an operator and team training with application for AN/SQQ-23. From the instructional technology standpoint, PME is a signal generator.

Radar Display and Distribution System (RADDS)

The RADDS is a full- and part-mission scenario training device under development for refresher training Operations Specialists (OS) A School graduates and AIC School graduates. RADDS is also designed for pre-training of Air Intercept Control (AIC) candidates. The system displays selected radar video from any of several basic radar systems on the AN/SPA-25G radar repeater via a SB-4229 switchboard and a CV-3989 signal converter. Application is for AN/SPA-25G radar repeater which is expected to replace the 37 existing models of non-NTDS repeaters currently in the field. The SB-4229 switchboard is expected to replace all 14 existing switchboard models.

Radar Environmental Simulator System (RESS) (AN/USQ-93)

The platform type for this system is surface ship, for installation in USS MAHN and USS. RESS is a manual or computer controlled threat simulator designed for embedding in New Threat Upgrade (NTU) ships to support training, testing and maintenance. RESS uses computerized threat simulations to control radio frequency levels in the combat radars aboard NTU ships to provide for operator training. Application is for AN/SPS-48E, 49(V), AN/SYS-2, SIMS MK XII IFF, and AN/SPG-5D. The RESS provides for individual radar operator training, detection sub-team training, and training of the entire combat system team.

Radar Video Simulator (RVS)

The platform type for this system is general use. The RVS is under development. This system generates 2D and 3D video out-puts that effectively simulate all major shipboard surveillance radars and appropriate SIF/IFF (Selective Identification Feature/Identification Friend-or-Foe) interrogations and responses. The RVS is intended to replace the SM-411/UYA-4. The RVS will provide operational and tactical training of basic radar operators, surveillance radar subteams, and combat system teams.

Radio Frequency Test Target Generator (RFTT)

The platform type for this system is surface ship, for deployment on all SPG-51 (TARTAR) ships. The RFTT is under development. RFTT provides fixed and variable parameter test targets and electronic counter measures for testing and operator training. Application is for AN/SPG-51 and is for operator training. RFTT is a signal generator.

Silverbox 2/WLR-1

The platform type for this system is surface ship, for deployment on NLR-1 ships. The Silverbox is a portable signal generator that stimulates radio receivers to support electronic warfare simulation for training in signal recognition. The Silverbox is an operator training for application with the AN/SLQ-17. From the instructional technology standpoint, the Silverbox is a signal generator.

Simulated Target Training Program (STTP)

The platform type for this system is surface ship, for deployment on DDG 47, CG 16/26, CGN 9/25/35. STTP generates simulated targets in response to a designation from the Weapon Direction System (WDS), from the Fire Control System (FCS) or from the Radar Set AN/SPG-55B. Air or surface engagements are simulated from target detection through missile firing without modification of other system programs. Application is for the MK-76, 115, DFCS AN/SPG-55B, and ECCM. The training level is for operator and team training. From the instructional technology standpoint, STTP is a signal generator.

Sonar Target Signal Simulator (STSS)

The platform type for this system is surface ship, for deployment on DD 963, DDG 993, and CG 47. STSS is a strap-on, stand alone sonar target signal simulator which injects contacts into sonar consoles and simulates audio for operator and team operational mission training. The STSS allows for simulated signals to be mixed with live sonar data. The application is for AN/SQS-53, 53A. The STSS can inject multiple contacts, simulate weapons being fired at the ship, and includes some environmental realism.

System Evaluator, Trainer (SEAT)

The platform type for this system is surface ship, for deployment on all NATO SEASPARROW equipped ships. SEAT provides simulated threats for operator proficiency training embedded in the fire control computer. This operator training is for application with the Improved Self Defense Surface Missile System (ISDSMS).

Air Force Project Products

Aeronautical Systems Division (ASD), Air Force Systems Command, Wright-Patterson Air Force Base

Computer-based decision aid for embedded training, "Embedded Training Quantification Methodology." This program is based on Lotus 1-2-3. An ASD technical report serves as the user's manual (O'Brien and Hess, vol. III, 1988) and technical data driving the model is documented in O'Brien and Hess, vol. IV (1988).

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McNeley, T.L., Hayes, D.R., Eckel, J.S., Ramsey, F.W., and Freytag, K.A. (1988) Follow-on Embedded Training Evaluation Demonstration. Draft ASD-TR. Dayton, Ohio: Aeronautical Systems Division.

Air Force Human Resources Laboratory (POC: Dr. Burk Burright, Special Projects Office. Brooks Air Force Base, Telephone (512) 536-3876)

Walsh, W. Embedded Training R&D Strategies for the Air Force Human Resources Laboratory. AFHRL technical report in preparation.

The following is an example of ET installed in Air Force platforms

World Wide Military Command and Control System (WWMCCS) Training Mode

WWMCCS is a communications network used by the U.S. Tri-services and by allied forces. The WWMCCS Information Network provides resource information used by the Joint Operations and Planning system to make logistical and tactical decisions. The WWMCCS

training mode provides simulated messages concerning resource availability. These messages are used for team training and readiness evaluations. The WWMCCS also contains CAI tapes which teach basic equipment operation and other related topics. The CAI mode is used primarily for individual and team training. The scenario and CAI modes allow for on- and off-line, full-mission and part-task training of equipment and team operator tasks. Both the simulation and CAI modes are integrated into the operational equipment.

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OPNAVINST Draft 1543.XX. Embedded Training (OP 112).

Project Manager Training Devices Letter, AMCPM-TND-E, 8 August 1988. Subject: Minutes of the JCTG-TSD Steering Committee meeting on 20 July 1988.

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APPENDIX A

CONTRACTED PROJECTS

The projects listed in this appendix are being performed by agencies under contract to the Department of Defense.

NTSC

The embedded training research currently being funded or conducted by NTSC includes:

- *Instructional Technologies for Embedded Training* (Richard Reynolds, NTSC COTR, Kent Williams, IST, Principal Investigator). This project is 6.2 research and includes four components:
 - Adaptive Computer Aided Instruction
 - Automated Expository Feedback
 - Intelligent Platforms
 - Missing Team Member Simulation (Reynolds and Williams, 1987 I/ITSC).
- *ET research in support of the SPA25-G* (Dennis Weller, NTSC COTR for contract to E-Tech) This project is mainly oriented to software development for operator training. The program was initiated using 6.3 funds but has been transitioned to 6.4 funding.
- *Battle Force Research Simulator (BFRS)* (Ron Stratton, NTSC Code 74) This involves developing the NTDS Advanced Combat Interception System. It is a testbed still under development which is hosted on a UYC43 and CIC suite for non-AEGIS. Current plans are to stimulate console displays through reworked software now being used on the 20B-5 Pierside Trainer.

- *LTRAN Lesson Comparison* (Lt. Chris Hampton NPRDC, Project Officer 619/553-8245) This project involves a comparison of two kinds of lessons for the LTRAN:
 - standard lessons - those developed using the ISD process
 - experimental lessons - using an innovative approach to structuring information (using a production system).

The focus of the experimental lessons is correcting student weaknesses. The exercise sequence is heuristic, individually selected for each student based on the history of the student's learning strengths and weaknesses. Lessons are designed around a detailed hierarchical framework in which students practice declarative information, then progress to procedural information, then performance of procedures. The information that can be presented to the student is very detailed (one exercise per rule), allowing diagnosis at a very detailed level. Follow-on work is planned to test this approach in a transfer of training experiment with criterion testing aboard ship or using a pier side trainer.

The authoring language for the LTRAN lessons is SCRIPT (specific to LTRAN), which has been modified for production of these training materials.

A report describing this work is currently in preparation to be published as an NTSC TR (Williams, Reynolds, and Carolan, "Embedded Training Technology, Development and Evaluation: Part I").

NAVY

Major Navy ET engineering initiatives include:

- *AN/BSY2 Combat Control Systems Trainer for the Seawolf Attack Submarine* (Contract awarded to RCA and GE late last year. IBM is an important sub-contractor. Rudy White, NTSC Code 3 is the Training System Project Manager. Overall project is managed by PMS 418.) This project is considered to be a model program for ET through the 1990's. The integrated system combines ET training for SONAR and combat control. IBM researchers are adapting the fiber optic network developed for the AN/BSY1 (a project that never reached full development).
- *Advanced Combat Direction System* This system is a module for the System Testing Readiness Assessment Group and is basically a signal-to-test system but will also include ET through stimulation.
- *Update 4* ET is planned as a component of Update 4 for the P-3 although requirements are still relatively undefined.
- *Deployable Acoustic Readiness Training System (DARTS)* DARTS is a stimulation ET system for the S-3B and P-3C aircraft. Darts is designed to be used on the ground.

According to Richard Reynolds, Navy ET-JWG lead, Trident Submarines also have some ET capability limited to SONAR training. AEGIS also has a limited ET capability. There are no current plans for incorporating ET for aircraft pilots (although such plans do exist for other flight crew positions).

UCF/IST

The focus of the IST ET contract is Adaptive Automated Instruction, specifically the instructional technology component of ET as opposed to the simulation/ stimulation component. The project involves developing an architecture for the adaptive control of exercise selection (restructuring and lesson content to be consistent with a rule based knowledge system). The software is being developed locally on the LTRAN emulator at NTSC. LTRAN can be configured to emulate a number of the consoles used in the fleet.

AIR FORCE

The most advanced Air Force ET system is On Board Warfare Simulation (OBEWS). This system is described in the Journal of Electronic Defense (June 1989).

- *On Board Electronic Warfare Simulation (OBEWS)* (Bud Casey POC, 904/882-9261) OBEWS is an ET electronic warfare simulation and is the first example of ET in actual operation. The engineering configuration is a pod on an F-16 aircraft which models a radar warning receiver. Once the threat is received, the pilot makes the appropriate response (for example, the pilot would conduct a terrain masking maneuver to occult threat, the dispersion of flares or chaff, or jamming of the radar signal. All events are recorded and up to four aircraft crews can be debriefed within 30 minutes. This scenario is accomplished using a digital map display. The system is currently running at Eglin AFB and is soon to undergo initial operational test and evaluation (IOT&E) at Nellis AFB.

Project Office is the Armament Division, Range Instrumentation Branch at Eglin AFB (AD/YI). The technical point of contact is Bud Casey (904/882-9261).

APPENDIX B SUPPORTING TECHNOLOGIES

Several technologies are critical to the development of ET. These technologies are listed below in a chart adapted from O'Brien and Hess, 1988 (ASD-TR-86-5019, Volume II).

TECHNOLOGY	SIGNIFICANCE
Helmet Mounted Display Sight (HMDS)	HMDS is needed to provide full field of view (FOV). Without full FOV, several key tasks could not be trained.
Integrated Terrain Access and Retrieval System (ITARS)	Provides mechanisms for generating high resolution displays. Without ITARS, several key tasks could not be trained.
Dynamic Modeling/Artificial Intelligence (AI)	Provides tools needed for simulation interactive targets. Studies have indicated that this feature is critical to effective training for several tasks.
Very High Speed Integrated Circuits(VHSIC)	Increases speed and capacity of onboard processors while reducing size, thereby facilitating all ET applications. Critical for sophisticated ET capabilities, such as those included in ATF concepts.
Global Positions System (GPS)/Improved Navigation Subsystem	Could provide positional information needed for accurate dry firing/scoring algorithms.
Improved Mission Planning System (MPS)	Enhancements to MPS (such as 3D graphics displays and advanced analytical capabilities) could provide the foundation for ET GPDS.
Improved Data Transfer Module (DTM)	DTMs provide a vehicle for loading ET programs into aircraft.

Continued on next page

TECHNOLOGIES	SIGNIFICANCE
Advanced Instructional Features (AIF)	These features increase the training effectiveness of ATDs. Many of these features could be incorporated into ET.
Aircrew Performance Measurements Techniques	These techniques may provide systematic measures for several hard-to-measure aircrew training areas. Without such measures, it is impossible to provide pilot with airflight feedback on these areas.
Instructional Strategies/Techniques	These techniques help define how ET should be used in operation units.
Techniques for User-Friendly Interface Design	These techniques can be used to develop simple user interfaces that require little training. It is critical that ET be easy to use if it is to be successfully implemented in operational units.

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