Implementing Embedded Training (ET): Volume 3 of 10: The Role of ET in the Training System Concept

This product provides a step-by-step procedure for developing a training system concept very early in the materiel acquisition process. This training system concept outlines appropriate roles for Embedded Training and Stand-alone Training Devices in supporting hands-on training for a materiel system, with respect to nine specific training needs or situations.
Research accomplished under contract for the Department of the Army

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Implementing Embedded Training (ET): Volume 3 of 10: The Role of ET in the Training System Concept

J. Thomas Roth

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FOREWORD

This document is Volume 3 of 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 technological thrust areas under internal 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 10 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. This includes a discussion of these factors:
   a. the total training system concept, including embedded training;
   b. how training systems must develop within more general processes of materiel system development;
   c. how embedded training must affect this relationship; and
   d. the content and uses of the remaining documents in the series, 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 as to whether ET should be further considered as an alternative training system 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** contains 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** provides guidance for integrating ET considerations and information into unit training documentation and practice.

9. **Volume 9: Logistics Implications** presents guidance on regarding 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** provides guidance on 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 discusses 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 where and 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.

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INTRODUCTION

The procedures presented in this document provide a means for generating potential training system concepts (in this case, limited to hands-on training support approaches) very early in the materiel system acquisition cycle. These procedures support the identification of hands-on training support concepts including embedded training (ET), stand-alone training devices (SADs), and conventional hands-on training approaches such as exercises, range firing, etc.

The training subsystem accompanying a new materiel system must be fielded prior to or concurrent with the materiel system. In order for this to occur, early and continuous consideration of training must take place. The procedures described here support the consideration of training support requirements at a functional performance level, prior to detailed analysis of crew or maintainer performance requirements. These procedures thus provide a means of considering appropriate alternative solutions to hands-on training needs in several training situations anticipated to be encountered for practically all types of systems. These procedures can also support the tradeoff between alternate soldier-system interfaces (SSIs) in the system design process. Possible alternative implications for training (embedded training, stand-alone training devices, etc.) associated with SSI design alternatives can be evaluated by applying these procedures to candidate SSI designs.

The training system concept development process supports the development of critical acquisition documents during the pre-concept and concept phases of the system acquisition process. Specific documents which may be impacted by these procedures include the first iterations of the organizational and operational (O&O) plan, the system training plan (STRAP), and the required operational capability (ROC) document; the justification for major system new start (JMSNS); evaluations of the possible inclusion of ET components; and preliminary training device requirements (TDR) documents.

These proceedings articulate with two other documents in the Implementing Embedded Training (ET) series. These are: Volume 2: ET as a System Alternative; and Volume 4: Identifying ET Requirements. If the recommended analytic procedures described in Volume 2 have been performed, the information generated by those procedures can be used as input for the procedures presented here. Likewise, the data generated as a result of the procedures discussed here can be used as an initial database for Volume 4 procedures to define ET requirements later in the acquisition process.
Limitations of the Procedures

These procedures provide an approach to developing a training system concept early in the system acquisition process. However, the procedures have certain limitations with respect to their coverage of the total training system. These are summarized below.

1. The procedures deal with general and global functional performance requirements for system crews or operators and maintainers rather than specific task-level training requirements. Specific training requirements are not anticipated to exist at the point in the life cycle (pre-concept) this procedure is expected to be used.

2. The procedures deal principally with hands-on training. This means that non-hands-on training (e.g., cognitive or knowledge training that does not involve hands-on activity) is not explicitly dealt with. This does not exclude cognitive or knowledge activities that may be practiced hands-on, however.

3. The procedures deal with training at the individual and crew-collective levels (and generic maintenance). Command, professional development, leadership, branch, and force-level training are not explicitly dealt with here. This is based on the assumption that, except in relatively rare cases, there is no emphasis in such training situations for system-related hands-on training. To the extent that such training is performed hands-on, however, it may be considered in these procedures. Where such functions are to be considered, they should be treated as crewmember or operator functions in these procedures. Specific positions (Step 1) should be identified for supervisors, leaders, or commanders, as applicable.

Overview of the Procedures

The procedures for developing a training system concept consist of nine steps. The first seven steps consist of identifying hands-on training requirements (at a functional performance requirements [FPR] level), and selecting appropriate means of hands-on training support for each FPR, for a number of specific training situations. The final two steps are concerned with integrating the results of the first seven steps, to develop an overall hands-on training support concept, and with documenting the concept in an easily understandable form.

The remainder of this document presents the procedures for each of the nine steps, in sequence. This document also includes two Appendixes. Appendix A presents a set of generic functional
performance requirements taxonomies which can be used to support these analyses, with suitable tailoring. Appendix B contains a set of exemplar SSI descriptions that can be used as a model for developing SSI concepts in Step 4.
PROCEDURES

The nine steps of the training system concept development procedures are presented in this section. An overview of the steps and their products is shown in Figure 1. For convenience, this Figure is repeated before the description of each step, with an indication of the step being performed. Each step description contains four parts, as follows:

1. The Objective of the step.
2. The Rationale for performing the step.
3. The Procedures to follow when performing the step.
4. The Product of the step--what results from performing the step.
Figure 1. Procedures overview.
Step 1: Identify Likely Crew Positions and Maintainer Positions for New System

Objective: Specify and name the likely crew positions (e.g., commander, gunner, loader, driver for a tank; pilot, copilot, door gunner for a utility helicopter, etc.) for the new system, as well as a generic maintainer position or specific maintainer positions (if these have been identified).

Rationale: Knowing the likely crew and maintainer positions is necessary to develop a concept of the equipment that each crewmember/maintainer is likely to deal with. This, in turn, aids in identifying the soldier-system interface (SSI) configurations of the new system. This information is needed to make training and performance requirements decisions and identify likely collective training requirements in later steps of the procedures.

Procedure: 1. Examine data on predecessor systems of similar types (good data sources are Field Manuals [FMs] and Technical Manuals [TMs] for predecessor systems), and identify typical crew positions for like-type systems.

2. Identify any planned changes in crew size based on assumptions, constraints, or technology.

3. Develop a list of likely crew positions for the new system. In making this list, you should consider:
   a. Crew positions found in predecessor systems.
   b. Planned reductions in crew size.
   c. Possible reallocation of functions across crew systems (with respect to predecessor systems).
   d. Differing roles of crewmembers due to possible reallocation of functions between the materiel system and soldiers.

4. Ensure that at least a "generic" maintainer position is included, in addition to crew positions. If maintainer position information is available, identify the specific maintainer positions that have been identified.

Product: A listing of crew positions, with descriptive titles, and maintainer positions, for considering system maintenance.
Step 2
Identify Functional Performance Requirements (FPRs) for Crew/Operator and Maintainer Positions

Functional Performance Requirements (FPRs) Listing

Step 7
Identify Preferred and Alternate Hands-on Training Support Approaches for Each FPR for Various Training Situations

Hands-on Training Support Approaches by FPR by Position

Step 8
Integrate Hands-on Training Approaches by Training Situation to Develop Training System Concept

Training System Concept

Step 9
Document Training System Concept and Prepare Supporting Materials

Final Training System Concept

Step 1
Identify Likely Crew Positions and a Generic Maintainer Position for New System

Crew Positions/Maintainer Listing

Step 2
Identify Functional Performance Requirements (FPRs) for Crew/Operator and Maintainer Positions

Functional Performance Requirements (FPRs) Listing

Step 3
Specify FPRs to be Accomplished by Crewmember/Operators and Maintainers

FPRs by Positions Listing

Step 4
Develop Soldier-System Interface (SSI) Equipment Suite Concepts for Crewmembers/Operators

SSI Equipment Suite Concepts

Step 5
Classify FPRs by Position for Performance Difficulty, Personability, Mission Criticality, Collective Performance

FPRs by Positions Listing, Annotated with Classifications

Step 6
Identify Training, Hands-on, Sustainment, and Collective Training Requirements, and Note FPR Suitability for ET

FPRs by Positions Listing, Further Annotated
Step 2: Identify Functional Performance Requirements (FPRs) for Crew or Operator and Maintainer Positions

Objective: Identify general functional areas of crewmember and maintainer performance which may require training.

Rationale: In order to estimate the characteristics of a training system, you must have an idea of what may need to be trained. At this point in the life cycle, only a general concept of what may have to be trained (functional performance requirements) is likely to be available. The functional performance requirements provide a basis for estimating likely training needs for the new system, in later steps of this analysis.

NOTE: Functional performance requirements should be considered from a soldier-performance point of view. They include tasks which must be performed by system operators and maintainers to enable the overall soldier-machine systems to achieve operational objectives.

Procedure: Develop a set of FPRs for the system, based on:

1. Knowledge of similar predecessor systems, along with available information about new functions, capabilities, etc. expected to be in the new system.

2. Task or functions data developed as a result of analyses to consider whether ET should be further considered for this system (Implementing Embedded Training (ET): Volume 2: ET as a System Alternative).

3. One of the functional performance requirements taxonomies included in Appendix A.

Ensure that at least a gross maintenance performance requirement is included—perhaps one requirement for preventive maintenance, and another for corrective maintenance and battle damage repair. If any information on more detailed maintainer functions is conveniently available, such information should be used in these analyses. Possible sources include maintainer functions of predecessor systems, ECA analyses, and HARDMAN studies.

Product: A functional performance requirements listing that covers both operator or crewmember and maintainer functional performance requirements.
Step 3
Specify FPRs to be Accomplished by Crewmember/Operators and Maintainers

FPRs by Positions Listing

Step 1
Identify Likely Crew Positions and a Generic Maintainer Position for New System

Crew Position-Maintainer Listing

Step 2
Identify Functional Performance Requirements (FPRs) for Crew/Operator and Maintainer Positions

Functional Performance Requirements (FPRs) Listing

Step 3
Specify FPRs to be Accomplished by Crewmember/Operators and Maintainers

FPRs by Positions Listing

Step 4
Develop Soldier-System Interface (SSI) Equipment Suite Concepts for Crewmembers/Operators

SSI Equipment Suite Concepts

Step 5
Classify FPRs by Position for Performance Difficulty, Pernubility, Mission Criticality, Collective Performance

FPRs by Positions List, Annotated with Classifications

Step 6
Identify Training, Hands-on, Sustainment, and Collective Training Requirements, and Note FPR Suitability for ET

FPRs by Positions Listing, Further Annotated

Step 7
Identify Preferred and Alternate Hands-on Training Support Approaches for Each FPR for Various Training Situations

Hands-on Training Support Approaches by FPR by Position

Step 8
Integrate Hands-on Training Approaches by Training Situation to Develop Training System Concept

Training System Concept

Step 9
Document Training System Concept and Prepare Supporting Materials

Training System Concept

Final Training System Concept
Step 3: Specify FPRs to be Accomplished by
Crewmembers or Operators and Maintainers

Objective: Identify which crewmember positions (or SSIs) and
maintainers will be involved in performing each of the FPRs
identified in Step 2.

Rationale: It is necessary to evaluate both individual and crew-
collective performance and training in later steps. This
step identifies FPRs which are only associated with
individuals versus FPRs that are collective in nature.

Procedure: Identify the crewmembers or maintainer positions involved
in performing each FPR. Then, annotate the FPR list,
indicating each crewmember and/or maintainer involved in
performing each requirement. Some useful data sources for
this step are Army training and evaluation plans (ARTEP),
soldier's manuals (SM), technical manuals (TM), any early
comparability analysis data that may be available, analyses
performed to investigate ET potential based on Implementing
Embedded Training (ET): Volume 2: ET as a System
Alternative, HAREMAN analysis results, and human factors
engineering analysis (HFEA) data. Crewmembers should be
identified as performing maintenance functions in many
cases, since they commonly perform preventive maintenance
checks and services (PMCS), and sometimes perform crew-
level troubleshooting and repair. The maintainer FPRs
should always be identified as performed by the "generic"
maintainer position, or other specific maintainer positions
that are identified.

Product: Annotations to the FPR list indicating the crewmembers (and
maintainers) that are involved in performing each FPR.
Step 1: Identify Likely Crew Positions and a Generic Maintainer Position for New System

Step 2: Identify Functional Performance Requirements (FPRs) for Crew/Operator and Maintainer Positions

Step 3: Specify FPRs to be Accomplished by Crewmembers/Operators and Maintainers


Step 5: Classify FPRs by Position for Performance Difficulty, Penchant, Mission Criticality, Collective Performance

Step 6: Identify Training, Hands-on, Sustainment, and Collective Training Requirements, and Note FPR Suitability for ET

Step 7: Identify Preferred and Alternate Hands-on Training Support Approaches for Each FPR for Various Training Situations

Step 8: Integrate Hands-on Training Approaches by Training Situation to Develop Training System Concept

Step 9: Document Training System Concept and Prepare Supporting Materials


SSI Equipment Suite Concepts
Step 4: Develop Soldier-System Interface (SSI) Equipment Suite Concepts for Crewmembers or Operators

**Objective:** Identify probable equipment items or functional equipment elements present at each SSI, to assist in considering hands-on performance and training requirements for the FPRs.

**Rationale:** Identifying equipment items (or functional elements) present at each crew position (or SSI) helps in later steps in deciding on criticality, perishability, training requirements, and feasibility for embedding hands-on training for the FPRs.

**Procedure:**

1. Identify equipment items or functional equipment elements, from selected predecessor systems, for each SSI. Multiple predecessor systems may be appropriate if functions from several systems are represented (e.g., if a composite baseline system is defined by HARDMAN or ECA). Useful data sources include TMs, SMs, and equipment descriptions.

   NOTE: Be sure to include the maintainers SSI(s) in this step and later steps.

2. Remove from consideration any SSIs that are expected to be eliminated in the new system. You should also note equipment items that are no longer to be considered (e.g., no loader position is expected in a new tank due to providing an autoloader mechanism). This information may be available from mission area analysis (MAA) summaries, or from concept documents for the new system.

3. Identify any anticipated reallocation of equipment items or functional equipment elements across SSIs in new system (e.g., the tank gunner now selects ammunition and fuze, since the loader position is eliminated by providing an autoloader mechanism).

4. Identify and associate with specific SSIs any new equipment items or functional equipment elements that are to be incorporated in the new system (e.g., controls and displays for the autoloader mechanism).

5. Summarize SSI equipment element suites to assist in considering performance and training requirements in later steps of this procedure.

**Product:** SSI equipment suite descriptions, for all crew positions that will be in the new system. Appendix B contains some example SSI equipment suite descriptions.
Step 5: Classify FPRs by Position for Performance Difficulty, Perishability, Mission Criticality, Collective Performance

Objective: Perform classifications of each FPR on four characteristics that support decisions about training, sustainment, embedded training feasibility, and hands-on performance in Step 6.

Rationale: These classifications assist you in determining what sort of training requirements are likely to exist for each FPR, in identifying the feasibility or desirability for embedding training, in identifying needs for sustainment, and in selecting the FPRs to include in the training system concept.

Procedure: Consider each FPR in turn, for each involved crewmember or maintainer position, and make the four classifications listed below. Use the SSI equipment suite descriptions, and any available task or functional data from predecessor systems to help you make the decisions. Record each classification by FPR and crewmembers or maintainers involved in FPR performance.

1. Classify the FPR for each crewmember or maintainer as to the performance difficulty of the FPR, according to the following guidance. Record the classification for each crewmember and maintainer.

Classify performance difficulty as HIGH, if there are likely to be complex decisions or many highly variable psychomotor activities involved in performing the FPR, or if the FPR routinely requires near simultaneous performance of multiple tasks on a frequent basis.

Classify performance difficulty as MODERATE, if there are likely to be moderately complex decisions or some variable psychomotor activities involved in performing the FPR, and if the FPR requires near simultaneous performance of multiple tasks only occasionally.

Classify performance difficulty as LOW, if it is unlikely that performing the FPR will require complex decisions or variable psychomotor activities, and if the FPR seldom or never requires near simultaneous performance of multiple tasks.

2. Classify each FPR on its perishability once learned (the need for frequent reinforced practice to maintain proficiency), according to the following guidance. Record the classification for each crewmember and maintainer, by FPR.
Classify perishability as HIGH if reinforced practice is needed more than once per week to maintain proficiency on the FPR to standard.

Classify perishability as MODERATE if reinforced practice is needed more than twice per month to maintain proficiency on the FPR to standard.

Classify perishability as LOW if reinforced practice is needed no more than once per month to maintain proficiency on the FPR to standard.

3. Classify each FPR on its criticality to mission success, according to the following guidance. Record the classification of criticality for each crewmember and maintainer, by FPR.

Classify mission criticality as HIGH, if there is more than a 50 percent chance that a mission may fail if the FPR is not performed to standard by the crewmember or maintainer.

Classify mission criticality as MODERATE, if there is between a 25 percent and a 50 percent chance that a mission may fail if the FPR is not performed to standard by the crewmember or maintainer.

Classify mission criticality as LOW, if there is less than a 25 percent chance that a mission may fail if the FPR is not performed to standard by the crewmember or maintainer.

4. Classify whether performing the FPR involves hands-on use of equipment as a primary activity of the crewmember or maintainer. Record this as a YES or NO decision for each crewmember and maintainer.

Product: Classifications for each involved crewmember and maintainer on each of the four characteristics, for each FPR. The classifications should be entered as annotations to the FPR list.
Step 1
Identify Likely Crew Positions and a Generic Maintainer Position for New System

Step 2
Identify Functional Performance Requirements (FPRs) for Crew/Operator and Maintainer Positions

Step 3
Specify FPRs to be Accomplished by Crewmember/Operators and Maintainers

Step 4
Develop Soldier-System Interface (SSI) Equipment Suite Concepts for Crewmembers/Operators

Step 5
Classify FPRs by Position for Performance Difficulty, Perishability, Mission Criticality, Collective Performance

Step 6
Identify Training, Hands-on, Sustainment, and Collective Training Requirements, and Note FPR Suitability for ET

Step 7
Identify Preferred and Alternate Hands-on Training Support Approaches for Each FPR for Various Training Situations

Step 8
Integrate Hands-on Training Approaches by Training Situation to Develop Training System Concept

Step 9
Document Training System Concept and Prepare Supporting Materials

Final Training System Concept

Identify Training, Hands-on, Sustainment, and Collective Training Requirements, and Note FPR Suitability for ET

FPRs by Positions Listing, Further Annotated
Step 6: Identify Training, Hands-on, Sustainment, and Collective Training Requirements, and Note FPR Suitability for ET

Objective: Apply selection criteria to each functional performance requirement to identify those that:

1. Require training.
2. Require sustainment.
3. Are candidates for ET.
4. Require collective performance (and, therefore, collective training).

Rationale: This step identifies categories of FPRs that will need to be considered in different types of training situations, in Step 7.

Procedure: Examine the classifications made in Step 5, on the basis of crewmembers or maintainers involved in performing each FPR, and make and record the following decisions for each crewmember or maintainer and FPR:

1. If mission criticality is MODERATE or HIGH or performance difficulty is MODERATE or HIGH for any crewmember, then initial (e.g., institutional) training is required for the FPR, at least for the crewmembers that satisfy this criterion.

2. If mission criticality is MODERATE or HIGH or perishability is MODERATE or HIGH for any crewmember, then sustainment is required for the FPR, and ET may be a candidate for the FPR in question, at least for that crewmember.

3. If more than one crewmember is involved in performing an FPR, then collective training and sustainment is required for that FPR.

Note that multiple classification is perfectly acceptable, and is expected for many FPRs—an FPR can require initial training, sustainment, collective training, and be an ET candidate.

Product: Recorded decisions about each of the classification areas. These decisions should be added as annotations to the FPR list.
Step 7: Identify Preferred and Alternate Hands-on Training Support Approaches for Each FPR for Various Training Situations

Objective: Identify preferred and alternate hands-on training support approaches for each FPR, for a variety of training situations (institutional training, new equipment training [NET], and unit sustainment training).

NOTE: For purposes of developing the training system concept, sustainment training is considered to include cross-training for other crew positions on the same system to which a soldier is assigned and skill upgrade training conducted in the unit, in addition to sustainment training which maintains skills acquired in initial institutional training.

Rationale: To develop the training system concept, it is necessary to identify hands-on training support approaches and alternatives for each FPR and each training situation (the approaches for all FPRs will be considered jointly in Step 8).

Procedure: 1. Obtain a list of the FPRs (by crewmember or maintainer), with notations about the decisions made in Step 6.

2. Disregard any FPRs for which neither initial training nor sustainment is required.

3. Using the flowchart in Figure 2, identify and record preferred and alternative hands-on support approaches for each training situation (institutional, unit-NET, unit-sustainment) for each FPR.

NOTE: An explanation of abbreviations used in Figure 2 is presented in Table 1.

Follow the appropriate decision paths in the flowchart for each FPR and crewmember or maintainer. For example, if you were considering an FPR for a crew position that required both initial training and sustainment, you would follow at least three of the paths through the first page of the flowchart: the individual training-institutional path for initial training; the individual training-NET path for NET, and the individual training-sustainment path for sustainment. You should consider both individual training and collective training, as applicable. If collective performance or training has been specified (in Step 6) for an FPR, follow the collective-training paths in the flowchart to find recommendations for hands-on
collective training approaches. Record the recommended hands-on training support approaches for each training situation for each FPR and crewmember ormaintainer.

**Product:** Identification of hands-on training support approaches for each training situation, for each FPR and crewmember or maintainer.
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<th>Abbreviation</th>
<th>Explanation</th>
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<tr>
<td>Positional SAD</td>
<td>A Stand-Alone Training Device (SAD) used to support hands-on training for a single crew position</td>
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<td>AET - no Embedded</td>
<td>Training using the actual equipment without Embedded Training capabilities</td>
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<tr>
<td>Exercise/OPTEMPO</td>
<td>Conventional, go-to-the-field, exercise-based training</td>
</tr>
<tr>
<td>Embedded</td>
<td>Embedded Training capabilities incorporated into operational systems</td>
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<td>SIMNET</td>
<td>Utilization of SIMulation NETwork (SIMNET) approach to support hands-on training</td>
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<tr>
<td>Crew/team SAD</td>
<td>A SAD used to support training for a crew or subset of crewmembers for a system</td>
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<tr>
<td>MTD</td>
<td>Maintenance Training Device (MTD) used to support hands-on training for maintainers</td>
</tr>
<tr>
<td>BIT/BITE/PITE</td>
<td>Built-in Test (BIT), Built-in Test Equipment (BITE), Plug-in Test Equipment (PITE)</td>
</tr>
<tr>
<td>OJT</td>
<td>On-the-job training</td>
</tr>
</tbody>
</table>
Figure 2. Training system concept development guidance.
Figure 2. Training system concept development guidance (concluded).
Step 8: Integrate Hands-on Training Approaches by Training Situation to Develop Training System Concept

Objective: Evaluate identified hands-on training alternatives for all FPRs to be trained in each training situation, to derive a joint approach or mix for hands-on training support alternatives for each situation.

Rationale: Recommended alternatives may differ across FPRs for a given training situation. This step enables you to consider and trade off mixed support approaches for each training situation, to develop a concept for how hands-on training will be supported overall in the training system.

Procedure:

1. Obtain a list of the FPRs to be trained in each training situation (institutional, unit-NET, unit sustainment), for operators and maintainers separately, annotated with the hands-on training support approaches you identified in Step 7.

2. Examine the recommended hands-on training support approaches across the FPRs for each training situation in the following list:

   a. Initial institutional training for individual crewmembers or operators.
   b. Unit-NET training for individual crewmembers or operators.
   c. Unit-sustainment training for individual crewmembers or operators.
   d. Collective institutional training for crewmembers or operators.
   e. Collective unit-NET training for crewmembers or operators.
   f. Collective unit-sustainment training for crewmembers or operators;
   g. Initial institutional training for maintainers (including transition training for newly introduced systems).
   h. Unit sustainment training for maintainers.

3. If the hands-on training support recommendations differ among the FPRs being considered for a given training
situation, you may want to specify a mixed support concept (more than one hands-on training support approach) for supporting hands-on training in the situation under consideration.

4. Record the hands-on training support approaches (either "pure" or "mixed") by training situation.

**Product:** A list of preferred and alternative hands-on training approaches and recommended mixes, by training situation. This is the training system concept produced by these procedures.
Step 1
Identify Likely Crew Positions and a Generic Maintainer Position for New System

Step 2
Identify Functional Performance Requirements (PPRs) for Crew/Operator and Maintainer Positions

Step 3
Specify PPRs to be Accomplished by Crewmember/Operators and Maintainers

Step 4
Develop Soldier-System Interface (SSI) Equipment Suite Concepts for Crewmembers/Operators

Step 5
Classify PPRs by Position for Performance Difficulty, Penchant, Mission Criticality, Collective Performance

Step 6
Identify Training, Hands-on, Sustainment, and Collective Training Requirements, and Note PPR Suitability for ET

Step 7
Identify Preferred and Alternate Hands-on Training Support Approaches for Each PPR for Various Training Situations

Step 8
Integrate Hands-on Training Approaches by Training Situation to Develop Training System Concept

Step 9
Document Training System Concept and Prepare Supporting Materials

Final Training System Concept
Step 9: Document Training System Concept and Prepare Supporting Materials

Objective: Document the training system concept in a simple and easily understood format. Also, provide supporting documentation for the training system concept, to establish an audit trail for the decisions made in these procedures.

Rationale: Presenting the training system concept in a simple and straightforward manner enables analysts and managers to comprehend the concept readily, and simplifies communication and understanding of the training system concept.

Procedure: Record the hands-on training support approaches for each training situation (developed in Step 3) in a matrix format similar to that shown in Figure 3. If a mixed approach is recommended for a particular training situation, make multiple entries in rows of the matrix, indicating the desirable mix of approaches. Use "X's" in matrix cells to indicate that a particular hands-on training support approach is appropriate for a given training situation. If you wish to indicate alternative approaches, several entries can be made for each training situation (one line per entry). Use of some coding (e.g., "P" for a preferred approach and "A" for an alternate) is recommended if this is done. Support the matrix summary with a listing of hands-on training support recommendations by functional performance requirement, for each training situation separately, to show the derivation of the recommendations presented in the matrix.

Product: The documented training system concept.

NOTE: The training system concept developed in these procedures should be considered preliminary. As the materiel system and its associated tasks, doctrine, and tactical use evolve, much additional data that impact the training system will become available. Later versions of "how to train" will have to take this information into account. The concept developed here should be thought of as "setting the stage" for initial studies of training and generation of requirements for the training system that will eventually be developed.
### Sample Training System Concept Presentation Matrix

<table>
<thead>
<tr>
<th>Training Situation</th>
<th>ET</th>
<th>Pos SAD</th>
<th>Crew SAD</th>
<th>Act. Eq.</th>
<th>MTD</th>
<th>OJT</th>
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<tr>
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<tr>
<td>New Equipment Training</td>
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<td>Maintainer</td>
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</table>

Figure 3. Example summary matrix for a training system concept.
APPENDIX A

EXAMPLE FUNCTIONAL PERFORMANCE REQUIREMENTS (FPRs)
TAXONOMIES FOR MATERIEL SYSTEMS
The taxonomies of operator Functional Performance Requirements (FPRs) in this Appendix are not intended to cover all possible types of systems. They are provided as a convenient starting point for considering FPRs for a number of types of major materiel systems for which training system concepts may need to be developed.
Close Combat Heavy (Infantry)  
Infantry Fighting Vehicles

Plan and prepare mission  
Drive vehicle  
Navigate  
Communicate  
Detect/locate/acquire target  
Attack target  
Defend against attack  
Perform reconnaissance  
Call for fire support  
Transport combat troops and supplies  
Perform post-mission tasks  
Compensate for equipment malfunctions and emergencies

Close Combat Light (Infantry)  
Antitank Vehicles

Plan and prepare mission  
Drive vehicle  
Navigate  
Communicate  
Detect/locate/acquire target  
Attack target  
Defend against attack  
Perform reconnaissance  
Call for fire support  
Perform post-mission tasks  
Compensate for equipment malfunctions and emergencies
Close Combat Light (Infantry)
Man-portable Weapons

Conduct pre-operational inspection
Prepare weapon for firing
Emplace weapon/Get into firing position
Detect/locate/acquire targets
Fire weapon
Perform post-firing tasks
Clear/recover from misfire

Close Combat Light
Medium Antitank Weapons

Conduct pre-operational inspection
Prepare weapon for firing
Emplace weapon/Get into firing position
Detect/locate/acquire targets
Fire weapon
Clear/recover from misfire
Perform post-firing tasks
Close Combat Light

Heavy Antitank Weapons

Conduct pre-operational inspection

Prepare weapon for firing

Emplace weapon/Get into firing position

Detect/locate/acquire targets

Fire weapon

Perform post-firing tasks

Clear/recover from misfire

Close Combat Heavy (Armor) Tanks

Plan and prepare mission

Drive vehicle

Navigate

Communicate

Detect/locate/acquire target

Attack target

Defend against attack

Perform reconnaissance

Call for fire support

Perform post-mission tasks

Compensate for equipment malfunctions and emergencies
Close Combat Heavy (Armor)
Cavalry Fighting Vehicles

Plan and prepare mission
Drive vehicle
Navigate
Communicate
Detect/locate/acquire target
Attack target
Defend against attack
Perform post-mission tasks
Perform reconnaissance
Call for fire support
Compensate for equipment malfunctions and emergencies
Transport combat troops

Fire Support (Field Artillery)
Medium Range Missiles

Prepare for march order
Move to firing point
Navigate
Communicate
Emplace system
Prepare weapon for firing
Fire weapon
Conduct post-firing inspections
Execute "failure to fire" procedures
Compensate for equipment malfunctions and emergencies
Perform emergency destruction of warhead
Displace system
Fire Support (Field Artillery)

Long Range Missiles

Prepare for march order

Move to firing point

Navigate

Communicate

Emplace system

Prepare weapon for firing

Fire weapon

Conduct post-firing inspections

Execute "failure to fire" procedures

Compensate for equipment malfunctions and emergencies

Perform emergency destruction of warhead

Displace system
Fire Support (Field Artillery)  
**Towed Howitzers**

Prepare for march order  
Drive/move cannon  
Navigate  
Emplace cannon  
Displace cannon  
Prepare cannon for firing  
Fire cannon  
Fire cannon at direct fire target  
Navigate  
Communicate  
Defend against attack  
Compensate for equipment malfunctions and emergencies  
Perform post-mission tasks
Fire Support (Field Artillery)
Self-Propelled Howitzers

Prepare for march order
Drive/move cannon
Navigate
Emplace cannon
Displace cannon
Prepare cannon for firing
Fire cannon
Fire cannon at direct fire targets
Fire crew served weapons
Navigate
Communicate
Defend against attack
Displace system
Compensate for equipment malfunctions and emergencies
Perform post-mission tasks
Fire Support (Field Artillery)
Rocket Systems
Prepare for march order
Move to firing point
Navigate
Communicate
Emplace system
Prepare weapon for firing
Fire weapon
Conduct post-firing inspections
Execute "failure to fire" procedures
Compensate for equipment malfunctions and emergencies
Perform emergency destruction of warhead
Displace system

Fire Support (Field Artillery)
Resupply Vehicles
Prepare for march order
Drive/move to weapon site
Drive/move to supply stores site
Navigate
Load/unload stores
Communicate
Defend against attack
Compensate for equipment malfunctions and emergencies
Perform post-mission tasks
Air Defense
Gun Systems

Prepare for march order
Move vehicle
Navigate
Emplace system
Prepare weapon for engagement
Load/reload weapon
Detect/locate/acquire target
Engage aircraft targets
Engage ground targets
Communicate
Defend against attack
Displace system
Perform post-mission tasks
Compensate for equipment malfunctions and emergencies
Air Defense
Line of Sight Missile Systems

Prepare for march order
Move vehicle
Navigate
Emplace system
Prepare weapon for engagement
Detect/locate/acquire target
Engage aircraft targets
Navigate
Communicate
Reload missile launchers
Replenish missile load
Defend against attack
Displace system
Perform post-mission tasks
Compensate for equipment malfunctions and emergencies
Air Defense
**Non-Line of Sight Systems**
- Prepare for march order
- Move vehicle
- Navigate
- Emplace system
- Prepare weapon for engagement
- Detect/locate/acquire target
- Engage aircraft targets
- Engage ground targets
- Communicate
- Reload missile launchers
- Replenish missile load
- Defend against attack
- Displace system
- Perform post-mission tasks
- Compensate for equipment malfunctions and emergencies

Air Defense
**Man-Portable Air Defense Systems**
- Conduct pre-operational inspection
- Prepare weapon for firing
- Emplace weapon/Get into firing position
- Detect/locate/acquire target
- Fire weapon
- Clear/recover from misfire
- Perform post-firing tasks
Aviation

Attack Helicopters

Plan and prepare for mission
Taxi and takeoff
Fly aircraft to/from mission area
Fly during night conditions
Fly during weather conditions
Manage weight and balance
Navigate
Communicate
Approach and land aircraft
Perform after-landing tasks
Compensate for in-flight equipment malfunctions and emergencies
Detect/locate/acquire targets
Attack target
Defend against ground attack
Defend against air attack
Perform reconnaissance
Call for fire support
Perform post-mission tasks
Aviation
Cargo Helicopters

Plan and prepare for mission
Taxi and takeoff
Fly aircraft to/from mission area
Fly during night conditions
Fly during weather conditions
Manage weight and balance
Navigate
Communicate
Approach and land aircraft
Perform after-landing tasks
Compensate for in-flight equipment malfunctions and emergencies
Defend against ground attack
Defend against air attack
Load/unload internal loads
Raise/lower external loads
Perform paradrop
Rappel troops
Call for fire support
Perform post-mission tasks
Aviation

Utility Helicopters

Plan and prepare for mission
Taxi and takeoff
Fly aircraft to/from mission area
Fly during night conditions
Fly during weather conditions
Manage weight and balance
Navigate
Communicate
Approach and land aircraft
Perform after-landing tasks
Compensate for in-flight equipment malfunctions and emergencies
Detect/locate/acquire targets
Attack target
Defend against ground attack
Defend against air attack
Load/unload internal loads
Raise/lower external loads
Perform paradrop
Rappel troops
Perform reconnaissance
Call for fire support
Perform post-mission tasks
Aviation
*Scout Helicopters*

Plan and prepare for mission

Taxi and takeoff

Fly aircraft to/from mission area

Fly during night conditions

Fly during weather conditions

Navigate

Communicate

Approach and land aircraft

Perform after-landing tasks

Compensate for in-flight equipment malfunctions and emergencies

Detect/locate/acquire targets

Attack target

Defend against ground attack

Defend against air attack

Perform reconnaissance

Call for fire support

Perform post-mission tasks
Aviation

**Fixed Wing Aircraft**

- Plan and prepare for mission
- Taxi and takeoff
- Fly aircraft to/from mission area
- Fly during night conditions
- Fly during weather conditions
- Navigate
- Communicate
- Approach and land aircraft
- Perform after-landing tasks
- Compensate for in-flight equipment malfunctions and emergencies
- Manage weight and balance
- Defend against ground attack
- Defend against air attack
- Perform paradrop
- Perform reconnaissance
- Perform post-mission tasks
Aviation
V/STOL Aircraft

Plan and prepare for mission
Taxi and takeoff
Fly aircraft to/from mission area
Fly during night conditions
Fly during weather conditions
Navigate
Communicate
Approach and land aircraft
Transition between vertical and forward modes
Perform after-landing tasks
Compensate for in-flight equipment malfunctions and emergencies
Acquire targets
Attack target
Manage weight and balance
Defend against ground attack
Defend against air attack
Raise/lower internal loads
Perform paradrop
Rappel troops
Perform reconnaissance
Call for fire support
Perform post-mission tasks
Combat Service Support
Light Cargo Trucks

Plan and prepare mission
Prepare load
Drive vehicle
Navigate
Defend against attack
Compensate for equipment malfunctions and emergencies
Load/unload vehicle
Perform post-mission procedures

Combat Service Support
Heavy Cargo Trucks

Plan and prepare mission
Prepare load
Drive vehicle
Navigate
Defend against attack
Compensate for equipment malfunctions and emergencies
Load/unload vehicle
Perform post-mission procedures
Combat Service Support
Recovery Vehicles

Plan and prepare mission
Drive vehicle to recovery site
Navigate
Position and prepare recovery vehicle
Prepare system to be recovered
Perform recovery
Perform post-recovery procedures
Tow disabled vehicle/equipment
Perform post-mission procedures

Intelligence and Electronic Warfare
Interpretation and Analysis Systems

Identify key environmental features
Identify key elements of threat force
Identify/select routes
Identify hazards to movement
Identify early warning of enemy threat
Predict enemy vulnerability/strength
Identify targets
Report map changes; update sitmap
Prepare briefings
Fuse multi-source intelligence
Command, Control, Communications
Fire Control Systems
Represent battlefield conditions
Acquire targets
Gather and interpret target information
Predict target behavior
Select and order targets
Select friendly units to engage targets
Manage weapon functions
Compensate for equipment malfunctions and emergencies
Communicate
Prepare briefings

Command, Control, Communications
Battlefield Management Systems
Represent battlefield conditions
Represent status of forces
Project battlefield operations
Project weather conditions
Select and order targets
Manage weapon functions
Plan personnel
Plan logistics
Select friendly units to engage targets
Control friendly forces for offense and defense
Prepare briefings
Command, Control, Communications
Communication Systems

Assemble equipment and antennas
Establish/enter communications network
Transmit and receive messages
Encode/decode messages
Apply transmission/reception security procedures
Apply anti-jamming procedures
Route information

Combat Support--Engineering and Mine Warfare
Demolition Detection Equipment

Plan and prepare mission
Operate detection equipment
Mark danger areas
Perform post-mission operations

Combat Support--Engineering and Mine Warfare
Combat Engineer Vehicles

Plan and prepare mission
Drive vehicle to obstacle removal/breaching site
Navigate
Plan exact approach to accomplish mission
Prepare system hardware for obstacle removal/breaching
Remove/breach obstacle
Perform post-removal/breachment procedures
Compensate for equipment malfunctions and emergencies
Perform post-mission procedures
Combat Support--Engineering and Mine Warfare

**Recovery Vehicles**

Plan and prepare mission

Drive vehicle to recovery site

Navigate

Position and prepare recovery vehicle

Position and prepare system to be recovered

Perform recovery

Perform post-recovery procedures

Perform post-mission procedures


Combat Support--Engineering and Mine Warfare

**Bridging Equipment**

Plan and prepare mission

Prepare bridge site

Excavate foundations

Construct bridge abutments

Construct bridge span

Construct/assemble bridge

Prepare bridge and transporter for launching

Launch bridge

Connect bridge

Recover bridge

Disassemble bridge

Perform post-mission tasks
Combat Support--Engineering and Mine Warfare
Mines and Explosives

Plan mission

Conduct pre-operational inspection

Transport explosive or mine

Emplace explosive or mine

Prepare diagram of layout

Arm weapon

Perform post-mission tasks
APPENDIX B

EXAMPLE SOLDIER-SYSTEM INTERFACE (SSI)
EQUIPMENT SUITE DESCRIPTIONS
The examples provided in this Appendix are not intended to cover all possible crew positions for all types of systems. They are simply samples provided to indicate the type of crew position SSI description that has been found to be helpful in thinking about and classifying operator functional performance requirements in the context of deriving the training system concept.
SOLDIER-SYSTEM INTERFACE EQUIPMENT SUITE

Position: Driver

- Driving controls (directional, transmission, brake, accelerator)

- Vehicle subsystems status and monitoring displays (fuel gauge, caution and warning panel, engine instruments, etc.)

- Vehicle subsystems controls (engine, electrical, hydraulic, lights, etc.)

- External vision
  - Direct view/vision blocks/optical sight
  - Indirect view (TV, LLLTV, IR/thermal) - includes controls as necessary

- Intercom controls

- Tactical situation display (possible)

- Navigation system - if used by driver
  - Map Display
  - Inertial position/azimuth
  - Map/compass backup

- Maintenance/diagnostics displays and controls
  - BIT/BITE

- APU controls and displays

- Environmental controls and displays

- Smoke generator controls

- Embedded Training display(s)

- Refuel controls

- Mission-module relevant controls and displays (engineer and logistic vehicles)
SOLDIER-SYSTEM INTERFACE EQUIPMENT SUITE

Position: Vehicle Commander

- External vision
  o Direct view/vision blocks/optical sight
  o Indirect view (TV, LLLTV, IR/thermal) - includes controls as necessary

- External auditory

- Radios
  o Controls
  o Displays
  o Transmit/receive

- Sensor controls
  o TV/LLLTV/IR

- Vetronics control/display (general purpose interface)

- Embedded Training display(s)

- Fire control (secondary role if dedicated gunner crewmember present; self-defense weapon always)
  o Laser rangefinder controls (if present)
  o Sight with or without radar/sensor/cue/status overlays
  o Ammunition selection controls (including round type, charge, fuze, as applicable)
  o Weapon azimuth/elevation controls (and displays)
  o Firing control (trigger)
  o Weapon guidance controls (if applicable)

- Tactical situation display (possible)

- Navigation system
  o Map Display
  o Inertial position/azimuth
  o Map/compass backup

- Command and control displays/target handoff

- Environmental controls

- Maintenance/diagnostic controls/displays

- Intercom controls

- Resupply functional controls

- Uncooperative IFF controls/displays
Position: Direct Fire Weapons Gunner

- Fire control
  - Laser rangefinder controls
  - Laser designator (if present)
  - Radar controls and displays (if MMW radar equipped)
  - Sight with or without radar/sensor/cue/status overlays
  - Ammunition selection controls (including round type, charge, fuze, as applicable)
  - Weapon azimuth/elevation controls (and displays)
  - Firing control (trigger)
  - Weapon guidance controls (if equipped with guided weapon)
- Intercom controls
- Tactical situation display (possible)
- Maintenance/diagnostic controls and displays (secondary role)
- Environmental controls
- Embedded Training display(s)
- Rearm function controls
- Uncooperative IFF controls and displays
Position: Indirect Fire Weapons Gunner

- Fire control
  - Weapon selection/assignment
  - Weapon status monitoring
  - Weapon mount/launcher control (azimuth, elevation)
  - Weapon launch control
  - Weapon sensor monitoring (weapons with man-in-loop; e.g. FOG-M)
  - Weapon guidance and control (man-in-loop only)
  - Command interface (launch orders)
  - Mission/fire mission planning displays/controls

- Intercom controls

- Maintenance/diagnostic controls and displays

- Environmental controls

- Embedded Training display(s)

- Rearm function controls and displays
SOLDIER-SYSTEM INTERFACE EQUIPMENT SUITE

Position: Sensor/communications/EW operator

- External vision
  o Direct view/vision blocks/optical sight
  o Indirect view (TV, LLLTV, IR/thermal) - includes controls as necessary

- Radar/threat warning/EW sensor/EW/jammer controls and displays (as applicable)

- Radios
  o Controls
  o Displays
  o Transmit/receive

- Sensor controls
  o TV/LLLTV/IR/threat warning

- Vetronics control/display (general purpose interface)

- Target handoff controls/displays (some cases)

- Environmental controls

- Intercom controls

- Embedded Training display(s)

- Maintenance and diagnostics controls and displays

- Uncooperative IFF controls and displays (as applicable)
SOLDIER-SYSTEM INTERFACE EQUIPMENT SUITE

Position: Mission Equipment Operator

- Mission equipment controls and displays (vary widely)
- Environmental controls
- Intercom controls
- External vision (many cases)
  o Direct view/vision blocks
  o Indirect view (TV, LLLTV, IR/thermal) - includes controls as necessary
- Embedded Training display(s)
SOLDIER-SYSTEM INTERFACE EQUIPMENT SUITE

Position: Battle Staff

- Tactical situation display(s) and control(s)
- Radios
  o Controls
  o Displays
  o Transmit/receive
- Sensor controls
  o TV/LLLTV/IR (possible)
- Target handoff controls and displays
- Environmental controls
- Intercom controls
- Navigation/position representation system
  o Map Display (possibly multiple)
  o Inertial position/azimuth
  o Map/compass backup
- External vision (possible)
  o Direct view/vision blocks/optical sight
  o Indirect view (TV, LLLTV, IR/thermal) - includes controls as necessary
- Embedded Training display(s)
- Removable workstations (replicate tactical situation/navigation controls/displays, target handoff, sensors [some cases], communications [some cases]
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<th>Abbreviation</th>
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<td>ARI</td>
<td>U.S. Army Research Institute for the Behavioral and Social Sciences</td>
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<td>ARTEP-MTP(s)</td>
<td>Army Training and Evaluation Plan-Mission Training Program(s)</td>
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<td>ASAP</td>
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<td>Built-in Test Equipment</td>
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<td>Functional Performance Requirement(s)</td>
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<td>HFEA</td>
<td>Human Factors Engineering Analysis</td>
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<td>IR&amp;D</td>
<td>Internal Research and Development</td>
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<td>Justification for Major System New Start</td>
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<td>Mission Area Analysis</td>
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<td>MANpower and Personnel Requirements INTEGRation</td>
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<tr>
<td>MTD, MTDs</td>
<td>Maintenance Training Device(s)</td>
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<td>New Equipment Training</td>
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<td>O&amp;O</td>
<td>Organizational and Operational Plan</td>
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<td>OJT</td>
<td>On-the-job Training</td>
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<td>Plug-in Test Equipment</td>
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<td>Project Manager for Training Devices</td>
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