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Implementing Embedded Training (ET): Volume 5 of 10: Designing the ET Component

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EDGAR M. JOHNSON
Technical Director

JON W. BLADES
COL, IN
Commanding

U.S. ARMY PROJECT MANAGER
FOR TRAINING DEVICES

WILLIAM MARROLETTI
Deputy Project Manager

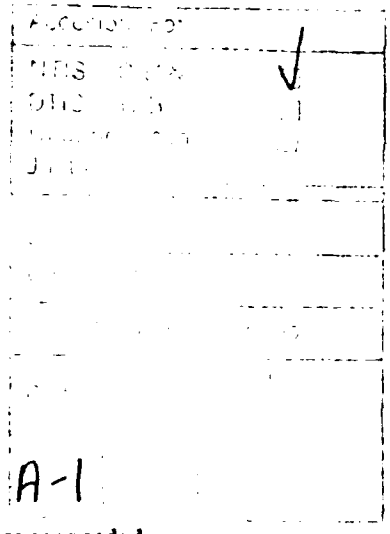
RICHARD J. LUNDSFORD, JR.
Col, EN
Project Manager

Research accomplished under contract
for the Department of the Army

Applied Science Associates, Inc.

Technical review by

Irving N. Alderman
Marshall A. Narva
Donald S. Peckham



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This document describes guidelines and procedures for designing Embedded Training (ET) components. Beginning with Embedded Training Requirements (ETRs) developed by using Volume 4 of this series, a step-by-step process, leading to the development and documentation of a design concept, is provided. Phase 1 reviews and verifies previously identified ETRs. The second and third phases identify detailed requirements for ETR stimuli, performance measures, and feedback and recording, and compile the detailed requirements to form the ET component concept. Phase 4 identifies scenario control, data management, and special instructional features. Phases 5 and 6 are a direct review of the defined ET component characteristics by prime system engineers and preparation of final documentation including the ET component functional specification.

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Implementing Embedded Training (ET): Volume 5 of 10: Designing the ET Component

J. Thomas Roth, Jeane Anne Fitzpatrick, Ronnie E. Warm, and Jan L. Ditzian
Applied Science Associates, Inc.

Manned Systems Group
John F. Hayes, Chief

Systems Research Laboratory
Robin L. Keesee, Director

U.S. Army Research Institute for the Behavioral and Social Sciences
5001 Eisenhower Avenue, Alexandria, Virginia 22333-5600

Office, Deputy Chief of Staff for Personnel
Department of the Army

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Human Performance Effectiveness and Simulation

FOREWORD

This document is the fifth in a series produced by the Army Research Institute for the Behavioral and Social Sciences (ARI) and the Project Manager for Training Devices (PM TRADE). The series consists of 10 related documents that present guidance for combat and training systems developers, including Army Materiel Command (AMC) laboratories, Training and Doctrine Command (TRADOC) Combat Developers and Training Developers, and contractor organizations involved in system development or developing technological thrust areas under independent research and development (IR&D) programs.

This series of documents includes guidelines and procedures that support the effective consideration, definition, development, and integration of embedded training (ET) capabilities for existing and developmental systems. The documents share the general title of Implementing Embedded Training (ET), with specific, descriptive subtitles for each document. They are as follows:

1. Volume 1: Overview presents an overall view of the guidance documents and their contents, purposes, and applications, including a discussion of the following:

   a. what the total training system concept, including embedded training, is;

   b. how training systems must develop within more general processes of materiel system development;

   c. how embedded training must affect this relationship; and

   d. what the content and uses of the remaining documents in the series are, as well as their relationships to the training systems development and acquisition processes, and how to use them.

2. Volume 2: ET as a System Alternative provides guidelines for the initial decision on whether ET should be further considered as a training system alternative for a given materiel system. It also includes guidance on considering ET as an alternative for systems under product improvement or modification, after fielding.

3. Volume 3: The Role of ET in the Training System Concept contains guidance for the early estimation of training system requirements and the potential allocation of such requirements to ET.

4. Volume 4: Identifying ET Requirements presents procedures for defining ET requirements (ETRs) at both initial levels (i.e., before initiating system development) and for revising and updating initial ETRs during system design and development.

5. Volume 5: Designing the ET Component contains analytic procedures and guidance for designing an ET component concept for a materiel system, based on specified ETRs.

6. Volume 6: Integrating ET with the Prime System discusses considerations, guidance, and "lessons learned" about factors that influence the effective integration of ET into materiel systems.

7. Volume 7: ET Test and Evaluation presents guidance for defining the aspects of the ET component (test issues) to be addressed in prototype and full-scale system testing.

8. Volume 8: Incorporating ET into Unit Training gives guidance for integrating ET considerations and information into unit training documentation and practice.

9. Volume 9: Logistics Implications presents helpful information on key logistics issues that should be addressed in the context of ET integration with prime item systems.

10. Volume 10: Integrating ET into Acquisition Documentation discusses developing the necessary documentation for, and specification of, an ET Component of a prime item during the Army's systems development and acquisition process. This document examines the Life Cycle System Management Model (LCSMM) and the Army Streamlined Acquisition Process (ASAP) and describes where and how to include ET considerations in the associated documentation. It also describes how to use the other volumes in the ET Guidelines series to generate the information required for the acquisition documentation, and provides guidance in preparing a contract Statement of Work for an ET Component to a prime item system.

W. Marroletti

WILLIAM MARROLETTI
Deputy Project Manager

Edgar M. Johnson

EDGAR M. JOHNSON
Technical Director

IMPLEMENTING EMBEDDED TRAINING (ET):
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IMPLEMENTING EMBEDDED TRAINING (ET): VOLUME 5 OF 10: DESIGNING THE ET COMPONENT

INTRODUCTION

In this volume, procedures to specify the design of an Embedded Training (ET) component are presented. Design factors that are addressed include lesson and scenario requirements, instructional features, software and hardware requirements, and system integration. The procedures were developed through experience with the analysis of existing ET and development of ET component designs for weapon systems. Generalization of these procedures to non-weapon systems should be done with care, as these procedures were developed with weapon systems primarily. Non-weapon systems may differ from weapon systems in that they require primarily cognitive tasks, or do not have clearly defined mission or operational timelines or sequencing.

It should be clearly understood that ET component design is closely linked to the total prime system design process. It is recommended that ET component designers become familiar with the contents of Volume 6 of this series (Integrating ET with the Prime System) when performing the procedures outlined here. This will significantly impact the decisions made during these procedures, and hopefully result in effective ET component design.

The remainder of this report is organized into six sections:

Phase 1: Review ETRs and Begin ET Design Database--describes the preliminary steps taken to review and verify ET Requirements (ETRs) data and to prepare for the design analyses.

Phase 2: Identify Presentation Requirements for Each ET Objective--presents detailed analyses of selected objectives to determine the stimuli to be presented, measures to be taken, and feedback and recording requirements.

Phase 3: Compile ET Objective Requirements Into ET Component Requirements--presents steps to compile and integrate the requirements of individual objectives into overall ET component requirements.

Phase 4: Select Training Features for the ET Component--presents steps to determine ET component requirements for scenario control features, data management features, and special instructional features.

Phase 5: System Design Concept Integration--describes steps to review defined ET component characteristics jointly with prime system engineers, integrating ET component definition into the overall system design process.

Phase 6: Produce ET Functional Specification--presents steps to produce final documentation, including lesson outlines, scenario descriptions, and the ET component functional specification.

Figure 1 shows an overview of the phases of the ET component design procedures.

Iterative Nature of Procedures

The procedures here will most probably be used more than once during the development of a system. An early, preliminary ET component design should be performed as soon as there is enough information available about the functions and tasks that system operators will perform. This can probably be done during system concept development. Early ET designs should be evaluated in a soldier-system interface test bed to assess the validity of ET courseware concepts.

Two more iterations of ET design may be needed during system development. The first should take place during the development and proveout phase of the acquisition process. Evaluation of this design should take place as part of user and technical test of the system. The final iteration of ET design should accompany final refinements and updates to system design, just prior to production. This will be the fielded ET component. Conducting the final design iteration at this time will enable the ET component to be highly concurrent with the fielded materiel system and reflect any late materiel design changes.

Lessons learned and products should feed forward from one iteration of ET design to another. While earlier versions of the ET component design will be based on less detailed or less complete data about the system, important decisions about characteristics of the ET component can be made at that time. This will enable later iterations of ET component design to add detail and decisions based on more complete and detailed information about the materiel system.

NOTE: Throughout this Volume, the term objective is used. This always refers to a training objective that is to be included in training presented by the ET component. A training objective is defined as a task or task-component behavior that can be evaluated independent

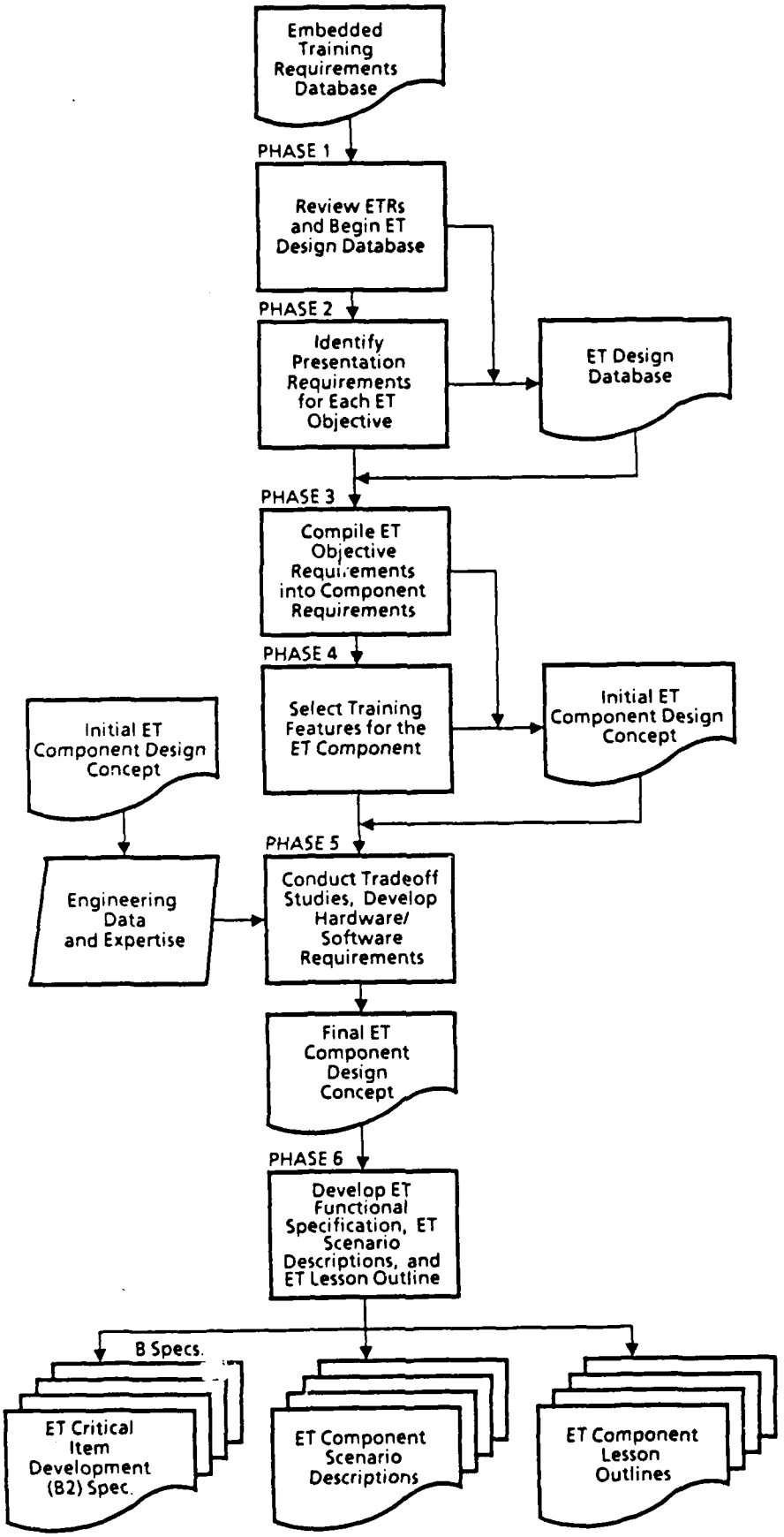

Figure 1. Overview of the phases of the ET component design procedures.

of other tasks or task-component behaviors. Examples of objective statements or descriptions are

- Acquire target using thermal sight.
- Prepare SIGINT summary.
- Perform route planning, including contingencies.
- Strip, clean, and assemble M16A2 rifle.
- Prepare mortar round for firing.
- Perform post-shutdown PMEs.
- Engage target with main gun.

Objectives are equivalent to the lowest level of analysis of tasks performed in ET Requirements (ETR) Phase 2 identification procedures in Volume 4 of this series.

Contents of This Document

At the beginning of each phase is a flowchart showing the steps within that phase, and the data inputs and outputs. Each phase consists of a series of numbered steps. The steps are numbered first by phase, then by step (e.g., 1.1 is Phase 1, Step 1).

Each step has four parts: a description of the objectives of that step; a rationale for why the step exists; the procedures to complete the step; and the product(s) of the step. Following the text for each step is an example of the form(s) associated with the output of the step. The example forms are filled out to show the kind of data expected in each field. At the end of the document, in Appendix A, there is a collection of blank forms that can be photocopied for use by the training analyst. To simplify cross-reference, these blank forms have the same figure numbers as in the text, where the form is filled out with sample data.

Appendix B contains a prototype, Critical Item Development Specification, to fulfill the requirements of MIL-STD-490A in specifying ET for a system. This prototype specification should be modified as required to specify ET developed using the procedure contained herein.

PHASE 1: REVIEW ETRS AND BEGIN ET DESIGN DATABASE

The purpose of Phase 1 is to ensure that the ETR data are current and complete and to allow the ET designer to become familiar with the ET Requirements and user population. This phase contains four steps:

These steps are described in the following sections. Figure 2 shows an overview of the steps in Phase 1.

NOTE: All of the examples of completed worksheets in this volume suggest the use of manual documentation. An alternative that you may wish to use is a computerized database management system. This can simplify record keeping and developing an audit trail for your analyses. If a computerized database was used to perform the procedures in Volume 4, and this database is available, you can use that database as the foundation for an expanded database to support these procedures.

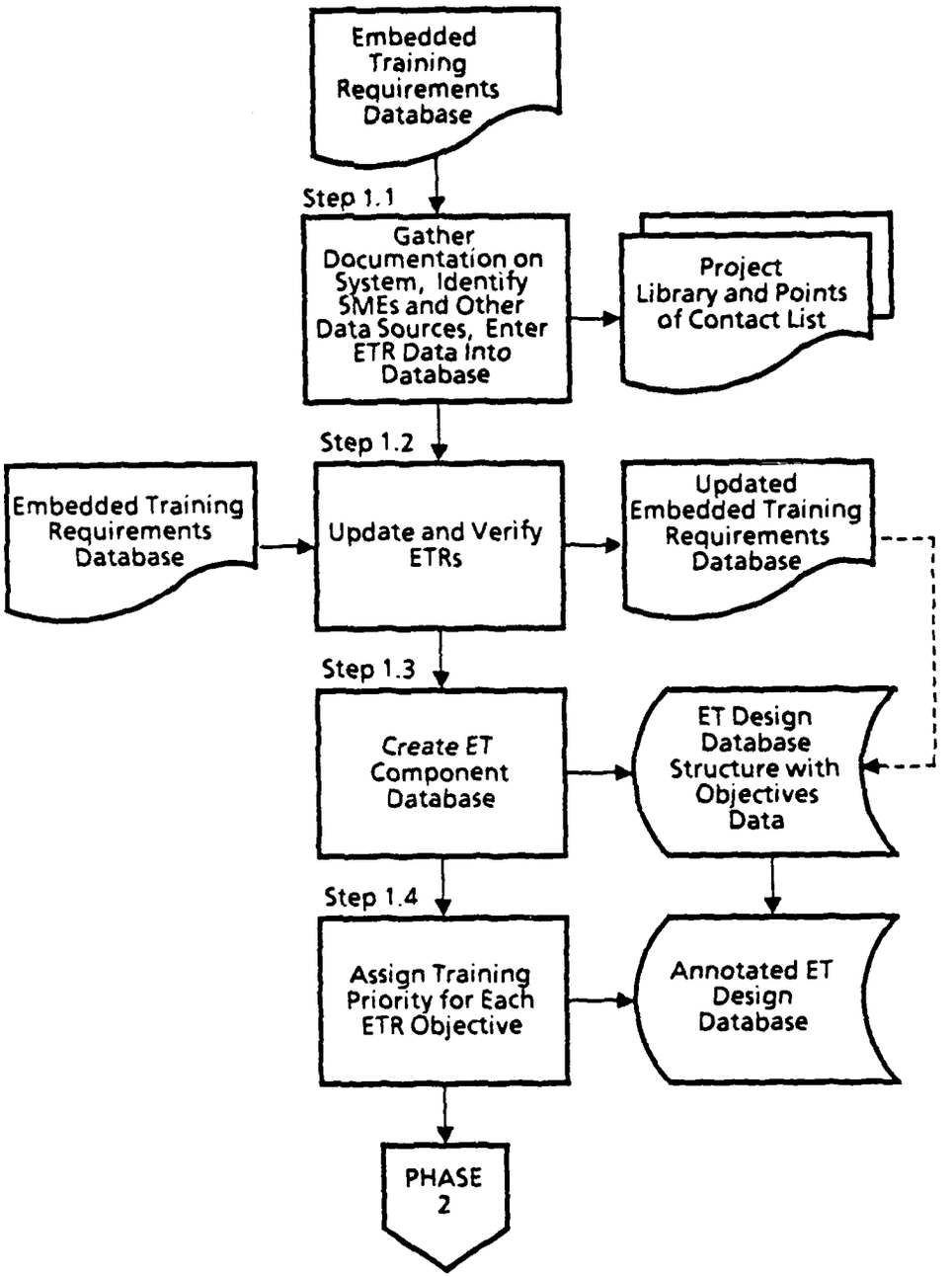

Figure 2. Phase 1: Review ETRs and begin ET design database.

Step 1.1: Gather Documentation on System, Identify SMEs and Other Data Sources, and Enter ETR Data Into Database

Objectives: Identify possible information sources about the system, create a bibliography, set up a current ETR database, and review user population data.

Rationale: The analyses and procedures to design the ET component depend entirely on current and accurate information sources, including both documentation and people resources (SMEs), as in the ETR procedures.

Procedures: Begin by obtaining the most current ETR data. The procedures in Volume 4 of this series (Identifying ET Requirements) were designed to provide the necessary ETR data. If the procedures in this document have not been applied, and ETR data are not available from another source, you should apply these procedures now, and generate ETRs for the system. The ETR data should include a list of sources used during the ETR analyses. These sources are still of use during the design procedures and should be the first sources obtained. Such documentation includes prime item specifications, Organizational and Operational (O&O) plans, MANPRINT and HARDMAN analyses, Mission Area Analysis (MAA) documentation, and Required Operational Capability (ROC) statements. This may be all that is available for a new system. A fielded system may have other documents useful to the designer, including Technical Manuals (TMs), Field Manuals (FMs), Soldier's Manuals (SMs), and Army Training and Evaluation Plans (ARTEPs).

Next, obtain additional data sources that supplement those used during ETR development. To accomplish this activity, it is necessary to identify and contact those agencies capable of providing additional documentation. The agencies may include Army Materiel Command (AMC), Training and Doctrine Command (TRADOC), Training System Managers (TSMs), schools' Directorates of Training and Doctrine (DOTD) and various involved laboratory and commodity commands, such as the Army Missile Command (MICOM). Products from materiel developers like the Materiel System Requirement Specification (MSRS) may also be useful. Additional source information may also be obtained from system contractors, if sources have been selected.

After obtaining the documentation needed to support the ET design procedures, create a complete bibliography. The bibliography must be kept current and should include

document locations so that it will be easy to find needed materials. If the bibliography is very large, it may be helpful to enter it into a database (in a Database Management System [DBMS]) and create multiple indices for easy referencing.

Next, the objectives hierarchy and the ETR data (generated by procedures in Volume 4 of this series, Identifying ET Requirements) can be placed in a manual or computerized database. If a computer database is going to be utilized, it is important that the database be established now, before starting the other steps of the design procedures. A computer database will speed up the analyses and make it easier to manage the data.

Finally, review the available data on the system user population. The characteristics of the personnel to be trained have a direct impact on the design of the ET component. Important points to look for are whether trainees may be skilled practitioners (as in cross-training) and what types of systems or equipment the trainees may have previously encountered. The Target Audience Description in the System MANPRINT Management Plan (SMMP) is a good source for these data.

Products: The products of this step include a project library, a list of agencies which may be contacted during the ET design procedures, a list of personnel who may serve as Subject Matter Experts (SMEs) during the ET design procedures, and an objectives database with current ETR information. The designer will be familiarized with the target population for the ET component and will know what data are presently available to support the design analyses.

Step 1.2: Update and Verify ETRs

Objectives: Review, update, and finalize the ETR data.

Rationale: The accuracy of the ETRs has a direct impact on the effectiveness of the ET component developed for a system. To ensure the ETRs are accurate, the designer must determine if the ETR analyses were completed and evaluate the impact of new information.

Procedures: First, determine whether the full ETR analyses have been completed. If the ETR analyses occurred early in the system life cycle, it may not have been possible to produce a complete and accurate set of ETRs. In such a case, Phase 2 of the ETR procedures (Volume 4 of this series) may have been bypassed. A brief review of the database will show whether the detailed information related to the ETR Phase 2 analyses are present. If Phase 2 was skipped, complete the ETR analyses before continuing, if data are available to do so. Otherwise, the ET component design that you produce will be a preliminary design. If this is the case, make sure you indicate the **design is preliminary when the design is documented.** Also, if you are working in a later phase of development (such as Proof of Principle), earlier ETR analyses and preliminary ET design concepts may need to be updated or re-performed due to changes in the system or the original ET analysis data.

Next, compare the ET objectives (produced by procedures in Volume 4) and associated analysis data with the current documentation. Look for significant changes in the prime system design that could impact the ETRs. Repeat the ETR analyses affected by identified changes. The ETR analyses performed can be limited to specific objectives affected by the changes. It may be useful to determine the date of the last ETR analysis cycle. In general, if the analyses were performed more than six months prior to the ET design procedures, enough changes will have occurred to warrant repeating the ETR analyses.

Next, review all of the ETR decisions. This involves reviewing the database objective by objective and verifying each ETR determination. Use the criteria shown in the ETR procedures to validate each entry. As errors are found, update the database.

During this step, continuously update the database to reflect any changes in the objectives and the ETR data. When the data appear complete and correct, the final ETR

list should be printed out. It is important to remember that the ETR data will continue to be updated as changes occur during the design process.

Products: An updated and validated ETR database.

Step 1.3: Create ET Component Database

Objectives: Create the ET component database structure and input ETR data into the new database structure.

Rationale: The ETR database (developed from procedures in Volume 4 of this series) contains all of the ETR front-end analysis data for all of the identified performance objectives. A new database containing those objectives which have been selected as ETRs (a subset of the whole task-hierarchy database) will be used for the rest of the design procedures. This database is ET-specific and more manageable than the larger front-end analysis database.

If a computer database will not be used, it will still be necessary to organize the data in the manner shown below.

Procedures: The first activity is to create a database structure for the new database. The procedure to set up the database will depend on the DBMS selected. The general data categories to be defined will include the following:

1. Number;
2. Description;
3. Priority Indicator;
4. Training Approach Codes;
5. Stimulus Category Indicators With Fidelity Category Indicators;
6. Performance Measures With Feedback Requirements;
7. Data Recording Requirements;
8. Storage Medium Requirements;
9. Knowledge Training Requirements;
10. Collective Training Requirements.

When the database structure has been created, copy all objective descriptions and numbers from the ETR database into the new design database.

Note that since the objective description and number are the same as in the original database, the objective number forms an easy cross-reference between the two databases.

Products: An ET design database structure with all current ETRs.

Step 1.4: Assign Training Priority for Each ETR Objective

Objectives: Assign each ETR a priority of 1, 2, or 3 depending on implementation code, objective classification code, and criticality.

Rationale: In later steps of the design procedures it may be necessary to perform tradeoffs based on cost and effectiveness. Priority data for each ETR assist in assessing which ETRs are more expendable than others.

Procedures: Priority will be determined on the basis of objective classification, implementation code, and criticality rating as performed in identifying ETRs using procedures in Phase 3, Volume 4 of this series. (Refer to Appendix C for a detailed explanation). This procedure involves finding an average priority based on these three factors. The following three tables show each factor's codes and the priority associated with each. All three factors will have been determined during performance of a comprehensive ETR analysis (Volume 4), and the codes for each factor should be in the ETR database for each ET-selected objective. The priority rating numbers are associated with the overall importance of each ET-selected objective.

Objective Classification	Priority Rating
6 - Integrated multiple skills performance:	1
5 - Variable or contingency procedures:	2
4 - Rule or concept utilization:	2
3 - Invariant procedures:	3
2 - Basic manipulative skills:	3
1 - Knowledges:	3

NOTE: The objective classifications are initially assigned during Phase 3 of Volume 4 procedures.

Implementation Codes	Priority Rating
H - High priority ET candidate:	1
T - Good ET candidate:	1
O - Good ET candidate, off-line measurement:	2
Q - May be ET candidate, no measurement:	3
X - May not be feasible as ET candidate:	3
I - Not good ET candidate, may be practiced:	3

Criticality Rating	Priority Rating
H - High criticality:	1
M - Moderate criticality:	2
L - Low criticality:	3

To determine each ETR's priority, add the individual priorities together and divide by three to find the average. For example, if the objective has an objective classification of "4 - Rule or concept utilization"; an implementation code "0 - Good ET candidate, off-line measurement"; and a criticality rating "1 - Highly critical to mission," the priority sum is found by adding 2 + 2 + 1 giving 5. The priority average is then 5/3 which is approximately 1.7. The average is rounded to one decimal place.

Once the average is found, apply the following priority criteria to determine actual ETR priority. On a scale of 1 (lowest) to 3 (highest), an average priority from 1.0 to 1.6 assigns the ETR a priority rating of "3," an average priority from 1.7 to 2.3 assigns the ETR a priority rating of "2," and an average priority from 2.4 to 3.0 assigns the ETR a priority rating of "1." The following figure illustrates the priority scale:

1.0 ---- 1.6	1.7 ---- 2.3	2.4 ---- 3.0
--Priority 3--	--Priority 2--	--Priority 1--

In the previous example, the average priority was 1.7. Applying this average to the scale, a final priority of 2 is entered into the design database.

NOTE: The scheme for prioritizing is based on "rules of thumb" which were developed during early systematic ET analyses. The guidance provided is approximate and should not overrule other factors in the tradeoff process without further justification. Objectives classifications are used here rather than the perishability judgments made in Volume 4 procedures. This is to provide an indication of the priority associated with each type of objective. The perishability judgment codes cannot do this.

Products: A priority rating for each ETR; the one digit priority codes are entered into the design database.

PHASE 2: IDENTIFY PRESENTATION REQUIREMENTS FOR EACH ET OBJECTIVE

This phase expands the information derived from the ETR selection process and Phase 1. Each ETR is analyzed to determine the stimuli associated with task performance and the relevant performance measures, feedback, and recording. These analyses result in a detailed description of how each objective is to be presented to the trainee. The following steps are performed:

Each of these steps is described in the following sections. During this phase, the appropriate information can be entered in a database or entered on the forms included in this section. (Additional forms for copying are contained in Appendix A.) Figure 3 shows an overview of the steps in Phase 2.

NOTE: If these procedures are being performed to develop a preliminary ET design concept for evaluation during early stages of the acquisition process (Requirements and Tech Base or early Proof of Principle), data to perform the steps in this phase may not be available. If this is the case, you may make specific assumptions about many of the ET component characteristics that are identified in this phase. If you do this, then you must explicitly document the assumptions that are made

when reporting the preliminary design. This will help ensure that analysts who develop more detailed ET component designs (later in the acquisition cycle) understand the assumptions that support the preliminary design.

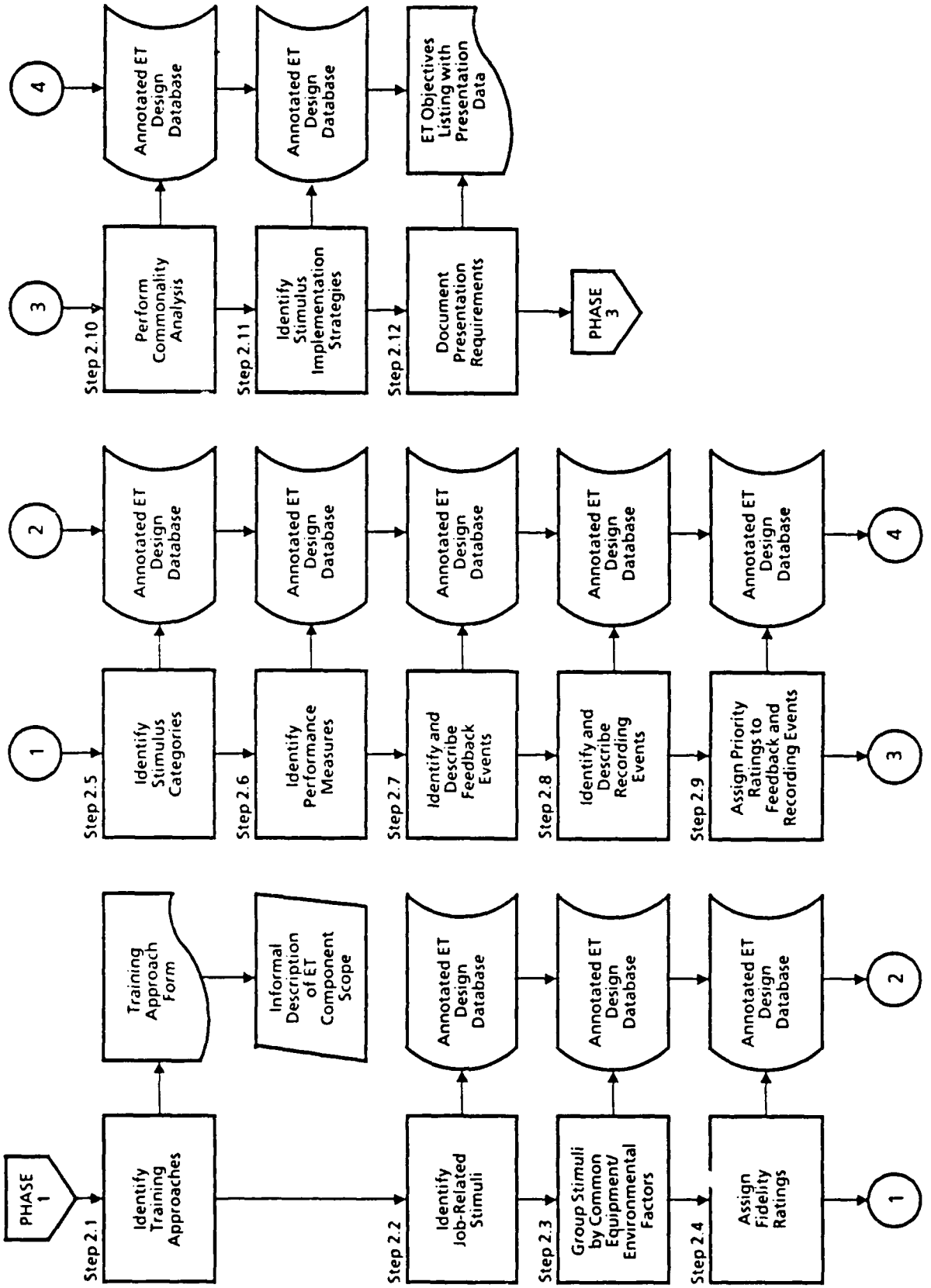

Figure 3. Phase 2: Identify presentation requirements for each ET objective.

Step 2.1: Identify Training Approaches

Objectives: Identify probable training approaches and settings.

Rationale: Identifying the probable training approaches provides a framework in which to approach the detailed analyses. For instance, training presentation requirements for full mission-phase training in the unit will differ from those of school-based part-task training, even for the same ETRs.

The decision must be made about whether or not to deliver knowledge training using ET. Other media, such as text, Computer-Aided Instruction (CAI), and instructor-led training are useful for knowledge training. ET may not be the most cost-effective solution. Considerations include location of training (i.e., school or unit); availability of other training media; and equipment availability for ET. If other media are more cost-effective, the decision may be made at the outset to exclude knowledge training from ET. This will reduce the amount of work in the ET design process. However, if the possibility remains that knowledge training may be delivered via ET, then the final decision can be made at the end of the ET design process, when requirements for knowledge training can be better assessed.

Procedures: Review each of the identified ETRs, considering each of the following points:

1. Will knowledge-based training be required? ETRs that include recall of procedures or facts probably require knowledge-based training. Check the knowledges associated with each ETR to determine when knowledge-based training will be necessary. This information will be used in Step 3.7.

2. Will part-task training be required?

3. Will full mission-phase training be required?

4. Will training be presented in the unit or school setting?

5. Will initial skills acquisition, sustainment, or transition training be required?

NOTE: It may be useful to review the determinations from the training system concept development process contained in Volume 3 of this series.

Enter the information in the database using the codes shown on the Training Approach Form, Figure 4, or use the form to document the appropriate information.

Based on the answers to these questions, it should be possible to formulate a general picture of the kinds of training to be accomplished with the ET component. Complete the summary when all ETRs have been entered.

Products: A completed Training Approach Form to help assess how to train each objective. Also, an informal description of the scope of the ET component should be developed. This description will help focus the following analyses, although a more comprehensive description of the ET component will evolve as the detailed requirements are identified.

Step 2.1: Training Approach Form

ETR Number	Knowledge-based Training (Y/N)	Part Task or Full Mission (P/F)	Unit or School (U/S)	Acquisition, Sustainment, Trainsition (A, S, T)
05.01	Y	P	U/S	A, S, T
05.01.01	N	P	U/S	A, S, T
05.01.03.01	Y	P	S	A
05.01.03.02	N	P	S	A
05.01.04	Y	P	S	A
05.01.05	Y	P	S	A

Summary

% Knowledge-based Training ____ % Part Task ____ % Full Mission ____ % Unit ____ % School ____ % A ____ % S ____ % T ____

Will the ET component be used for Job Performance Aiding?

Figure 4. Training approach form.

Step 2.2: Identify Job-related Stimuli

Objectives: Determine the stimuli associated with each ETR.

Rationale: The ET component must be designed to present relevant stimuli for training. The focus is on identifying job-related stimuli to be reproduced in the training setting.

Procedures: Assemble any related documentation, such as HARDMAN or MANPRINT Comparison-Based Prediction (CBP) of Early Comparability Analysis studies. If possible, work jointly with SMEs during this step. Note that broad knowledge of system design characteristics is essential to complete this step (and the following steps).

Select an ETR for analysis, beginning at the lowest level of the objectives hierarchy. Such a bottom-up approach allows information from lower-level objectives to be "fed into" the descriptions of higher-level objectives.

For each ETR, three aspects of the task stimuli will be considered: equipment-related stimuli, environmental factors, and operator responses and interactions. Note that the distinction between the aspects is not important; what matters is that the descriptions should be as complete as possible. Consider the following questions:

1. What items of equipment are involved in the performance of this objective? List all items that the operator (trainee) will manipulate or which provide needed information. For each item of equipment, what subsystems or functions are involved? What specific controls and displays? List each item. For each control or display, what conditions or indications are relevant to this objective? Are the indications static or dynamic? Describe the conditions or indications associated with each item.

2. What aspects of the environment influence performance of this objective? Possible environmental factors include weather, geography, and the threat environment. List those aspects of the environment expected to impact on performance. What specific environmental variables (e.g., temperature) and what specific conditions (e.g., below-freezing) are relevant to this objective? List the conditions expected to affect task performance, including ranges for variables.

3. What effects do operator actions have on these stimuli? How will the stimuli change with the operator's responses? For each operator action, what is the equipment and environment reaction? Annotate each listed stimulus with associated responses and interactions.

Review the stimulus descriptions for completeness. The listed stimuli should describe all that is known about the performance environment, including dynamics and operator interactions. If your descriptions are incomplete because you do not have sufficient information, indicate this on the forms or in the database. This will help you or others to remember to complete the descriptions at a later time. When the stimulus descriptions for an ETR are as complete as possible, select the next ETR for analysis.

Products: Comprehensive stimulus descriptions for all ETRs should be entered into the ET component database or on the Stimulus Information Form(s), Figure 5.

Step 2.2: Stimulus Information Form

Embedded Training Requirement (ETR) Number: 05.01.01

Equipment Items

Equipment: FOG-M Console **Subsystem:** PDPs

Controls and Displays: PDPs (Programmable Display Push buttons)

Descriptions: Backlit push buttons with several messages per button.

Effects of Operator Action: Select launch parameters. One selection changes several PDP messages.

Fidelity: High

Recommended Implementation Strategies: Use PDPs on console but control their function. All other messages via CRT.

Equipment: FOG-M console **Subsystem:** Joystick

Controls and Displays: Trigger

Descriptions: Joystick fires missile with trigger, then uses other controls to control missile.

Effects of Operator Action: Fire missile

Fidelity: High

Recommended Implementation Strategies: Use trigger at appropriate time but do not fire missile

Figure 5. Stimulus information form.

Step 2.2: Stimulus Information Form

Embedded Training Requirement (ETR) Number: 08.05

Environmental Conditions

Condition: Fog

Range: None to patchy overcast with 200 foot ceiling

Description: Fog obscures targets and terrain

Effects of Operator Action: Operator navigates and identifies during clear flight segments.

Fidelity: Medium

Recommended Implementation Strategies: Simulate fog with reduced contrast.

Condition:

Range:

Description:

Effects of Operator Action:

Fidelity:

Recommended Implementation Strategies:

Figure 5. Stimulus information form. (Continued)

Step 2.3: Group Stimuli by Common Equipment and Environmental Factors

Objectives: Create a system of cross-references between ETRs on the basis of stimulus content.

Rationale: Easy cross-referencing will facilitate later analyses in Step 3.2. If ETRs can be grouped, even on the basis of broad categories of stimulus content, it will assist in setting priorities and determining implementation strategies.

Procedures: Begin by determining what types of groupings are useful. At a minimum, the stimuli should be grouped by common items of equipment. In addition, it may also be useful to group by common environmental conditions. When certain tasks or groups of ETRs are associated with specific environmental variables or conditions (e.g., terrain, weather, threats, etc.), it will probably be useful to group by those factors.

Begin by grouping stimuli by common items of equipment. The first step in this process is to determine the level of detail that should be used for the equipment grouping. Review the stimulus lists to determine what level of detail is most useful. The stimulus grouping can correspond to items of equipment, specific equipment subsystems, or to individual displays and controls. The level of detail selected should allow for a meaningful grouping of stimuli. It is usually too cumbersome to group stimuli by individual displays or controls when most of the stimuli involve different displays or controls. On the other hand, when most of the stimuli involve the same equipment subsystem, grouping by individual displays and controls can be useful. In most cases, however, it is be adequate to group stimuli by major equipment subsystems. Once the level of detail has been determined, the stimuli should be grouped by equipment items at that level.

Grouping by environmental factors is fairly straightforward. In most cases, the stimulus groupings correspond to specific environmental factors (e.g., weather, threat, etc.).

After the level of organization has been selected, the stimuli should be placed into the appropriate equipment item and environmental factors groups. To accomplish this, select an ETR at the lowest level of the objectives hierarchy. Up to now, stimulus lists have been associated with each ETR. Starting with these stimulus lists, place each of the stimuli at the selected level of detail in its associated equipment item or environmental condition group. Annotate the stimuli with the number of the ETR in

which it appears. Repeat this process for each ETR. Enter the stimulus grouping information on the Stimulus Grouping Form.

Products: A listing of equipment items (and environmental features) annotated with the ETRs in which they appear, on Stimulus Grouping Forms, Figure 6.

Step 2.3: Stimulus Grouping Form

Equipment Grouping

Level of Detail (check one) Equipment ____
Equipment Subsystem ____
Controls/Displays ✓

Equipment Item: Video brightness
ETR Numbers: 06.01 01, 12.

Equipment Item: Video contrast
ETR Numbers: 06.01.01, 10.01.01, 12.

Equipment Item: Iris diameter
ETR Numbers: 06601.02, 12.

Equipment Item: Seeker Slew
ETR Numbers: 06.02, 07.01.01, 07.01.03, 08.01, 08.02, 08.04, 10.01, 10.03, 12.

Equipment Item: _____
ETR Numbers:

Equipment Item: _____
ETR Numbers:

Equipment Item: _____
ETR Numbers:

Equipment Item: _____
ETR Numbers:

Equipment Items: _____
ETR Numbers:

Equipment Items: _____
ETR Numbers:

Figure 6. Stimulus grouping form.

Step 2.3: Stimulus Grouping Form

Equipment Grouping

Level of Detail (check one) Equipment ____
Equipment Subsystem ✓
Controls/Displays ____

Equipment Item: Seeker
ETR Numbers: 04.02, 04.03, 04.04, 04.05, 06., 07.01.01, 08.02, 08.04.03, 08.04.04, 12.

Equipment Item: PDPs
ETR Numbers: 04.04, 04.05, 05., 12.

Equipment Item: _____
ETR Numbers:

Equipment Item: _____
ETR Numbers:

Equipment Item: _____
ETR Numbers:

Equipment Item: _____
ETR Numbers:

Equipment Item: _____
ETR Numbers:

Equipment Item: _____
ETR Numbers:

Equipment Items: _____
ETR Numbers:

Equipment Items: _____
ETR Numbers:

Figure 6. Stimulus grouping form. (Continued)

Step 2.3: Stimulus Grouping Form

Environmental Factor Grouping

Environmental Factor: Fog
ETR Numbers: 07.01, 08.04, 09., 10., 11.02

Environmental Factor: Smoke
ETR Numbers: Same as Fog

Environmental Factor: Terrain
ETR Numbers: 06.02, 07.01, 08.02, 08.04.02, 08.05, 09., 10., 11.02, 12.

Environmental Factor: _____
ETR Numbers:

Environmental Factor: _____
ETR Numbers:

Environmental Factor: _____
ETR Numbers:

Environmental Factor: _____
ETR Numbers:

Environmental Factor: _____
ETR Numbers:

Environmental Factor: _____
ETR Numbers:

Environmental Factor: _____
ETR Numbers:

Figure 6. Stimulus grouping form. (Continued)

Step 2.4: Assign Fidelity Ratings

Objectives: Rate each stimulus according to the fidelity requirements of the associated ETRs.

Rationale: Fidelity requirements are related to the degree to which stimuli used in training should function and appear like real-world stimuli. Stimuli high in fidelity are as close as possible to real-world stimuli in function and appearance. On the other hand, low fidelity stimuli represent the function and appearance of real-world stimuli, without reproducing all aspects of their appearance and actions. Estimates of fidelity requirements are derived by determining whether a loss in training effectiveness will result if the training stimuli do not appear and function like real-world stimuli.

In some cases lower fidelity improves training by removing the distracting effects of extraneous stimuli, and by allowing for training inputs or constraints that would not be part of a high fidelity presentation. This tends to be the case for initial training for procedures. For example, a weapon system trainer that presents special error messages that are not found in the real system, and that does not allow the trainee to fire real ammunition, represents some of the benefits of lower fidelity.

The possibility of lower fidelity must be considered at this point, in order to allow for potential fidelity-reducing inputs at other stages in the design process (Steps 3.3, Implementation Strategies; 3.5, Feedback Requirements; 4.1, Scenario Control Features; 4.3, Special Instructional Features; and Step 4.4, On-line and Off-line Training Requirements).

Procedures: The general guidelines described below can provide assistance in making decisions about fidelity. However, fidelity decisions should be made on an individual ETR by stimuli basis; the guidelines below should not outweigh variables related to the training uses of the stimuli.

In general, stimuli with any of the following aspects may require a higher degree of fidelity:

1. Difficult to understand or comprehend;

2. Involves perception of motion or relative position;

3. Unusual or abnormal;

4. Related to hazardous or potentially dangerous events;

5. Vary along a continuous (rather than discrete) scale;

6. Involve complex data;

7. Involve fine manipulation;

8. Critical to task performance;

9. Involve sustainment or mastery of integrated skill performance.

In general, a lower degree of fidelity may be required by stimuli that can be described as follows:

1. Easy to understand;

2. Does not involve perception of motion or relative position;

3. Common or ordinary;

4. Not related to hazardous or potentially dangerous events;

5. Vary along a discrete scale;

6. Involve simple data;

7. Do not require fine manipulation;

8. Are not critical to task performance;

9. Involve initial training of discrete steps involving basic skills or knowledges.

Select an ETR and rate <u>each</u> associated stimulus as follows:

1. High fidelity (H) if the stimulus should be as close to "real-world" in physical appearance and function as possible.

2. Medium fidelity (M) if the stimulus can be altered without a negative impact upon training and can be only analogous to "real-world" stimuli in terms of physical appearance and function.

3. Low fidelity (L) if the stimulus can be altered greatly without a negative impact upon training, and

its physical appearance and function can be represented rather than reproduced.

Products: Each stimulus of each ETR annotated with a fidelity rating.

Step 2.5: Identify Stimulus Categories

Objectives: Categorize ETRs by the types of stimuli required.

Rationale: The types of stimuli that must be presented drive the ET component design and implementation.

Procedures: Select an ETR, starting at the lowest level of the hierarchy. The lowest level of the objectives hierarchy means the objectives that are the most subordinate, or components of other, higher-level objectives. Only the stimulus categories should be considered now; it is not necessary to consider specific stimuli at this point. For each listed stimulus, select the applicable categories (a stimulus may be described by more than one category) and annotate the ETR listing with the categories selected:

1. Visual (including movement required to perform or learn the task or objective, color, etc.);
2. Auditory (including voice);
3. Tactile (stimulus related to touch including texture, vibration);
4. Kinesthetic (stimulus related to sense of motion);
5. Other (any stimulus which does not fall into above categories; include descriptive comment).

Annotate the ETR with each category selected.

Repeat for each objective at the lowest level of the hierarchy. When you have finished this analysis at one level of the hierarchy, move up to the next level and continue. Work through the objective hierarchy until all objectives have been assessed. In many cases, ratings from lower-level objectives can be "fed into" higher-level objective analysis. When using ratings from lower-level objectives to assess the stimuli associated with higher-level objectives, be sure to review each rating to ensure that it still applies in the new context.

Products: Each ETR (objective) annotated with the types of stimuli needed; each stimulus coded by type.

Step 2.6: Identify Performance Measures

Objectives: Identify relevant performance measures for each ETR, based on the standards of performance identified in the original ETR database.

Rationale: Measurement of performance is crucial for training. The types of measures needed will impact on ET component design and implementation.

Procedures: Select an ETR for analysis. Review its identified standards and whether it is to be implemented for different training types (e.g., full mission-phase vs. part-task) or different trainee groups.

Identify each relevant type of measure. Some examples of performance measures are listed below:

1. Time to complete;
2. Speed of response;
3. Correct action selection;
4. Correct sequence of actions;
5. Precision of manipulation;
6. Precision of aim;
7. Smoothness of action;
8. Other (include descriptive comment).

For each selected measure, briefly describe how the measure could be applied to the ETR, including the trainee's action and the scoring criteria. In addition, indicate whether the measure under consideration should be applied to an individual trainee's performance or to crew/team performance.

Products: For each ETR, relevant types of measures are selected; each selected type of measure annotated with a verbal description of the measures anticipated applications. In Figure 7 is an example of the Performance Measure and Feedback Information Form, with performance measurement information from Step 2.6 inserted.

Steps 2.6 - 2.9: Performance Measure and Feedback Information Form

Embedded Training Requirement (ETR) Number 08.05.01

Performance Measure: Course heading

Application: Return to within ±0.5 degrees of course after waypoint check error

Crew (CM) or Trainee (TM): TM

Feedback Description:

Feedback Codes:

Freeze: Y / N

Priority:

Recording Events (Description, Codes, and Priority):

Performance Measure Categories for ETR: accuracy

Feedback Event Categories for ETR:

Recording Event Categories for ETR:

Figure 7. Performance measure and feedback information form.

Step 2.7: Identify and Describe Feedback Events

Objectives: Identify appropriate feedback for each ETR.

Rationale: Training effectiveness is enhanced by timely and relevant feedback. Each identified performance measure is a potential source of feedback.

Procedures: Select an ETR and review its identified standards and measures.

It is essential that correct or incorrect actions be identified for the trainee or the team. Most practice situations will incorporate "natural" feedback, such as an equipment output in response to operator input. For training purposes, it is usually desirable to incorporate additional, or "artificial" feedback. The following guidelines can be used in devising appropriate feedback events:

1. Complete feedback is presented in the context of the material, rather than merely indicating right or wrong. For example, complete feedback for performance of a procedure would include stating what step has been performed incorrectly, the incorrect action taken, and the correct alternative action.

2. Timely feedback is given after each practice trial, rather than after several trials. Any time the practice situation involves multiple trials, present feedback immediately, so the trainee will not continue to practice incorrect actions.

3. Similar feedback is presented in the same state as the product or outcome. For example, feedback on equipment set-up might consist of an illustration of correctly configured equipment, rather than a written checklist.

4. Specific feedback identifies errors in performance, rather than merely assigning a score or grade. For example, feedback for target acquisition practice should include reviewing the targets hit or missed, rather than merely stating the percent hit.

In general, any item for which a performance measure is to obtained will require feedback at some level to the trainee(s).

Using the above guidelines, consider how feedback can be presented to the trainee for each measure associated with an ETR. Describe both what feedback will be useful and when it will occur. If appropriate, specify that the exercise should freeze to present feedback for errors; note that scenario freeze is considered again in Step 4.1.

For each feedback event, indicate whether crew/team (CF) or individual trainee (TF) feedback is required. Usually measures that require more than one individual to perform will also require crew/team feedback.

For each feedback event described, note whether it will occur immediately (IF) within an exercise, a summary (SF) at the end of the exercise, or delayed (DF) beyond the end of an exercise. The recording requirements for summary and delayed feedback will be considered in the next step. Note that a given measure can produce multiple feedback events, including immediate, summary, and delayed feedback.

Record feedback requirements in the database for each ETR, or annotate the Performance Measure and Feedback Information form (see Figure 8).

The focus of this step is to devise optimum feedback for each ETR to be presented during training. The next step considers recording or summarizing performance for later use.

Products: Each measure (associated with each ETR) is annotated with a description of the feedback to be provided. Each feedback event described is also coded IF (immediate feedback during exercise), SF (summary at end of exercise), or DF (delayed beyond end of exercise). In Figure 8 is an example of the Performance Measure and Feedback Information Form, with feedback event information added to the data generated in Step 2.6.

NOTE: If additional guidance is needed with respect to feedback, it may be useful to consult the Appendix of the following document.

Marco, R. A., Begg, J., Israelite, L., and Bernstein, K. (1986). An enhanced instructional design process for developing interactive courseware. Alexandria, VA: U.S. Army Research Institute (Technical Report 713).

Steps 2.6 - 2.9: Performance Measure and Feedback Information Form

Embedded Training Requirement (ETR) Number 08.05.01

Performance Measure: Course heading

Application: Return to within ±.05 degrees of Course after waypoint check error.

Crew (CM) or Trainee (TM): TM

Feedback Description: Trainee failed to return to Course.

Feedback Codes: TF, IF, SF

Freeze: Y / (N)

Priority:

Recording Events (Description, Codes, and Priority):

Performance Measure Categories for ETR: accuracy

Feedback Event Categories for ETR: TF, IF, SF

Recording Event Categories for ETR:

Figure 8. Performance measure and feedback information form.

Step 2.8: Identify and Describe Recording Events

Objectives: To identify trainee behaviors, measures, or summaries of measures to be recorded for use after the training session.

Rationale: Information on trainee performance can be useful to the trainee, crew, instructors or training managers, or those responsible for assessing unit readiness.

Procedures: Select an ETR and review the identified performance measures. To select recording events, consider the following points:

1. Who can use recorded information? Possibilities include the trainee, the crew, the instructor, the team leader, and the unit commander.

2. How can the information be used? Possibilities include guidance of future training, remediation, or assessment of unit readiness.

3. When will the information be used? Possibilities include at the end of the training session, at the end of a defined block of training, or at an undefined future time (delayed feedback). It is only necessary to consider whether the information will be used at a future time. That point will be specified later in these procedures.

4. What specific information will be useful? Possibilities include step-by-step records of trainee or crew performance, records of trainee or crew scores on specific measures during a specific training session, or summaries of performance over time for one or more trainees.

For each measure, describe the recording events that are considered desirable in each of the following categories:

1. Summary feedback recording (SR);

2. Delayed feedback recording (DR);

3. Trainee assessment recording (TR);

4. Crew/team assessment recording (CR);

5. Instructional management recording (IR);

6. Unit assessment recording (UR).

Code each identified event as SR, DR, TR, CR, IR, or UR.

Products: Each ETR should be annotated with the identified recording events. Each identified event should also be coded by category. In Figure 9 is an example of the Performance Measure and Feedback Information Form, with recording event information added to the data from Steps 2.6 and 2.7.

Steps 2.6 - 2.9: Performance Measure and Feedback Information Form

Embedded Training Requirement (ETR) Number 08.05.01

Performance Measure: Course heading

Application: Return to within ± 0.5 degrees of course after waypoint check error.

Crew (CM) or Trainee (TM): TM

Feedback Description: Trainee failed to return to course.

Feedback Codes: TF, IF, SF

Freeze: Y / (N)

Priority:

Recording Events (Description, Codes, and Priority): Waypoint missed SR, TR. Failed mission IR.

Performance Measure Categories for ETR: accuracy

Feedback Event Categories for ETR: TF, IF, SF

Recording Event Categories for ETR: SR, TR, IR

Figure 9. Performance measure and feedback information form.

Step 2.9: Assign Priority Ratings to Feedback and Recording Events

Objectives: Rate feedback and recording events as high or low priority.

Rationale: The number or type of feedback and recording events may be limited by cost constraints or other implementation factors. If not all feedback and recording events can be implemented, those events which are most important should be given first priority.

Procedures: Select an ETR and review its identified feedback and recording events.

Rate each event as H (high priority) or L (low priority) based on the following factors:

1. Feedback to the trainee during training (within exercise or end of exercise) is generally high in priority; summary data for later use is usually lower in priority.

2. Rate as high priority those feedback events that are necessary to prevent practice of incorrect actions and to facilitate transfer of learning to later practice situations; feedback events that can be categorized as "nice-to-know" rather than crucial to learning may be lower in priority.

3. Recording events that are crucial to stated functions of the ET component (e.g., remedial training) are high priority; recording events that form potentially useful add-ons to the ET components (e.g., unit readiness assessment) are lower in priority.

Consider each identified event using these guidelines. Note that for each operational system, the uses of the ET component may be defined differently. Rate as high priority those feedback and recording events that will be most appropriate for the defined functions of the specific ET component. For example, if unit readiness assessment is the main purpose of the ET component, then the guidelines stated above will not apply.

Products: Priority rating assigned to each identified feedback or recording event. In Figure 10 is an example of the Performance Measure and Feedback Information Form, with priority ratings added to the data from Steps 2.6, 2.7, and 2.8.

Steps 2.6 - 2.9: Performance Measure and Feedback Information Form

Embedded Training Requirement (ETR) Number 08.05.01

Performance Measure: Course heading

Application: Return to within ± 0.5 degrees of course after waypoint check error.

Crew (CM) or Trainee (TM): TM

Feedback Description: Trainee failed to return to course.

Feedback Codes: TF, IF, SF

Freeze: Y / (N)

Priority: High

Recording Events (Description, Codes, and Priority): Waypoint missed SR, TR. Failed mission IR High priority.

Performance Measure Categories for ETR: accuracy

Feedback Event Categories for ETR: TF, IF, SF

Recording Event Categories for ETR: SR, TR, IR

Figure 10. Performance measure and feedback information form.

Step 2.10: Perform Commonality Analysis

Objectives: Identify common elements among the stimuli, measures, and feedback and recording requirements.

Rationale: In the previous steps, presentation requirements were identified and categorized, and stimuli were grouped by content. In this step, the process of cross-referencing is extended to the identified categories of stimuli, measures, feedback, and recording events. This additional cross-referencing streamlines the design process by providing an overview of the ET component characteristics.

Procedures: Compare each ETR against all others, identifying first instances and cross-referencing repeated cases for each of the following:

1. Stimulus categories (visual, auditory, or tactile and kinesthetic). When stimuli belong in more than one category, cross reference by each applicable category.

2. Performance measure categories (time to complete, speed of response, correct action selection, etc.).

3. Feedback event categories (within-exercise, end-of-exercise, or delayed).

4. Recording event categories (summary feedback, delayed feedback, trainee assessment, crew/team assessment, instructional management, unit assessment). Enter the corresponding ETR numbers in the appropriate category on the Commonality Analysis Form.

Use the Performance Measure and Feedback Information forms completed in Steps 2.6 through 2.9 for these data.

Products: Unique and repeated elements identified and coded as such on a completed Commonality Analysis Form, Figure 11.

Step 2.10: Commonality Analysis Form

(Enter the ETR Numbers associated with each category)

Stimulus Categories

Visual: 03.02, 05.01, 05.02, 05.03, 05.04, 05.05, 06.01, 06.02, 07, 08., 09., 10., 11., 12.

Auditory: 03.02, 03.03, 06.02

Tactile/Kinesthetic: 03.02, 03.03, 05.02, 05.04, 05.05, 06.01, 06.02, 07, 08., 09., 10.02, 11., 12.

Other:

Figure 11. Commonality analysis form.

Step 2.10: Commonality Analysis Form

Feedback Event Categories

Immediate Feedback (within exercise) (IF): 05.01

Delayed Feedback (other than summary) (DF): 05.01, 06.01, 06.03, ~~07.01~~, 07.02, ~~07.03~~, 08.01

Summary Feedback (end-of-exercise) (SF): 05.01, 06.01, 06.03, 07.01, 07.02, 07.03, 08.03

Trainee Feedback (TF): All feedback is TF

Crew/Team Feedback (CF):

Figure 11. Commonality analysis form. (Continued)

Step 2.10: Commonality Analysis Form

Recording Event Categories

Summary Feedback Recording (SR): 05.01, 06.01, 06.03, 07.01, 07.02, 07.03, 08.03

Delayed Feedback Recording (DR): 05.01, 06.01, 06.03, 07.02, 08.01

Trainee Assessment Recording (TR): All recording

Crew/Team Assessment Recording (CR): _____

Instructional Management Recording (IR): All SR is potential IR.

Unit Assessment Recording (UR): 12.

Figure 11. Commonality analysis form. (Continued)

Step 2.10: Commonality Analysis Form

Performance Measure Categories

Time to Complete: 05.01, 08.01, 08.02, 10.01, 11.02, 12.

Speed of Response: 05.01, 06.01, 07., 09.01, 09.02, 10.02

Correct Action Selection: 05.01, 05.02, 06.01, 06.03, 07.01, 07.02, 07.03, 09.02, 10.01, 10.02

Correct Sequence of Actions: 05.01, 05.02, 06.01, 06.02, 06.03, 07.01, 07.03, 08.02, 08.04, 10.01, 10.02, 10.03, 11.01, 12.

Precision of Manipulation: 07.02, 07.03, 08.01, 08.02, 08.04, 08.05, 10.01

Precision of Aim: 06.02, 08.04, 10.01, 10.03

Smoothness of Action: 07.02, 07.03, 08.02, 08.04, 10.01, 10.03

Other:

Figure 11. Commonality analysis form. (Continued)

Step 2.11: Identify Stimulus Implementation Strategies

Objectives: Begin to define implementation strategies for the identified ETR stimulus requirements.

Rationale: To this point, ETR presentation has been defined with little reference to real-world constraints. This is intentional; desired presentation features should be recorded even if it is not immediately apparent that they can be implemented. Now, however, the identified stimulus requirements can be reviewed to identify probable implementation approaches. In addition, desirable implementation approaches that are incompatible with system instruments can be identified. Depending upon the phase of system development, it may be possible to impact design decisions. As advised in Volume 6 of this series, it is essential to assure sufficient computer processing and memory capacity, and to provide for appropriate "hooks" or entries into operational software, to support ET.

Procedures: Begin by reviewing the prime system characteristics and any stated limitations on the ET component. Of particular importance are the computational capabilities and the input/output device characteristics.

Select an ETR and review the presentation requirements, as well as any comments on the anticipated training scenarios.

Tables 1 and 2 can be used to identify implementation approaches for various stimulus requirements. Use Table 1, Stimulus Implementation Strategies, to identify possible implementation approaches. Table 2, Implementation Strategy Criteria, shows factors influencing the selection of a stimulus implementation approach. Review both tables to identify a recommended implementation strategy for each identified stimulus.

When stimuli fall into more than one stimulus category, select an implementation strategy to accommodate each applicable stimulus category. In other words, several strategies may be appropriate at the same time.

Note any discrepancies or contradictions in the identified implementation strategies. Any identified implementation strategy which is apparently not compatible with the known parameters of the prime system should be noted also.

Products: Each ETR annotated with possible implementation approaches and ETR stimuli; those requirements with implementation strategies that are not feasible given known system constraints noted as such.

Table 1

Stimulus Implementation Strategies

Stimulus or Stimuli Group	Possible Implementation Strategy	Implementation Requirements
Visual, auditory, tactile, or kinesthetic	Actual operation	Operation of prime equipment compatible with use of ET component; safety not compromised.
	Stimulation of prime equipment	Appropriate components (integral or strap-on) to produce stimuli and sense trainee actions; computer capability to stimulate and control.
Visual (including color or motion).	Computer-generated or simulated imagery.	Display device (integral or strap-on); computer capability to generate stimuli and control.
	Video tape	Video tape player and display device (integral or strap-on); if to be computer controlled, then computer capability.
	Video disc	Video disc player and display device (integral or strap-on); computer capability to control.
Audio (including voice).	Audio tape	Audio tape player (integral or strap-on); if to be computer controlled, then computer capability.
	Synthesized sound	Appropriate components (integral or strap-on); computer capability to produce stimuli and control.

NOTE: Use one or more strategies as appropriate.

Table 2

Implementation Strategy Criteria

Select this implementation strategy:	When these criteria apply:	Potential limitations:
Prime equipment stimulation	Stimuli to be presented consist of prime equipment displays/indications.	Security of regular equipment or operations compromised. Safety of operator or equipment. Overly high fidelity creates poor training environment. Technical infeasibility.
Computer generated or simulated imagery	Stimuli to be presented consist of CRT display symbology or optics; Prime system does not incorporate equipment capble of providing stimuli.	Computer processing capability restrictions. Fidelity too low. Data for sample imagery unavailable or restricted.
Video tape	Visual and audio stimuli are needed; Limited variability in video sequences is acceptable.	Slow selection of sequences. Low quality of still frame presentation.
Video disc	Visual and audio stimuli are needed; High levels of variability in video sequences are anticipated.	No revision possible, remake disc. Unsuitable in moving environment with high g-loadings. No recording capability.
Audio tape	Audio stimuli only are required (or visual stimuli provided by another implementation strategy); Limited variability in audio sequences is acceptable.	Slow selection of sequences.
Synthesized sound	Audio stimuli only are required (or visual stimuli provided by another implementation strategy); High levels of variability in audio sequences are anticipated.	Vocabulary size limited by processor and speed requirements. Speech quality lower than audio/video tape.

NOTE: Use one or more strategies as appropriate.

Step 2.12: Document Presentation Requirements

Objectives: Prepare interim documentation.

Rationale: Prime system engineers and others are expected to need information on the ET component design as early as possible. At this point, a substantial body of data has been produced and reviewed. Documentation detailing the results of Phases 1 and 2 should facilitate communication during the following phases. Engineering review of the presentation requirements is the next step in a process of tradeoff studies.

Procedures: Review the data generated in the preceding steps. Depending on system design phase and other factors unique to each effort, various combinations of data may be useful to prime system designers or other concerned parties.

Possible combinations include the following:

1. List equipment to be stimulated (and describe, including dynamics and interactions).

2. List identified proposed implementation approaches (and describe stimuli, for each ETR).

3. Document alternative presentation approaches, using knowledge of technical limitations and resource requirements.

Products: Documentation containing selected combinations of the available data.

PHASE 3: COMPILE ET OBJECTIVE REQUIREMENTS INTO ET COMPONENT REQUIREMENTS

This phase uses the data developed in the previous two phases to develop some specific ET component requirements, and from those preliminary requirements, defines an initial ET component concept. There are two differences between the preceding analyses and those in Phase 3. First, the procedures presented here (and in the following phases) are overall evaluations of the ET data, rather than objective-by-objective analyses. The objective information is compiled to produce an aggregate ET component definition. Secondly, the steps can be characterized as manipulation of data rather than data entry. While the previous phases created the ET design database, Phase 3 begins the documentation process.

Phase 3 documents the results in a form that allows tradeoff studies to be performed by system engineers and training developers. There are nine steps to this phase, as follows:

Figure 12 outlines the steps in Phase 3. Each step is described below.

NOTE: If you are performing a preliminary ET component design early in the acquisition process, you may not have data that are sufficiently complete and detailed to perform the steps in this phase. If so, steps 3.2, 3.3, 3.4, and 3.5 may be omitted. However, <u>if you omit these steps, it must be made clear that this was done when reporting on the preliminary design</u>. This will help to assure that these steps are performed in later analyses to specify the "real" ET component.

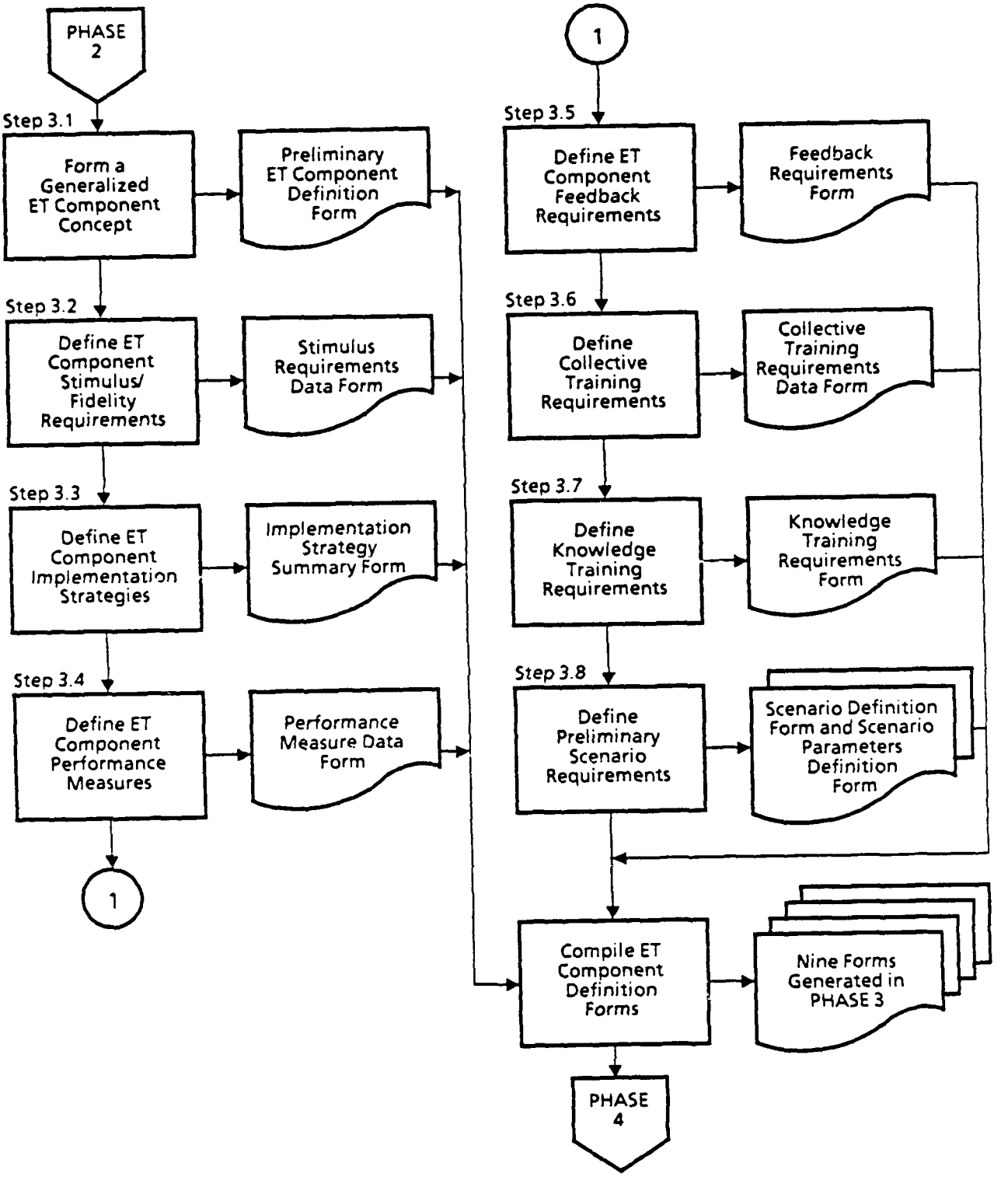

Figure 12. Phase 3: Compile ET objective requirements into ET component requirements.

Step 3.1: Form a Generalized ET Component Concept

Objectives: Review ET requirements and associated data, and form a general concept of the ET component.

Rationale: After performing the evaluations objective-by-objective, this step provides the designer with the opportunity to begin to conceptualize and define the ET component. An overall review of the ET Requirements and their ET-related data is needed to begin this process. Those stimulus requirements appearing most frequently are the predominant ET component stimulus requirements. The same is true for fidelity requirements, performance measures, training adaptivity, feedback requirements, and data recording requirements. Once the designer has a good sense of what the ET component is required to do, the other procedures for actual ET component definition can be performed more easily.

Procedures: Begin by obtaining either a list of objectives selected for ET, annotated with the data documented in Phase 2, or a Stimulus Information Form and a Performance Measure and Feedback Information Form for each ETR. At a minimum, the following data are necessary for each ETR:

1. Objective Number;
2. Objective Description;
3. Stimulus Requirements with Fidelity Requirements;
4. Performance Measures with Feedback Requirements;
5. Recording Requirements;
6. Stimulus Categories;
7. Performance Measure Categories;
8. Feedback Event Categories;
9. Recording Event Categories.

Next, scan the ETR information and note those requirements that appear most frequently. Utilize the cross-references generated in Phase 2 to streamline this process. Step 2.3, Group Stimuli by Common Equipment and Environmental Factors, produced a Stimulus Grouping Form; Step 2.10, Perform Commonality Analysis, produced a Commonality Analysis Form. Also, the informal description of the scope of the ET component developed in Step 2.1 should be consulted as a general guide. These frequent requirements should be noted on the Preliminary ET Component Definition Form (shown in Figure 13). This form is only intended to assist the designer in gaining an overall preliminary perspective of the ET component requirements.

Under Stimuli and Fidelity, describe frequently occurring stimulus content items (cross-referenced in Step 2.3). Enter the stimulus category, number of occurrences, and

associated fidelity requirements (Step 2.4) in the corresponding areas. Also, describe specific examples of the context in which the stimulus is presented and the fidelity required.

Under Performance Measures, record information related to frequently occurring measures (cross-referenced in Step 2.10). Under Feedback, describe common feedback events (cross-referenced in Step 2.10).

Products: Completed Preliminary ET Component Definition Form (Figure 13).

Step 3.1: Preliminary ET Component Definition Form

Stimuli and Fidelity

Stimulus Content Item: Enemy tank
Category: visual
Number of Occurrences: 3
Specific Examples of Stimulus Presentation: Tank in distance. Tank appears larger as missile approaches. All overhead aspects of tank required.

Associated Fidelity Required: High
Specific Examples of Fidelity: Trainee discriminates tank from friendly tanks. Trainee identifies high-priority tanks.

Stimulus Content Item: Fog
Category: Environmental
Number of Occurrences: 7
Specific Examples of Stimulus Presentation: Fog obscures targets and terrain.

Associated Fidelity Required: Medium
Specific Examples of Fidelity: Gunner navigates missile over terrain features seen through patchy fog.

Figure 13. Preliminary ET component definition form.

Step 3.1: Preliminary ET Component Definition Form

Performance Measures

Record each measure (e.g., Enter button press), whether it is a measure of individual trainee or crew performance, the equipment associated with the measure (e.g., Keyboard), and the type of measure (e.g., Correct part of sequence) in the table below:

Measure	Crew/ Trainee	Equipment	Type
Trigger pull	T	joystick trigger	accuracy, time
PDP press	T	PDPs	sequence, time
seeker slew button press	T	joystick seeker slew control	Maintain target track

Figure 13. Preliminary ET component definition form. (Continued)

Step 3.1: Preliminary ET Component Definition Form

Feedback

Record the immediate feedback required, associated performance measure, and describe the presentation format below:

Feedback Required	Crew/ Trainee	Performance Measure	Description
Wrong PDP T		PDP press	Beep tone, text

Figure 13. Preliminary ET component definition form. (Continued)

Step 3.1: Preliminary ET Component Definition Form

Record the summary feedback required, associated measure, and describe the presentation format below:

Feedback Required	Crew/ Trainee	Performance Measure	Description
Complete PDP sequence T		No. of errors, time to complete, sequence	Text describing errors. Summary report of number of correct trials out of total number of trials

Figure 13. Preliminary ET component definition form. (Continued)

Step 3.1: Preliminary ET Component Definition Form

Record the delayed feedback required, associated measure, and describe the presentation format below:

Feedback Required	Crew/ Trainee	Performance Measure	Description
None			

Figure 13. Preliminary ET component definition form. (Continued)

Step 3.2: Define ET Component Stimulus and Fidelity Requirements

Objectives: Define the required stimuli and fidelity of the ET component.

Rationale: Stimulus and fidelity requirements for each ETR must be combined to define the total component requirements.

Procedures: In Step 2.10 (Perform Commonality Analysis), stimuli were cross-referenced by broad categories (visual, auditory, and tactile or kinesthetic). Also, common elements of equipment and environmental factors were identified in Step 2.3 (Group Stimuli by Common Equipment and Environmental Factors). These two cross-references form the starting point for this step.

The Stimulus Requirements Data Form (shown in Figure 14) is used to record component stimulus requirements. Begin by assigning a reference number to each combination of stimulus category and equipment item (or environmental factor). Select one of these "intersections" and record each identified stimulus event. Stimulus events were added to the ETR database or documented on the Stimulus Information by ETR Form in Step 2.2. Review the results of that step to identify the stimulus event. Also record the objective where the stimulus requirement originated, and the identified fidelity rating.

When all the stimuli (for the selected intersection of stimulus category and equipment item or environmental factor) have been recorded, review them and briefly summarize the combined requirements.

Repeat this process for each stimulus category and each identified equipment item and environmental factor.

Products: Completed Stimulus Requirements Data Form (Figure 14).

Step 3.2: Stimulus Requirements Data Form

Stimulus Requirement (SR) Number: 1

Stimulus Category: Visual

Equipment Item or Environmental Factor: Fog

Stimulus Events	Objective Number	Fidelity
Identify target	09., 10., 11.02., 12.	High
Navigate missile using terrain features	07.01, 08.04, 12.	Medium

Figure 14. Stimulus requirements data form.

Step 3.2: Stimulus Requirements Data Form

Summary Description:

Fog may obscure targets to be identified and terrain used for visual navigation. Target identification requires high fidelity view. Fog also obscures targets for initial lock-on. Targets may be low fidelity for lock-on training.

Figure 14. Stimulus requirements data form. (Continued)

Step 3.3: Define ET Component Implementation Strategies

Objectives: Identify probable ET component implementation strategies.

Rationale: The ETR implementation strategies previously identified are now reviewed to determine total ET component requirements. The implementation strategies chosen for each ETR will be modified to define a consistent approach for the complete ET component.

Procedures: Select one of the Stimulus Requirements Data Forms. For each objective, implementation strategies were previously identified. Review each of the selected strategies for the listed set of Stimulus Requirements (SRs). Consider the following points:

1. Can a single implementation strategy meet all the requirements?

2. What combinations of approaches will meet all the requirements?

3. What implementation strategies meet almost all requirements?

Based on these considerations, select one or more preferred implementation strategies for the SR set. Use the Implementation Strategy Summary Form to record the selected approaches. The Implementation Strategy Summary Form is shown in Figure 15.

When preferred implementation strategies have been identified for each SR set, review all the selected approaches. Using the same factors, identify a limited set of preferred implementation strategies for the total ET component. Record these implementation strategies on the form.

Products: Completed Implementation Strategy Summary Form (Figure 15).

Step 3.3: Implementation Strategy Summary Form

Stimulus Requirement (SR) Number	Implementation Strategies
1	a. Slides obscured by fog. b. Videodisk overlay on CGI. c. CGI terrain and target

Figure 15. Implementation strategy summary form.

Step 3.3: Implementation Strategy Summary Form

Preferred package implementation strategies: For identification training high fidelity is required. Videodisk and slide do this. For navigation, medium fidelity is acceptable. CGI does this. For aiming, low fidelity targets are acceptable. CGI does this. Best package is videodisk over CGI. Second best is videodisk or slide for still target identification and CGI for terrain and moving target aiming training.

Figure 15. Implementation strategy summary form. (Continued)

Step 3.4: Define ET Component Performance Measures

Objectives: Assemble a comprehensive list of performance measures.

Rationale: Performance measures must be explicitly defined before system engineers can estimate hardware and software requirements. The performance measures and measurement procedures also provide the software designer with data needed to write program code for automated performance measurement.

Procedures: Using the printout produced in Step 3.1 (to identify the unique performance measures), examine the data on each objective and record the details about each performance measure on the Performance Measures Data Form (shown in Figure 16). The Preliminary ET Component Definition Form is used as a guide.

Assign a reference number to each unique application of a performance measure. Enter the reference number in the area labeled PM Number. Enter a brief description of the measure under Performance Measure (e.g., "Time to center crosshairs on target"). Under Type of Measure, enter the performance measure category from the Performance Measure and Feedback Information Form (assigned in Step 2.6, Identify Performance Measures). Describe how the measure is applied in the area labeled Measurement Procedure.

Under Response to Trainee Failure, describe the ET component response when trainee performance does not meet the measure criteria. For example, the ET component could freeze the scenario and present an error message or sound a warning tone and display a message. Alternatively, error information may be stored for summary presentation.

Under Prime Equipment Used for Measurement, list the prime equipment items used by the trainee and the prime equipment necessary in order for the trainees to perform the procedure being measured (e.g., control stick, central processor, CRT display, etc.).

Under Objective Numbers, list all the objectives that apply the measure or use the measurement results. Enter all the selected feedback or recording category codes (defined in Steps 2.7, Identify and Describe Feedback Events; and 2.8, Identify and Describe Recording Events) for each objective in the column labeled Feedback and Recording Codes.

Additional comments and clarifying remarks can be entered under Other Information.

Perform this procedure for all objectives.

Products: Completed Performance Measure Data Form (Figure 16) for each performance measure.

Step 3.4: Performance Measure Data Form

Performance Measure (PM) Number: 1

Performance Measure: PDP press

Type of Measure: Correct action selection

Measurement Procedure: Read PDPs and compare to correct response

Response to Trainee Failure: Beep and error message.

Prime Equipment Used for Measurement: Computer (press PDP press and flags)

Objective Numbers	Feedback and Recording Codes
05.01, 05.02	IF, SF, DF, SR, DR
12.	DF, SF, SR, DR

Figure 16. Performance measure data form.

Step 3.4: Performance Measure Data Form

Other Information: None

Figure 16. Performance measure data form. (Continued)

Step 3.5: Define ET Component Feedback Requirements

Objectives: Identify ET component feedback requirements and define the summary feedback format.

Rationale: Definitive descriptions of the feedback requirements are necessary for hardware and software engineers to estimate ET component hardware and software requirements. The more detail contained in the feedback descriptions, the more accurately the engineers can determine the system capabilities necessary to support the feedback requirements.

Procedures: Using the printout produced in Step 3.1, go through the list of objectives and identify the unique feedback requirements. For each feedback requirement, fill out the Feedback Requirements Form (shown in Figure 17). The procedures to complete Step 3.5 are similar to the "storyboarding" that is done for audiovisual or CAI programs.

Assign a reference number to each identified feedback event. Enter the reference number and a brief description of the feedback event in the areas labeled FR Number and Feedback, respectively. Under Type of Feedback, enter the feedback classification codes from the Performance Measure and Feedback Information Form (IF, SF, or DF and CF or TF from Step 2.7). From the Performance Measure Data Forms (Step 3.4), determine the number of each measure used for the feedback event, and enter them under PM Numbers.

In the sections under Feedback Information, describe the text message to be presented, the presentation device, and the display location (include the device and any specifics; e.g., "CRT display, lower right corner"). Under Detail, draw a free-hand sketch of the feedback display. Under When Presented, indicate when the feedback should occur (e.g., end of training session, end of block of training, or future time). Do this separately for each type of feedback (IF, SF, DF, CF, TF) for each FR. The goal is to lay out every feedback event separately.

Any additional comments can be entered under Other Information. If there is any reason to believe that variations in feedback over time, or according to the trainee's skill level, may be necessary, note it here. Provide a description of how the feedback might change under the anticipated conditions or variations.

Products: Completed Feedback Requirements Form (Figure 17) for each feedback event.

Step 3.5: Feedback Requirements Form

Feedback Requirement (FR) Number: 1

Feedback: Summary of success at completing the launch sequence according to the specified type of launch.

Type of Feedback: SF, TF

Performance Measure (PM) Numbers: 1

Feedback Information

Text Required: Note omissions and un-needed steps performed. State time to complete. State correctness.

Presentation Devices: CRT

Display Location: Frame dedicated to feedback.

When Presented: End of launch sequence.

Other: Offer chance to repeat launch if trainee desires.

Figure 17. Feedback requirements form.

Step 3.5: Feedback Requirements Form

Detail:
(Example)

You completed this fire on Azimuth launch correctly.

Your launch was completed in 120 seconds. This is within the time allowed by performance standards.

You could have skipped the re-check of the inertial navigation alignment, since you did this in the previous exercise. This is not an error, though.

Good work.

Press enter to continue or I to repeat this launch.

Figure 17. Feedback requirements form. (Continued)

Step 3.6: Define Collective Training Requirements

Objectives: Determine the collective training and implementation approaches.

Rationale: It is necessary to know whether the ET component is to be used for training teams and individuals or individuals only. This information is necessary for the hardware and software to be designed.

Procedures: Team and crew performance measures, feedback, and recording events were identified in Steps 2.6 (Identify Performance Measures), 2.7 (Identify and Describe Feedback Events), and 2.8 (Identify and Describe Recording Events), respectively. Review the results of these steps to determine whether team training (internal collective training) requirements exist. In addition, an O&O plan and MAA data can be used to select the two following collective training categories:

1. Internal Collective Training is selected if the prime system has multiple user stations required to operate together for the prime system to be effective (e.g., Missile Minder coordinating the fires of several Hawk batteries).

2. External Collective Training is selected if the prime system is to be used in conjunction with other prime systems to be effective (e.g., Missile Minder coordinating the fires of several Hawk batteries).

Some systems may require training in both categories.

Enter the information on the Collective Training Requirements Data Form (shown in Figure 18).

Products: Completed Collective Training Requirements Data Form (Figure 18).

Step 3.6: Collective Training Requirements Form

Internal Collective Training (team or crew training)

Number of Positions: None

Positions Involved: _____

Number of Stations: _____

Implementation Comments: _____

Figure 18. Collective training requirements form.

Step 3.6: Collective Training Requirements Form

External Collective Training

Number of Prime Systems: 2

Prime Systems Involved: HMMWV and FOG-M

Implementation Comments: Driver of HMMWV must coordinate with gunner to:

1. Navigate to launch site
2. Position vehicle with respect to north, ± X degrees, to ensure proper missile navigation.

Figure 18. Collective training requirements form. (Continued)

Step 3.7: Define Knowledge Training Requirements

Objectives: Define the requirements for knowledge-based training.

Rationale: Knowledge training has unique requirements which must be addressed for those ET components that are to train such objectives. Much of the design process to this point has focused on requirements for hands-on exercises. Some ET components, however, may include substantial knowledge training capabilities. The process provides for a trade study to assess whether ET is the appropriate medium for presentation of knowledge information.

Procedures: The ETRs that contain knowledge objectives were identified in Step 2.1 (Identify Training Approaches). Begin by reviewing the Training Approach Forms. Determine a preliminary lesson sequence by applying the following guidelines:

1. Consider which objectives are dependent on other objectives. For example, if the trainee must have learned certain facts prior to learning a rule that applies those facts, the rule learning objective is considered dependent. Dependent objectives must occur later than their prerequisites, in this case, the acquisition of facts.

2. Consider which objectives are related to each other. For example, if the trainee has learned to classify a particular type of threat, it may be easier to learn another threat classification. Such related objectives should be placed close to one another to maximize transfer of learning.

For objectives which are independent and unrelated, any logical order is acceptable. For example, lessons may be ordered in a sequence corresponding to mission phases.

For all dependent objectives, be sure to identify all those that are related to each prerequisite objective. A prerequisite objective on which several other objectives are dependent should be placed in the training sequence before any of the dependent objectives. It may also be useful to refresh a prerequisite objective (or at least review it) before each of the dependent objectives, in the training sequence.

Record the lesson sequences on the Knowledge Training Requirements Form (shown in Figure 19). Assign each identified lesson a Number and Title. Record the objectives to be taught in each lesson in the field labeled Objective Numbers.

The next field is labeled Implementation Factors. In this field, record factors associated with the types of knowledge training to be provided. Consider the following possible entries:

1. Text (required for presentation of facts, text drill-and-practice, text testing, and training package control).

2. Graphics (required for visual recognition or discrimination).

3. Dynamic simulation (required for practice of timing, discrimination of or among moving targets, etc.).

4. Adaptive or Intelligent CAI (required for automatic variations in presentation order, practice difficulty, etc.).

Refer to MIL-STD-1379D for additional information related to the definition of knowledge training requirements.

Enter any additional comments on the knowledge lessons under Comments. Under this heading enter recommendations or decisions about the suitability of ET for presentation of this knowledge information. Once the ET implementation requirements have been described, tradeoff studies between ET and alternative presentation techniques, such as print media, training devices, and instructors can be made. In some instances the decision may be a global one, such as a directive that there will be no use of text during unit training. In other instances the relative benefits of an alternative may be strong, such as when an operating manual already exists in the weapon system.

Products: Completed Knowledge Training Requirements Form (Figure 19) .

Step 3.7: Knowledge Training Requirements Form

Lesson Number: 3

Lesson Title: Launch a FOG-M missile

Objective Numbers: 05.01

Implementation Factors: Text, dynamic simulation

Comments: Mostly procedures training

Lesson Number: 4

Lesson Title: Use the seeker

Objective Numbers: 06.01, 06.02, 06.03

Implementation Factors: Text, graphics, Dynamic simulation

Comments: Learn to maneuver the seeker and understand its relation to missile movement

Figure 19. Knowledge training requirements form.

Step 3.8: Define Preliminary Scenario Requirements

Objectives: Determine the required scenarios and scenario parameters.

Rationale: It is necessary for ET component hardware and software engineers to know the types of scenarios required to support ET and the basic parameters required by these scenarios.

Procedures: If scenarios are not going to be used for ET, skip this step.

Obtain the ET objectives list produced in Form a Generalized ET Component Concept (Step 3.1), the Performance Measure Data Forms (Step 3.4), and the Feedback Requirements Forms (Step 3.5).

Examine the ET objectives list and select the objectives which appear high enough in the hierarchy to support and warrant discrete scenarios by themselves. This list of objectives is the initial list of scenarios needed. To select, start with the mission level, proceed to the phase level, and finish at the first task level.

Starting at objectives to generate scenarios is a beginning, but more than one scenario may be needed for an objective. For example, an objective like: "Guide the missile through all types of meteorological conditions," might require specifying scenarios with the following representations: (1) fog, (2) rain, (3) snow, (4) steady wind, (5) gusting wind, and (6) specified combinations of the foregoing conditions.

It is important to remember that although missions and phases may sometimes not be selected for ET, some of the missions and phases may have many tasks that can be selected. If this occurs, select the highest level objectives for the initial list of scenarios.

Identify the scenario categories that should be trained by comparing each objective in the initial list of scenarios with the following scenario category criteria:

1. Practice scenarios - Only summary feedback required and no contingencies practiced.

2. Interactive learning scenarios - Immediate feedback required; contingencies may be presented.

3. Practice contingency scenarios - Contingencies presented; only summary feedback.

Make up a form for each type of scenario, and check the type at the top of the form. Enter each item from the initial list of scenarios under the appropriate Scenario Definition Form (shown in Figure 20).

There may be occasions when more than one scenario will be required for an objective. The number of scenarios depends upon how and for what purposes the objective will be trained. Use the guidelines listed below to identify those objectives that require multiple scenarios:

1. Objectives that are used for more than one training type (i.e., initial, sustainment, and transition).

2. Objectives that will be performed under conditions varying in levels of difficulty.

3. Objectives that will be trained in more than one training environment (e.g., the unit and the school).

4. Objectives that will be performed under multiple environmental or other conditions, or continuously or occasionally varying conditions. It may not be possible to include all of the conditions affecting the performance of the objective in the same scenario.

5. Objectives that will be trained to more than one skill level.

In the area titled Contingency Descriptions, list the specific contingencies to be presented. The list should include environmental conditions (e.g., ECM and weather) which affect the effectiveness of the prime system, degraded systems operations, and crew casualties. Much of this information will come directly from the stimulus descriptions.

Complete the Scenario Parameters Definition Form (shown in Figure 21) for each identified scenario.

Enter the scenario reference number in the corresponding areas. These numbers will be used for reference later in these procedures. Review the objective information to determine the scenario parameters.

Under Target Information, the first decision is whether targets appear out-the-window or on a CRT. The stimulus parameters are a little different for the two presentations. Enter the maximum number of targets

(total, friendly, and enemy). When non-targets are utilized in the scenario for training discrimination, recognition, or other skills, include these "non-targets" in the friendly category under Target Characteristics. Check off each characteristic required. Describe the specific targets to be presented. Under Environmental Conditions, check off the conditions that affect the objective under consideration, and note any comments (such as weather intensities, names of jammers, etc.). Under Degraded Systems, list the systems or subsystems which may fail. Include descriptive information under Comments.

Products: Completed Scenario Definition Form (Figure 20) and Scenario Parameters Definition Form (Figure 21).

Step 3.8: Scenario Definition Form

Practice: ____ Interactive: ✓ Contingency Practice: ____

Scenario Number	Objective No.	Objective Title/Description
1	05.01.02	Confirm and correct launch data
•		
•		
•		
•		
30	09.01	Detect target

Contingency Descriptions: _____

Figure 20. Scenario definition form.

Step 3.8: Scenario Parameters Definition Form

Scenario Number: 30.

Target Information

Out the window view: _____. CRT view: ✓.

Maximum number of targets: 1.

Friendly: _____. Enemy: ✓.

Target characteristics for out the window view:

Motion: _____. Color: _____. Panoramic: _____.

Adequate fidelity for target information: _____.

Ability to track target: _____.

Other: _____

Target characteristics for CRT view:

Motion: ✓. Color: _____. Text: _____. Symbols: _____.

Other: _____

Specific target names or classes:

Enemy tanks or artillery

Figure 21. Scenario parameters definition form.

Step 3.8: Scenario Parameters Definition Form

Environmental Conditions

Rain: ✓. Haze: ✓. Smoke: ✓. Wind: ___.

Fog: ✓. Snow: ✓. ECM: ___. ECCM: ___.

Sea State: ___. Decoys: ___. Darkness: ✓. Chaff: ___

Other: ___

Comments:

Trainee should detect potential targets under all atmospheric conditions. Full identification may not be possible.

Degraded Systems

System/Subsystem	Comments
Iris failure	Compensate with contrast control

Figure 21. Scenario parameters definition form. (Continued)

Step 3.9: Compile ET Component Definition Forms

Objectives: Prepare the forms generated during this phase for use in the ET component design concept development.

Rationale: The ET Component Definition Forms produced in Phase 3 are essential to the development of the ET component design concept. The information contained in these forms will be used to make decisions about the ET component design concept throughout Phase 4.

Procedures: Compile the following definition and data forms:

1. Preliminary ET Component Definition Form
2. Stimulus Requirements Data Form
3. Implementation Strategy Summary Form
4. Performance Measure Data Form
5. Feedback Requirements Form
6. Collective Training Requirements Form
7. Knowledge Training Requirements Form
8. Scenario Definition Form
9. Scenario Parameters Definition Form

Products: ET component definition package.

PHASE 4: SELECT TRAINING FEATURES FOR THE ET COMPONENT

This phase contains the steps for selecting the various features an embedded training component may have. The features selected have a definite impact on the hardware and software design and should be explicitly defined. This phase includes a final step to assemble all of the forms generated in Phases 3 and 4 into an ET component concept documents. The steps of this phase include:

A graphic overview of Phase 4 is presented in Figure 22. Each of the steps in Phase 4 is described below.

NOTE: If you are performing preliminary design of an ET component early in the acquisition process, you may not have enough information available to perform this phase. If this is the case, you may omit the phase. If you do so, you must indicate this in reporting the result of the preliminary ET component design. This will help to ensure that this phase is performed later, during development of the actual ET design.

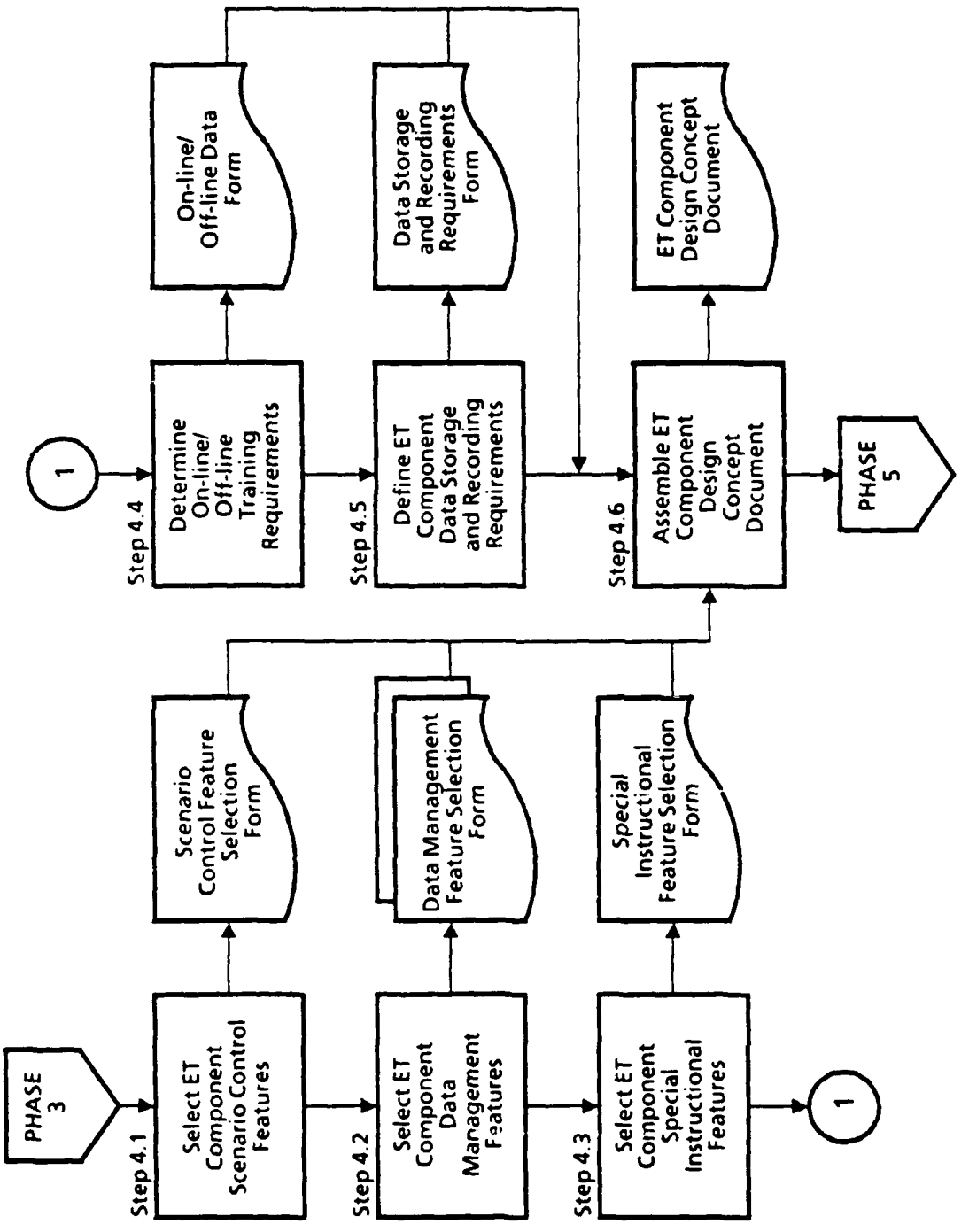

Figure 22. Phase 4: Select training features for the ET component

Step 4.1: Select ET Component Scenario Control Features

Objectives: Select the scenario control features for the ET component, identifying the method of implementation and intended use of each scenario control feature, and prioritize each scenario control feature according to its training value.

Rationale: Scenario control features are used by trainees, instructors, "smart" software, or training managers to control the training or feedback session. To ensure that relevant scenario control features are included, each scenario control feature presented in this step should be considered for inclusion in the ET component. Specific information on how each selected feature should be implemented is necessary so system engineers can design the hardware and software with the features selected. The priority rating is necessary for future tradeoffs.

Procedures: If the ET component is not going to have scenarios, skip this step.

Using the data generated in the previous phases, complete the Scenario Control Selection Form (shown in Figure 23). The following list of features is to be considered. Each feature is discussed along with some guidelines for selection and implementation:

1. Scenario Authoring is always a required feature because there is always a need to update scenario libraries and ensure there is enough scenario variability for effective training. Selection and implementation, however, is dictated by Army doctrine. Most likely, TRADOC or the school will have scenario authoring control. Implementation approaches and uses depend on the doctrine and appropriate authority. Check the appropriate sources to determine the primary authoring authority and the implementation approach.

2. Scenario Control is always needed, in one or more of the following implementations: (1) use of scenario scripts (in multi-station prime systems and if training personnel are available to enter scenario parameters during training); (2) automated adaptive training (when sophisticated software can be developed and cost is not too high); (3) manual on-line adaptation during the scenario (manual on-line adoption may be used by either instruct or personnel or the trainee(s) themselves; it could include items such as: a. turn off or on failure mode simulation, b. enable or disable weapon movement, c. use

netted or simulated communication, and d. enable or disable simulated ECM); and (4) adaptive selections during set-up routines (when flexibility for various skill level personnel, multiple environments, and scenario difficulty variations are required).

3. Scenario Freeze is not always needed, but has implementations that include: (1) automatic freeze in response to unsafe or grossly incorrect trainee actions, and (2) manual (instructor-mediated) freeze selection for discussions. Examine feedback requirements to determine whether this feature is valuable and which implementation is suitable. Potential uses of the scenarios freeze feature were identified in Step 2.7. In addition, if many highly critical items are selected for immediate feedback, this may be a valuable feature.

   When scenario freeze is included, it is necessary to consider when the scenario should be resumed after the freeze. For instance, the scenario can be resumed at the following points:

   a. Resume on correct control setting;
   b. Resume where fault occurred;
   c. Resume at the beginning of the scenario;
   d. Variable selection.

   In addition to when to resume the scenario, the ET system designers will need to know how the next activity after the freeze is controlled. Select the next activity control from the following alternatives:

   a. The instructor controls the next activity;
   b. The trainee controls the next activity;
   c. The ET component controls the next activity.

4. Scenario Playback is not always necessary, but has implementations that include: (1) playback on actual equipment (preferred but not always feasible in systems such as helicopters), and (2) playback on other equipment (requires transmission of data to other equipment or storage of data on a transportable medium). Examine the feedback and recording requirements for the ET component, and select this feature if scenario playback is valuable for feedback or other purposes.

5. Scenario Fast Forward may be selected if scenario playback is selected, because fast forward is a very

useful feature for controlling the playback. Also, select fast forward to allow presentation of parts of scenario for more flexible training. When scenario fast forward is included in training, select either instructor or trainee control.

6. Scenario Review is another feature that is useful during scenario playback. This feature can be used to move backwards through a scenario during playback. Scenario review can also be selected to allow repeated presentations of scenario parts during training. When scenario review is included in the training, select either instructor or trainee control.

Enter descriptive information in the appropriate spaces on the Scenario Control Feature Selection Form. Leave features not selected blank.

Assign a priority rating to each scenario control feature using the following rating criteria:

Priority Rating	Rationale for Assigning Rating
1	Feature is highly critical for effective training.
2	Feature is not critical, but it would be of value to ET.
3	Feature would be a "nice to have" option.

Enter the priority ratings in the areas labeled Priority Rating. Briefly justify the ratings in the Implementation and Usage Comments field.

Products: Completed Scenario Control Feature Selection Form (Figure 23).

Step 4.1: Scenario Control Feature Selection Form

Scenario Authoring

Primary author authority: TRADOC

Authoring on prime equipment:

Authoring on other equipment:

Scenario Control

Implementation and usage comments: Script, adaptive training. Environmental control is nice-to-have(3).

Priority rating: 2

Scenario Freeze

Implementation and usage comments: Useful in lock-on and in identification, but playback may accomplish same ends. Freeze most useful with playback.

Priority rating: 2

Figure 23. Scenario control feature selection form.

Step 4.1: Scenario Control Feature Selection Form

Scenario Playback

Implementation and usage comments: Very useful in lock-on and identification training.

Priority rating: 1

Scenario Fast Forward

Implementation and usage comments: Useful, but relatively short scenarios can be reviewed without it

Priority rating: 2

Scenario Review

Implementation and usage comments:

Priority rating: 3

Figure 23. Scenario control feature selection form. (Continued)

Step 4.2: Select ET Component Data Management Features

Objectives: Select the data management features for the ET component, identifying the method of implementation and intended use of each data management feature, and prioritize each data management feature according to its training value.

Rationale: Data management features are used by training managers to record and report training results. It is necessary to select those data management features needed. This provides the engineers with data to begin the ET component hardware and software design. The priority ratings will assist in later tradeoffs.

Procedures: Use the data from the previous phases to determine the usefulness of the data management features listed below. Begin with the identified recording requirements on the Performance Measure and Information Form (from Step 2.8, Identify and Describe Recording Events). Use the following guidelines for selecting features and enter the information on the Data Management Feature Selection Form (shown in Figure 24).

1. Built-in Student Recordkeeping is selected when performance measure data indicate that a historical record of trainee performance is required. This may also be required by doctrine. Implementing this feature can be done in two ways: (1) the prime equipment can store student records and provide facilities for training personnel to access the information, or (2) the data can be transmitted or transported to other equipment for storage and management use. Select the first option when the Prime equipment has an environment which is conducive to database management (e.g., an aircraft might not be suitable, but a more office-like atmosphere such as a TACFIRE control station might be), and when prime equipment availability would not appear to be a problem. The second option is only possible when there is a capability to transmit the data or when there is a transportable storage medium available.

2. Report Generation is selected when a printing device can be used by the equipment where records are kept. The record can be the data from a just-completed training session, or data stored over a period of time. The data generated in the report should be selectable by the training manager.

   Describe the desired capabilities of each feature under Implementation and Usage Comments (including

specific data items to be recorded or reported). If a feature is not selected, leave the area blank.

Assign a priority rating to each selected feature using the following rating criteria:

Priority Rating	Rationale for Assigning Rating
1	Feature is highly critical for effective training.
2	Feature is not highly critical, but it would be of substantial value.
3	Feature is a "nice to have" option.

Enter the priority ratings in the fields labeled Priority Rating.

Products: Completed Data Management Feature Selection Form (Figure 24).

Step 4.2: Data Management Feature Selection Form

Built-in recordkeeping

On prime equipment: ✓ On other equipment: _____

Implementation and usage comments: The system computer should have the power to perform recordkeeping

Priority rating: 1

Report generation

On prime equipment: 1 On other equipment: 2

Implementation and usage comments: The system computer has the power to generate reports. However it lacks a printer and its operating system may not allow the use of standard software. Summary data should be reported.

Priority rating: 1

Figure 24. Data management feature selection form.

Step 4.3: Select ET Component Special Instructional Features

Objectives: Select the special instructional features for the ET component, identify the method of implementation and intended use of each special instructional feature, and prioritize each special instructional feature according to its training value.

Rationale: Built-in help or demonstration modes may be useful for some ET components. Both of these special instructional features should be considered as part of the ET component concept so system developers can design the software and hardware necessary for each feature.

Procedures: Use the data from the previous phases to determine the usefulness of the instructional features listed below. Follow the guidelines for selecting each feature, and enter the information on the Special Instructional Feature Selection Form (shown in Figure 25).

1. Built-in Help Facilities (that help the trainee use the ET component) may be selected in two situations: (1) when ET is substantially different from normal system operations, or (2) when ET has complex features which might need explanation from time to time.

   If the ET interface is substantially different from the operational interface, a help facility is needed.

   If ET has complex features which are not part of the user population's knowledge base, a help facility for those features is required.

2. Demonstration Training Modes may be needed when there are complex tactical decisions or operational skills to be trained by ET.

   If the user population is being initially trained in such skills with ET, a demonstration mode is required. To utilize a demonstration mode, a trainer must be present to demonstrate the skills and observe the trainee performing them.

   If the ET component is to be used for readiness evaluations, a demonstration mode is useful.

Describe the desired special instructional features in the appropriate areas of the form.

Use a separate form to describe Built-in Help Facilities or Demonstration Training Modes.

Assign a priority rating to each selected feature using the following table:

Priority Rating	Rationale for Assigning Rating
1	Feature is highly critical for effective training.
2	Feature is not highly critical, but it would be of substantial value.
3	Feature is a "nice to have" option.

Enter the rating in the fields labeled Priority Rating. Briefly justify the rating in the Implementation comments.

Products: Completed Special Instructional Feature Selection Form (Figure 25).

Step 4.3: Special Instructional Feature Selection Form

Built-in Help Facility: ✓ Demonstration Training Mode: ____

Feature	Priority Rating
PDP guidance	1
Use of ET	1
Relating map to terrain	2

Figure 25. Special instructional feature selection form.

Step 4.3: Special Instructional Feature Selection Form

Built-in Help Facility: _____ Demonstration Training Mode: ✓

Feature	Priority Rating
PDP light-up under ET control	2
Use of ET	1
Missile flight	1
Identify targets	1
Use of seeker	1
Relating map to terrain	1
Controlling flight	2

Figure 25. Special instructional feature selection form. (Continued)

Step 4.4: Determine On-line and Off-line Training Requirements

Objectives: Determine requirements for on-line and off-line training.

Rationale: System developers need to know whether embedded training will occur while the operational equipment is being used for a mission. This information is needed because there is a substantial difference between engineering a subsystem that operates standalone and one that operates with other subsystems operating. At no time may the ET component interfere with the operation of the prime equipment during a mission.

Procedures: Review the implementation strategy selections (from Step 2.11, Identify Stimulus Implementation Strategies). If actual operation of prime equipment is necessary to present stimuli and the system must be capable of performing its mission concurrent with the use of ET, then training will occur on-line. For training without actual operation stimuli, off-line training will usually be a possibility; however, if the prime system has a high State-Of-Readiness (SOR) requirement, on-line training is necessary. In addition, on-line training may be necessary when the transition time between training and operational modes exceeds that allowed by the system SOR requirements.

Determine the highest SOR value for the prime system. For example, the Patriot SOR value for a unit in Europe would be higher than for one in the Continental United States (CONUS). Therefore, the SOR value of the unit in Europe is used. When the prime system has multiple locations with different SOR requirements, it may be possible to vary the training mode (i.e., on-line or off-line) according to SOR requirements. However, the prime system capability must support the highest SOR requirement and the final decision to vary the training mode by location should include resource considerations. Record the information on the On-line and Off-line Data Form (shown in Figure 26), in the field labeled Prime System SOR Requirements.

If the prime system has multiple stations, each station should be selectable for off-line training while the other stations are performing an operational mission. The ET component should have no effect on the stations performing the operational mission. Describe the selection of user stations under Prime System User Stations.

Describe the various types of on-line and off-line training required in the appropriate areas of the form. On-line training comments must include a list of equipment the ET component should inhibit for safety reasons. For

example, a prime system with radar and external communications, being used for on-line training, must have those systems inhibited so that training-related signals will not be confused with actual signals.

The field for Transition Constraints should address an estimate of the allowable time and equipment requirements for transition from ET mode to operational mode and vice versa. Transition from ET to operational mode will affect weapon and troop readiness, and is critical to preparedness. However, the transition from operational mode to ET mode has strong implications about whether ET will actually be used in the field. There is a separate field for on-line and off-line transitions.

Products: Completed On-line and Off-line Data Form (Figure 26).

Step 4.4: On-line and Off-line Data Form

Prime System SOR Requirements: Moderate to high SOR due to front-line deployment.

Prime System User Stations: Single-station system.

Off-line Training Comments:

Transition Constraints:

On-line Training Comments: Full console and electronics are required. However missiles are not needed must be disabled. Radio is not needed except in netted collective training.

Transition Constraints: There should be a procedure to disengage ET at any point in training. This transition should take under one minute.

Figure 26. On-line and Off-line data form.

Step 4.5: Define ET Component Data Storage and Recording Requirements

Objectives: Identify each unique data element to be stored or recorded, and determine length of time of storage for each selected data element.

Rationale: In order to provide the ET component engineers with data to determine the memory and data storage requirements, the ET designer must identify all the data elements that need to be stored. You must also determine whether these data elements are stored during the training session only (short term), are needed after training session but not after power shutdown (medium term), or are needed as a record even after power shutdown (long term).

Procedures: First, obtain the printout produced in Step 3.1 (Form a Generalized ET Component Concept) and all of the forms generated in Phases 3 and 4. The forms needed include the Performance Measure Data Form (Step 3.4), the Feedback Requirements Form (Step 3.5), and Data Management Feature Selection Form (Step 4.2). In addition, you will need the Performance Measure and Feedback Information Form (Steps 2.6 - 2.9).

The following procedures describe how to identify each unique data element which requires storage or recording, and assign each element a reference number and assess storage requirements.

Enter each number on the Data Storage and Recording Requirements Form (shown in Figure 27) in the field labeled Data Element Number. Using the ET objectives database, identify each unique datum selected as a recording requirement on the Performance Measure and Feedback Information Form in Step 2.8. There may be more than one datum for each objective and the same datum may be selected for more than one objective. Describe each data element in the field labeled Data Element for Recording. Record the objective number(s) of the objective(s) from which each datum is derived under Objective Number(s).

Next, using the performance Measure Data Form (from Step 3.4), Identify each performance measure criterion as a datum to be recorded. Also, identify each measurement result as a datum for recording. Record each unique datum and the PM number in the spaces provided. Use the Feedback Requirements Form (Step 3.5) and identify each element required for feedback as a datum to be recorded. Record each unique datum and the FR number in the spaces provided.

Examine the Performance Measure Data Form (Step 3.4), Feedback Requirements Form (Step 3.5), and the Data Management Feature Selection Form (Step 4.2) to determine the recording storage time required for each datum, following the storage decision criteria given below:

Storage Time Length	Data Utilization Criteria
Short	Data only for immediate feedback.
	Data for accumulative measures (i.e., measures used with other measures to determine overall performance).
Medium	Data for summary feedback (end of exercise).
	Data for scenario replay.
	Data for end of training session printouts.
Long	Data for student records of previous performance.

Check the time length (short, medium, long) for each datum on the Data Storage and Recording Requirements Form. Some data may require more than one storage time length.

Products: Completed Data Storage and Recording Requirements Form (Figure 27).

Step 4.5: Data Storage and Recording Requirements Form

Data Element Number: 1

Data Element for Recording: PDP press

Objective Number(s): 05., 12.

PM Number: 1 FR Number: 5

Select Time Length: Short ✓ Medium ___ Long ___

Data Element Number: 2

Data Element for Recording: Seeker cross hairs centered

Objective Number(s): 07.01, 08., 09., 10., 12.

PM Number: 20 FR Number: 20

Select Time Length: Short ___ Medium ___ Long ✓

Data Element Number: _____

Data Element for Recording: _____

Objective Number(s): _____

PM Number: _____ FR Number: _____

Select Time Length: Short ___ Medium ___ Long ___

Figure 27. Data storage and recording requirements form.

Step 4.6: Assemble ET Component Design Concept Document

Objectives: Assemble the forms produced during the previous phases into an ET component design concept document.

Rationale: Documentation containing the information derived thus far will be useful to ET component design engineers. This document is also used during the various trade-off analyses performed in the next phase.

Procedures: Assemble the generated forms and printouts into an ET component design concept document, placing the forms into sections as follows:

Section 1, is an introduction containing the Preliminary ET Component Definition Form (Step 3.1).

Section 2, the Stimulus Requirements Data Forms (Step 3.2).

Section 3, the Implementation Strategy Summary Forms (Step 3.3).

Section 4, the Performance Measure Data Forms (Step 3.4).

Section 5, the Feedback Requirements Forms (Step 3.5).

Section 6, the Collective Training Requirements Forms (Step 3.6).

Section 7, the Knowledge Training Requirements Forms (Step 3.7).

Section 8, the Scenario Definition Forms (Step 3.8).

Section 9, the ET component features forms including the Scenario Control Feature Selection Form (Step 4.1), the Data Management Feature Selection Form (Step 4.2), and the Special Instructional Feature Selection Form (Step 4.3).

Section 10, the On-line and Off-line Data Form (Step 4.4).

Section 11, the Data Storage and Recording Requirements Form (Step 4.5).

Bibliography containing all sources consulted to perform the analyses.

Appendix containing the ET objectives listing containing number, description, and commonality data.

Create a comprehensive Table of Contents for easier referencing. The introduction should also contain a short overview of the document.

Products: ET component design concept report.

PHASE 5: SYSTEM DESIGN CONCEPT INTEGRATION

The purpose of Phase 5 is to integrate ET design requirements into the prime system development process. Phase 5 is part of the ongoing coordination between training designers and system engineers which was initiated in Step 2.12. This phase absolutely requires the participation of prime system engineers and Army representatives, as well as training designers.

Detailed procedures for design concept integration will vary by system. At a minimum, the two steps following are required. Note that integrating ET with the prime item system is a very high priority activity for the ET designer. You should make every effort to interact with prime item system designers throughout the ET component design process to help ensure that the designers never lose sight of the need to provide for ET. Also, the considerations and issues presented in Volume 6 of this series may be extremely important in your interactions with system designers.

Figure 28 outlines Phase 5. Each of the steps is discussed in the following sections.

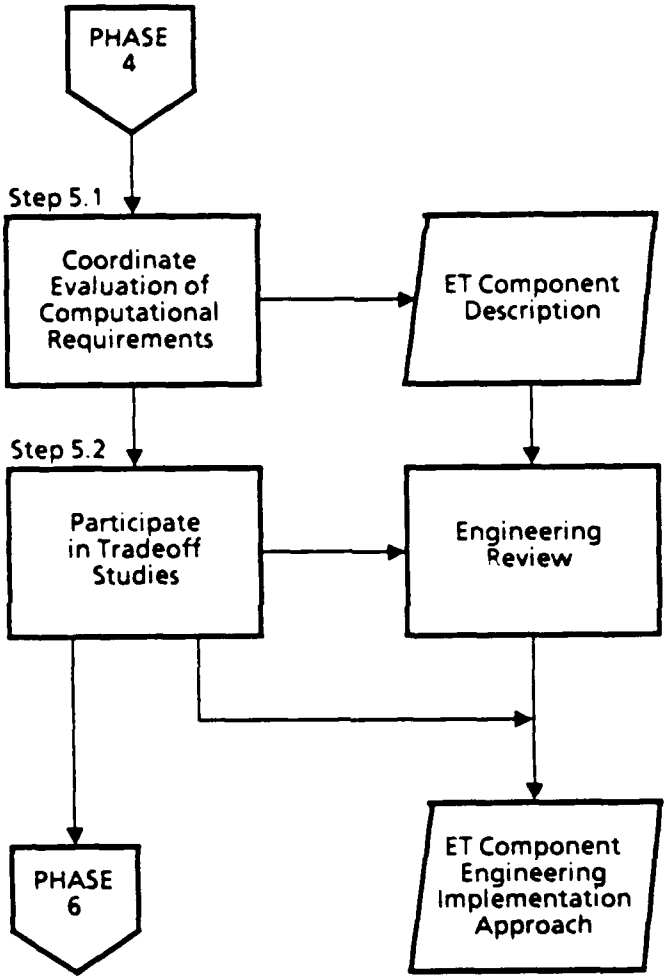

Figure 28. Phase 5: System design concept integration.

Step 5.1: Coordinate Evaluation of Computational Requirements

Objectives: Coordinate evaluation of the ET component's processing, I/O, and storage requirements.

Rationale: System design engineers must assess computational and memory requirements in order to develop the system requirement specification and evaluate any proposals for ET component development. Training designers must work closely with the system engineers to ensure that training requirements are met.

Procedures: Specific procedures for coordinating evaluation of ET component requirements will vary greatly, depending on the system design context.

Specific points to be addressed include:

1. Processing Requirements
2. Input/Output Requirements
3. Memory Requirements
4. Magnetic Storage Requirements

Products: Description of ET component computational requirements formulated by system design engineers with appropriate training analyst input.

Step 5.2: Participate in Tradeoff Studies

Objectives: Determine an optimum training implementation approach, in terms of cost and technical feasibility, as well as training effectiveness. This optimization uses the ET component data generated thus far, along with data on alternative training approaches developed from the ISD model, to arrive at a selection or mix of training components (ET, CAI, text, platform, training device, etc.).

Rationale: Selected implementation approaches must be reconsidered to select the most cost-effective and usable approach. Training analysis can provide only part of the information needed to conduct trade-off analyses; however, training analysts must be active participants to ensure that training requirements are addressed.

Procedures: Many of the procedures involved in the trade-off analysis will be system-specific. The following general guidance can be offered--for trade-offs regarding the ET component only.

The selected ET component implementation strategies will be reviewed and evaluated. Main points to be considered include the following:

1. Will the ET component be integrated (completely designed into the prime equipment and not separable from it), adjunct (partially integrated into the prime system, with strap-on components used for some but not all ET), or strap-on (designed to be separable from the prime equipment except for connecting hardware)? While there may be training-effectiveness and training management reasons to prefer a particular strategy, this decision will also be affected by the prime system design constraints such as size and weight, and the effect of adjunct and strap-on implementation strategies upon SOR requirement, as well as cost factors.

2. Does the selected implementation approach have alternatives that could be less costly? Does the cost of the selected implementation approach exceed absolute constraints? The trade-off analysis must select an alternative that falls within known cost parameters, and that supports the most desired training features at the least cost.

3. Is the selected approach technologically feasible? The selected approach must be determined to be implementable given current technology.

The ETR priority ratings assigned in Step 1.4 may be used to assist in trade-off determinations.

Products: System design engineers will have finalized the ET component implementation approach, with appropriate training analyst input.

PHASE 6: PRODUCE ET FUNCTIONAL SPECIFICATION

Phase 6 is the final phase of the design procedures. In this phase, the information produced throughout the procedures is compiled into several forms of documentation. Every design effort will culminate in the production of a functional specification for the ET component. The following steps comprise Phase 6:

Figure 29 shows an overview of the steps in Phase 6. Each of these steps is described in the following sections.

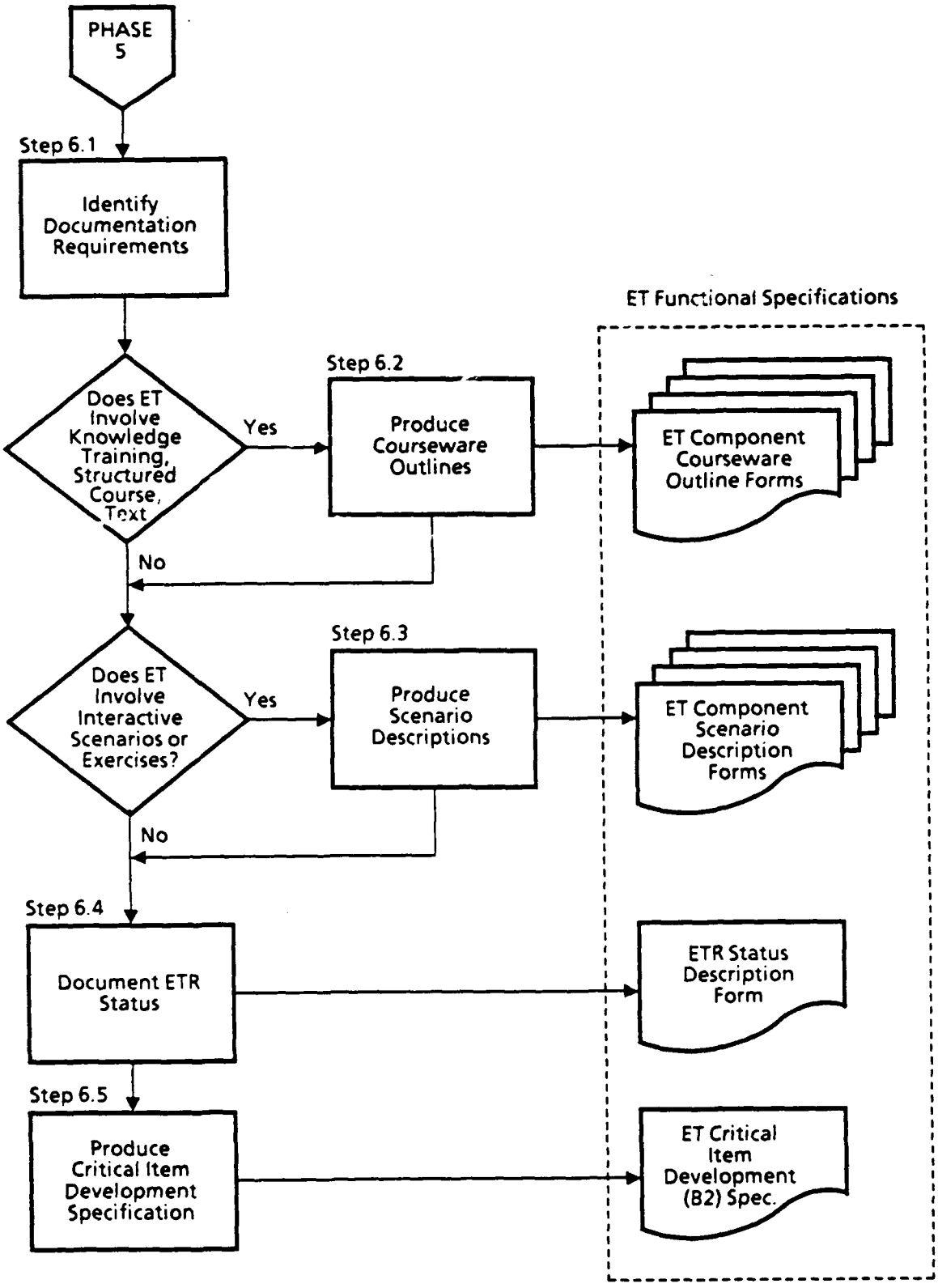

Figure 29. Phase 6: Produce ET functional specification.

Step 6.1: Identify Documentation Requirements

Objectives: Determine which of the following steps are applicable to the current effort.

Rationale: Only those ET systems involving knowledge training will require courseware outlines; various factors may affect the scope of other documentation.

Procedures: Review the ET component design and consider the following factors:

1. Knowledge training requirements were identified in Step 3.7. If the ET component will be used for knowledge training, or is expected to be used in a structured course context, courseware outlines will be needed. Typically, courseware outlines will be needed for designs involving initial skill training. ET that employs feedback during scenarios, or text presentation as part of the scenario introduction or content will also require courseware outlines. Step 6.2 describes the development of courseware outlines.

2. For all ET designs involving interactive scenarios or exercises, scenario descriptions will be produced. Almost all ET components will be used in this way at least. Step 6.3 concerns the development of scenario descriptions.

3. In all ET component design efforts, the final product will be a functional specification. Step 6.5 describes functional specification development.

Products: Need for various documentation items will have been determined; performance of the following steps is based on this determination.

Step 6.2: Produce Courseware Outlines

Objectives Produce detailed outlines of ET courseware.

Rationale: For those implementations involving traditionally structured lessons (such as CAI), the lessonware developers will need detailed courseware outlines.

Procedures: In Phase 3, preliminary lesson outlines were produced. These tentative outlines have now been reviewed and can be finalized.

The ET Component Courseware Outline Form (shown in Figure 30) can be used to describe the desired lessons. For each lesson, state the Lesson Number, Title, and content security Classification. List the objectives to be trained, and note the presentation method or methods to be used (e.g., CAI with videotape).

Under Segments, list each segment of instruction, briefly describing its content. (Note that a segment should be roughly equivalent to an objective.) In the Notes column, describe how the segment is to be presented, including graphics and level of detail.

Under Practice and Test Items, list the performance measurement events to take place during the lesson. In the Notes column, describe the timing of each event in relation to the instructional segments.

See MIL-STD-1379D for additional information related to producing courseware outlines.

Products: Completed ET Component Courseware Outline Forms (Figure 30).

Step 6.2: ET Component Courseware Outline Form

Lesson Number: 5

Lesson Title: Navigating the FOG-M

Classification: Unclassified

Objective Numbers:

07.01, 07.01.01, 07.01.02

Presentation Method(s):

Segments:	Notes:
A. Relating Map Display to Seeker Video	
B. Controlling Flight During Cruise	
C. Navigation Performance Test	Lesson test at end

Practice and Test Items:

	Notes:
Find specified features on map and on video during a flight segment;	First. Do this after teaching with still views
Adjust flight parameters during cruise segment;	Second
Integrate map, video, and flight parameters	Last. Should be practiced before testing

Figure 30. ET component courseware outline form.

Step 6.3: Produce Scenario Descriptions

Objectives: Produce detailed descriptions of the training exercises to be presented by the ET component.

Rationale: Detailed scenario descriptions are needed by software and lessonware developers.

Procedures: In Step 3.8, preliminary scenario descriptions were prepared. These preliminary descriptions were added to in Phase 4 and reviewed in Phase 5. Now, final scenario descriptions can be produced.

The ET Component Scenario Description Form (shown in Figure 31) can be used to prepare scenario descriptions. For each required scenario, enter the scenario number and title, and the objectives to be trained.

Under Parameter List, list the variable parameters of the exercise. Items to be listed include threats (number and kind), weather or terrain conditions, equipment malfunctions, etc. Each listed parameter should be described in the Description section. The descriptions should include how and when each parameter shall vary. Be certain to specify parameters that must vary simultaneously (e.g., variations in weather and variations in threat environment may occur in same exercise).

Under Measures List, list the performance measures to be active during the scenario. In the Description section, describe how and when the measurement events will occur, including feedback and recording information when applicable.

Under Instructional Features List, list the features to be active during the scenario. Under Descriptions, state how and when each feature is to be used. For instance, if scenario freeze is to be utilized, describe the conditions that will cause the freeze to occur.

Note that the forms produced in previous phases can be referenced or attached, rather than rewriting information that has not changed. However, be sure to review the forms and add all information relevant to each scenario.

Products: Detailed scenario descriptions for all of the scenarios previously identified using the ET Component Scenario Description Form (Figure 31).

Step 6.3: ET Component Scenario Description Form

Scenario Number: 50

Scenario Title: Navigate over terrain containing a ridgeline

Objective(s):

Parameter	Description
Ridgeline 500 meters above avg. terrain	Must end with drop to average terrain
Target area	3 tanks

Measure	Description
Time to target area	

Instructional Feature	Description
Freeze, Replay	Freeze on crash into mountain/ridge.

Figure 31. ET component scenario description form.

Step 6.4: Document ETR Status

Objectives: Determine which of the ETRs in the original database have not been included in this ET concept.

Rationale: It is important to training developers to know which of the ETRs are included in this training concept. It may be necessary to develop additional scenarios or course outlines to later include those ETRs that have been left out. If this is not feasible, then the objectives designated as ETRs that are not included in the ET concept will have to be addressed by other training modes. Special attention should be given to those ETRs not included in this ET concept that were given a high training priority.

Procedures: The procedure to accomplish this step is fairly straightforward. Obtain a list of the original ETRs (from Step 1.4). This list should include: the ETR Number, the ETR Title or Description, and the Training Priority. Transfer the data to the Embedded Training Requirement (ETR) Status Description Form (Figure 32). For each ETR on that list, indicate the reference number of the Lesson or Scenario in which the ETR is trained. Enter INCLUDED or NOT INCLUDED under Status to show if ETR is trained under this ET concept.

Products: Original ETR list annotated with the scenario or lesson numbers in which it is trained and those ETRs not included in this concept indicated as such. The ETR Status Description Form (Figure 32) can be used to do this.

Step 6.4: Embedded Training Requirement (ETR) Status Description Form

ETR Number	ETR Title	Lesson/ Scenario	Training Priority	Status
07.01	Relate Map/Video	L 5	High	I
07.02	Switch between seeker and map	L 5	High	I
07.03	Identify corresponding landmarks on map and video	L 5	High	I

Figure 32. Embedded training requirement (ETR) status description form.

Step 6.5: Produce Critical Item Development Specification

Objectives: Produce a functional specification for the ET component.

Rationale: The final product of the design effort must be a workable specification of ET component functions.

NOTE: The exact type of specification developed should be coordinated closely with the materiel developer's organization. It is suggestd that close consultation with materiel developer representatives take place before finalizing the specification, to ensure that the specification meets the appropriate requirements. Consult MIL-STD-490A for appropriate types of specifications.

Procedures: The ET component specification should incorporate all of the information generated during the ET design process. Specifically, the specification should include hardware and software requirements, as well as full descriptions of the required training functions and features. Appendix B contains a model generic ET component specification. This model can be followed, or other formats may be used that present the necessary information.

As a minimum, incorporate the following into the ET component functional specification:

1. The name of the operational system.
2. The type of training to be provided (sustainment, initial skills, etc.).
3. A brief description of the trainee population.
4. Definition of the ET component-system interface, including "level of embeddedness" (fully integrated, adjunct, or strap-on).
5. Definition of the ET component modes of operation.
6. Limit on transition time from training mode to operational mode.
7. List of missions to be trained.
8. Descriptions of the training setting (e.g., unit vs. school) and training environment (e.g., field operating conditions).
9. Scenario descriptions.

10. Lesson outlines.

11. Descriptions of stimulation and simulation characteristics.

12. Descriptions of instructional features.

13. Hardware characteristics descriptions, including utilized prime system equipment.

14. Software characteristics descriptions, including stimulation and simulation, instructional features, and support programs.

Products: The ET functional specification, incorporating the scenario descriptions and lesson outlines generated above.

APPENDIX A

BLANK FORMS FOR USE DURING ET COMPONENT DESIGN

Step 2.1: Training Approach Form

ETR Number	Knowledge-based Training (Y/N)	Part Task or Full Mission (P/F)	Unit or School (U/S)	Acquisition, Sustainment, Trainsition (A, S, T)

Summary

% Knowledge-based Training _____ % Part Task ____ % Full Mission ____ % Unit ____ % School ____ % A ____ % S ____ % T ____

Will the ET component be used for Job Performance Aiding?

Figure 4. Training approach form.

Step 2.2: Stimulus Information Form

Embedded Training Requirement (ETR) Number: _____

Equipment Items

Equipment: _____ Subsystem: _____

Controls and Displays: _____

_____

Descriptions: _____

_____

Effects of Operator Action: _____

_____

Fidelity: _____

_____

Recommended Implementation Strategies: _____

_____

Equipment: _____ Subsystem: _____

Controls and Displays: _____

_____

Descriptions: _____

_____

Effects of Operator Action: _____

_____

Fidelity: _____

_____

Recommended Implementation Strategies: _____

_____

Figure 5. Stimulus information form.

Step 2.2: Stimulus Information Form

Embedded Training Requirement (ETR) Number: _____

Environmental Conditions

Condition: _____

_____

Range: _____

_____

Description: _____

_____

Effects of Operator Action: _____

_____

Fidelity: _____

_____

Recommended Implementation Strategies: _____

_____

Condition: _____

_____

Range: _____

_____

Description: _____

_____

Effects of Operator Action: _____

_____

Fidelity: _____

_____

Recommended Implementation Strategies: _____

_____

Figure 5. Stimulus information form. (Continued)

Step 2.3: Stimulus Grouping Form

Equipment Grouping

Level of Detail (check one) Equipment _____
Equipment Subsystem _____
Controls or Displays ____

Equipment Item: _____
ETR Numbers:

Equipment Item: _____
ETR Numbers:

Equipment Item: _____
ETR Numbers:

Equipment Item: _____
ETR Numbers:

Equipment Item: _____
ETR Numbers:

Equipment Item: _____
ETR Numbers:

Equipment Item: _____
ETR Numbers:

Equipment Item: _____
ETR Numbers:

Equipment Items: _____
ETR Numbers:

Equipment Items: _____
ETR Numbers:

Figure 6. Stimulus grouping form.

Step 2.3: Stimulus Grouping Form

Environmental Factor Grouping

Environmental Factor: _____
ETR Numbers:

Environmental Factor: _____
ETR Numbers:

Environmental Factor: _____
ETR Numbers:

Environmental Factor: _____
ETR Numbers:

Environmental Factor: _____
ETR Numbers:

Environmental Factor: _____
ETR Numbers:

Environmental Factor: _____
ETR Numbers:

Environmental Factor: _____
ETR Numbers:

Environmental Factor: _____
ETR Numbers:

Environmental Factor: _____
ETR Numbers:

Figure 6. Stimulus grouping form. (Continued)

Steps 2.6 - 2.9: Performance Measure and Feedback Information Form

Embedded Training Requirement (ETR) Number _____

Performance Measure: _____

_____

Application: _____

_____

Crew (CM) or Trainee (TM): _____

_____

Feedback Description: _____

_____

Feedback Codes: _____

_____

Freeze: Y / N

Priority: _____

Recording Events (Description, Codes, and Priority): _____

_____

_____

Performance Measure Categories for ETR:

Feedback Event Categories for ETR:

Recording Event Categories for ETR:

Figures 7, 8, 9, and 10. Performance Measure and Feedback Information Form

Step 2.10: Commonality Analysis Form

(Enter the ETR Numbers associated with each category)

Stimulus Categories

Visual: _____

_____

_____

_____

_____

Auditory: _____

_____

_____

_____

_____

Tactile/Kinesthetic: _____

_____

_____

_____

_____

Other: _____

_____

_____

_____

_____

Figure 11. Commonality analysis form.

Step 2.10: Commonality Analysis Form

Feedback Event Categories

Immediate Feedback (within exercise) (IF): _____

Delayed Feedback (other than summary) (DF): _____

Summary Feedback (end-of-exercise) (SF): _____

Trainee Feedback (TF): _____

Crew/Team Feedback (CF): _____

Figure 11. Commonality analysis form. (Continued)

Step 2.10: Commonality Analysis Form

Performance Measure Categories

Time to Complete: _____

_____

_____

Speed of Response: _____

_____

_____

Correct Action Selection: _____

_____

_____

Correct Sequence of Actions: _____

_____

_____

Precision of Manipulation: _____

_____

_____

Precision of Aim: _____

_____

_____

Smoothness of Action: _____

_____

_____

Other: _____

_____

Figure 11. Commonality analysis form. (Continued)

Step 2.10: Commonality Analysis Form

Recording Event Categories

Summary Feedback Recording (SR): _____

_____

_____

Delayed Feedback Recording (DR): _____

_____

_____

Trainee Assessment Recording (TR): _____

_____

_____

Crew/Team Assessment Recording (CR): _____

_____

_____

Instructional Management Recording (IR): _____

_____

_____

Unit Assessment Recording (UR): _____

_____

_____

Figure 11. Commonality analysis form. (Continued)

Step 3.1: Preliminary ET Component Definition Form

Stimuli/Fidelity

Stimulus Content Item: _____
Category: _____
Number of Occurrences: _____
Specific Examples of Stimulus Presentation: _____

_____

_____

_____

_____

Associated Fidelity Required: _____

Specific Examples of Fidelity: _____

_____

_____

_____

Stimulus Content Item: _____
Category: _____
Number of Occurrences: _____
Specific Examples of Stimulus Presentation: _____

_____

_____

_____

_____

Associated Fidelity Required: _____

Specific Examples of Fidelity: _____

_____

_____

_____

Figure 13. Preliminary ET component definition form.

Step 3.1: Preliminary ET Component Definition Form

Performance Measures

Record each measure (e.g., Enter button press), whether it is a measure of individual trainee or crew performance, the equipment associated with the measure (e.g., Keyboard), and the type of measure (e.g., Correct part of sequence) in the table below:

Measure	Crew and/or Trainee	Equipment	Type

Figure 13. Preliminary ET component definition form. (Continued)

Step 3.1: Preliminary ET Component Definition Form

Feedback

Record the immediate feedback required, associated performance measure, and describe the presentation format below:

Feedback Required	Crew and/or Trainee	Performance Measure	Description

Figure 13. Preliminary ET component definition form. (Continued)

Step 3.1: Preliminary ET Component Definition Form

Record the summary feedback required, associated measure, and describe the presentation format below:

Feedback Required	Crew and/or Trainee	Performance Measure	Description

Figure 13. Preliminary ET component definition form. (Continued)

Step 3.1: Preliminary ET Component Definition Form

Record the delayed feedback required, associated measure, and describe the presentation format below:

Feedback Required	Crew and/or Trainee	Performance Measure	Description

Figure 13. Preliminary ET component definition form. (Continued)

Step 3.2: Stimulus Requirements Data Form

Stimulus Requirement (SR) Number: _____

Stimulus Category: _____

Equipment Item or Environmental Factor: _____

Stimulus Events	Objective Number	Fidelity

Figure 14. Stimulus requirements data form.

Step 3.2: Stimulus Requirements Data Form

Summary Description:

Figure 14. Stimulus requirements data form. (Continued)

Step 3.3: Implementation Strategy Summary Form

Stimulus Requirement (SR) Number	Implementation Strategies
_____	_____
	_____
	_____
	_____
_____	_____
	_____
	_____
	_____
_____	_____
	_____
	_____
	_____
_____	_____
	_____
	_____
	_____
_____	_____
	_____
	_____
	_____

Figure 15. Implementation strategy summary form.

Step 3.3: Implementation Strategy Summary Form

Preferred package implementation strategies: _____

Figure 15. Implementation strategy summary form. (Continued)

Step 3.4: Performance Measure Data Form

Performance Measure (PM) Number: _____

Performance Measure: _____

_____

_____

Type of Measure: _____

Measurement Procedure: _____

_____

_____

Response to Trainee Failure: _____

_____

_____

Prime Equipment Used for Measurement: _____

_____

_____

Objective Numbers	Feedback or Recording

Figure 16. Performance measure data form.

Step 3.4: Performance Measure Data Form

Other Information: _____

Figure 16. Performance measure data form. (Continued)

Step 3.5: Feedback Requirements Form

Feedback Requirement (FR) Number: _____

Feedback: _____

_____

_____

_____

Type of Feedback: _____

Performance Measure (PM) Numbers: _____

_____

_____

Feedback Information

Text Required: _____

_____

Presentation Devices: _____

_____

Display Location: _____

_____

When Presented: _____

_____

Other: _____

_____

Figure 17. Feedback requirements form.

Step 3.5: Feedback Requirements Form

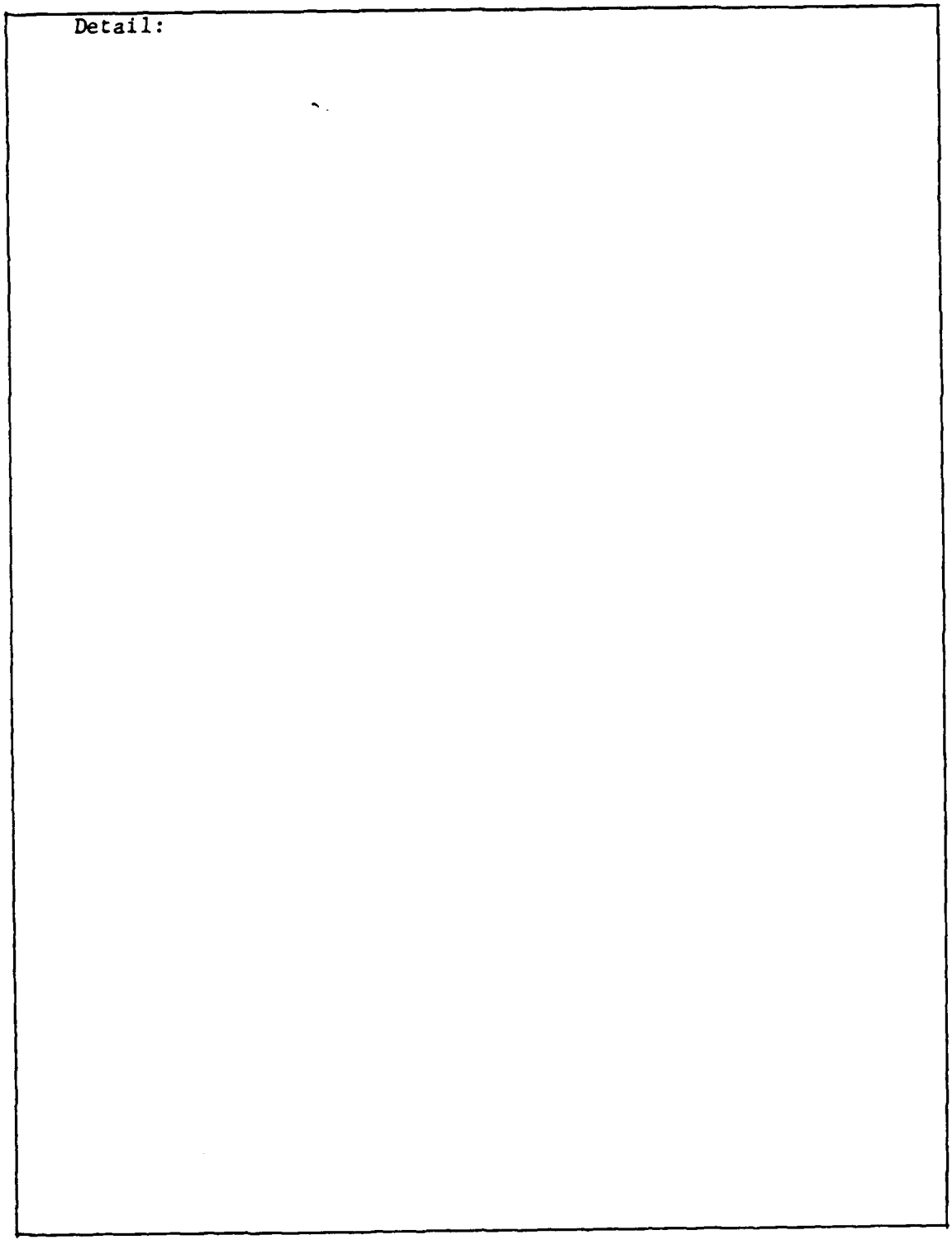

Figure 17. Feedback requirements form. (Continued)

Step 3.6: Collective Training Requirements Form

Internal Collective Training (team or crew training)

Number of Positions: _____

Positions Involved: _____

Number of Stations: _____

Implementation Comments: _____

Figure 18. Collective training requirements form.

Step 3.6: Collective Training Requirements Form

External Collective Training

Number of Prime Systems: _____

Prime Systems Involved: _____

_____

Implementation Comments: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Figure 18. Collective training requirements form. (Continued)

Step 3.7: Knowledge Training Requirements Form

Lesson Number: _____

Lesson Title: _____

_____

Objective Numbers: _____

_____

_____

_____

Implementation Factors: _____

Comments: _____

_____

_____

Lesson Number: _____

Lesson Title: _____

_____

Objective Numbers: _____

_____

_____

_____

Implementation Factors: _____

_____

Comments: _____

_____

_____

Figure 19. Knowledge training requirements form.

Step 3.8: Scenario Definition Form

Practice: _____ Interactive: _____ Contingency Practice: ____

Scenario Number	Objective No.	Objective Description

Contingency Descriptions: _____

Figure 20. Scenario definition form.

Step 3.8: Scenario Parameters Definition Form

Scenario Number: _____.

Target Information

Out the window view: _____. CRT view: _____.

Maximum number of targets: _____.

Friendly: _____. Enemy: _____.

Target characteristics for out the window view:

Motion: _____. Color: _____. Panoramic: _____.

Adequate fidelity for target information: _____.

Ability to track target: _____.

Other: _____

Target characteristics for CRT view:

Motion: _____. Color: _____. Text: _____. Symbols: _____.

Other: _____

Specific target names or classes:

_____

_____

_____

_____

_____

_____

_____

_____

Figure 21. Scenario parameters definition form.

Step 3.8: Scenario Parameters Definition Form

Environmental Conditions

Rain: ____. Haze: ____. Smoke: ____. Wind: ____.

Fog: ____. Snow: ____. ECM: ____. ECCM: ____.

Sea State: ____. Decoys: ____. Darkness: ____. Chaff: ____

Other: _____

Comments:

_____

_____

_____

_____

_____

_____

_____

_____

Degraded Systems

System/Subsystem	Comments

Figure 21. Scenario parameters definition form. (Continued)

Step 4.1: Scenario Control Feature Selection Form

Scenario Authoring

Primary author authority: _____

_____

_____

Authoring on prime equipment: _____

_____

_____

Authoring on other equipment: _____

_____

_____

_____

Scenario Control

Implementation and usage comments: _____

_____

_____

_____

_____

Priority rating: _____

Scenario Freeze

Implementation and usage comments: _____

_____

_____

_____

_____

Priority rating: _____

Figure 23. Scenario control feature selection form.

Step 4.1: Scenario Control Feature Selection Form

Scenario Playback

Implementation and usage comments: _____

_____

_____

_____

_____

Priority rating: _____

Scenario Fast Forward

Implementation and usage comments: _____

_____

_____

_____

_____

Priority rating: _____

Scenario Review

Implementation and usage comments: _____

_____

_____

Priority rating: _____

Figure 23. Scenario control feature selection form. (Continued)

Step 4.2: Data Management Feature Selection Form

Built-in recordkeeping

On prime equipment: _____ On other equipment: _____

Implementation and usage comments: _____

_____

_____

_____

_____

_____

_____

_____

Priority rating: _____

Report generation

On prime equipment: _____ On other equipment: _____

Implementation and usage comments: _____

_____

_____

_____

_____

_____

_____

_____

Priority rating: _____

Figure 24. Data management feature selection form.

Step 4.3: Special Instructional Feature Selection Form

Built-in Help Facility: _____ Demonstration Training Mode: _____

Feature	Priority Rating

Figure 25. Special instructional feature selection form.

Step 4.4: On-line and Off-line Data Form

Prime System SOR Requirements: _____

_____

_____

_____

Prime System User Stations: _____

_____

_____

_____

Off-line Training Comments: _____

_____

_____

_____

Transition Constraints: _____

_____

_____

_____

On-line Training Comments: _____

_____

_____

_____

Transition Constraints: _____

_____

_____

_____

Figure 26. On-line and off-line data form.

Step 4.5: Data Storage and Recording Requirements Form

Data Element Number: _____

Data Element for Recording: _____

_____

Objective Number(s): _____

_____

PM Number: _____ FR Number: _____

Select Time Length: Short ___ Medium ___ Long ___

Data Element Number: _____

Data Element for Recording: _____

_____

Objective Number(s): _____

_____

PM Number: _____ FR Number: _____

Select Time Length: Short ___ Medium ___ Long ___

Data Element Number: _____

Data Element for Recording: _____

_____

Objective Number(s): _____

_____

PM Number: _____ FR Number: _____

Select Time Length: Short ___ Medium ___ Long___

Figure 27. Data storage and recording requirements form.

Step 6.2: ET Component Courseware Outline Form

Lesson Number: _____

Lesson Title: _____

Classification: _____

Objective Numbers:

_____

_____

_____

_____

_____

Presentation Method(s): _____

Segments:	Notes:
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Practice or Test Items:	Notes:
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Figure 30. ET component courseware outline form.

Step 6.3: ET Component Scenario Description Form

Scenario Number: _____

Scenario Title: _____

Objective(s): _____

Parameter	Description

Measure	Description

Instructional Feature	Description

Figure 31. ET component scenario description form.

Step 6.4: Embedded Training Requirement (ETR) Status Description Form

ETR Number	ETR Title	Lesson or Scenario	Training Priority	Status

Figure 32. Embedded training requirement (ETR) status description form.

APPENDIX B

PROTOTYPE CRITICAL ITEM DEVELOPMENT SPECIFICATION

1.0 SCOPE

1.1 This specification establishes the performance, design, development, and test requirements for the Embedded Training (ET) component of the _____ (system name) _____.

The purpose of this ET component is _____.

2.0 APPLICABLE DOCUMENTS

The following documents (issue in effect on the date of invitation for bids or request for proposal) form a part of this specification to the extent specified herein.

2.1 Government documents

Specifications

List specification numbers and titles.

Specify whether documents are included

for reference or are part of the spec.

Standards

List standard numbers and titles.

Specify whether documents are included

for reference or are part of the spec.

Publications

List publication numbers and titles.

Specify whether documents are included

for reference or are part of the spec.

2.2 Other publications

List publication numbers and titles.

Specify whether documents are included

for reference or are part of the spec.

3.0 REQUIREMENTS

3.1 Critical item definition

The ET component for the (system name) is to provide sustainment/initial skills/transition training for (target MOS).

3.1.1 Interface definition/integration requirements

The ET component shall be fully embedded/adjunct/strapped-on. The interface between the ET component and other system components shall be as follows:

brief description of hardware interface.

brief description of software interface.

brief description of human interface.

3.2 Characteristics

3.2.1 Performance

3.2.1.1 Training modes

The ET component shall have the following modes of operation: _____.

3.2.1.1.1 Training mode access/exit

Transition between any training mode and any system operation mode shall be rapid and require minimal trainee/operator effort. Maximum time for access to training mode shall be (minutes/seconds). Maximum time for exit from training mode shall be (minutes/seconds). Additional requirements for transition between modes are as follows: (include hardware and manpower restrictions).

3.2.1.2 Training characteristics

The following paragraphs define the training application of the ET component and its characteristics.

3.2.1.2.1 Missions to be trained

The following missions are to be trained:

List of missions to be trained.

3.2.1.2.2 Training setting

The ET component shall be used in the following setting(s): Unit/school (any known details).

3.2.1.2.3 Training environment

Utilization of the ET component shall occur under the following conditions: (description of training environment) .

3.2.1.2.4 Exercises and lessons

The lessons and/or exercises to be presented by the ET component are described in the following subparagraphs.

3.2.1.2.4.1 Training exercises/scenarios

The ET component shall present the following exercises, at a minimum: (attach scenario descriptions) .

3.2.1.2.4.2 Lessons

The ET component shall present the following lessons, at a minimum: (attach courseware outlines) .

3.2.1.2.4.3 Lesson/exercise presentation strategies

The exercises and lessons shall be presented as described in the following subparagraphs.

3.2.1.2.4.3.1 Equipment stimulation characteristics

The following table lists system components to be stimulated and describes the functions to be presented.

(component) (functions to be presented)

(component) (functions to be presented)

3.2.1.2.4.3.2 Simulation characteristics

The following equipment functions and environmental characteristics shall be simulated:

(equipment functions)

(environmental characteristics)

Additionally, any other simulation necessary to meet the requirements of the exercises and lessons shall be provided.

3.2.1.2.5 Instructional features

The following instructional features shall be provided by the ET component:

(include on-line/off-line control features, feedback, adaptive training features)

3.2.1.2.6 Authoring features

There shall exist the capability to make additions, changes, and revisions to exercises and lessons presented by the ET component. The following modification capability shall be provided by the hardware and software of the ET component:

(include changes to lessons, scenario locations, stimuli) .

3.2.2 Physical characteristics

The following table shows hardware items to be utilized by the ET component. Each item is shown as fully embedded, adjunct, or strap-on, and its function is stated. Weight, transport, durability, health and safety, and vulnerability criteria are specified for each item, as appropriate.

(item)	(embedded/adjunct/strap-on)	(function)	(other criteria)
(item)	(embedded/adjunct/strap-on)	(function)	(other criteria)

3.2.3 Reliability

3.2.3.1 Operational system reliability

The ET component shall not degrade system reliability for operational use below that which is acceptable for the system as a whole, as stated in the prime item spec. The system shall be deemed to be available for use of if can be restored to full operability by transitioning out of ET mode.

3.2.3.2 ET component reliability

The reliability factors of the ET component shall be the same as those established in the prime item development specification for the operational system, unless specific waivers are granted by the procuring authority.

3.2.4 Maintainability

The maintainability factors of the ET component shall be the same as those established in the prime item development specification for the operational system, unless specific waivers are granted by the procuring authority.

3.2.5 Environmental conditions

The ET component shall be capable of operating under the same environmental conditions as those established in the prime item development specification for the operational system unless specific waivers are granted by the procuring authority.

3.2.6 Transportability

The ET component shall conform to the same transportability standards as those established in the prime item development specification for the operational system unless specific waivers are granted by the procuring authority. Adjunct and strap-on equipment shall be transportable as indicated below:

(indicate specific subsystem and transportability requirement)

(indicate specific subsystem and transportability requirement)

3.3 Design and construction

This section should be completed in accord with MIL-STD-490A. There are no special provisions for the ET component except for paragraph 3.3.6, Safety.

3.3.1 Materials, processes, and parts

This section should be completed in accord with MIL-STD-490A.

3.3.2 Electromagnetic radiation

This section should be completed in accord with MIL-STD-490A.

3.3.3 Nameplates and product marking

This section should be completed in accord with MIL-STD-490A.

3.3.4 Workmanship

This section should be completed in accord with MIL-STD-490A.

3.3.5 Interchangeability

This section should be completed in accord with MIL-STD-490A.

3.3.6 Safety

The ET component shall conform to the same safety standards as those established in the prime item development specification for the operational system unless specific waivers are granted by the procuring authority.

3.3.6.1 Training environment safety

Special provision shall be made for use of ET in environments that restrict the use of training or operational functions, such as motor pool training, or use of laser equipment near personnel. The following provisions shall be included:

(indicate training environment and safety consideration)

(indicate training environment and safety consideration)

3.4 Documentation

This section should be completed in accord with MIL-STD-490A.

3.5 Logistics

This section should be completed in accord with MIL-STD-490A.

3.6 Precedence

This section should be completed in accord with MIL-STD-490A.

4.0 QUALITY ASSURANCE PROVISIONS

This section should be completed in accord with MIL-STD-490A.

5.0 PREPARATION FOR DELIVERY

This section should be completed in accord with MIL-STD-490A.

6.0 NOTES

This section should be completed in accord with MIL-STD-490A.

10.0 APPENDIX I

This section should be completed in accord with MIL-STD-490A. Courseware outlines and scenario descriptions may be included here.

APPENDIX C

OBJECTIVE CLASSIFICATION, IMPLEMENTATION CODE, AND CRITICALITY RATING DESCRIPTION

The three factors (objective classification, implementation code, and criticality rating) and the classifications within them were developed during an earlier effort in the ET program, and are documented in Implementing Embedded Training (ET): Volume 4 of 10: Identifying ET Requirements. A full description and rationale for the classifications will be found there.

The categories within the three factors were rank-ordered, in order to arrive at a scaling approach that could be used to assign priorities to each ETR in terms of implementation via ET. The data were forced into a three category rank-ordering because the ET nomination process does not require finer grain data, and the ranking into only three categories is highly reliable.

The rank ordering of the objective classification is based on the following premises:

1. **Performance of integrated multiple skill activities has** the highest priority for ET because the actual equipment often presents the most natural environment to integrate the performance of all the skills required for actual job performance. ET offers the potential to re-create the operating environment that is necessary to call forth the requisite complex responses to real situations.

2. Variable or contingency procedures and rule or concept utilization are next in order, since these types of ETRs often are best practiced in a performance situation as much like the "real world" as possible.

3. Knowledges, basic manipulative skills, and invariant procedures are grouped together and are ranked lowest in terms of priority for ET. Training for these types of objectives does not take full advantage of ET's unique potential.

The implementation codes were revised and simplified slightly from those in Volume 4. The rank ordering uses the following premises:

1. Good to excellent candidates receive the highest priority for ET.

2. Good ET candidates for which performance measurement is possible, but not in an automated form, are next in order.

3. The lowest priority is assigned to infeasible or doubtful ET candidates, or those for which ET is a possibility but no performance measurement can be implemented.

The criticality ratings were simply rank-ordered.

APPENDIX D

LIST OF ACRONYMS AND ABBREVIATIONS

AMC	U.S. Army Materiel Command
ARI	U.S. Army Research Institute for the Behavioral and Social Sciences
ARTEP, ARTEPs	Army Training and Evaluation Plan(s)/Program
CAI	Computer-Assisted Instruction
CBP	Comparison-Based Prediction
CONUS	Continental United States
DBMS, DBMSs	Database Management System(s)
DOTD	Directorate of Training and Doctrine
ECA	A specific Early Comparability Analysis technique
ET	Embedded Training
ETR, ETRs	Embedded Training Requirement(s)
FM, FMs	Field Manual(s)
HARDMAN	HARDware versus MANpower analyses
ISD	Instructional Systems Development
MAA	Mission Area Analysis
MANPRINT	MANpower and PeRsonnel INTegration
MICOM	Missile Command
MSRS	Materiel System Requirement Specification
O&O	Organizational and Operational (Plan)
PDP	Programmable Display Pushbutton
PM TRADE	U.S. Army Project Manager for Training Devices
ROC	Required Operational Capability
SM, SMs	Soldier's Manual(s)
SME, SMEs	Subject Matter Expert(s)
SOR	State-of-Readiness
SRs	Stimulus Requirements
TM, TMs	Technical Manual(s)
TRADOC	U.S. Army Training and Doctrine Command
TSM, TSMs	TRADOC System Manager(s)